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(RESEARCH ARTICLE)

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Platelet count and platelet indices as predictor of severity of dengue fever: A cross-sectional study

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Abstract

Background: Dengue fever is a rapidly spreading mosquito-borne viral illness with a wide clinical spectrum ranging from mild febrile illness to severe dengue hemorrhagic fever and dengue shock syndrome. Early prediction of disease severity is crucial for timely management and improved patient outcomes.

Objective: This study aims to evaluate the role of platelet count and platelet indices—mean platelet volume (MPV), platelet distribution width (PDW), and plateletcrit (PCT)—as reliable predictors of dengue fever severity.

Methods: A cross-sectional observational study was conducted over one year at a tertiary care hospital, including 500 dengue-positive patients confirmed by serological testing. Patients were categorized into three groups based on platelet count (<20,000/mm^3, 20,000–100,000/mm^3, and 100,001–150,000/mm^3). Platelet indices were measured using an automated hematology analyzer (SYSMEX XN-550). Clinical features were correlated with platelet parameters to assess their prognostic value.

Results: The study found significant correlations between decreased platelet counts and increased severity of dengue fever. MPV and PDW showed inverse and direct relationships respectively with platelet counts, indicating their utility as markers of platelet activation and disease progression. Lower plateletcrit values were observed in patients with severe thrombocytopenia. These platelet indices demonstrated potential as early predictors of disease severity and bleeding risk in dengue patients.

Conclusion: Platelet count along with platelet indices such as MPV, PDW, and PCT are valuable prognostic markers for assessing the severity of dengue fever. Incorporating these parameters into routine clinical evaluation can aid in early identification of patients at risk for severe disease and guide appropriate management strategies.

Keywords: Dengue fever; Platelet count; Mean platelet volume (MPV); Platelet distribution width (PDW); Plateletcrit (PCT); Thrombocytopenia; Disease severity; Prognostic markers

1. Introduction

Dengue fever (DF) is a mosquito-borne viral infection caused by the dengue virus, a member of the Flaviviridae family, transmitted primarily by *Aedes aegypti* mosquitoes. It is recognized as the most rapidly spreading arboviral disease globally, with an estimated 390 million infections annually, of which approximately 96 million manifest clinically[1]. The disease burden is especially high in tropical and subtropical regions, affecting over 3.9 billion people worldwide, with

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Southeast Asia accounting for about 70% of cases (WHO, 2021). India, being one of the most endemic countries, has witnessed increasing outbreaks and rising mortality due to dengue over the past few decades[2,3].

Dengue infection results in a complex pathophysiological process involving bone marrow suppression and peripheral platelet destruction, leading to thrombocytopenia—a hallmark of severe dengue infection[5]. Platelet indices, such as mean platelet volume (MPV), platelet distribution width (PDW), and plateletcrit (PCT), reflect changes in platelet size, variability, and total platelet mass, respectively, and serve as indirect markers of platelet activation and bone marrow respons [5,6]. An imbalance in platelet production and destruction exacerbates vascular permeability, contributing to hemorrhagic manifestations and plasma leakage seen in severe dengue[7].

The clinical spectrum of dengue ranges from mild febrile illness to life-threatening dengue hemorrhagic fever (DHF) and dengue shock syndrome (DSS)[8]. Early identification of patients likely to develop severe disease is critical to reducing mortality by guiding prompt supportive therapy and hospital resource allocation [8]. However, the nonspecific clinical features and overlapping symptoms with other febrile illnesses make early diagnosis and risk stratification challenging [9]. Laboratory parameters, particularly platelet-related markers, provide valuable prognostic information that can aid clinicians in this regard.

While platelet count is routinely used to monitor dengue progression, platelet indices remain underutilized despite evidence suggesting their utility in predicting disease severity [10]. MPV and PDW have been associated with platelet activation and size heterogeneity, reflecting the dynamics of platelet turnover and destruction during dengue infection[11]. Similarly, PCT represents the volume percentage of platelets in blood and may provide additional insight into platelet mass depletion. Understanding the patterns of these indices in dengue patients can improve early risk stratification and management decisions.

2. Materials and Methods

This study was designed as a cross-sectional observational study aimed at evaluating platelet count and platelet indices as predictors of severity in dengue fever. The research was conducted in the Department of Pathology, Rohilkhand Medical College and Hospital, Bareilly, Uttar Pradesh, India. The study was carried out over a period of one year, from August 2023 to July 2024. A total of 500 Dengue-positive patients were examined.

Patients presenting with fever and confirmed dengue infection by serological tests and with thrombocytopenia (platelet count below normal reference range) were all included in the study.

Patients with other known causes of thrombocytopenia (e.g., haematological malignancies) or with co-infections such as malaria or bacterial infections or currently receiving anti-platelet or anticoagulant therapy were not included in the study.

Blood samples were collected aseptically by trained phlebotomists using disposable needles and syringes into EDTA vacutainers. Proper labelling and handling protocols were strictly followed to maintain sample integrity. Samples were analyzed using an automated haematology analyzer, SYSMEX XN-550, which utilizes impedance and fluorescence flow cytometry for accurate measurement of complete blood count and platelet indices, including: Platelet Count (PC), Mean Platelet Volume (MPV), Platelet Distribution Width (PDW) and Plateletcrit (PCT)

Patients were classified into three groups according to their platelet counts for comparative analysis:

- **Group 1:** Platelet Count < 20,000/mm^3
- **Group 2:** Platelet Count 20,000 – 100,000/mm^3
- **Group 3:** Platelet Count 100,001 – 150,000/mm^3

The study protocol was reviewed and approved by the Institutional Ethics Committee. Written informed consent was obtained from all participants. Confidentiality and anonymity of patient data were maintained throughout the study in compliance with ethical guidelines.

3. Results

During the study period, a total 500 Dengue-Positive patients were examined. Of these 232(46.4%) were males and 268(53.6%) were females (Figure 1.). Median Age was 25 years. Clinical features (Figure 2.) like Fever was the most

common clinical feature seen in all cases (100.0%), followed by myalgia (91.0%), Abdominal Pain (77.40%), Petechiae (30.80%), Joint Pain (28.40%) and least common clinical feature is Bleeding (4.80%). Platelet count and Indices of all 500 patients were collected and noted over a period of 5 Days i.e. on Day 1, Day 3 and Day 5 of admission (Table 1.). It was noted that Mean platelet count (Figure 3.) was 0.56×10^5/L at day 1, 0.62×10^5/L at day 3 and 0.8×10^5/L at day 5. Mean platelet distribution width (Figure 4.) was 64.93% at day 1, 64.1% at day 3 and 61.32% at day 5. Mean platelet volume (Figure 5.) was 14.82 fL at day 1, 16.79 at day 3 and 16.06 fL at day 5. Mean platelet large cell ratio (Figure 6.) was 40.33% at day 1, 40.08 % at day 3 and 38.91 % at day 5. Mean plateletcrit (Figure 7.) was 0.14at day 1, 0.15 at day 3 and 0.16 at day 5, Mean Duration of Hospital stay among all the patients was 7.5 Days and range is 5-17 Days

Mean platelet counts ($\times10^5$ mm^{-3}) rose steadily from 0.56 (Day 1) to 0.62 (Day 3) and 0.80 (Day 5). MPV increased from 14.8 fL (Day 1) to 16.8 fL (Day 3) before plateauing 16.1 fL (Day 5). PDW fell from 64.9% to 61.3% over the same interval. PCT climbed modestly from 0.05% (Day 1) to 0.10% (Day 3) to 0.13% (Day 5).

Group 1 (Platelet Count < 20,000/mm^3): This group showed the lowest platelet counts and shows the lowest mean MPV and PCT values but the highest PDW values. The high PDW indicates increased platelet size variability due to platelet destruction and regeneration. Clinical severity is mostly severe in this group (30 out of 50 patients), consistent with thrombocytopenia-related complications.

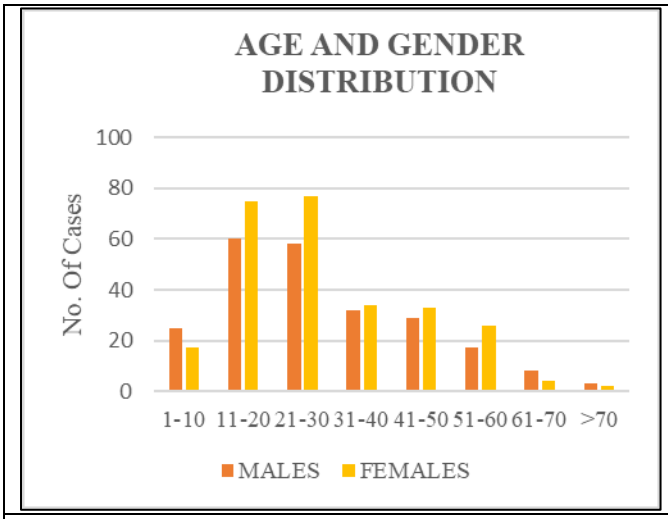

Figure 1 Age-Sex Distribution

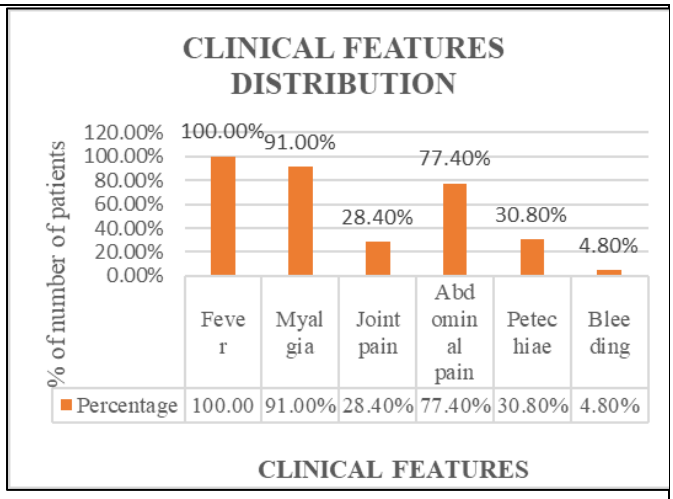

Figure 2 Clinical Features Distribution

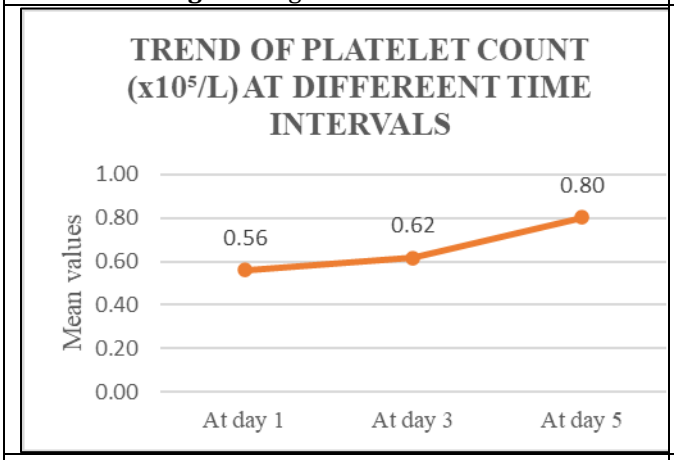

Figure 3 Mean Platelet Count Distribution

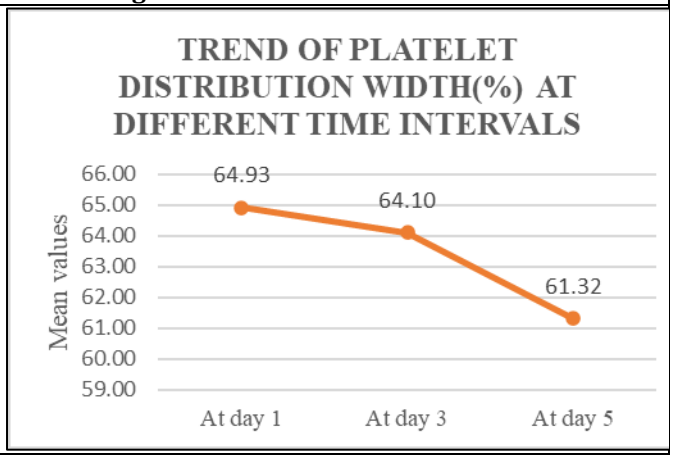

Figure 4 Mean PDW Distribution

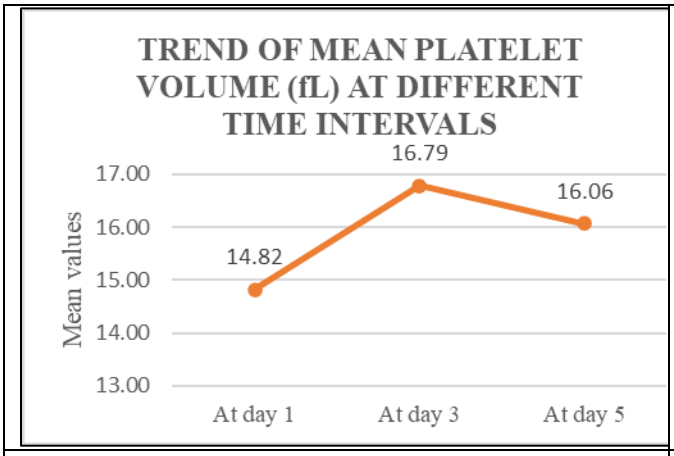

Figure 5 Mean MPV Distribution

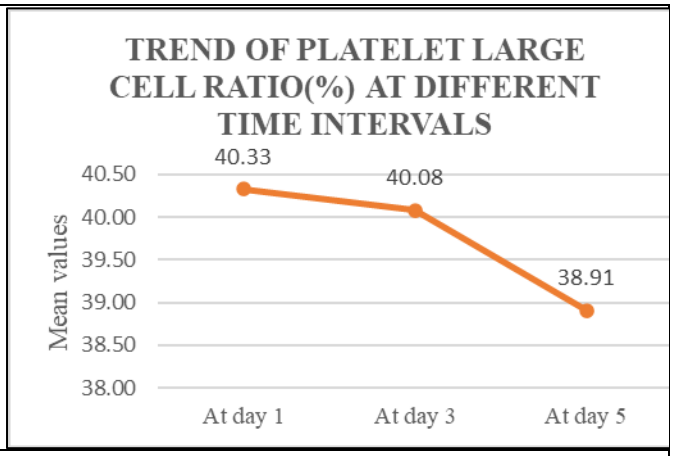

Figure 6 Mean P-LCR Distribution

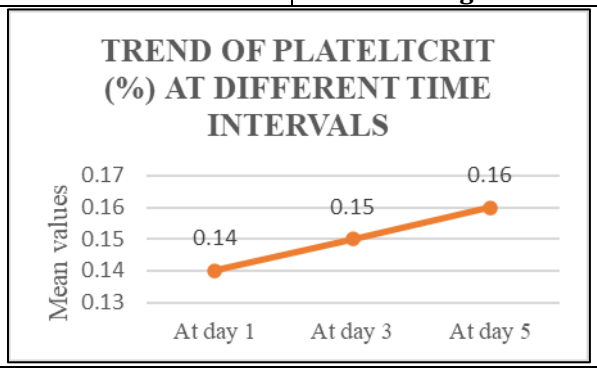

Figure 7 Mean PCT Distribution

Table 1 Mean Values Of Platelet Count and Platelet Indices on Day-1, Day-3 and Day-5

	Platelet Count		PDW		MPV		P-LCR		PCT	
	Mean Value	Range	Mean Value	Range	Mean Value	Range	Mean Value	Range	Mean Value	Range
DAY 1	0.56	0.07-1.46	64.93	50.6-72.2	14.82	11.8-16.4	40.33	35.2-43.1	0.14	0.09-0.22
DAY 3	0.62	0.14-1.72	64.1	46.9-70.8	16.79	13.3-19	40.08	34-42.8	0.15	0.1-0.24
DAY 5	0.80	0.08-2.01	61.32	36.1-72	16.06	12.7-17.7	38.91	32.5-43.1	0.16	0.09-0.24

- **Group 2 (Platelet Count 20,000–100,000/mm^3):** Patients in this intermediate range show moderate MPV and PDW values with higher PCT compared to Group 1. Clinical severity is more balanced but skewed towards mild and moderate categories.
- **Group 3 (Platelet Count 100,001–150,000/mm^3):** This group showed platelet counts approaching normal limits, with the highest mean MPV and PCT values and lowest PDW, indicating healthier platelet populations. Most patients exhibit mild clinical severity, and severe cases are absent.
- **Mean Platelet Volume (MPV):** Shows an increasing trend with higher platelet counts, indicating healthier platelet production in less severe cases.
- **Platelet Distribution Width (PDW):** Decreases as platelet counts improve, suggesting reduced platelet destruction and activation in milder disease.
- **Plateletcrit (PCT):** Increases with platelet count, reflecting the total platelet mass in circulation.

4. Discussion

The progressive fall in platelet count that we observed was most pronounced at admission and recovering by day-5. This parallels the classical temporal pattern reported by Thakur *et al*.[4,] and Paul *et al.* [3]. Our data also confirm that counts < 20 000 mm^3 carry the greatest risk of severe clinical outcomes, a threshold highlighted previously by Nehara *et al*.[8].

Univariate and multivariable analyses demonstrated that a very low platelet count together with an elevated PDW independently predicted severe dengue in our cohort. These results echo the diagnostic performance of combined indices reported by Sontakke *et al.*[5] in children and by Mangshetty *et al*.[11] in paediatric wards, confirming their utility across age groups and geographic settings.

Mean platelet volume increased steadily as counts recovered, while PDW declined—a mirror-image relationship described by Paul et al.[3] and Brahma et al.[12]. A low MPV in the face of profound thrombocytopenia suggests inadequate megakaryocyte compensation and therefore heightened risk, whereas a rising MPV heralds marrow recovery. Conversely, the wide PDW early in illness reflects heterogeneous platelet sizes generated by accelerated peripheral destruction and 'stress' thrombopoiesis as stated by Jacob et al.[7].

Because automated haematology analysers yield values of MPV, PDW and PCT without extra cost or blood volume, these indices can be incorporated into daily ward rounds. Patients exhibiting PDW > 17 % or MPV < 9 fL on admission should be earmarked for closer haemodynamic monitoring and early fluid-management protocols—an approach advocated by Asha et al.[10] to ration scarce ICU beds during outbreaks. In primary-care or resource-limited hospitals, a simple rule-in/rule-out algorithm using platelet count + indices could trigger timely referral before shock or bleeding ensues.

Longitudinal, multicentric studies tracking daily platelet indices from day 0 to convalescence—and correlating them with virological load, cytokine panels and endothelial biomarkers—are needed to construct robust prediction nomograms. Incorporating novel parameters such as the immature platelet fraction (recommended by Thakur et al.[4]) or soluble NS1 titres could further sharpen prognostication. Finally, validation of cost-effective bedside algorithms that combine clinical warning signs with platelet-index cut-offs across diverse health-care settings will be essential before universal guideline adoption.

Limitations of this study are firstly, the cross-sectional design captures platelet dynamics only at three discrete points, limiting causal inference and missing finer kinetic changes. Second, being single-centre, the work may reflect local serotype predominance or management practices and may not extrapolate to all endemic areas. Third, although the calculated sample of 500 provided adequate power, larger multi-season cohorts would strengthen rare-outcome estimates (e.g., fatal DSS). Lastly, we did not measure complementary biomarkers such as cytokine profiles or immature platelet fraction, which might refine risk prediction.

5. Conclusion

This cross-sectional study of 500 confirmed dengue cases demonstrates that thrombocytopenia accompanied by low MPV, high PDW and low PCT is strongly associated with the development of severe dengue manifestations (DHF/DSS). Platelet count < 20 000 mm^3 and PDW > 17 % emerged as independent predictors of severity, while a rising MPV paralleled clinical recovery. These findings corroborate—and extend—earlier regional and international reports that platelet indices mirror the balance between marrow compensation and peripheral platelet destruction during dengue infection. Automated haematology analysers already generate MPV, PDW and PCT with no additional cost, making them ideal bedside biomarkers in both tertiary and resource-limited settings. A simple admission screen—Platelet count, MPV and PDW—can stratify patients into low-, intermediate- and high-risk categories, guiding decisions on admission level, fluid-management intensity and frequency of haemodynamic monitoring. Incorporating index-based thresholds (e.g., PDW > 17 % or MPV < 9 fL + Platelets < 50 000 mm^3) into triage algorithms could reduce late referrals and optimise ICU utilisation during epidemics. Few recommendations can be made like for Routine reporting in Laboratories should be flag abnormal MPV/PDW/PCT values alongside platelet counts on dengue patient reports. Clinical protocols: Hospitals in endemic regions should embed platelet-index cut-offs into standard treatment pathways and electronic alerts. Clinicians and nurses should receive targeted education on interpreting platelet indices for early detection of impending severe dengue. Surveillance & Research Health systems should collect multicentre, longitudinal data integrating platelet indices with virological and inflammatory markers to refine predictive models and validate universal cut-offs.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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