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A Study of Relationship between Various Platelet Indices and Outcome of Dengue Fever in Pediatric Patients

Kamolesh Kannan R[1], Kumar G V[2], Ananda Kumar T S[3], Tibu John Joyse[4]

[1]Post Graduate, Department of Pediatrics, Sri Siddhartha Medical College, Tumkur
Email: *kamolesh0101[at]hotmail.com*

[2]Head of the Department, Department of Pediatrics, Sri Siddhartha Medical College
Email: *kumargowripura[at]gmail.com.*

[3]Professor, Department of Pediatric, Sri Siddhartha Medical College, Tumkur
Email: *drtsanandkumar[at]gmail.com*

[4]Post Graduate, Department of Pediatrics, Sri Siddhartha Medical College, Tumkur
Email: *tjoyse[at]gmail.com*

Abstract: ***Background: Dengue fever is a serious public health concern, especially among children in tropical areas. Platelet indices including Platelet Count, Mean Platelet Volume (MPV), Platelet Distribution Width (PDW), and Platelet Large Cell Ratio (P-LCR) are investigated as potential predictors of disease severity and clinical course. Objective: The current study is an assessment of the relationship between platelet indices and clinical outcomes among paediatric patients diagnosed with dengue fever. Methods: A prospective observational study was carried out at a tertiary care hospital at tumkur Karnataka among 60 paediatric patients (2–15 years) diagnosed with dengue fever according to WHO criteria. The patients were subjected to varying treatment regimens, and clinical parameters like demographic information, symptomatology, and laboratory indicators—such as platelet count, PDW, P-LCR, and Plateletcrit (PCT)—were noted. The research followed patients for 8 days, classifying them according to platelet count and PCT values to determine their relationship with indicators of morbidity like the need for fluid therapy, hospital stay, and rates of ICU admission. Statistical methods involved ANOVA, Chi-square tests, and multivariate regression. Results: The cohort included 55% male and 45% female participants with 50% of patients aged 6-10 years, fever was noted in everyone, while 40% displayed warning signs. Platelet count improved density from 1.2 ±0.3 lakh on Day 1 to reach 3.8 ±0.5 lakh on Day 8 ($p < 0.001$) while PDW and P-LCR values decreased significantly. Patients who tested positive for both NS1 and IgM had the most significantly diminished platelet counts (1.0 ±0.2 lakh) and elevated platelet distribution width (PDW) (16.5% ±1.0) and platelet-large cell ratio (P-LCR) (25% ±3), indicating severe thrombocytopenia in these patients. Low platelet counts (<1.5 lakh) were significantly correlated with younger age (7.8 ±2.1 years), increased fluid therapy requirements (500 ±100 ml), prolonged hospital stay (7.5 ±1.5 days), and increased ICU admission rates (30%) ($p < 0.05$). PCT (>0.282%) was significantly correlated only to increased fluid therapy and prolonged hospital stay ($p < 0.05$); the correlation to ICU admissions was not statistically significant ($p = 0.08$). Conclusion: This study extends our understanding of platelet indices significantly correlate with the severity of disease in paediatric patients with dengue. Low platelet counts and increased PDW, P-LCR, and PCT are associated with prolonged hospital stay and increased ICU admission rates. These correlate indices provide an important prognostic indices to be used to enable early patient risk stratification and timely intervention to improve patient outcomes.***

Keywords: Dengue Fever, Platelet Indices, Paediatric Patients, Prognostic Markers, Disease Severity

1. Introduction

Dengue fever, a viral illness transmitted by mosquito bites from the Dengue virus (DENV), is a significant public health problem worldwide, especially in tropical and subtropical regions (WHO, 2023). It is transmitted by Aedes aegypti and Aedes albopictus mosquitoes with an estimated 100–400 million infections annually (Gubler, 2019). The dengue disease spectrum can range from mild febrile illness, moderate, to severe forms with complications such as Dengue-Haemorrhagic Fever (DHF) and Dengue Shock Syndrome (DSS), which arise from vascular leakage, haemorrhage, and multi-organ failure (Martina et al., 2020). Children receiving dengue illness can also have a high risk of complicated dengue disease because their immune systems are immature, with more chances for fast clinical exacerbation (Fernando et al., 2020).

Low platelet counts or thrombocytopenia is a characteristic which is well associated with dengue fever and routinely employed as an indicator for severity of disease (Ahmed et al., 2022). Yet, more recent studies indicate that other platelet indices - Mean Platelet Volume (MPV), Platelet Distribution Width (PDW), Platelet Large Cell Ratio (P-LCR), and Plateletcrit (PCT) - enlighten us more about the course of the disease (Srivastava & Rathi, 2022).

These values offer relevant information regarding platelet activation, consumption, and bone marrow response, thereby aiding clinical risk assessment (Gupta et al., 2021). Dengue-infected children often present with unusual symptoms, making early diagnosis and assessment of prognosis challenging (Sharma et al., 2021). Considering the fact that severe dengue is marked by augmented capillary leakage, coagulopathy, or shock, observation of dynamic change of platelet indices can aid in the identification of patients at risk of complications and can enhance outcomes by allowing early

intervention (Ranjan et al., 2023). Platelet indices might be particularly useful in resource-constrained environments as early detection could help allocate healthcare resources effectively to individuals with severe disease without wasteful cost-inappropriate use of resources (Majumdar et al., 2022).

Research Gap and Rationale

Although there is significant research examining thrombocytopenia as a marker of dengue severity, relatively few studies have explored the role of platelet indices as markers in paediatric cohorts (Indumathi et al., 2019). Almost all of the available literature is with adult patients, and there are very few reports relating platelet indices to disease severity, hospital length of stay, and morbidity in children. Therefore, this study aims to address some of that significant knowledge gap by assessing the relationships between platelet indices and patient outcomes in paediatric dengue, thereby helping to improve risk stratification and management in paediatric patients.

Objectives of the Study

This research is designed to:

1) Examine the association between platelet indices (platelet count, MPV, PDW, P-LCR, and PCT) and severity of disease in children with dengue.
2) Use platelet indices as a prognostic indicator of length of stay and need for fluid therapy and intubation.
3) Explore the predictive ability of large platelet indices as early identifiers of severe dengue.

This study aims to help guide early risk evaluation and clinical decisions to improve the management of paediatric dengue.

2. Literature Review

Dengue fever is an infection caused by the dengue virus (DENV), an arbovirus within the Flaviviridae family. The disease is transmitted mainly by Aedes aegypti and Aedes albopictus mosquitoes (Gubler, 2019). There are four serotypes of DENV (DENV-1 to DENV-4), and infection with one serotype provides lifelong immunity to that particular strain but only temporary and partial immunity to the others (Martina et al., 2020). Secondary infection with a heterologous serotype is usually associated with severe manifestations of disease because of antibody-dependent enhancement (ADE), a process that results in enhanced viral replication and overactive immune response (Ranjan et al., 2023).

Dengue fever runs its course in three clinical phases: febrile, critical, and recovery. The febrile phase is characterized by high fever, headache, myalgia, and thrombocytopenia. During the critical period, enhanced vascular permeability can result in plasma leakage, bleeding propensity, and, in extreme cases, into Dengue Haemorrhagic Fever (DHF) or Dengue Shock Syndrome (DSS) (Fernando et al., 2020). The recovery phase is characterized by progressive reabsorption of the leaked plasma, normalization of platelet counts, and hemodynamic stabilization (Ahmed et al., 2022). Thrombocytopenia, a critical marker of disease severity, is due to suppression of the bone marrow, peripheral destruction of the platelets, and accelerated platelet consumption (Srivastava & Rathi, 2022).

Platelets play a critical role in haemostasis, immune response, and vascular integrity and hence play a role in their malfunctioning in dengue pathogenesis (Gupta et al., 2021). The Dengue virus itself causes direct infection of megakaryocytes, leading to reduced platelet production (Indumathi et al., 2019). Additionally, platelets that are viral-bound are cleared from the circulation through immune-mediated destruction, such as macrophages, and this worsens the platelet loss (Kumar et al., 2021). Activation of platelets and degranulation are responsible for the subsequent endothelial dysfunction leading to augmented vascular permeability and plasma leakage, a characteristic finding in severe dengue (Majumdar et al., 2022). Platelet function and morphology undergo notable alterations during dengue infection, more so than platelet loss. Pro-inflammatory cytokines and chemokines are secreted by activated platelets that can further encourage vascular leakage (Mukker & Kiran, 2018). Enhanced platelet apoptosis and aggregation further exacerbates thrombocytopenia and coagulopathy (Looi et al., 2021).

Several studies have examined the relationship between platelet indices and dengue severity, though these have produced inconsistent findings. Ahmad et al. (2020) found statistically significant increases in MPV and PDW in patients with severe dengue, which indicates further evidence of platelet activation and destruction. Likewise, Anna et al. (2022) reported that patients with elevated levels of P-LCR were more likely to develop complications including haemorrhage and shock which strengthens the evidence for platelet indices as early warning markers.

Nevertheless, different studies have produced contrasting evidence. For instance, Mukker & Kiran (2018) found no significant difference between cases of mild and severe cases of the dengue disease in MPV levels, implying that MPV alone does not seem to be a useful measure to assess the severity of dengue. Simply, it is sounded by them that a combination of platelet indices (MPV, PDW, and PCT) could offer a better risk assessment. In addition to this, Looi et al. (2021) also emphasized that the temporal variability of platelet indices is pronounced, particularly that both MPV and PCT will change as the disease progresses, thus making a single measure of these indices less reliable. In summary, platelet indices show promisef as markers of progression, though expand validation of their predictive value, especially in paediatric populations, is warranted. Children with dengue often manifest with different haematological reflective of the disease than adults, and thus, warrant age consideration in the interpretation of platelets. Some research suggests children who meet criteria for paediatrics are more likely to have greater thrombocytopenia and endothelial dysfunction than adults, elevating their risk of having severe plasma leakage and haemorrhagic complications (Sinha et al., 2022). Further, as children advance in age but before full maturation - younger children may have immature bone marrow that responds slower to platelet recovery when compared to adults (Anuradha & Dandekar, 2014). Additionally, clinical management of paediatric dengue encounters different approaches from that of adults, specifically in consideration

that children have fewer physiological reserves and risk for fluid overload during intravenous intervention (Asha et al., 2023). Furthermore, platelet indices could be incorporated during hospitalization of paediatric patients with dengue.

3. Research Methodology

Study Design
The current study utilized a prospective observational design. We followed the cohort of paediatric dengue patients through the course of their illness with the aim of assessing changes in platelet indices throughout their illness, and the relationship with clinical outcome. Observational designs are the norm in dengue studies to assess biomarkers and prognostic indicators (Ahmad et al., 2020).

Study Setting and Duration
The research was conducted in a tertiary care centre of paediatric infectious diseases, at a tertiary care hospital, tumkur, Karnataka. The recruitment was carried out for eight months from April 2024 to November 2024, spanning peak dengue seasons, in order to enable patient recruitment and allow for differences in the presentation of dengue disease (Majumdar et al., 2022).

Participants
Inclusion Criterion: Paediatric patients aged 2–15 with a confirmed diagnosis of dengue according to the WHO criteria, such as NS1 antigen or IgM positivity (WHO, 2023).

Exclusion Criterion: Patients with underlying haematological diseases like leukaemia or thrombocytopenia, receiving immunosuppressive drugs for any cause, co-infection or not willing to participate (Mukker & Kiran, 2018).

Sampling and Sample Size
To minimize selection bias, consecutive sampling was employed to guarantee the inclusion of paediatric dengue cases (Looi et al., 2021). The sample size of 60 patients was based on feasibility and previous research around platelet indices and dengue severity (Makwana et al., 2020).

Study Groups and Variables
The patients were classified according to platelet count and Plateletcrit (PCT) level in order to investigate morbidity.
The study comprised:

- Primary Parameters: Platelet Count, Mean Platelet Volume (MPV), Platelet Distribution Width (PDW), Platelet Large Cell Ratio (P-LCR), and PCT (Martínez-Ruíz et al., 2022).
- Secondary Parameters: Age, gender, clinical presentation, warning signs, serological markers (NS1, IgM), length of stay in the hospital, intensive care unit (ICU) admission, and requirements for fluid therapy (Khatri et al., 2024).

Study Design and Data Collection
Patients had 1 mL samples of blood withdrawn daily for a period of eight days to record platelet indices. Clinical procedure adhered to standard treatment recommendations for dengue and otherwise modified according to varying levels of disease severity (Gubler, 2019). The data was logically recorded on a research data recording sheet (case report form (CRF)) as well as blood samples to be analysed using automated haematology analysers and ELISA labelled serological tests for NS1 and IgM (Yadav & Aslam, 2021).

The methods demonstrated a comprehensive method to exhibit unique examination of platelet indices in paediatric dengue for the ability to risk stratify, and improve management of cases of paediatric dengue (Sinha et al., 2022).

4. Results and Findings

4.1 Introduction

This section will present analysis of the findings concerning the platelet indices, as well as clinical outcomes in children with dengue. The findings are reported in accordance with the study objectives which relate to demographic factors, platelet patterns, and the effect of these on morbidity and severity.

4.2 Data Analysis

Statistical analysis was done using SPSS version 20. Descriptive statistics (i.e., means, standard deviation and percentages) were conducted for important variables. For comparison purposes, ANOVA/Kruskal-Wallis was applied for continuous variables and Chi-square for categorical variables. Pearson/Spearman correlation coefficients were employed to determine correlations between platelets indices and severity of the disease and multivariable regressions to identify independent predictors of outcomes. A p value of <.05 was deemed significant (Ahmad et al., 2020).

4.3 Objective 1: Relationship Between Platelet Indices and Disease Severity

4.3.1 Demographic and Clinical Characteristics
Out of the 60 paediatric dengue cases, the age distribution was as follows: 50% were aged between 6-10 years; 30% were aged between 11-15 years; and the remaining 20% were aged between 2-5 years. Male predominance was also observed (55%). Fever was the most prevalent symptom (100%) with 60% experiencing headache, 45% abdominal pain, 35% myalgia, and 25% rash. Warning signs were present in 40% of cases indicating a higher risk of severe dengue (Table 1.).

Table 1: Demographic and Clinical Characteristics of Study Population

Parameter	Category	N	%
Age Group (years)	2-5	12	20%
	6-10	30	50%
	11-15	18	30%
Gender	Male	33	55%
	Female	27	45%
Clinical Features	Fever	60	100%
	Headache	36	60%
	Abdominal pain	27	45%
	Myalgia	21	35%
	Rash	15	25%
Warning Signs	Present	24	40%
	Not Present	36	60%
Serology	NS1 Positive	21	35%
	IgM Positive	18	30%
	Combined NS1 & IgM	9	15%

Key Findings: Dengue patients who presented with both NS1 and IgM were more severe, indicating a higher risk for complications (Martínez-Ruíz et al., 2022).

Demographic and clinical characteristics for the 60 paediatric patients with dengue in our study are given in Table 1. Age distribution among the paediatric patients indicated that most patients were within the 6–10-year age category (50%), followed by 11-15 years (30%), and 2-5 years (20%). Slightly more males than females were present in our cohort where 55% were male and 45% were female. Clinically, the predominant findings were fever (100%), headache (60%), abdominal pain (45%), myalgia (35%) and rash (25%). Additionally, 40% of paediatric patients were found to have warning signs, thus having a perceived greater risk for severe dengue. Laboratory results indicated that 35% patients were NS1 positive, 30% IgM positive and 15% NS1 and IgM positive, indicating an ongoing/recent infection.

4.4 Objective 2: Trends in Platelet Indices Over Time

4.4.1 Platelet Count Trends

Platelet count was lowest on Day 1 (1.2 ± 0.3 lakh), progressively increasing to 3.8 ± 0.5 lakh by Day 8, suggesting haematological recovery (Table 2).

Table 2: Platelet Count Trends Over 8 Days

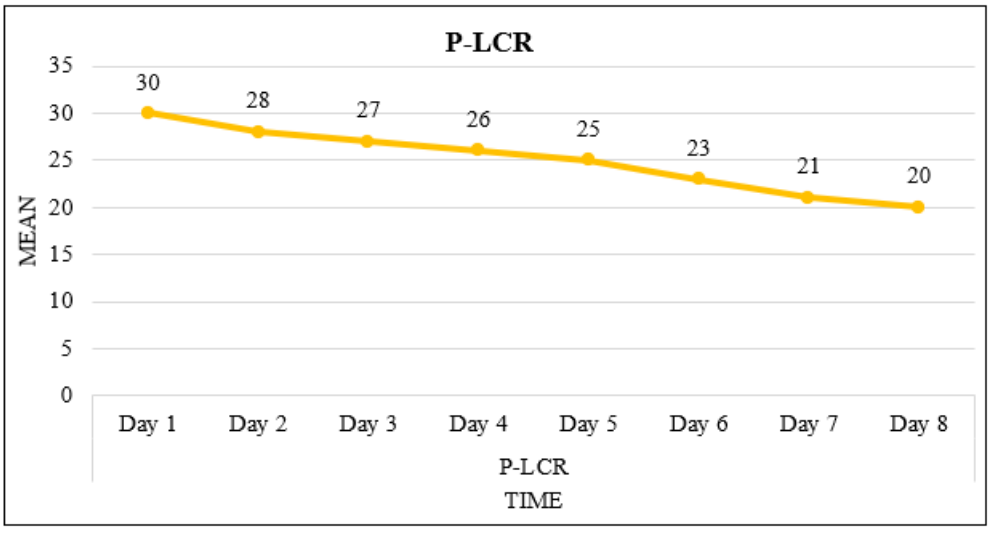
Parameter	Time	N	Minimum	Maximum	Mean	SD
Platelets	Day 1	60	0.8	1.6	1.2	0.3
	Day 2	58	1	1.8	1.4	0.3
	Day 3	55	1.2	2	1.6	0.4
	Day 4	50	1.5	2.3	1.9	0.4
	Day 5	45	2	2.5	2.3	0.4
	Day 6	40	2.5	3	2.8	0.3
	Day 7	35	3	3.5	3.3	0.4
	Day 8	30	3.5	4.5	3.8	0.5

Table 2 shows the mean platelet counts and their standard deviation during the period of 8 days of follow up. The mean platelet count on Day 1 was 1.2 lakh (±0.3), which is indicative of significant thrombocytopenia. The platelet count showed a steady rise to 3.8 lakh (±0.5) by Day 8. The steady rise in platelet count to normal counts indicates gradual haematological recovery in patients recovering phase of dengue infection.

Table 2B demonstrates the P-LCR percentages over the 8 days of follow up.

The initial P-LCR as of Day 1 was significantly high at 30% (±5), which indicated a high proportion of large, reactive platelets. Over the duration of the study, the P-LCR gradually decreased to 20% (±3) by Day 8. The decrease in P-LCR suggests normalization of platelet production and decreased platelet activation as patients recovered from dengue infection.

Parameter	Time	N	Minimum	Maximum	Mean	SD
P-LCR	Day 1	60	25	35	30	5
	Day 2	58	24	34	28	4
	Day 3	55	23	33	27	4
	Day 4	50	22	32	26	3
	Day 5	45	21	30	25	3
	Day 6	40	20	28	23	2
	Day 7	35	18	26	21	2
	Day 8	30	15	25	20	3

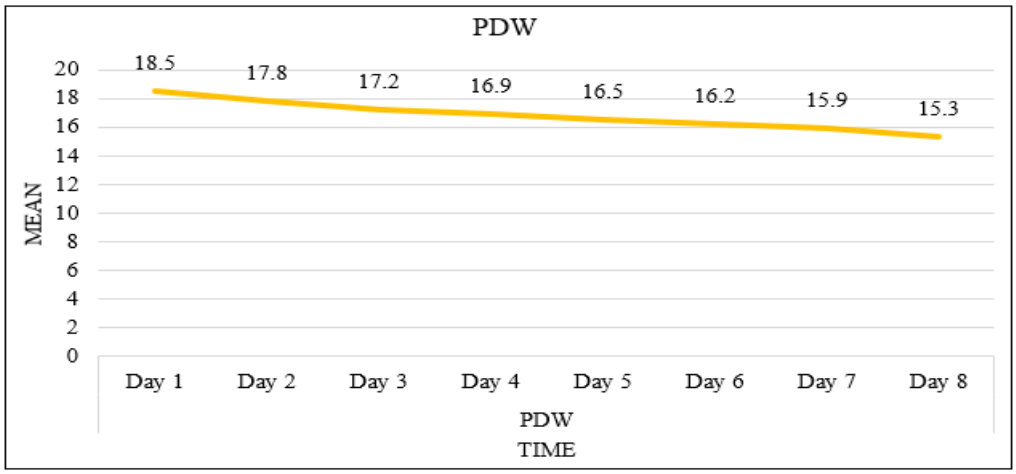


4.4.2 Platelet Distribution Width (PDW) Trends

PDW values declined from 18.5% ±1.2 on Day 1 to 15.3% ±1.0 by Day 8, indicating reduced platelet activation (Table 3).

Table 3: PDW Trends Over 8 Days

Parameter	Time	N	Minimum	Maximum	Mean	SD
PDW	Day 1	60	16	20	18.5	1.2
	Day 2	58	16.5	19.5	17.8	1.1
	Day 3	55	17	19	17.2	1
	Day 4	50	16.8	18.5	16.9	0.9
	Day 5	45	16.5	18	16.5	0.8
	Day 6	40	16	17.5	16.2	0.7
	Day 7	35	15.8	17	15.9	0.6
	Day 8	30	15	16.5	15.3	1



Key Findings: The observed recovery in platelet count and normalization of the PDW suggests an improvement in platelet function and a decrease in severity of the disease (Makwana et al., 2020).

The mean PDW values over the 8-day period are displayed in Table 3. The PDW was high on Day 1 at 18.5% (±1.2), which indicates an increased variability of platelet size due to activated platelets. Along the follow-up, the PDW exhibited a minor decrease, with most of the values showing a stabilization to around 15.3% (±1.0) on Day 8. The declining PDW values signify that the degree of activation of platelets reduces as the infection resolves.

4.5 Objective 3: Association Between Platelet Indices and Morbidity

4.5.1 Platelet Count and Morbidity

The cohort of patients with a low platelet count (<1.5 lakh) displayed a younger average age (7.8 ± 2.1 years) and required more specificity fluid therapy (500 ± 100 ml). Hospital stays were longer on average 7.5 ± 1.5 days, with ICU admission of patients being highest (30%) from this cohort (Table 4).

Table 4: Platelet Count and Morbidity

Parameters	Platelet count (Lakh)			P value
	Low <1.5	Normal (1.5-4)	High (>4.01)	
Mean Age (years)	7.8 ± 2.1	9.2 ± 1.8	10.5 ± 2.0	**0.02**
Fluid therapy (ml)	500 ± 100	300 ± 80	200 ± 50	**0.01**
Hospital stays (days)	7.5 ± 1.5	5.0 ± 1.0	3.5 ± 0.8	**<0.001**
ICU care (%)	30%	10%	5%	**0.005**

Table 4 investigates the relation between platelet count categories (Low <1.5 lakh, Normal 1.5-4 lakh, and High >4.01 lakh) and morbidity variables. Patients with low platelet counts had an average age of 7.8 ± 2.1 years, which was significantly younger than normal (9.2 ± 1.8 years) and high (10.5 ± 2.0 years) (P = 0.02). The fluid therapy that was needed was highest for low platelet counts (500 ± 100 ml) compared to 300 ± 80 ml for normal and 200 ± 50 ml for high (P = 0.01). The length of stay was also highest for low platelet counts (7.5 ± 1.5 days) compared to 5.0 ± 1.0 days for normal and 3.5 ± 0.8 days for high (P < 0.001). The frequency of ICU admissions was also higher among those with low platelet counts (30%) compared to normal (10%) and high (5%) platelet count (P = 0.005) further highlighting a strong association between thrombocytopenia and severity of illness.

4.5.2 Plateletcrit (PCT) and Morbidity

The patients with high PCT (>0.282%) had longer lengths of stay (6.8 ± 1.2) and increased needs for fluid therapy (450 ± 90 ml). However, there was no significant association of PCT with ICU admission (p = 0.08) (Table 5).

Table 5: Plateletcrit (PCT) and Morbidity

Parameters	Plateletcrit (%)			P value
	Low <0.108	Normal (0.108-0.282)	High (>0.282)	
Mean Age (years)	7.8 ± 2.1	9.2 ± 1.8	9.0 ± 1.5	**0.15**
Fluid therapy (ml)	500 ± 100	300 ± 80	450 ± 90	**0.03**
Hospital stays (days)	7.5 ± 1.5	5.0 ± 1.0	6.8 ± 1.2	**0.04**
ICU care (%)	30%	10%	25%	**0.08**

Significant Observations

- Low platelet count is consistently associated with increased morbidity (longer hospitalizations, increased ICU admissions).
- High plateletcrit (PCT) is associated with longer hospitalizations but not increased ICU admissions.

Table 5 evaluates associations between plateletcrit (PCT) categories (Low <0.108%, Normal 0.108-0.282%, High >0.282%) and morbidity variables. Patients with high PCT had a mean age of 9.0 ± 1.5 years, which was not significantly different than others (P = 0.15). Participants within the high PCT group had a significantly greater fluid therapy requirement (450 ± 90 ml) than those in the low (500 ± 100 ml) or normal (300 ± 80 ml) PCT groups (P = 0.03). Additionally, high PCT patients had greater hospital stay length (6.8 ± 1.2 days) than low and normal (7.5 ± 1.5 and 5.0 ± 1.0 days, respectively) PCT groups (P = 0.04). Finally, high PCT patients had a slightly higher proportion of ICU admissions (25% vs. 30% and 10% for the low and normal PCT groups, respectively), although this comparison was not statistically significant (P = 0.08). Overall, additional findings suggest that increased PCT was associated with increased morbidity but did not statistically reach significance.

The findings bolster prognostic importance of platelet indices for risk stratification and clinical management of paediatric dengue (Yadav & Aslam, 2021).

4.6 Comparison of Lab Parameters with Serology

Table 3 presents comparisons of important laboratory metrics based on serological group by NS1 positive status, IgM positive status, and in combination, NS1 and IgM positive cases. The mean platelet count was the lowest for a mean of 1.0 lakh ± 0.2 for the combined positive serological group, with the NS1 group at 1.3 lakh ± 0.3 and IgM group at 1.2 lakh ± 0.3, indicating the combined positive group had more significant thrombocytopenia than both serological sets separately. The same pattern was seen with PDW and P-LCR being significantly higher for the combined positive group, with a mean of 16.5% ± 1.0 and 25% ± 3 respectively. These values suggest that there is increased platelet activation and platelet turnover in this serological group. Measuring MPV followed the same pattern compared to other groups, as the combined positive group was significantly higher at a mean of 9.5 fL ± 0.5, which again emphasizes the relationship to severe manifestations of dengue in the combined serological positive group.

Parameter	NS1+ve Cases	IgM+ve Cases	IgM+ve and NS1+ve Cases
Mean platelet count (Lakh)	1.3 ± 0.3	1.2 ± 0.3	1.0 ± 0.2
Mean plateletcrit (PCT) (%)	0.25 ± 0.05	0.23 ± 0.04	0.18 ± 0.03
Mean PDW (%)	15.2 ± 0.8	16.0 ± 0.9	16.5 ± 1.0
Mean P-LCR (%)	22 ± 2	23 ± 2	25 ± 3
Mean MPV (fL)	8.5 ± 0.4	8.7 ± 0.5	9.5 ± 0.5

5. Discussion

The objective of this study was to better understand the association between different platelet indices and clinical outcomes in paediatric dengue patients. The data was derived from 60 individuals who had been diagnosed with dengue. The data contributes to our understanding of the significance of platelet count, PDW, P-LCR, and PCT in terms of disease severity/morbidity. The studies justify previously demonstrated significance of platelet indices in predicting clinical outcomes, which provides early recognition of high-risk patients (Ahmad et al., 2020).

1) Demographic and Clinical Profile

The age distribution indicates that 50% of patients were 6-10 years of age, 30% were 11-15 years of age, and 20% were 2-5 years of age indicating a preponderance of school aged children, likely due to increased outdoor time exposing them to mosquito vector transmission (Martínez-Ruíz et al., 2022). A male predominance (55%) was found, which is consistent with studies that suggest male have more outdoor exposure increasing the likelihood of exposure (Mukker & Kiran, 2018). The most common presenting symptom was fever (100%), followed by headache (60%), abdominal pain (45%), myalgia (35%), and rash (25%), which are aligned with the classic clinical description of dengue (Khatri et al., 2024). Warning signs were present in 40% of the patients indicating a higher risk of severe complications (Table 1).

2) Platelet Count Trends

Thrombocytopenia was also prominent, beginning with a mean platelet count of 1.2 ± 0.3 lakh on Day 1 and increasing relatively to 3.8 ± 0.5 lakh by Day 8, indicating progressive haematological recovery (Table 2). This is consistent with dengue pathophysiology, which reflects initial bone marrow suppression and peripheral destruction of platelets followed by the recovery in the convalescent phase (Makwana et al., 2020).

Association Between Platelet Indices and Disease Severity

a) Platelet Distribution Width (PDW)

- PDW, which is an indicator of platelet heterogeneity and activation, was significantly increased (18.5% ±1.2) on Day 1, subsequently decreasing to 15.3% ±1.0 by Day 8, suggesting decreased platelet activation over time (Table 3). Increased PDW results from increased turnover and destruction of the platelets indicative of more severe dengue (Yadav & Aslam, 2021).
- **Platelet Large Cell Ratio (P-LCR)**
- P-LCR was also high on Day 1 (30% ±5) and decreased on Day 8 to 20% ±3, suggestive of a higher proportion of large reactive platelets in the early time points of infection (Table 4). Increased P-LCR has been associated with increased platelet consumption, and severe thrombocytopenia, all characteristic of severe dengue (Looi et al., 2021).

b) Platelet Indices in Serological Groups

- The group of patients who were positive for both NS1 and IgM antibodies had the lowest platelet counts (1.0 ± 0.2 lakh), the highest PDW (16.5% ±1.0) and the highest P-LCR (25% ±3) (Table 5). These results suggest that these patients have a greater degree of platelet activation and severity of thrombocytopenia during the secondary dengue infections, specifically when antibody dependent

enhancement (ADE) may be leading to worsening of the disease process (Sinha et al., 2022).

Correlation of Platelet Indices with Morbidity Parameters

a) Platelet Count and Morbidity

- Younger patients, with a mean age of 7.8 ± 2.1 years, had lower (<1.5 lakh) platelet counts and received greater fluid therapy, (500 ± 100 ml) stayed longer (7.5 ± 1.5 days), and required ICU admission (30%) (Table 6) compared to the older subjects. This shows that thrombocytopenia has a role in predicting poor outcome in severe dengue (Fernando et al., 2020).

b) Plateletcrit (PCT) and Hospitalization

- Patients with elevated PCT (>0.282%) had increased hospital length-of-stay (6.8 ± 1.2 days) and fluid therapy requirements (450 ± 90 ml), but the need for ICU admission was similar (p = 0.08) (Table 7). Although PCT has been correlated with increased platelet mass, the prediction of ICU admission remains unclear and requires further evaluation (Majumdar et al., 2022).

6. Clinical Implications and Future Directions

Utility of Platelet Indices in Risk Stratification

The results of this study imply that; while platelet count alone is useful for early risk assessment, utilizing platelet indices (PDW, P-LCR, and PCT) along with platelet count can improve early risk assessment. For example, high PDW and P-LCR suggest greater platelet activation and would result in more monitoring of the patient (Makwana et al., 2020). This methodology is part of the concept of personalized medicine, which involves risk profiles being designed for individual patients to determine clinical approach/intervention (Ahmed et al., 2022).

7. Limitations and Recommendations

The study offers valuable insights but has several limitations:

- With a sample size of only 60 patients, the study's generalizability is limited in its findings and requires larger multicentric studies for validation.
- The study was conducted in a single tertiary care center, introducing possible selection bias and may limit the generalizabiltiy of the findings.
- Mild dengue outpatient cases were probably under-reported, skewing the case severity distribution in the dataset.

8. Interventional Strategies

Future studies can assess the application of targeted therapies through the utilization of platelet indices. For instance, early fluid resuscitation can reduce severe outcomes among patients with high PDW and P-LCR (Looi et al., 2021). Thus, the integration of advanced haematological monitoring into standard care can enhance the accuracy with which we treat dengue in children.

9. Conclusion

This study highlights a significant correlation between platelet indices and disease severity among children with dengue. Decreased platelet counts, as well as elevated PDW, P-LCR, and PCT, were associated with longer hospital stays and higher rates of ICU admission suggesting their application as prognostic markers. With platelet profiling being included in routine procedures for the evaluation of dengue, these results can result in proper risk stratification, earlier interventions, and ultimately better outcomes. Further studies in bigger, multicentric populations are needed to confirm these findings and examine progressive interventions based on platelet indices for individualized management of dengue.

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- Ethical approval: The study was approved by the Institutional Ethics Committee

Declaration by Author

I certify that the manuscript titled 'A STUDY OF RELATIONSHIP BETWEEN VARIOUS PLATELET INDICES AND OUTCOME OF DENGUE FEVER IN PEDIATRIC PATIENTS.' Represent valid work and that neither this manuscript nor one with substantially similar content under my/our authorship has been published or is being considered for publication elsewhere. The author (s) undersigned hereby transfer (s), assign (s), or otherwise convey (s), all copyright ownership, including any and all rights incidental there to, exclusively to the International journal of science and research, in the event that such work is published in the International journal of science and research. I/we assume full responsibility for any infringement of copyright or plagiarism.

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Authors' name (s) in order of appearance in the manuscript
Dr. KAMOLESH KANNAN R
Dr. KUMAR G V
Dr. ANANDA KUMAR TS
Dr. TIBU JOHN JOYSE