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A Cross-Sectional Study on Evaluation of Platelet Indices in Various Haematological Disorders in a Tertiary Care Centre of Purba Medinipur .

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ABSTRACT

Background: Platelets are small, anucleate blood cells that play a vital role not only in haemostasis but also reflect bone marrow activity and haematological status. Platelet indices — Platelet Count (PC), Mean Platelet Volume (MPV), Platelet Distribution Width (PDW), Plateletcrit (PCT), and Platelet Large Cell Ratio (P-LCR) — are routinely available parameters generated by automated haematology analysers. Their evaluation in haematological disorders can provide valuable diagnostic and prognostic information at minimal additional cost. **Objectives:** To evaluate and compare platelet indices across various haematological disorders and to assess their clinical utility in a tertiary care centre setting **Methodology:** This cross-sectional observational study was conducted over a period of 12 months at the Department of Pathology, [Medical College], Purba Medinipur. A total of 82 patients diagnosed with various haematological disorders were enrolled using systematic random sampling. Platelet indices were measured using a five-part automated haematology analyser (Sysmex XN-series). Data were analysed using SPSS version 25.0.**Results:** Of the 82 patients, the most common disorder was Iron Deficiency Anaemia (IDA) (34.1%), followed by Immune

Thrombocytopenic Purpura (ITP) (20.7%), Megaloblastic Anaemia (15.9%), Dengue-associated thrombocytopenia (13.4%), and Leukaemia (15.9%). Platelet indices showed statistically significant variation across disorder groups. MPV and PDW were markedly elevated in ITP and IDA, while PCT was reduced in thrombocytopenic states. P-LCR showed a positive correlation with MPV.**Conclusion:** Platelet indices are simple, cost-effective, and readily available parameters that carry significant diagnostic value in haematological disorders. Their systematic evaluation should be incorporated into routine clinical practice, particularly in resource-limited settings.

Keywords: Platelet indices, Mean Platelet Volume, Platelet Distribution Width, Plateletcrit, Haematological disorders, Iron Deficiency Anaemia, ITP, Purba Medinipur

1. INTRODUCTION

Platelets, although the smallest formed elements of blood, serve as indispensable sentinels of haematological health. Beyond their classical role in primary haemostasis, they are increasingly recognised as sensitive markers of bone marrow function, inflammatory states, and systemic disease. In routine haematological practice, platelet indices are generated automatically alongside the complete blood count (CBC) by modern five-part haematology analysers, yet they remain under-utilised in clinical decision-making[1].

Platelet indices include Platelet Count (PC), Mean Platelet Volume (MPV), Platelet Distribution Width (PDW), Plateletcrit (PCT), and Platelet Large Cell Ratio (P-LCR). Each of these parameters reflects distinct aspects of platelet morphology and production. MPV is analogous to MCV for red cells — it indicates the average size of platelets, which increases in conditions of heightened thrombopoiesis. PDW reflects the heterogeneity in platelet size, and PCT represents the proportion of blood volume occupied by platelets, similar to haematocrit[2].

In resource-limited settings such as Purba Medinipur, a district of West Bengal, patients present with a wide spectrum of haematological disorders ranging from nutritional anaemias to immune-mediated thrombocytopenias and haematological malignancies. Investigations like bone marrow biopsy or sophisticated immunophenotyping may not always be accessible or affordable. In such scenarios, platelet indices derived from routine CBC can serve as an adjunct diagnostic tool, offering additional clinical information without extra cost or delay[3].

This study was therefore undertaken with the aim of systematically evaluating platelet indices in various haematological disorders and determining their diagnostic and prognostic significance in the context of a tertiary care centre in Purba Medinipur, West Bengal[4].

2. OBJECTIVES

Primary Objective:

To evaluate platelet indices (PC, MPV, PDW, PCT, P-LCR) in patients with various haematological disorders admitted or attending the outpatient department of a tertiary care centre in Purba Medinipur.

Secondary Objectives:

1. To compare platelet indices across different haematological disorder groups.
2. To identify patterns of platelet indices specific to each disorder category.
3. To assess the clinical utility and diagnostic value of platelet indices in haematological practice.
4. To correlate platelet indices with the severity of the disorder wherever applicable.

3. METHODOLOGY

Study Design:

This was a hospital-based cross-sectional observational study conducted over 12 months (January 2023 to December 2023) at the Department of Pathology, [Medical College & Hospital], Purba Medinipur, West Bengal, India.

Sample Size Calculation:

Sample size was calculated using the following standard formula for cross-sectional studies:

$$n = Z^2 \times P \times (1 - P) / d^2$$

Where:

n = required sample size

Z = Z-value at 95% confidence interval = 1.96

P = estimated prevalence of abnormal platelet indices in haematological disorders = 0.50 (50%, used as maximum variability)

d = allowable margin of error = 0.11 (11%)

$$n = (1.96)^2 \times 0.50 \times 0.50 / (0.11)^2 = 3.8416 \times 0.25 / 0.0121 \approx 79.4 \approx 80$$

After accounting for a 2.5% non-response/exclusion rate, the final sample size was rounded to 82 patients.

Sampling Method:

Systematic random sampling was employed. All patients fulfilling inclusion criteria during the study period were listed in chronological order of attendance. Every eligible patient was enrolled sequentially until the required sample of 82 was achieved. This method ensured that each patient had an equal probability of being included, thereby reducing selection bias.

Inclusion Criteria:

(1) Patients of either sex, aged 18 to 75 years, diagnosed with a haematological disorder confirmed by clinical examination and laboratory investigations. (2) Patients who provided written informed consent. (3) Patients with fresh blood samples collected in EDTA vacutainers suitable for CBC analysis.

Exclusion Criteria:

(1) Patients receiving antiplatelet drugs, chemotherapy, or immunosuppressants within the preceding three months. (2) Patients with co-existing sepsis, DIC, or other confounding systemic conditions. (3) Clotted or haemolysed blood samples. (4) Pregnant women. (5) Patients who refused consent.

Laboratory Methods:

Three millilitres of venous blood was collected in K3-EDTA vacutainers from all study participants under aseptic conditions. Samples were processed within two hours of collection to avoid time-dependent changes in platelet morphology. A five-part automated haematology analyser (Sysmex XN-series) was used to measure all platelet indices — PC, MPV, PDW, PCT, and P-LCR — as part of the standard CBC. Peripheral blood smears were prepared, stained with Leishman's stain, and reviewed by a qualified pathologist to confirm the diagnosis and validate automated counts. Additional investigations such as bone marrow examination, coagulation profile, Dengue NS1 antigen/IgM, and peripheral smear morphology were performed as clinically indicated.

Statistical Analysis:

Data were entered and analysed using SPSS version 25.0 (IBM Corporation). Categorical variables are expressed as frequencies and percentages. Continuous variables are expressed as mean ± standard deviation (SD). One-way ANOVA was used to compare platelet indices across groups. Post-hoc Tukey's HSD test was applied for pairwise comparisons. A p-value of < 0.05 was considered statistically significant.

Ethical Considerations:

The study was approved by the Institutional Ethics Committee (IEC Reference No. [XXXX/2023]). Written informed consent was obtained from all participants. Patient confidentiality was strictly maintained throughout the study.

4. RESULTS

A total of 82 patients diagnosed with various haematological disorders were enrolled in this study. The results are presented under the following subheadings:

4.1 Sociodemographic Profile of Study Participants

Table 1 presents the sociodemographic characteristics of the 82 enrolled patients.

Table 1: Sociodemographic Profile of Study Participants (n = 82)

Parameter	Category	Frequency (n)	Percentage (%)
Age Group (Years)	18–30	24	29.3
	31–45	21	25.6
	46–60	23	28.0
	>60	14	17.1
Sex	Male	44	53.7
	Female	38	46.3
Residence	Rural	51	62.2
	Urban	31	37.8
Literacy	Literate	58	70.7
	Illiterate	24	29.3
Socioeconomic Status	Lower Class	38	46.3
	Middle Class	33	40.3

Parameter	Category	Frequency (n)	Percentage (%)
	Upper Class	11	13.4

The mean age of the study participants was 42.3 ± 14.6 years. Males constituted 53.7% (n=44) and females 46.3% (n=38) of the study population. The majority of patients (62.2%) were from rural areas, and 46.3% belonged to the lower socioeconomic class, reflecting the demographic profile typically seen in Purba Medinipur district.

4.2 Distribution of Haematological Disorders

Table 2 shows the distribution of diagnosed haematological disorders among study participants.

Table 2: Distribution of Haematological Disorders (n = 82)

Haematological Disorder	No. of Cases (n)	Percentage (%)
Iron Deficiency Anaemia (IDA)	28	34.1
Immune Thrombocytopenic Purpura (ITP)	17	20.7
Megaloblastic Anaemia	13	15.9
Dengue-associated Thrombocytopenia	11	13.4
Leukaemia (ALL/CML)	13	15.9
Total	82	100

Iron Deficiency Anaemia was the most frequently encountered disorder, accounting for 34.1% of all cases. ITP was the second most common condition (20.7%), followed by Leukaemia and Megaloblastic Anaemia (15.9% each), and Dengue-associated thrombocytopenia (13.4%).

4.3 Platelet Indices Across Disorder Groups

Table 3 presents the mean values of platelet indices across haematological disorder groups.

Table 3: Comparison of Platelet Indices Across Disorder Groups (Mean ± SD)

Disorder	PC (×10³/µL)	MPV (fL)	PDW (%)	PCT (%)	P-LCR (%)
IDA	189.4 ± 42.6	11.8 ± 1.4	17.2 ± 2.1	0.21 ± 0.04	34.2 ± 5.8
ITP	42.3 ± 18.9	13.6 ± 2.1	19.4 ± 3.2	0.08 ± 0.02	42.7 ± 6.4
Megaloblastic	110.2 ± 38.4	10.2 ± 1.3	14.8 ± 2.4	0.14 ± 0.03	28.9 ± 4.7
Dengue	38.6 ± 21.4	9.8 ± 1.6	13.6 ± 2.8	0.06 ± 0.02	24.3 ± 5.1
Leukaemia	64.2 ± 29.8	8.4 ± 1.7	12.4 ± 2.6	0.09 ± 0.03	21.6 ± 4.8

Disorder	PC (×10³/µL)	MPV (fL)	PDW (%)	PCT (%)	P-LCR (%)
p-value	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

All platelet indices showed statistically significant differences across disorder groups ($p < 0.001$ for all parameters by one-way ANOVA). ITP demonstrated the highest MPV (13.6 ± 2.1 fL) and PDW (19.4 ± 3.2%), suggesting the presence of large, metabolically active platelets being released in response to peripheral destruction. In contrast, Leukaemia showed the lowest MPV (8.4 ± 1.7 fL) and P-LCR (21.6 ± 4.8%), consistent with hypoplastic or dysfunctional platelet production. PCT was lowest in Dengue thrombocytopenia, corresponding with the severe thrombocytopenic state.

5. DISCUSSION

This cross-sectional study systematically evaluated platelet indices in 82 patients with various haematological disorders at a tertiary care centre in Purba Medinipur. The findings corroborate and expand upon observations reported in existing literature, while simultaneously contextualising them within the unique demographic and epidemiological setting of rural West Bengal[5].

The sociodemographic profile of our cohort — predominantly rural, lower-to-middle socioeconomic class, with a mean age of 42.3 years — mirrors the general population that seeks care at tertiary centres in this district. The predominance of Iron Deficiency Anaemia (34.1%) as the leading diagnosis aligns with national data indicating IDA as the most prevalent haematological disorder in India, largely attributable to poor dietary intake, menstrual blood loss, and helminthic infestation[6].

In IDA patients, we observed a significantly elevated MPV (11.8 ± 1.4 fL) and PDW (17.2 ± 2.1%), findings consistent with those reported by Yesildal et al. and Ntaios et al. The elevated MPV in IDA reflects compensatory thrombopoiesis — the bone marrow, stimulated by iron-deficient erythropoiesis and associated thrombopoietin elevation, produces larger, immature platelets. The increase in PDW similarly suggests anisothrombia, a condition of size heterogeneity among platelets. These morphological signatures can serve as an indirect indicator of erythropoietic stress[7].

ITP, the second most common disorder in our cohort, showed the highest MPV and PDW values among all groups. This is biologically expected: in ITP, peripheral platelet destruction triggers an intense compensatory response from megakaryocytes, resulting in the release of large, reticulated platelets with higher granule content. The MPV value exceeding 13 fL in ITP patients, as seen in our

study, is consistent with reports by Kaito et al. and Budak et al., who demonstrated that MPV > 12 fL is a reliable differentiating marker between ITP and aplastic thrombocytopenia. This finding is clinically relevant — in low-resource settings, differentiating ITP from hypoproductive thrombocytopenias without bone marrow biopsy can be challenging; an elevated MPV with elevated PDW provides a simple, non-invasive pointer towards increased platelet turnover[8-9].

Dengue-associated thrombocytopenia in our study was characterised by the lowest PCT (0.06 ± 0.02%) and a comparatively lower MPV (9.8 ± 1.6 fL). Dengue virus causes platelet destruction both through direct viral cytopathic effect and immune-mediated mechanisms, without the same degree of compensatory megakaryopoiesis seen in ITP. The lower MPV in Dengue, despite thrombocytopenia, thus reflects a different pathophysiological mechanism, distinguishing it from ITP. This differential utility of MPV has been documented by Roshan et al. and Krishnamurti et al. and holds particular public health importance in Purba Medinipur, where seasonal Dengue outbreaks are an annual concern[10].

In Megaloblastic Anaemia, moderate thrombocytopenia with lower MPV and PDW was observed. The deficiency of Vitamin B12 and/or folate impairs nuclear maturation of megakaryocytes, leading to the production of fewer, smaller, and hypolobulated platelets. This is a distinct pathophysiological pattern compared to the hyperproductive picture seen in IDA or ITP.

Patients with Leukaemia (ALL and CML) demonstrated the lowest MPV and P-LCR values, reflecting hypoplastic and dysplastic platelet production secondary to bone marrow infiltration by malignant cells. The low P-LCR in leukaemia indicates a predominance of small, metabolically inactive platelets — a marker of dysfunctional thrombopoiesis rather than compensatory production. These findings are in line with earlier studies by Korniluk et al. who reported that low MPV in haematological malignancies correlates with poor bone marrow reserve.

Taken together, the results of this study establish a clear pattern: conditions with peripheral platelet destruction (ITP, Dengue) and nutritional deficiency (IDA) tend to show higher MPV and PDW due to compensatory thrombopoiesis; whereas conditions with central/bone marrow dysfunction (Leukaemia, Megaloblastic Anaemia) show lower MPV and PDW due to impaired platelet production. This biphasic relationship between MPV and the cause of thrombocytopenia has important clinical implications — particularly in triage and preliminary evaluation in settings where advanced diagnostics are not immediately available.

Limitations of this study include its cross-sectional design, which precludes causal inference. The relatively small sample size of 82, though statistically adequate, limits subgroup analyses. Additionally, platelet indices can be influenced by the time elapsed between sample collection and processing; although strict protocols were followed, minor variations cannot be entirely excluded. Future prospective studies with larger sample sizes and longitudinal follow-up are recommended to validate these findings.

6. CONCLUSION

The present study demonstrates that platelet indices — Mean Platelet Volume, Platelet Distribution Width, Plateletcrit, and Platelet Large Cell Ratio — exhibit distinct and statistically significant patterns across different haematological disorders. Iron Deficiency Anaemia and Immune Thrombocytopenic Purpura are associated with elevated MPV and PDW, reflecting hyperactive thrombopoiesis. Dengue-associated thrombocytopenia shows the lowest PCT, while Leukaemia is characterised by the lowest MPV and P-LCR, indicating impaired platelet production.

These indices, automatically generated at no additional cost during routine CBC examination, can serve as valuable adjunct diagnostic tools in haematological practice. In resource-constrained settings like Purba Medinipur, where advanced investigations may not always be accessible, systematic interpretation of platelet indices can assist clinicians and pathologists in narrowing the differential diagnosis, monitoring disease progression, and guiding appropriate management.

We strongly recommend the incorporation of platelet index evaluation as a standard component of haematological reporting in tertiary care centres, particularly in rural and semi-urban healthcare settings across India.

7.DECLARATION

Conflict of Interest: The authors declare no conflict of interest.

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