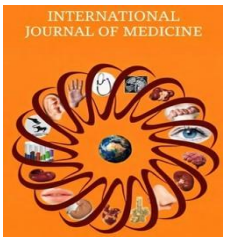

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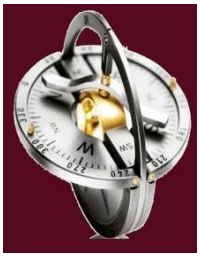

Original Research

A Comparative Study of Platelet Indices Amongst Diabetic and Non-Diabetic Patients at a Tertiary Care Hospital

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Abstract

Background: Diabetes mellitus is a major global public health concern and is associated with a heightened risk of cardiovascular and microvascular complications. Platelet activation plays a critical role in the pathogenesis of diabetic vascular disease. Platelet indices such as mean platelet volume (MPV), platelet distribution width (PDW), and plateletcrit (PCT), which are routinely available from aut omated blood counts, may serve as simple and cost-effective markers of platelet activation in diabetes. ***Aim:*** To compare platelet indices among diabetic and non-diabetic patients attending a tertiary care hospital. ***Objectives:*** To evaluate differences in platelet count, MPV, PDW, and plateletcrit between diabetic and non-diabetic individuals and to assess the correlation of these indices with fasting blood glucose levels. ***Methods:*** This hospital-based prospective comparative observational study was conducted in the Department of General Medicine at a tertiary care hospital in Ahmedabad over an 18-month period. A total of 300 participants were enrolled, comprising 150 diabetic patients and 150 non-diabetic controls aged 25-70 years. Platelet indices were measured using automated hematologyanalyzers. Statistical analysis was performed using SPSS version 25, with independent sample t-tests used for group comparisons and Pearson correlation analysis for associations with fasting blood glucose. A p value <0.05 was considered statistically significant. ***Results:*** The mean platelet count did not differ significantly between diabetics and non-diabetics (p = 0.44). However, diabetics demonstrated significantly higher MPV (13.35 ± 2.16 fL vs. 11.45 ± 1.28 fL), PDW (18.45 ± 4.36 fL vs. 14.95 ± 3.57 fL), and plateletcrit (34.83 ± 9.14% vs. 29.31 ± 6.81%) compared to non-diabetics (all p = 0.001). No statistically significant correlation was observed between fasting blood glucose levels and platelet indices in either group. ***Conclusion*:** Diabetic patients exhibit significantly elevated MPV, PDW, and plateletcrit, reflecting enhanced platelet activation and a pro-thrombotic state, despite comparable platelet counts. Platelet indices may serve as readily available, cost -effective markers for identifying increased vascular risk in patients with diabetes mellitus.

Keywords: *Diabetes mellitus; Platelet indices; Mean platelet volume; Platelet distribution width; Plateletcrit; Cardiovascular risk*

Introduction

Diabetes mellitus is a chronic metabolic disorder of global public health importance, characterized by persistent hyperglycemia resulting from defects in insulin secretion, insulin action, or both. As per standard case definitions, diabetes mellitus is diagnosed based on fasting plasma glucose ≥126 mg/dl, post-prandial plasma glucose ≥200 mg/dl, HbA1c ≥6.5%, or a random plasma glucose ≥200 mg/dl in the presence of classic symptoms of hyperglycemia. The disease is associated with long-term damage, dysfunction, and failure of various organs, particularly the heart, blood vessels, kidneys, nerves, and eyes, thereby contributing substantially to morbidity, mortality, and healthcare burden [1].

From a background perspective, diabetes mellitus has emerged as one of the fastest growing non-communicable diseases worldwide. The International Diabetes Federation (IDF) estimates that over 537 million adults globally are living with diabetes, a number projected to rise to 643 million by 2030 and 783 million by 2045. The rising prevalence is closely linked to rapid urbanization, sedentary lifestyles, dietary transitions, obesity, and population aging. Importantly, diabetes significantly accelerates the development of atherosclerosis and cardiovascular disease, which remains the leading cause of death among diabetic individuals [1,2].

India represents a major epicenter of the global diabetes epidemic. According to the IDF Diabetes Atlas and national epidemio logical data, India harbors over 101 million people with diabetes, earning the distinction of being one of the countries with the highest diabetic burden worldwide. The prevalence of diabetes in India has shown a steep upward trend over the last few decades, with increasing inci dence noted not only in urban areas but also in semi-urban and rural populations. Furthermore, Indian patients tend to develop diabetes at a younger age and with a higher propensity for vascular complications, thereby amplifying long-term health and economic consequences [2,3].

At the regional level, Gujarat has witnessed a steady rise in diabetes prevalence in both urban and rural settings, in line with national trends. Data from state-level surveys and hospital-based studies indicate a growing burden of type 2 diabetes mellitus, accompanied by an increasing incidence of cardiovascular and microvascular complications. This rising disease load places considerable strain on tertiary care institutio ns in Gujarat, highlighting the need for early risk stratification and preventive strategies using simple and accessible diagnos tic markers [3].

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The pathophysiology of diabetic vascular complications is complex and multifactorial, involving chronic inflammation, endothelial dysfunction, oxidative stress, dyslipidemia, and abnormalities in hemostasis. Among these mechanisms, altered platelet function has gained increasing attention due to its central role in thrombosis and atherogenesis. Platelets are no longer viewed merely as mediators of hemostasis; rather, they actively participate in inflammatory signaling, vascular injury, and plaque formation. Since the seminal work of Bizzozero on platelet discovery, subsequent research has established their critical contribution to cardiovascular pathology [4-6].

In patients with diabetes mellitus, chronic hyperglycemia leads to enhanced platelet activation, increased platelet adhesiven ess, and accelerated platelet turnover. Non-enzymatic glycation of platelet surface proteins, reduced nitric oxide bioavailability, increased intracellular calcium levels, and oxidative stress collectively contribute to a pro-thrombotic platelet phenotype. These functional alterations are often reflected as morphological changes measurable through platelet indices such as mean platelet volume (MPV), platelet distribution width (PDW), and plateletcrit (PCT), which are routinely reported in automated complete blood count analyses [7,8].

Mean platelet volume is widely recognized as an indirect marker of platelet activation, with larger platelets being more enzymatically active, metabolically aggressive, and more thrombogenic. Elevated MPV has been associated with adverse cardiovascular outcomes, metabolic syndrome, and poor glycemic control. Similarly, PDW reflects heterogeneity in platelet size and activation, while plateletcrit represents the overall circulating platelet mass, offering additional insight into thrombotic potential [9,10].
Although several international and Indian studies have demonstrated significantly higher MPV, PDW, and plateletcrit values among diabetic patients compared to non-diabetics, results remain inconsistent across different populations and clinical settings. Moreover, limited data are available from tertiary care hospitals in Gujarat evaluating these platelet indices in diabetic versus non-diabetic patients using a comparative design [11].

Despite the high and rising burden of diabetes mellitus and its vascular complications in India and Gujarat, there is a paucity of locally generated evidence assessing simple, cost-effective hematological markers that could aid in early identification of thrombotic risk among diabetic patients. Platelet indices, being routinely available and inexpensive, remain underutilized in routine clinical practice. Therefore, there is a clear need to systematically evaluate and compare platelet indices among diabetic and non-diabetic patients in a tertiary care setting to determine their potential role as early markers of platelet activation and vascular risk in diabetes mellitus.

The primary aim of this study was to evaluate and compare platelet indices—namely mean platelet volume (MPV), platelet distribution width (PDW), and plateletcrit (PCT)—between diabetic and non-diabetic patients attending a tertiary care hospital. The specific objectives included assessing differences in platelet indices between the two groups, analyzing their association with glycemic status, and exploring the potential role of these indices as markers of platelet activation in diabetes mellitus. By elucidating these differences, this study seeks to contribute to a better understanding of the hematological alterations associated with diabetes and their possible link to vascular risk. The findings are expected to support the use of routinely available platelet indices as simple, cost-effective tools for early identification of patients at higher risk of thrombotic and cardiovascular complications, thereby aiding clinicians in risk stratification, preventive strategies, and guiding future longitudinal research on the prognostic utility of platelet indices in diabetic populations.

Materials and Methods

This hospital-based comparative observational study was conducted in the Department of General Medicine at Dr. M. K. Shah Medical College & Research Centre and SMS Multispecialty Hospital, Chandkheda, Ahmedabad, from 25 July 2023 to 25 January 202 5. A total of 300 participants aged 25-70 years were enrolled using purposive sampling after obtaining institutional ethics committee approval and written informed consent. The study population comprised 150 patients with diabetes mellitus and 150 non-diabetic controls, selected based on predefined inclusion and exclusion criteria.

All participants underwent detailed clinical evaluation, anthropometric measurements, and blood pressure assessment following standard protocols. Fasting blood samples were collected for estimation of fasting plasma glucose, platelet indices including mean platelet volume (MPV), platelet distribution width (PDW), plateletcrit (PCT), platelet count, and serum creatinine. Platelet indices were analyzed using an automated hematologyanalyzer as part of routine complete blood count testing.

Data were entered in Microsoft Excel and statistically analyzed using SPSS version 25.0. Quantitative variables were expressed as mean ± standard deviation, while qualitative variables were expressed as frequencies and percentages. Comparisons between diabetic and non-diabetic groups were performed using the independent samples t-test and chi-square test as appropriate. Pearson's correlation coefficient was used to assess the relationship between fasting blood glucose and platelet indices. A p-value of less than 0.05 was considered statistically significant.

Results

A total of 300 participants were included in the study, comprising 150 patients with diabetes mellitus and 150 non-diabetic controls. Both groups were comparable with respect to gender distribution, age categories, and body mass index, with no statistically significant differences observed between the groups ($p > 0.05$), indicating adequate baseline comparability.

Platelet counts did not differ significantly between diabetic and non-diabetic patients. However, platelet indices showed marked differences between the two groups. Mean platelet volume (MPV) was significantly higher among diabetic patients compared to non-diabetics. Similarly, platelet distribution width (PDW) and plateletcrit (PCT) values were significantly elevated in the diabetic group, with all differences achieving statistical significance ($p < 0.001$).

Correlation analysis demonstrated no statistically significant association between fasting blood glucose levels and platelet indices, including MPV, PDW, and plateletcrit, in both diabetic and non-diabetic groups. Although weak positive and negative correlations were observed, these did not reach statistical significance.

On multivariate logistic regression analysis, higher MPV, PDW, and plateletcrit were independently associated with the presence of diabetes mellitus. MPV showed the strongest association, with each 1 fL increase in MPV increasing the odds of diabetes by approximate ly 82% (aOR 1.82, 95% CI 1.45-2.29, $p < 0.001$). PDW and plateletcrit also remained significant predictors after adjustment for age, gender, BMI, and platelet count. Platelet count, age, gender, and BMI did not show independent associations with diabetes mellitus.
Overall, the study demonstrated significantly altered platelet indices in patients with diabetes mellitus compared to non-diabetic controls, while platelet count and correlations with fasting blood glucose remained non-significant.

Table 1. Demographic and Baseline Characteristics of Study Participants (N = 300)

Variable	Diabetics (n = 150)	Non-Diabetics (n = 150)	p-value
Age group (years)			
25-40	80 (53.3%)	67 (44.7%)	0.13
41-55	54 (36.0%)	56 (37.3%)	
56-70	16 (10.7%)	27 (18.0%)	
Mean age (years)	41.76 ± SD	44.62 ± SD	–
Gender			
Male	72 (48.0%)	77 (51.3%)	0.56

Female	78 (52.0%)	73 (48.7%)	
Body Mass Index (BMI)			
Normal (18.5-22.9 kg/m²)	51 (34.0%)	63 (42.0%)	0.35
Overweight (23-24.9 kg/m²)	54 (36.0%)	49 (32.7%)	
Obese (≥25 kg/m²)	45 (30.0%)	38 (25.3%)	

Table 2. Comparison of Platelet Indices Between Diabetic and Non-Diabetic Patients

Platelet Parameter	Diabetics (Mean ± SD)	Non-Diabetics (Mean ± SD)	p-value
Platelet count (×10³/mm³)	261.41 ± 53.94	256.59 ± 54.22	0.44
Mean Platelet Volume (MPV, fL)	13.35 ± 2.16	11.45 ± 1.28	**0.001**
Platelet Distribution Width (PDW, fL)	18.45 ± 4.36	14.95 ± 3.57	**0.001**
Plateletcrit (PCT, %)	34.83 ± 9.14	29.31 ± 6.81	**0.001**

Independent samples t-test applied; p < 0.05 considered statistically significant

Table 3. Correlation of Platelet Indices with Fasting Blood Glucose

A. Diabetic Patients (n = 150)

Platelet Index	Pearson r	p-value
MPV	0.004	0.96
PDW	−0.05	0.54
Plateletcrit	−0.09	0.29

B. Non-Diabetic Patients (n = 150)

Platelet Index	Pearson r	p-value
MPV	0.05	0.50
PDW	0.03	0.71
Plateletcrit	−0.06	0.44

Pearson correlation applied

Table 4. Multiple Logistic Regression Analysis for Factors Associated with Diabetes Mellitus

Variable	Adjusted Odds Ratio (aOR)	95% Confidence Interval	p-value
Mean Platelet Volume (MPV, fL)	**1.82**	1.45 - 2.29	**<0.001**
Platelet Distribution Width (PDW, fL)	**1.27**	1.12 - 1.45	**0.001**
Plateletcrit (PCT, %)	**1.06**	1.02 - 1.11	**0.004**
Platelet Count (×10³/mm³)	1.01	0.99 - 1.02	0.44
Age (years)	1.02	0.99 - 1.04	0.13
Male gender	0.94	0.61 - 1.44	0.56
BMI (kg/m²)	1.04	0.98 - 1.10	0.35

Figure 1. Comparison of Platelet Indices

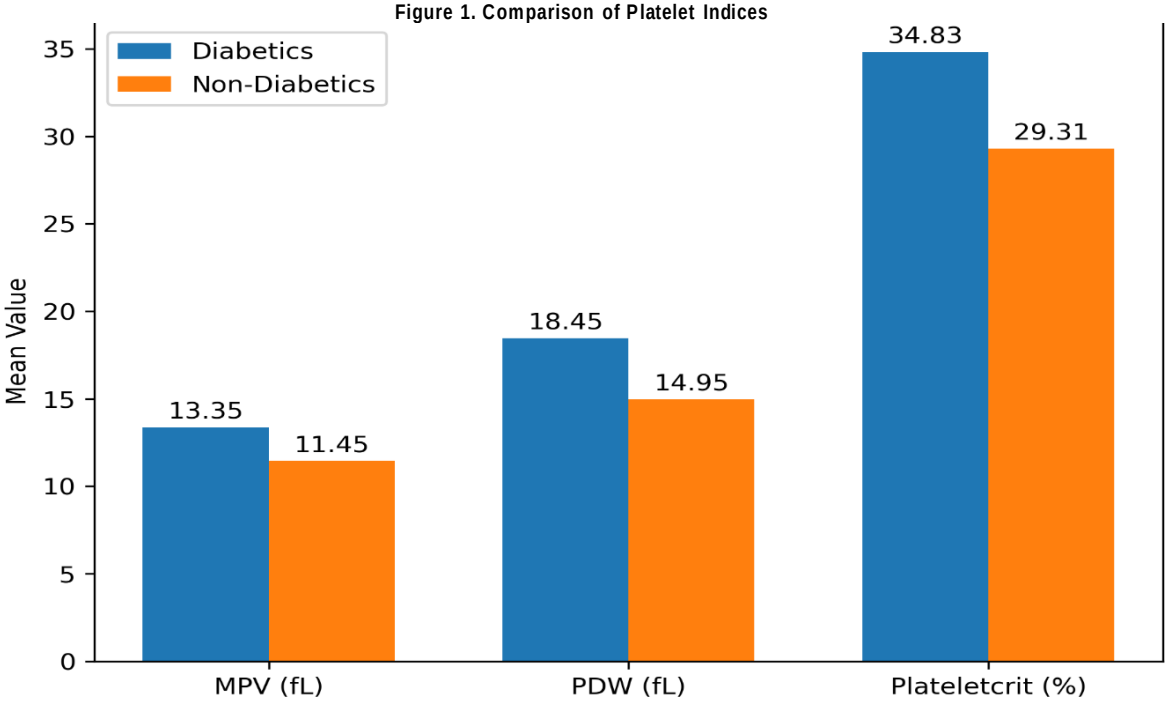
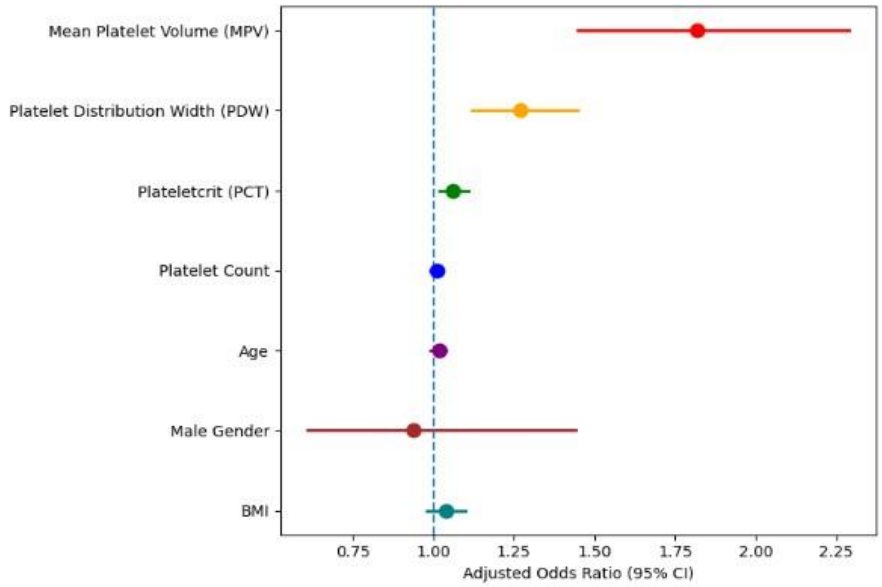


Figure 2. Multivariate Logistic Regression Forest Plot Platelet Indices and Diabetes Mellitus



Discussion

In the present study, the mean platelet count among diabetic patients was 261.41 ± 53.94 ×10³/mm³, which was comparable to that observed in non-diabetics (256.59 ± 54.22 ×10³/mm³), with no statistically significant difference (p = 0.44). This finding suggests that diabetes mellitus predominantly affects platelet function rather than absolute platelet number. Similar observations were reported by Hekimsoy et al., who found mean platelet counts of 258.6 ± 62.3 ×10³/mm³ in diabetics and 255.4 ± 58. 7 ×10³/mm³ in controls, with no significant difference [12]. Kumar et al. also reported comparable platelet counts between diabetics and non-diabetics, reinforcing that qualitative platelet changes predominate in diabetes [13].

A major finding of this study was the significantly higher mean platelet volume (MPV) in diabetics (13.35 ± 2.16 fL) compared to non-diabetics (11.45 ± 1.28 fL, p = 0.001), indicating enhanced platelet activation. Hekimsoy et al. reported MPV values of 9.6 ± 1.1 fL in diabetics versus 8.8 ± 0.9 fL in controls, showing a similar direction of association despite lower absolute values [14]. Jindal et al. observ ed MPV of 11.2 ± 1.3 fL in diabetics compared to 9.8 ± 1.1 fL in non-diabetics [15]. Rajagopal et al. reported mean MPV values of 10.9 ± 1.4 fL among diabetics and proposed MPV as a predictor of impending vascular complications [16]. Shilpi and Potekar documented MPV values of 10.6 ± 1.2 fL in diabetics versus 9.3 ± 0.8 fL in controls [17]. Compared to these studies, the higher MPV observed in the present study may reflect gre ater metabolic stress or population-specific risk factors.

In this study, platelet distribution width (PDW) was significantly higher in diabetics (18.45 ± 4.36 fL) compared to non-diabetics (14.95 ± 3.57 fL, p = 0.001), indicating increased heterogeneity in platelet size. Atak et al. reported PDW values of 17.2 ± 3.9 fL in diabetics compared to 13.8 ± 3.2 fL in controls, closely aligning with the present findings [18]. Joshi and Jaison also demonstrated significa ntly elevated PDW in diabetics (16.9 ± 3.6 fL) compared to non-diabetics (13.4 ± 2.8 fL) [19]. The higher PDW values in this study support ongoing platelet activation and increased platelet turnover in diabetes mellitus.

Plateletcrit (PCT), representing total circulating platelet mass, was significantly higher among diabetics in this study (34.83 ± 9.14%) compared to non-diabetics (29.31 ± 6.81%, p = 0.001). Buch et al. reported mean plateletcrit values of 0.31 ± 0.07% in diabetics versus 0.26 ± 0.06% in controls, showing a similar trend of increased platelet mass in diabetes [12]. Kshirsagar et al. also demonstrated significantly higher plateletcrit among diabetics, particularly those with microvascular complications [13]. Although absolute values differ due to analyzer variability and reporting units, the consistent increase in diabetics across studies underscores its clinical relevance.

Correlation analysis in the present study showed no statistically significant association between fasting blood glucose and platelet indices. MPV showed a negligible positive correlation (r = 0.004, p = 0.96), while PDW (r = -0.05, p = 0.54) and plateletcrit (r = -0.09, p = 0.29) showed weak negative correlations among diabetics. Similar findings were reported by Alhadas et al., who found no significant correlation between fasting glucose and MPV or PDW, and by Biadgo et al., who suggested that platelet indices reflect chronic metabolic and inflammatory burden rather than single-point glycemic measurements [14,15].

Overall, when compared with multiple national and international studies, the present study consistently demonstrates significantly high er MPV, PDW, and plateletcrit in diabetics, independent of platelet count. These findings reinforce the role of platelet indices as simple, cost-effective markers of platelet hyperreactivity and pro-thrombotic tendency in diabetes mellitus, supporting their utility in early vascular risk assessment.

Conclusion

This hospital-based comparative observational study demonstrated that while absolute platelet counts did not differ significantly between diabetic and non-diabetic patients, platelet indices–namely mean platelet volume (MPV), platelet distribution width (PDW), and plateletcrit–were significantly higher in patients with diabetes mellitus. These findings indicate enhanced platelet activation, increased platelet heterogeneity, and greater circulating platelet mass in diabetic individuals, reflecting a pro-thrombotic and inflammatory milieu. The lack of significant correlation between fasting blood glucose and platelet indices suggests that platelet dysfunction in diabetes is influenced more by chronic metabolic stress and systemic inflammation than by single-point glycemic measurements. Overall, this study supports the utility of platelet indices as simple, inexpensive, and readily available hematological markers that may help identify increased vascular risk in patients with diabetes mellitus in routine clinical practice.

Limitations

Despite its strengths, the study has certain limitations. Being a single-center, hospital-based study, the findings may not be fully generalizable to the community or primary care settings. The cross-sectional design limits the ability to establish causal relationships between diabetes and alterations in platelet indices. Glycemic control was assessed using fasting blood glucose alone, without incorporating HbA1c or measures of glycemic variability, which may better reflect long-term metabolic control. Additionally, microvascular and macrovascular complications were not stratified in detail, and platelet function tests beyond routine indices were not performed due to resource constraints.

Based on the findings of this study, routine assessment of platelet indices should be considered in patients with diabetes mellitus as part of standard hematological evaluation, given their potential role in early detection of vascular risk. Larger multicentric prospective studies incorporating HbA1c, duration of diabetes, and detailed assessment of diabetic complications are recommended to further eluci date the clinical significance of altered platelet indices. Future research should explore the prognostic value of MPV, PDW, and plateletcrit in predicting cardiovascular and microvascular outcomes in diabetes. Integration of platelet indices with other inflammatory and metabolic markers may also enhance risk stratification and guide early preventive strategies in diabetic care.

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