ORIGINAL RESEARCH PAPER
Volume - 15 | Issue - 05 | May - 2026 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

IMMATURE PLATELET FRACTION AS AN EARLY MARKER OF PLATELET RECOVERY IN DENGUE INFECTION

Pathology

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ABSTRACT

Background: Dengue is a common mosquito-borne viral illness associated with thrombocytopenia, creating challenges in predicting platelet recovery. The immature platelet fraction (IPF), reflecting bone marrow thrombopoietic activity, has emerged as a potential early biomarker of recovery.**Aim:** To evaluate the role of IPF as an early predictor of platelet recovery in dengue infection.**Materials and Methods:** A cross-sectional study was conducted from June to December 2025 at a tertiary care hospital affiliated with a medical college, including 53 serologically confirmed dengue patients. Platelet count and immature platelet fraction (IPF) were measured on Days 1–3 using an automated hematology analyzer. Statistical analysis was performed using paired t-test and Pearson's correlation ($p < 0.05$ was considered statistically significant).**Results:** Among 53 participants, males constituted 60.4% and females 39.6%, with the majority belonging to the 21–30 years age group (41.5%). The mean platelet count showed a progressive increase from 85,037.74 on Day 1 to 145,566.04 on Day 3. In contrast, the mean IPF decreased from 10.90% to 6.72% over the same period. A statistically significant inverse correlation was observed between platelet count and IPF across all three days: Day 1 ($r = -0.508$, $p < 0.001$), Day 2 ($r = -0.504$, $p < 0.001$), and Day 3 ($r = -0.273$, $p = 0.048$).**Conclusion:** IPF is a simple, rapid, and reliable biomarker for early prediction of platelet recovery in dengue and may help reduce unnecessary platelet transfusions and optimize patient management.

KEYWORDS

Dengue, Immature Platelet Fraction, Thrombocytopenia, Platelet Recovery

INTRODUCTION

Dengue fever, caused by the Dengue virus (DENV) and transmitted by Aedes mosquitoes, is a significant global health problem. According to the World Health Organization, "there are an estimated 100–400 million infections each year," and "about half of the world's population is now at risk" [1,2].

In developing countries with tropical climates, the burden of dengue has increased substantially due to rapid urbanization, changing lifestyles, and inadequate water storage practices. According to the National Centre for Vector Borne Diseases Control, India reported 2,33,251 dengue cases and 303 deaths in 2022, emphasizing the need for improved disease monitoring and management strategies [3].

Thrombocytopenia is one of the most consistent hematological findings in dengue infection and is considered an important indicator of disease severity and progression [2,4]. It often results in unnecessary platelet transfusions and prolonged hospital stay, as conventional platelet counts do not provide information regarding bone marrow activity or platelet production [3].

The mechanism of thrombocytopenia in dengue is multifactorial, including bone marrow suppression, immune-mediated platelet destruction, and peripheral consumption [4].

Common platelet indices such as mean platelet volume (MPV), platelet distribution width (PDW), platelet-large cell ratio (P-LCR), and plateletcrit (PCT) have been studied in thrombocytopenia. The immature platelet fraction (IPF) is a relatively new parameter that represents an automated measure of reticulated platelets in peripheral blood and reflects real-time thrombopoietic activity [5,6].

Automated hematology analyzers enable rapid and reliable measurement of IPF without requiring additional blood sampling [5,6]. Newly formed immature platelets are larger, more reactive, and contain residual RNA derived from megakaryocytes, referred to as reticulated platelets (RPs), and help estimate platelet production [7].

Assessment of RP production enables differentiation between increased platelet destruction and decreased production, thereby reducing the need for invasive procedures such as bone marrow examination [7].

IPF levels increase with enhanced bone marrow platelet production and thus serve as an indirect marker of thrombopoiesis [8].

Recent studies have highlighted the role of IPF as an early predictor of platelet recovery in dengue patients. IPF has been shown to rise 24–72 hours prior to platelet count recovery and correlates with subsequent platelet increments [8–10]. Elevated IPF levels have also been associated with platelet recovery within 48–72 hours, making it a useful clinical tool in patient management [9–11].

Thus, IPF serves as a simple, rapid, non-invasive, and reliable biomarker of platelet recovery in dengue infection.

AIMS AND OBJECTIVES

Aim:

To study the role of immature platelet fraction as a predictor of platelet recovery in dengue.

Objectives:

- To correlate IPF with platelet count recovery
- To evaluate IPF as an early recovery marker

MATERIALS AND METHODS

Study Design and Setting:

A cross-sectional study was conducted from June 2025 to December 2025 at a tertiary care hospital affiliated with a medical college, including 53 laboratory-confirmed dengue patients.

Study Population:

Patients diagnosed with dengue infection based on serological evidence either NS1 antigen or IgM antibody positivity were included in the study.

Sampling Method:

Laboratory-confirmed dengue patients underwent complete blood count (CBC) analysis from EDTA-anticoagulated blood samples using the Mindray BC-6800 Plus hematology analyzer on Day 1, Day 2, and Day 3 of admission.

Inclusion Criteria:

- Patients of all age groups
- Serologically confirmed dengue cases (NS1 antigen or IgM positive)

Exclusion Criteria:
Patients with hematological malignancies, receiving recent chemotherapy, Chronic liver disease and other causes of thrombocytopenia such as disseminated intravascular coagulation (DIC), thrombotic thrombocytopenic purpura (TTP), immune thrombocytopenic purpura (ITP), or sepsis unrelated to dengue

The following hematological parameters were recorded: Total platelet count, Immature Platelet Fraction (IPF), Mean Platelet Volume (MPV), Platelet Distribution Width (PDW), Platelet Large Cell Ratio (P-LCR)

Measurement of IPF:
Immature platelet fraction was measured using fluorescent flow cytometry in the reticulocyte channel of the analyzer. An asymmetric cyanine dye binds to residual RNA present in immature platelets, enabling their differentiation based on increased fluorescence intensity and size.

IPF (%) = (Immature platelet count / Total platelet count) × 100

Definition of Platelet Recovery: Platelet recovery defined as increase in platelet count within 48–72 hours.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed statistically. Quantitative variables were expressed as mean ± standard deviation (SD). Changes in platelet count and IPF values over time were analyzed using the paired t-test. Correlation between platelet count and IPF was assessed using Pearson's correlation coefficient. A p-value <0.05 was considered statistically significant.

RESULTS:

Table 1: Distribution of Participants by Sex (n = 53)

Sex	Frequency (n)	Percentage (%)
Female	21	39.6
Male	32	60.4
Total	53	100.0

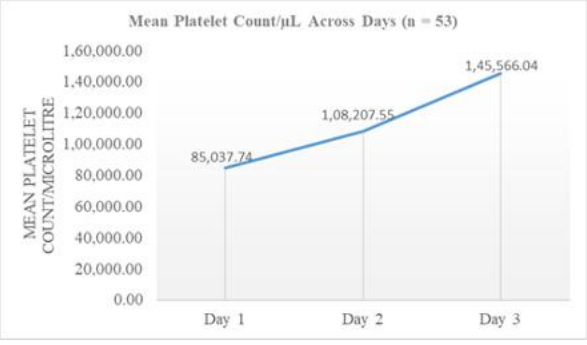
In present study out of the 53 participants, the majority were male (n = 32, 60.4%), while females comprised 39.6% (n = 21) of the study population.

Table 2: Age-wise Distribution of Participants (n = 53)

Age Group (years)	Frequency (n)	Percentage (%)
0–10	0	0.0
11–20	8	15.1
21–30	22	41.5
31–40	8	15.1
41–50	6	11.3
51–60	4	7.5
61–70	4	7.5
71–80	1	1.9
Total	53	100.0

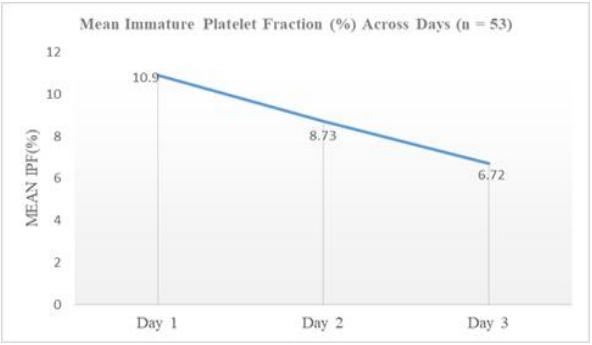
In present study, the majority of participants belonged to the 21–30 years age group (n = 22, 41.5%), followed by the 11–20 years and 31–40 years age groups (n = 8, 15.1% each). The least representation was observed in the 71–80 years age group (n = 1, 1.9%). No participants were observed in the 0–10 years age group.

Graph 1: Mean Platelet Count/µL Across Days (n = 53)



In present study, the mean platelet count demonstrated a progressive increase across three days, rising from 85,037.74 on Day 1 to 108,207.55 on Day 2 and 145,566.04 on Day 3.

Graph 2: Mean Immature Platelet Fraction (%) Across Days (n = 53)



In present study, the mean IPF demonstrated a declining trend over three days, decreasing from 10.90% on Day 1 to 8.73% on Day 2 and 6.72% on Day 3.

Table 3: Day-wise Distribution of Platelet Count and IPF (n = 53)

Day	Platelet Count (Mean ± SD)	IPF (%) (Mean ± SD)
Day 1	85,037.74 ± 48,175.94	10.90 ± 6.42
Day 2	108,207.55 ± 63,057.78	8.73 ± 4.77
Day 3	145,566.04 ± 100,134.24	6.72 ± 3.39

In present study, the day-wise distribution of platelet count and immature platelet fraction (IPF) demonstrated a progressive increase in mean platelet count from Day 1 (85,037.74 ± 48,175.94) to Day 3 (145,566.04 ± 100,134.24). In contrast, the mean IPF showed a declining trend, decreasing from 10.90 ± 6.42 on Day 1 to 6.72 ± 3.39 on Day 3. This opposing trend indicates a significant inverse relationship between platelet count and IPF over time.

Table 4: Correlation between Platelet Count and IPF Across Three Days (n = 53)

Day	Variables Compared	Pearson Correlation (r)	p-value	Interpretation
Day 1	PLT vs IPF	-0.508	<0.001	Moderate negative
Day 2	PLT vs IPF	-0.504	<0.001	Moderate negative
Day 3	PLT vs IPF	-0.273	0.048	Weak negative

The present study showed a correlation between platelet count and immature platelet fraction (IPF) over three consecutive days. A statistically significant moderate negative correlation was observed on Day 1 ($r = -0.508$, $p < 0.001$) and Day 2 ($r = -0.504$, $p < 0.001$). On Day 3, a weak negative correlation was noted ($r = -0.273$, $p = 0.048$), which remained statistically significant. These findings indicate an inverse relationship between platelet count and IPF, with IPF values decreasing as platelet counts increase during the course of recovery. The increase in platelet count and decrease in IPF over time were statistically significant ($p < 0.001$).

DISCUSSION

In the present study, a total of 53 dengue patients were evaluated to assess the role of immature platelet fraction (IPF) as a marker of platelet recovery. The study demonstrated a progressive increase in platelet count along with a corresponding decline in IPF over three consecutive days, indicating a significant inverse relationship between these two parameters. This finding is consistent with the established pathophysiology of dengue, where thrombocytopenia due to peripheral destruction is followed by compensatory bone marrow response.

In terms of demographic profile, a male predominance (60.4%) was observed in the present study. Comparable findings have been reported by Puspita RI et al., where males constituted approximately 60% of cases [12]. This consistent pattern may be attributed to increased outdoor exposure, occupational risk, and higher likelihood of mosquito contact among males.

The age-wise distribution in the present study showed that the majority of patients (41.5%) belonged to the 21–30 years age group, indicating that young adults are most commonly affected. This observation is consistent with findings by Puspita RI et al., who reported a mean age of 24.83 years [12]. The higher incidence in this population may be related to increased mobility, occupational exposure, and urban transmission dynamics.

The present study demonstrated a progressive rise in platelet count from Day 1 to Day 3, reflecting recovery from thrombocytopenia. A similar trend has been reported by Looi KW et al., who observed that platelet recovery typically occurs during the convalescent phase [10]. Abeysuriya V et al. also reported that platelet counts begin to rise significantly during days 2–3 of illness, correlating with bone marrow recovery [9].

In contrast, the mean IPF demonstrated a declining trend from 10.90% on Day 1 to 6.72% on Day 3 in the present study. Chuansumrit A et al. reported that IPF values ≥10% are predictive of platelet recovery within 72 hours [13]. Similarly, Abe Y et al. demonstrated that IPF decreases as platelet production normalizes [6]. In addition, Briggs C et al. highlighted that IPF is elevated in conditions with increased peripheral platelet destruction and declines with recovery [5]. These findings closely parallel the declining IPF trend observed in the present study.

Correlation analysis in the present study revealed a statistically significant moderate negative correlation between platelet count and IPF on Day 1 and Day 2, followed by a weaker correlation on Day 3. This inverse relationship is supported by previous studies. Puspita RI et al. demonstrated a strong correlation ®= 0.746, $p < 0.001$) between IPF and platelet changes [12]. Similarly, Abeysuriya V et al. confirmed that IPF is a significant predictor of platelet recovery, particularly during days 2 and 3 of illness [9]. Furthermore, Looi KW et al. reported that IPF rises 2–3 days prior to platelet recovery, indicating its role as an early predictive marker [10].

The present study has certain limitations. The sample size was relatively small and the study was conducted at a single center. The duration of follow-up was limited to three days, and no long-term outcomes were assessed. Larger multicentric studies are required to validate these findings.

CONCLUSION:

In the present study, immature platelet fraction (IPF) was found to be a consistent, useful, and reliable biomarker in patients with thrombocytopenia, even at very low platelet counts. Elevated IPF levels during the acute phase indicate preserved and active bone marrow thrombopoiesis. A decline in IPF was observed to precede the rise in platelet count, highlighting its significant predictive value for platelet recovery. Therefore, IPF serves as an early and useful biomarker in dengue infection, aiding clinicians in anticipating platelet recovery, reducing unnecessary platelet transfusions, and improving overall patient management.

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