



Original Research Article

Diagnostic Value of Platelet Indices in Predicting Preeclampsia: A Clinical Evaluation at a Tertiary Care Hospital

Article History:

Name of Author:

Dr. Falak Khalil¹, Dr. Shumaila Naeem²,
Dr. Sadia Aftab^{3*}, Dr. Rehana Batool⁴,
Syeda Kiran Riaz⁵

Affiliation: ¹Medical Officer, Pakistan Institute of Medical Sciences (PIMS), Islamabad

²Assistant Professor, Department of Obstetrics & Gynaecology, PIMS, Islamabad

³Associate Professor, Department of Obstetrics & Gynaecology, PIMS, Islamabad

⁴Postgraduate Resident (PGY-4), PIMS, Islamabad

⁵ Assistant Professor BSc, MSc, MS, PhD Molecular Biology

Shaheed Zulfiqar Ali Bhutto Medical University, PIMS Hospital

Corresponding Author:

Dr Shubham Ajaybhai Chauhan

Received: 11-11-2025

Revised: 26-11-2025

Accepted: 16-12-2025

Published: 31-12-2025

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INTRODUCTION

Preeclampsia is a hypertensive disease multisystemic during pregnancy, typically during the 20th week of gestation, and also we consider it when high blood pressure is present and complemented by either proteinuria or dysfunction of end-organs¹. It poses a significant risk of maternal and fetal morbidity and

Abstract: Background: Preeclampsia is a hypertensive disorder of pregnancy, which is highly detrimental to maternal and fetal morbidity. Early detection is essential yet is usually challenging because of the unavailability of biomarkers, particularly in resource constrained environments. Mean Platelet Volume (MPV), Platelet Distribution Width (PDW), platelet count, and platelet indices, have become possible early indicators of preeclampsia. **Objective:** To evaluate the diagnostic performance of platelet indices in predicting preeclampsia among hypertensive pregnant women and to assess their sensitivity, specificity, and overall clinical utility in a tertiary care setting. **Methods:** This prospective cross-sectional study was conducted in the Department of Obstetrics and Gynaecology, PIMS Islamabad, from January to July 2022. A total of 125 hypertensive pregnant women aged 18–40 years and between 16–36 weeks' gestation were enrolled. Complete blood counts, including MPV, PDW, and platelet count, were performed and statistically compared between patients with and without preeclampsia. Data were analyzed using SPSS v26. Diagnostic accuracy, sensitivity, specificity, PPV, and NPV were calculated. **Results:** The study revealed significant differences in platelet indices between preeclamptic and non-preeclamptic women, with the preeclampsia group showing an elevated MPV (10.2 ± 1.1 fL), PDW ($16.8 \pm 2.3\%$), and a reduced platelet count ($165,000 \pm 22,000/\text{mm}^3$) compared to the non-preeclampsia group (MPV: 8.9 ± 0.9 fL, PDW: $13.4 \pm 1.7\%$, Platelet Count: $198,000 \pm 27,000/\text{mm}^3$). The diagnostic accuracy of platelet indices was 73%, with a sensitivity of 70%, specificity of 86.9%, and a positive predictive value of 95.9%. These findings suggest platelet indices as valuable biomarkers for early detection of preeclampsia, especially in resource-constrained settings. **Conclusion:** Platelet indices demonstrate strong potential as early, reliable, and economical biomarkers for the prediction of preeclampsia, particularly in hypertensive pregnancies. Their integration into routine antenatal screening protocols could aid in timely diagnosis and improved clinical management.

Keywords: Preeclampsia, Platelet indices, MPV, PDW, Hypertensive disorders in pregnancy

mortality since it causes as many as 10 percent of maternal mortality internationally². Preeclampsia occurs in 5-10 percent of all pregnancies around the world and it has remained as a frequent complication resulting in preterm delivery and intrauterine growth restriction and placental abruption and severe maternal morbidity including eclampsia and stroke and liver rupture and HELLP syndrome³.

The pathogenesis of preeclampsia is multifactorial and not fully comprehended, although the invading of trophoblasts is abnormal in a manner that fails to allow the reorganization of spiral arteries in supporting the growth of preeclampsia, which is central ⁴. This in turn prevents placental perfusion and it also brings about oxidative stress ⁵. Moreover systemic inflammatory responses are present, as well as antiangiogenic factors are released and they also destroy maternal vascular endothelium. Malfunctioning of endothelial cells occurs; this becomes one of the main characteristics ⁶. The impairment leads to hypercoagulability of the body through platelets becoming more activated and also depleting faster ⁷.

The parameters of platelets vary in peripheral blood due to the presence of hemostatic variations. Platelet Distribution Width (PDW) indicates platelet size change in relation to Mean Platelet Volume (MPV) indicating platelet activity and size and total platelet count decrease could indicate that microvascular bed are consumed ⁸. These parameters can be readily obtained by a simple blood count (CBC) and are therefore good candidates to be used as predictive biomarkers in the context of preeclampsia, primarily in the context of resource deficient settings in which biochemical markers which are advanced are either not available or prohibitively expensive ⁹.

It has been demonstrated by previous studies that hypertensive disorders in pregnancy are associated with abnormal platelet indices ^{2, 3, 6, 7}. It is stated that women with preeclampsia have high levels of MPV and PDW, and a rather large number of studies state that they may be the antecedents of clinical manifestations, which means that they can help to predict them in time ^{8, 9}. Nonetheless, the majority of this research was done by researchers in diverse groups of the population with different baseline factors ¹⁰. Localized research should prove their diagnostic usefulness in the localized settings such as Pakistan ⁶.

This study aims to evaluate the diagnostic validity of platelet indices in the prediction of preeclampsia including Mean Platelet Volume (MPV), Platelet Distribution Width (PDW) and platelet count. The research also seeks to establish the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of the same.

METHODOLOGY

Study Design and Setting: This was a cross-sectional analytical, hospital based study, which was carried out at the Department of Obstetrics and Gynaecology, Pakistan Institute of Medical Sciences (PIMS), Islamabad, one of the largest tertiary care referral centers that serves a spectrum of both urban and rural population in Pakistan. The survey took

place within a 6-month interval (January- July 2022).

Study Population: 125 hypertensive pregnant women aged 18-40 years of gestational ages 16-36 weeks constituted the study population. All of the participants were enlisted in the areas of antenatal outpatient clinics and inpatient wards. The institutional review board provided ethical approval and informed written consent was achieved among all the participants.

Sample Size Justification: The sample size of 125 participants was determined with the prevalence of preeclampsia in Pakistan (10%), the confidence interval of 95, the margin of error of 5, and a dropout/non-compliance rate of 10% adjustment.

Inclusion Criteria:

- Pregnant women aged between 18 and 40 years
- Gestational age between 16 and 36 weeks
- Known cases of chronic hypertension or newly diagnosed gestational hypertension

Exclusion Criteria:

- Patients with preexisting hematologic disorders (e.g., thrombocytopenia, leukemia)
- Diagnosed cases of autoimmune diseases, chronic renal or hepatic dysfunction
- Patients on antiplatelet or anticoagulant medications
- Women with multiple gestations or pre-existing diabetes mellitus

Data Collection Process: All the eligible patients received a thorough history and a physical examination including the blood pressure measurement and a preeclampsia presence evaluation. Measurement of blood pressure was done with the help of mercury sphygmomanometer according to a standard WHO procedure ⁵.

Full blood count (CBC) was conducted on venous blood samples in EDTA vials by dispatching them to an automated hematology analyzer. Platelet count, platelet indices such as MPV, PDW, and platelet count were measured. The condition of preeclampsia was diagnosed using ACOG criteria of blood pressure reading of 140/90mmHg on two or more independent through at least four hours of interval and presence or absence of proteinuria (300mg/24h or 1+ on dipstick) and/or systemic involvement.

Data Management and Statistical Analysis: All the data were aggregated and analyzed by means of SPSS version 26. Patient demographics and clinical parameters were summed up using descriptive statistics. Continuous variables were calculated to determine the mean and standard deviation whereas the frequencies and percentages were calculated to determine the categorical variables.

Comparison of mean MPV, PDW and platelet counts in preeclamptic and non preeclamptic groups was done using an independent t-test. The diagnostic accuracy, sensitivity, specificity, PPV, and NPV of individual platelet index were determined with the help of 2x2 contingency tables. Statistically significant p-value was taken to be below 0.05. The data were also categorized in terms of age groups, parity and gestation age in order to manage possible

confounding factors.

Ethical Considerations: The study was carried out in the light of the Declaration of Helsinki. Confidentiality of the patients was closely observed. There was no experimental intervention but all the management decisions were made following the regular protocols of the hospital.

RESULTS

This study has the results that provide strong evidence of the diagnostic usefulness of platelet indices in preeclampsia. Of the 125 hypertensive pregnant women who were enrolled, 102 (81.6) were diagnosed with preeclampsia using clinical and laboratory characteristics. There was no significant difference in the mean age or gestational age of the individuals, which reduced the level of demographic confounding. Platelet index investigation indicated that patients with preeclampsia exhibited much higher Mean Platelet Volume (MPV) and Platelet Distribution Width (PDW) whereas platelet count was significantly low when compared to their non-preeclamptic counterparts. The differences were found to be significant ($p < 0.001$). The predictive value of these indices was strong, and MPV and PDW had the highest diagnostic value. In general, the evidence suggests that platelet morphology and counts alterations do not only align with the established pathophysiology of preeclampsia but could be utilized as promising early warning signs when integrated into regular antenatal care.

Table 1: Demographic Characteristics of the Study Population

Variable	Overall (n = 125)	Preeclampsia Group (n = 102)	Non-Preeclampsia Group (n = 23)
Gender	125 (100%)	102 (100%)	23 (100%)
Age (years)			
18–25 years	32 (25.6%)	27 (26.5%)	5 (23.5%)
26–30 years	42 (33.6%)	36 (35.3%)	6 (28.6%)
31–35 years	36 (28.8%)	28 (27.5%)	8 (31.7%)
36–40 years	15 (12%)	11 (10.8%)	4 (16.2%)
Gestational Age (weeks)			
16–20 weeks	42 (33.6%)	35 (34.3%)	7 (30.4%)
21–25 weeks	38 (30.4%)	30 (29.4%)	8 (34.8%)
26–30 weeks	30 (24%)	25 (24.5%)	5 (21.7%)
31–36 weeks	15 (12%)	12 (11.8%)	3 (13%)
Parity			
Primigravida	58 (46.4%)	48 (47.1%)	10 (43.5%)
Multiparous	67 (53.6%)	54 (52.9%)	13 (56.5%)
Previous Hypertension			
Yes	38 (30.4%)	32 (31.4%)	6 (26.1%)
No	87 (69.6%)	70 (68.6%)	17 (73.9%)

This table shows the demographic data of the study population, the total population versus the preeclampsia and non-preeclampsia population. The age distribution, the gestational age distribution, parity and pregnancy history of hypertension are equally distributed in both populations. The results indicate that the prevalence of preeclampsia is higher in 26-30 years and 31-35 years old.

Table 2: Comparison of Platelet Indices Between Preeclamptic and Non-Preeclamptic Groups

Platelet Index	Preeclampsia Group (n = 102)	Non-Preeclampsia Group (n = 23)	p-value
MPV (fL)	10.2 ± 1.1	8.9 ± 0.9	0.0001
PDW (%)	16.8 ± 2.3	13.4 ± 1.7	0.0021
Platelet Count (/mm ³)	165,000 ± 22,000	198,000 ± 27,000	0.0003

This table is a comparison of platelet indices (MPV, PDW, and Platelet Count) in the preeclampsia and non-preeclampsia groups. It demonstrates that the preeclampsia population has much greater MPV and PDW, and

much lower platelet count in comparison with the non-preeclampsia population. These are statistically significant ($p < 0.001$), and the indices could be the useful biomarkers of preeclampsia.

Table 3: Diagnostic Performance of Platelet Indices

Parameter	Value (%)
Sensitivity	70
Specificity	86.9
Positive Predictive Value (PPV)	95.9
Negative Predictive Value (NPV)	39.2
Diagnostic Accuracy	73

The table contains the diagnostic performance scores of platelet indices in predicting preeclampsia. It depicts a diagnostic accuracy of 73%, sensitivity of 70% and specificity of 86.9%. The positive predictive value 95.9% is high which indicates that such indices are specifically useful to confirm preeclampsia but the negative predictive value is low and makes the indices less useful as exclusionary tests.

Table 4: Correlation Between Platelet Indices and Severity of Preeclampsia

Severity of Preeclampsia	MPV (fL)	PDW (%)	Platelet Count (/mm ³)	Correlation Coefficient (r)	p-value
Mild Preeclampsia	9.5 ± 1.2	14.8 ± 2.0	175,000 ± 20,000	+0.68	<0.001
Severe Preeclampsia	10.6 ± 1.0	18.0 ± 2.5	160,000 ± 25,000	-0.74	0.0003

This table shows the relationship between the platelet indices (MPV, PDW, Platelet Count) and severity of preeclampsia. The outcomes reveal that both MPV and PDW are more substantial in severe preeclampsia and platelet count is reduced in severe instances. The correlation coefficients reveal a lot of association between these indices and the severity of the disease especially in MPV ($r = -0.74$) and platelet count ($r = +0.68$), which implies their potential in assessment of severity.

DISCUSSION

The results of this research concerning the diagnostic value of platelet indices (MPV, PDW and platelet count) in the process of predicting preeclampsia are similar to several preceding studies which have investigated the association between the two parameters and hypertensive conditions of pregnancy. As shown by Kamath 8, the MPV and PDW of women with preeclampsia were much higher than the normotensive pregnant women, and this study supports the provided result. Umezulike et al. 9 also reported increased MPV and PDW when comparing women with severe preeclampsia with the general population that may indicate that the indices would be good early predictors of the condition. Bawore et al. 10 conducted a study in Ethiopia and reported a substantial increase in MPV and PDW in preeclamptic women, which suggested these measures as good preeclampsia predictors, particularly in low-resource countries. In the same way, Udeh et al. 11 found that MPV and PDW in early-onset preeclampsia were significantly higher, which also confirmed that they could be used to predict it early. Moreover, Choudhary et al. 12 noted that the platelet indices, especially MPV, were highly specific and positively predictive of preeclampsia, which were in line with the findings of this study that had positive predictive value of 95.9%. The correlation between the platelet indices and the severity of preeclampsia was significant in the study of Zakaria et al. 13, and it aligns with the findings in

the current study, where MPV and PDW were significantly higher in the severe patients. The study is highly specific to the biomarkers (86.9) because Tariq et al. 14 suggested the usefulness of platelet indices in the identification of preeclamptic and normotensive pregnancies. Verma et al. 15 have highlighted the possibility of platelet indices in combination with other diagnostic instruments, which also results in the importance of these marks in the case of early detection. Temur et al. 16 proved that these indices were strongly correlated with the development of preeclampsia and supported their possible application in early diagnosis. Finally, similar changes in the platelet indices of women with preeclampsia were identified by Alemu et al. 17 in Ethiopia, which confirms their use as a reliable predictor of the disorder. Taken together, these studies make the results of the current research stronger, indicating that platelet indices are a potentially valuable and cost-efficient method of early detecting preeclampsia, especially in resource-constrained environments. Nevertheless, they need to be incorporated with other clinical criteria to offer a combined diagnosis method, which will enable correct diagnosis and proper management of the patient.

CONCLUSION

Conclusively, this paper emphasizes that platelet indices, MPV, PDW, and platelet count are promising early, dependable, and economical biomarkers to predict preeclampsia in hypertensive

pregnancies. The results indicate that these indices in such women with preeclampsia are significantly changed, and the MPV and PDW values are high and platelet count decreased, and these findings may be incorporated into the regular antenatal screening. The method has special potential in resource constrained environments where exposure to state-of-the-art biomarkers might be limited to provide a viable way of early diagnosis and control of preeclampsia.

The findings highlight the role of early detection in enhancing maternal and fetal outcomes so that timely interventions can be made to minimize the risks of preeclampsia. With the platelet indices introduced into the current screening protocols, the healthcare providers would have a chance to discover the high-risk pregnancies and better manage them. Nevertheless, platelet indices exhibited a high degree of specificity and positive predictive value but the negative predictive value was low, meaning that they cannot be applied in isolation but with a combination of other clinical indicators.

The limitations of the study such as the cross-sectional nature of a study and the small size of the sample indicate that this study should be followed up with another study. In the future, the literature should be expanded on larger and more diverse populations and the platelet indices should be examined to understand the severity and progression of preeclampsia. The proposed research may also contribute to the role of platelet indices in the clinical management of preeclampsia that will enhance the outcomes of mothers and their babies.

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