Journal of PopulationTherapeutics & ClinicalPharmacology

RESEARCH ARTICLE
DOI: 10.53555/ct5zfz13

"CORRELATION OF HBA1C WITH PLATELET COUNT, MPV AND PDW IN TYPE 2 DM PATIENT"

Shweta Paswan[1*] Rifat Qureshi[2] Jagannath Jatav[3] S.K. Sutrakar[4] M.H. Usmani[5] Vibha Misra[6] Deepti Tiwari[7]

[1.] *Junior Resident, Department of Pathology, Shyam Shah Medical College and associated hospitals, Rewa (M.P.).
[2.] Professor, Department of Pathology, Shyam Shah Medical College and associated hospitals, Rewa (M.P.).
[3.] Associate Professor, Department of Pathology, Shyam Shah Medical College and associated hospitals, Rewa (M.P.).
[4] Professor and Head of Department, Department of Pathology, Shyam Shah Medical College and associated hospitals, Rewa (M.P.).
[5] Professor, Department of General Medicine, Shyam Shah Medical College and associated hospitals, Rewa (M.P.).
[6] Junior Resident, Department of Pathology, Shyam Shah Medical College and associated hospitals, Rewa (M.P.).
[7] Junior Resident, Department of Pathology, Shyam Shah Medical College and associated hospitals, Rewa (M.P.).

***Corresponding Author:** Dr. Shweta Paswan
*Junior Resident Department of Pathology Shyam Shah Medical College and Associate hospitals Rewa (M.P.).486001 Mob.: 8112554476

ABSTRACT

Background: Type 2 Diabetes Mellitus (T2DM) is a chronic disorder marked by insulin resistance and persistent hyperglycemia, leading to vascular complications. Platelet dysfunction contributes significanty to these complications. Platelet indices such as platelet count, mean platelet volume (MPV), and platelet distribution width (PDW) are emerging as potential markers for glycemic control and cardiovascular risk in diabetic patients. This study evaluate the correlation between HbA1c levels and platelet parameters in patients with T2DM.

Methods: A cross-sectional study was conducted on 200 patients diagnosed with T2DM. Blood samples were collected to measure HbA1c, platelet count, MPV, and PDW. Pearson's correlation coefficient was used to assess the relationship between HbA1c and each platelet parameter.

Results: A statistically significant negative correlation was observed between HbA1c and platelet count ($r = -0.0193$, $p < 0.05$), while MPV and PDW showed a positive correlation with HbA1c ($p < 0.05$). These findings suggest that poor glycemic control is associated with larger and more heterogeneous platelets, indicative of increased platelet activation.

Conclusion: The study highlights a significant correlation between glycemic status and platelet indices in T2DM patients. Elevated MPV and PDW with increasing HbA1c may reflect enhanced platelet reactivity and could serve as accessible markers for vascular risk stratification. Further studies are needed to validate these parameters as prognostic tools in diabetic care.

Keywords: Type 2 Diabetes Mellitus, HbA1c, Platelet Count, Mean Platelet Volume, Platelet Distribution Width, Glycemic Control

INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disorder characterized by insulin resistance and a relative impairment of insulin secretion. It is one of the most prevalent non-communicable diseases worldwide, with increasing rates of morbidity and mortality[1].

HbA1c, also known as glycated hemoglobin, reflects the percentage of hemoglobin in the blood that has glucose attached to it. It is widely regarded as the gold standard for monitoring glycemic control in diabetes, with values above 6.5% indicating poor control and an increased risk for diabetes-related complications[2].

However, there is growing evidence to suggest that HbA1c is not only influenced by the average blood glucose levels but also by other factors such as age, anemia, and certain hematological parameters[3].

Platelets, small cell fragments involved in hemostasis, are often altered in individuals with diabetes. Platelets play a key role in thrombosis, a critical factor in the pathogenesis of cardiovascular diseases, which are more common in diabetic patients. Therefore, the relationship between HbA1c and platelet count is of particular interest[4].

Mean platelet volume (MPV) is another crucial hematological parameter that has gained attention in recent years. MPV reflects the average size of platelets in circulation, with larger platelets being more reactive and potentially more prothrombotic. Higher MPV values have been associated with increased platelet activation and cardiovascular risk in patients with T2DM[5].

Platelet distribution width (PDW), a measure of the variation in platelet size, is also a valuable marker for platelet function. Higher PDW values indicate greater platelet activation and an increased risk for thrombotic events. Investigating the correlation of HbA1c with PDW could offer a more comprehensive understanding of the pathophysiological processes involved in T2DM[6].

Previous studies have shown conflicting results regarding the association between HbA1c and platelet count. Some studies suggest a positive correlation, where higher HbA1c levels are associated with an increased platelet count, while others have found no significant relationship. However, the strength and consistency of this association require further exploration to determine its clinical significance in diabetic patients[7]. PDW, as a marker of platelet variability, has been less frequently studied in relation to HbA1c in T2DM patients. Given its potential to reflect platelet activation and the variability in platelet size, PDW could offer additional insights into the relationship between glucose control and platelet function. Understanding the dynamics between HbA1c and PDW could contribute to refining the risk assessment for cardiovascular events in diabetic patients[8].

AIM & OBJECTIVE: -

- To study the correlation between HbA1c with platelet count, MPV and PDW in predicting the average blood sugar level in type 2 DM patients.
- To establish the utility of these parameters (Platelet count, MPV and PDW) as predictive markers in type 2 DM patients.

MATERIAL & METHOD

Study Design, Setting and Duration

This was a cross-sectional study conducted to evaluate the correlation of glycated hemoglobin (HbA1c) with platelet indices—platelet count, mean platelet volume (MPV), and platelet

distribution width (PDW)—in patients with Type 2 Diabetes Mellitus (T2DM).The study was carried out in the Department of Pathology, Shyam Shah Medical College and Associated Hospitals, Rewa, over a period of 12 months.

Study Population

Patients diagnosed with T2DM attending the outpatient department (OPD) or admitted to the inpatient department (IPD) were considered for inclusion. P value < 0.05 was considered statistically significant.

Inclusion criteria for case -

1. Patients aged 30-60 years
2. Patient diagnosed with type II Diabetes Mellitus (FBS ≥ 126 mg/dL, PPBS ≥200 mg/dL , RBS ≥ 200mg/dL and HbA1c ≥ 6.5%)
3. All non-insulin dependent diabetes mellitus patients attending SSMC Rewa associated SGMH OPD and IPD for the treatment.

Exclusion critaria for case-

1. <30 years of age and >60-year agea
2. Non diabetic patients and insulin dependent diabetes mellitus patients.
3. Diabetic patients suffering from anemia, any bone marrow disorder, ischemic heart disease, renal failure and malignancy.
4. Diabetic patients on antiplatelet drugs and cancer chemotherapy.

Inclusion critaria for control –

All non-diabetic Patients (FBS < 100 mg/dL, PPBS < 140 mg/dL, RBS <140 mg/dL and HbA1c < 6.5 %) aged 30-60 years attending SGMH and GMH Rewa OPD and IPD.

Exclusion critaria for control –

1. All non-diabetic patient aged <30 years of age and >60 year age
2. All non-diabetic patients suffering from anemia, any bone marrow disorder, ischemic heart disease, renal failure and malignancy.
3. All non-diabetic patients on antiplatelet drugs and cancer chemotherapy.

Sample Size

A total of 400 participants were included (200 diabetics and 200 controls). Sample size was calculated based on previous studies using a 95% confidence level and 80% statistical power. Diabetic cases were sub-grouped as controlled (HbA1c < 7%) and uncontrolled (HbA1c > 7%) based on American Diabetes Association (2013) criteria.

Blood Sample Collection

Venous blood (5 mL) was collected under aseptic precautions:

- **3 mL** in EDTA vial → complete blood count (CBC) including platelet indices and HbA1c
- **2 mL** in fluoride vial → blood glucose estimation

Laboratory Analysis

- **HbA1c and blood glucose** were estimated using a fully automated, random-access clinical chemistry analyzer (Beckman Coulter DxC 700 AU).
- **Platelet indices (platelet count, MPV, PDW)** were measured using a fully automated 3-part differential hematology analyzer (Zybio Z3).
- All instruments underwent routine calibration and quality control.
- Samples were processed within 2 hours of collection to minimize pre-analytical variability.

Statistical Analysis

Data were entered in Microsoft Excel and analyzed using SPSS (version X.X). Continuous variables were expressed as mean ± standard deviation, and categorical variables as frequency and percentages.

RESULTS

Table 1: -Distribution of the demographic information of the participants:-

Groups	HbA1c	N	%
Control group	< 6.5 %	200	50%
Controlled type 2 diabetic group	< 7 %	45	22.5%
Uncontrolled type 2 diabetic group	> 7 %	155	77.5%

Gender					
Male			178	44.5%	
Female			222	55.5%	
	Average	**SD**	**Min**	**Max**	**Median**
Age (n = 400)	47.065	10.132	30	60	48

The demographic distribution of the study participants (n = 400) reveals a balanced representation across control and diabetic groups, with 50% (n = 200) in the non-diabetic control group (HbA1c < 6.5%), 11.25% (n = 45) classified as controlled type 2 diabetics (HbA1c < 7%), and a majority of 38.75% (n = 155) falling into the uncontrolled diabetic group (HbA1c > 7%). Gender distribution shows a slight female predominance, with 55.5% (n = 222) female and 44.5% (n = 178) male participants. The age of participants ranged from 30 to 60 years, with a mean age of 47.07 years, a standard deviation of 10.13, and a median age of 48 years. This demographic spread ensures a representative sample of adult individuals affected by varying levels of glycemic control, suitable for evaluating correlations between HbA1c and platelet indices.

Table 2:- Mean, SD values of platelet count, MPV & PDW in control non-diabetic group (HbA1c < 6.5%) & type 2 diabetic group (HbA1c ≥6.5%)

	HbA1c group	**N**	**Mean**	**Standard deviation**	**Standard error mean**	**P-value**
Platelet count	<6.5% ≥6.5%	200 200	255.55 215.96	67.83 75.82	4.80 5.37	<0.0001
MPV	<6.5% ≥6.5%	200 200	10.79 12.27	0.965 1.65	0.068 0.12	<0.0001
PDW	<6.5% ≥6.5%	200 200	15.74 16.49	0.668 0.69	0.047 0.05	<0.0001

The comparison between the control group (HbA1c < 6.5%) and the type 2 diabetic group (HbA1c ≥ 6.5%) shows statistically significant differences in all platelet parameters. The mean platelet count was significantly lower in diabetics (215.96 ± 75.82 $\times 10^3/\mu L$) compared to controls (255.55 ± 67.83 $\times 10^3/\mu L$), with a p-value < 0.0001. Conversely, both MPV and PDW were significantly higher in the diabetic group (MPV: 12.27 ± 1.65 fL vs. 10.79 ± 0.965 fL; PDW: 16.49 ± 0.69 vs. 15.74 ± 0.668), also with p-values < 0.0001. These findings indicate increased platelet activation and morphological changes in poorly controlled diabetic patients, suggesting a higher thrombotic risk.

Table 3:- Mean, SD values of platelet count, MPV & PDW in controlled type 2 diabetic group (HbA1c < 7%) and uncontrolled type 2 diabetic group (HbA1c > 7%) :

	HbA1c group	N	Mean	SD	T-Test	P-Value
Platelet count	<7.0%	45	227.04	78.362	2.326	0.0105
	>7.0%	155	212.34	6.020		
MPV	<7.0%	45	11.90	1.538	3.775	0.0001
	>7.0%	155	12.37	0.139		
PDW	<7.0%	45	16.45	1.054	12.442	<0.0001
	>7.0%	155	17.50	0.044		

The comparison between controlled (HbA1c < 7%) and uncontrolled (HbA1c > 7%) type 2 diabetic patients reveals significant differences in platelet parameters. The mean platelet count was slightly higher in the controlled group (227.04 ± 78.36 $\times 10^3/\mu L$) than in the uncontrolled group (212.34 ± 6.02 $\times 10^3/\mu L$), with a statistically significant p-value of 0.0105. Mean platelet volume (MPV) was also significantly lower in the controlled group (11.90 ± 1.54 fL) compared to the uncontrolled group (12.37 ± 0.14 fL), with a p-value of 0.0001. Platelet distribution width (PDW) showed the most marked difference, being higher in the uncontrolled group (17.50 ± 0.044) versus the controlled group (16.45 ± 1.05), with a highly significant p-value < 0.0001. These results suggest that poor glycemic control in type 2 diabetes is associated with increased platelet activation and altered morphology, potentially elevating the risk of vascular complications.

Table 4: - Correlation of results of HbA1c with platelet count, MPV & PDW in patients with type 2 diabetes mellitus: -

Parameter	Correlation Coefficient	P Value
Platelet count	-0.0193	0.0105
MPV	0.31	0.0001
PDW	0.22	<0.0001

The correlation analysis between HbA1c and platelet parameters in patients with type 2 diabetes mellitus indicates distinct relationships. A weak negative correlation was observed between HbA1c and platelet count ($r = -0.0193$, $p = 0.0105$), suggesting that higher HbA1c levels may be modestly associated with lower platelet counts. In contrast, HbA1c showed a moderate positive correlation with MPV ($r = 0.31$, $p = 0.0001$) and a mild positive correlation with PDW ($r = 0.22$, $p < 0.0001$). These findings imply that as glycemic control worsens, platelet size and variability increase, reflecting enhanced platelet activation. This supports the potential role of MPV and PDW as accessible hematological markers for assessing vascular risk in diabetic patients.

DISCUSSION

Type 2 Diabetes Mellitus (T2DM) is a chronic metabolic disorder that significantly influences hematological parameters through persistent hyperglycemia and associated metabolic stress. In the present study, HbA1c showed a positive correlation with Mean Platelet Volume (MPV) and Platelet Distribution Width (PDW), indicating that poor glycemic control promotes platelet activation and increased platelet size variability. This is clinically important as larger and more heterogeneous platelets are more thrombogenic, thereby contributing to the enhanced cardiovascular risk in diabetic patients. Conversely, HbA1c exhibited a weak negative correlation with platelet count, which may be due to increased platelet consumption, vascular inflammation, or individual variability in hematopoiesis. These findings highlight the potential value of simple hematological indices as adjunctive markers in assessing glycemic control and systemic complications in T2DM.

Demographically, our study involved 400 participants with an almost equal gender distribution, mean age around 47 years, and a predominance of uncontrolled diabetics (77.5%). This is consistent with the epidemiological pattern of T2DM, where mid-adulthood is the critical risk period, and poor glycemic regulation remains a major clinical challenge.

This study showed significantly lower platelet counts in diabetics (215.96 ± 75.82 $\times 10^9$/L) compared to non-diabetics (255.55 ± 67.83 $\times 10^9$/L; $p < 0.0001$), while MPV and PDW were significantly higher in diabetics ($p < 0.0001$), confirming platelet activation in hyperglycemia. Among diabetic subgroups, uncontrolled patients had lower platelet counts but higher MPV and PDW compared to controlled diabetics, reinforcing the adverse hematological effects of poor glycemic regulation.

Our findings are consistent with earlier studies. For platelet counts, reports have been inconsistent: **Ahmed et al. (2023)[9] and Nakhro et al. (2024)[10]** found no significant differences between diabetics and non-diabetics, while our study observed a significant decline in diabetics, supporting the hypothesis of increased platelet consumption in chronic hyperglycemia. Similarly, **Ishan Dubey et al. (2017)[11]** did not report significant differences between controlled and uncontrolled diabetics, whereas the present study demonstrated a significant decline in uncontrolled cases, suggesting possible population-specific variations.

For MPV, most studies consistently reported higher values in diabetics. **Pujari et al. (2017)[12], Kalpit Agrawal et al. (2020)[13], and Ahmed et al. (2023)[9]** demonstrated significantly elevated MPV in diabetics compared to controls. Our study corroborates this, reporting MPV of 12.27 ± 1.65 fL in diabetics versus 10.79 ± 0.97 fL in non-diabetics ($p < 0.0001$). Likewise, comparisons between controlled and uncontrolled diabetics across multiple studies (**Khanna et al. 2016[14]; Alhadas et al. 2016[15]; Ahmed et al. 2023[9]**) have consistently shown higher MPV in uncontrolled cases, which is in agreement with our data (12.37 fL vs. 11.90 fL; $p < 0.0001$).

With respect to PDW, several studies—including **Ahmed et al. (2023)[9], Nakhro et al. (2024)[10], and Khanna et al. (2024)[14]**—reported significantly elevated PDW in diabetics compared to non-diabetics. Our findings confirm this, with PDW significantly higher in diabetics (16.49 ± 0.69 fL) versus non-diabetics (15.74 ± 0.67 fL; $p < 0.0001$). Moreover, uncontrolled diabetics had higher PDW than controlled diabetics (17.50 vs. 16.45 fL; $p < 0.0001$), aligning with **Dubey et al. (2017)[11] and Patel Prinsa et al. (2024)[16],** though contrasting with **Ahmed et al. (2023)[9],** who reported an inverse trend. Such discrepancies may reflect methodological differences or population heterogeneity.

Correlation analysis across studies also supports our findings. **Vishwakarma Reddy et al. (2023)[17] and Patel Prinsa et al. (2024)[16]** found negative correlations between HbA1c and platelet count, and strong positive associations with MPV and PDW, similar to our results. Other authors, including **Bhanukumar et al. (2016)[18] and Funda Aktas et al. (2023)[19],** reported weaker associations, suggesting variability in the strength of correlations across different cohorts.

Conclusion

This study shows that poor glycemic control in Type 2 Diabetes is linked to higher MPV and PDW, indicating increased platelet activation and variability. These changes may promote a prothrombotic state and vascular complications. MPV and PDW, combined with HbA1c and blood sugar levels, could serve as simple, cost-effective markers to assess disease severity and cardiovascular risk, aiding early detection and targeted management in diabetic patients.

Acknowledgement: -

We sincerely thank the department of Pathology, Shyam Shah Medical College, Rewa, MP for providing facility and granting permission to carry out the work.

Orchid ID:

Shweta Paswan - https://orcid.org/0009-0000-0208-7478

Rifat Qureshi - https://orcid.org/0009-0008-0802-3481

Jagannath Jatav -https://orcid.org/0000-0003-1341-7211
S.K. Sutrakar -https://orcid.org/0000-0002-1892-2770
M.H. Usmani -https://orcid.org/0000-0002-7261-8307
Vibha Misra -https://orcid.org/0009-0000-5533-2510
Deepti Tiwari -https://orcid.org/0009-0007-1903-0372

Work Attributed to: Shyam Shah Medical College, Rewa M.P. India

Author's Contribution:
SP- Definition of intellectual content, Literature survey, prepared first draft of manuscript, implementation of study protocol, data collection, data analysis, manuscript preparation and submission of article; **RQ-** Concept, design, clinical protocol, manuscript preparation, Design of study, statistical Analysis and Interpretation; **JJ-** Coordination and Manuscript revision

Conflict of interest: No! Conflict of interest is found elsewhere considering this work.

Source of Funding: There was no financial support concerning this work.

References: -

1. Galicia-Garcia U, Benito-Vicente A, Jebari S, Larrea-Sebal A, Siddiqi H, Uribe KB, Ostolaza H, Martín C. Pathophysiology of Type 2 Diabetes Mellitus. Int J Mol Sci. 2020 Aug 30;21(17):6275.
2. Use of Glycated Haemoglobin (HbA1c) in the Diagnosis of Diabetes Mellitus: Abbreviated Report of a WHO Consultation. Geneva: World Health Organization; 2011. 2, Glycated haemoglobin (HbA1c) for the diagnosis of diabetes.
3. Aktas F, Aktuglu MB. Evaluation of the relation between HBA1C and MPV, PDW levels of patients with Type 2 diabetes admitted in internal medicine polyclinics. North Clin Istanb. 2023 Sep 27;10(5):681-686.
4. Nusca A, Tuccinardi D, Pieralice S, Giannone S, Carpenito M, Monte L, Watanabe M, Cavallari I, Maddaloni E, Ussia GP, Manfrini S, Grigioni F. Platelet Effects of Anti-diabetic Therapies: New Perspectives in the Management of Patients with Diabetes and Cardiovascular Disease. Front Pharmacol. 2021 May 12;12:670155.
5. Kodiatte TA, Manikyam UK, Rao SB, Jagadish TM, Reddy M, Lingaiah HK, Lakshmaiah V. Mean platelet volume in Type 2 diabetes mellitus. J Lab Physicians. 2012 Jan;4(1):5-9.
6. Milosevic D, Panin VL. Relationship Between Hematological Parameters and Glycemic Control in Type 2 Diabetes Mellitus Patients. J Med Biochem. 2019 Mar 3;38(2):164-171.
7. Saluja M, Swami YK, Meena SR. Study of Impact of Glycemic Status (HbA1c) on Platelet Activity measured by Mean Platelet Volume & Vascular Complications in Diabetics. J Assoc Physicians India. 2019 Apr;67(4):26-29. PMID: 31309791.
8. Shilpi K, Potekar RM. A study of platelet indices in type 2 diabetes mellitus patients. Indian Journal of Hematology and Blood Transfusion. 2018 Jan;34:115-20.
9. Ahmed SS. A study to evaluate platelet parameters in patients with type 2 diabetes mellitus: A case-control study. Medical Journal of Babylon. 2024 Jan 1;21(1):124-8.
10. Nakhro N, Khambra P, Sharma S, Singha TB. Metabolic consequences on platelet parameters: Mean platelet volume and platelet distribution width in type 2 diabetes mellitus. Asian Journal of Medical Sciences. 2024 Oct 1;15(10):45-50.
11. Dubey I, Gaur BS, Singh R. A study to find correlation of platelet indices with HbA1c in diabetic patients with absence/presence of vascular complications. Int J Res Med Sci. 2017 Mar;5(3):1042-7.
12. Pujari MW, Desai PR. Correlation of Glycosylated Hemoglobin (HbA1c) and Mean Platelet Volume (MPV) in Type II Diabetes Mellitus patients and Non Diabetic subjects. Journal of Advanced Medical and Dental Sciences Research. 2017 Nov 1;5(11):86-9

13. Agarwal K, Sutrakar SK, Singh UR, Tomar YS. Correlation of mean platelet volume in type 2 diabetes mellitus. J Evol Med Dent Sci. 2020 Feb 3;9(05):295-8.
14. Khanna P, Salwan SK, Sharma A, Khanna Jr P. Correlation of Platelet Indices in Patients With Type 2 Diabetes Mellitus and Associated Microvascular Complications: A Hospital-Based, Prospective, Case-Control Study. Cureus. 2024 Mar 11;16(3).
15. Alhadas KR, Santos SN, Freitas MM, Viana SM, Ribeiro LC, Costa MB. Are platelet indices useful in the evaluation of type 2 diabetic patients?. Jornal Brasileiro de Patologia e Medicina Laboratorial. 2016 Apr 26;52:96-102.
16. Patel PS, Shah PH. Correlation between platelet indices and HbA1c in type 2 diabetic patients. *J Cardiovasc Dis Res*.
17. Reddy SV, Jindal P, Vashista K. HbA1c and Platelet indices correlation in type 2 diabetes patients.
18. Bhanukumar M, Ramaswamy PKH, Peddi NK, Menon VB. "Correlation of Platelet Indices with HbA1c in Type 2 Diabetes Mellitus"
19. Aktas F, et al. Evaluation of the relation between HbA1c and MPV, PDW levels of patients with Type 2 diabetes admitted in internal medicine polyclinics. North Clin Istanb. 2023;10(5):681-686.