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Evaluation of Platelets Count and Mean Platelets Volume in Type2 Diabetes patients in Hospitals of Sanaa City - Yemen

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Abstract

Background: Type 2 diabetes mellitus is frequently associated with increased platelet activation, contributing to vascular complications. Mean platelet volume and platelet count are accessible hematological indices that may reflect platelet function and disease progression.

Objective: This study aimed to evaluate platelet count and mean platelet volume among Type 2 diabetes mellitus patients and explore their relationship with the duration of diabetes, glycemic control, and body mass index.

Methods: A cross-sectional study was conducted involving 371 patients with Type 2 diabetes mellitus attending three major hospitals in Sana'a from September 2024 to July 2025. Data on demographics, clinical history, and hematological indices were collected and analyzed using SPSS (version 28.0).

Results: The mean platelet count was 295.66 ± 90.24 ×10/L, and the mean platelet volume was 9.83 ± 1.47 fL. The platelet count was significantly higher in patients with diabetes duration of 6 years than in those with diabetes duration of <6 years ($p = 0.025$). Platelet count was positively correlated with fasting blood sugar ($p = 0.013$), body mass index ($p = 0.001$), and diabetes duration ($p = 0.004$). A significant negative correlation was found between the platelet count and MPV ($p = 0.001$).

Conclusion: Platelet count increases with longer diabetes duration, indicating possible progressive platelet activation. However, mean platelet volume was not a reliable indicator of diabetic progression in this cohort. Platelet count may serve as a cost-effective marker for long-term monitoring in low-resource settings, such as Yemen.

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1. INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disorder characterized by persistent hyperglycemia due to impaired insulin secretion, action, or both, affecting carbohydrate, lipid, and protein metabolism [1]. Globally, the prevalence of diabetes has increased from 108 million in 1980 to 537 million in 2021, with projections estimating 783 million cases by 2045 [2, 3]. T2DM accounts for over 90% of all diabetes cases and is particularly common in low- and middle-income countries [4, 5]. In Yemen, approximately 366,000 individuals are diagnosed with T2DM, with an additional 447,000 undiagnosed cases, resulting in an estimated prevalence of 8.45% [6].

Diabetes is associated with increased platelet reactivity and altered platelet indices, which contribute to both

macrovascular complications, such as cardiovascular disease and stroke, and microvascular complications, including nephropathy, retinopathy, and neuropathy [7, 8]. Mean platelet volume (MPV) is a hematological parameter that reflects the average size of platelets in the bloodstream and serves as an indirect marker of platelet function and activation [9]. Larger platelets are metabolically and enzymatically more active and contain higher levels of prothrombotic agents, such as platelet factor 4, P-selectin, thromboxane A2, and serotonin [10]. Consequently, an elevated MPV indicates increased platelet reactivity, which plays a role in the pathophysiology of thrombotic and inflammatory conditions [10].

In T2DM, a high MPV has been linked to atherothrombotic complications, including coronary artery disease, peripheral artery disease, and stroke [11]. Notably, approximately 80% of deaths in patients with diabetes are related to thrombotic events, with 75% resulting from cardiovascular complications [12].

Access to advanced methods for evaluating platelet activation is often limited in resource-constrained settings such as developing countries. Therefore, simple and affordable markers, such as platelet count and MPV, are important for the early detection and monitoring of diabetic complications. Evaluating these indices may help identify patients at a higher risk and guide the development of more effective management strategies. This study aimed to evaluate platelet count and (MPV among patients with T2DM and to determine their associations with diabetes duration, glycemic control, and body mass index.

2. MATERIALS AND METHODS

This cross-sectional study was conducted from September 2024 to July 2025 at three major hospitals in Sana'a City, Yemen: Al-Jomhori Teaching Hospital, Kuwait University Hospital, and Al-Thawra Hospital. These hospitals serve as key referral centers for internal medicine in the capital and were selected as representative sites for this study. The study population included all adult patients diagnosed with T2DM who attended internal medicine outpatient clinics during the study period. Patients were consecutively enrolled based on the eligibility criteria. The inclusion criteria encompassed adult patients of both sexes with a confirmed diagnosis of T2DM who attended outpatient clinics during the study period and provided informed consent. The exclusion criteria were as follows: patients on antithrombotic agents (e.g., warfarin, heparin, aspirin) within 10 days prior to sample collection and those with a history of recent surgery, venous thromboembolism, inherited coagulation disorders, cancer, hyperthyroidism, or severe illness. Patients with incomplete diagnostic data, inadequate sample quality, or who declined to participate were also excluded. Data were collected through face-to-face interviews using a structured, pretested questionnaire. The questionnaire captured sociodemographic variables (age, sex, and education level), behavioral and clinical factors (physical activity, duration of diabetes, antidiabetic drug use, and blood pressure), and laboratory findings. Anthropometric measurements and clinical examinations were performed by internal medicine specialists before blood sample collection. Blood samples were collected according to standard operating procedures. A total of 3 mL of venous blood was drawn from each participant into EDTA tubes for Complete Blood Count (CBC). We performed CBC analysis using the Dymind Coulter DxH76, which applies the Coulter principle to count and differentiate blood cells based on volume, conductivity, and scatter (VCS) technology. Ethical approval was obtained from the Faculty of Medicine at Sana'a University and the research committee of each participating hospital. Written informed consent was obtained from all participants before data collection. All procedures followed the ethical standards outlined in the Declaration of Helsinki and the guidelines of participating institutions.

2.1. Statistical Analysis

Data analysis was performed using the Statistical Package for Social Sciences (SPSS) version 28.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize the participants' demographic and clinical characteristics. T-test was used to calculate the difference in means between groups. Statistical significance was set at $P < 0.05$.

3. RESULTS

3.1. Socio-Demographic Characteristics

A total of 371 participants diagnosed with type 2 diabetes were enrolled in the study. Of these, 54.2% (201) were male, and 45.8% (170) were female. Regarding age distribution, the largest proportion of participants fell within the 51–60-year age group, accounting for 40.4% (n=150), followed by the 41–50-year group with 36.9% (n=137). Participants aged 61–70 years comprised 12.4% (n=46), while 8.4% (n=31) were in the 31–40-year group. Only 1.9% (n=7) were older than 70 years.

According to educational status, 51.8% (192) had primary education, followed by 22.6% (84) with secondary education. A smaller proportion were illiterate (17.5%, n=65), held a diploma (1.6%, n=6), had a bachelor's degree (5.9%, n=22), or were postgraduate degree holders (0.6%, n=2). Regarding place of residence, most participants (76.5%, n=284) lived in urban areas, whereas 23.5% (n=87) were from rural settings. Regarding employment status, 42.9% (n=159) were employed, while 57.1% (n=212) were unemployed. The average height of the participants was 1.58 ± 0.06 m, the mean weight was

63.68 ± 6.18 kg, and the mean body mass index (BMI) was 25.50 ± 3.01 kg/m² (Table 1).

3.2. Clinical and Behavioral Characteristics

Among the 371 study participants with type 2 diabetes, 69.8% (259) had been living with the condition for less than 6 years. Almost all participants (99.5%, n=369) were taking antidiabetic medication. Of those on medication, 82.9% (n=306) had been using antidiabetic drugs for less than 6 years. Regarding lifestyle behaviors, only 6.7% (n=25) of the participants reported engaging in regular physical exercise, while the majority (93.3%, n=346) did not. Cigarette smoking was reported by 19.1% (n=71) of the participants. Among the female participants (n=170), 19.4% (n=33) reported using oral contracept. Regarding nutritional status based on BMI, 38.0% (n=141) were overweight and 8.6% (n=32) were obese. Blood pressure measurements revealed that 83.3% (n=309) of the participants had normal readings, whereas 16.7% (n=62) had abnormal blood pressure (Table 2).

In patients with T2DM, the mean platelet count was 295.66 ± 90.24 $\times 10^9$/L, while the mean MPV was 9.83 ± 1.47 fL. Patients with a duration of T2DM $\geq$6 years had a significantly higher mean platelet count than those with a T2DM duration of <6 years (P = 0.025). No significant difference was observed in MPV between the two groups (P = 0.630) (Table 3).

Platelet count was negatively correlated with MPV (r = -0.203; p = 0.001) and positively correlated with fasting blood sugar (FBS) (r = 0.129; p = 0.013), BMI (r = 0.278; p = 0.001), and duration of T2DM (r = 0.149; p = 0.004). MPV was negatively correlated with platelet count (r = -0.203; p = 0.001). However, no significant correlations were observed between MPV and FBS (r = -0.051; p = 0.325), BMI (r = -0.033; p = 0.524), or duration of T2DM (r = -0.061; p = 0.240) (Table 4).

4. DISCUSSION

Diabetes mellitus is a chronic disease with major vascular complications and an increasing global economic impact, especially in low- and middle-income countries [13]. This emphasizes the need for simple, cost-effective indicators to monitor vascular changes [13]. Platelet indices, such as platelet count and MPV, have gained attention for their affordability and accessibility, although evidence on their relationship with glycemic control remains inconsistent [14–19].

In our study, the highest proportion of type 2 diabetes cases occurred in the 51–60-year age group (40.4%). This supports the findings of Khanna *et al.* [20] and others [21, 22], who also reported a peak prevalence in late middle age. This trend likely reflects physiological changes such as increased insulin resistance, reduced physical activity, weight gain, and co-existing metabolic conditions (e.g., hypertension and dyslipidemia). Conversely, some studies from different regions reported earlier peaks in the 41–50-year age group [23, 24], possibly due to earlier exposure to risk factors, lifestyle differences, or more frequent health screenings. Such variations underscore the influence of sociodemographic and healthcare factors on the age at diagnosis.

The gender distribution in our study showed a slight male predominance (54.2%). This pattern has been noted in several studies [22, 23, 25, 26], possibly reflecting higher exposure to behavioral risk factors or differences in health care utilization among men. However, other reports, such as those by Khanna *et al.* [20], found higher prevalence in females, suggesting that gender-related trends may vary by region and cultural context.

Regarding hematological parameters, the platelet count was significantly higher in patients with diabetes duration $\geq$6 years. This suggests that a longer disease duration may promote platelet hyperreactivity, potentially through chronic hyperglycemia, endothelial dysfunction, and low-grade inflammation, which enhance platelet production and activation. Our findings contrast with those of Yadav *et al.* [27], who reported no association, possibly due to differences in population size, glycemic control, or study design.

No significant difference in MPV was observed between the groups, in line with the report by Yadav *et al.* and Kodiatte *et al.* [27, 28]. However, some studies, such as that by Dwivedi and Davangeri [29], found a positive correlation between MPV and diabetes duration, supporting the hypothesis that persistent hyperglycemia may drive progressive platelet activation. These discrepancies may stem from methodological differences or variations in the clinical characteristics of the study populations.

In the present study, platelet count was significantly negatively correlated with MPV (r = –0.203, p = 0.001) and positively associated with FBS, BMI, and duration of T2DM. Conversely, MPV was only negatively correlated with platelet count, with no significant relationship with FBS, BMI, or diabetes duration. These findings are partly consistent with those of Akinsegun *et al.* [30], who also reported an inverse association between platelet count and MPV. However, unlike their results, our data showed positive correlations between platelet count and FBS and the duration of T2DM. Both studies, however, support a positive association between platelet count and BMI, suggesting that obesity may promote platelet production, irrespective of population differences.

Regarding MPV, our findings did not demonstrate significant associations with FBS, BMI, or disease duration, which contrasts with the findings of Akinsegun *et al.* [30] and other studies linking MPV to poor glycemic control and longer diabetes duration [28, 31, 32]. One possible

Table 1. Demographic Characteristics of Study Population (n=371)

Characteristic	Number (n)	Percentage (%)
Gender		
Male	201	54.2
Female	170	45.8
Age Groups		
31-40 years	31	8.4
41-50 years	137	36.9
51-60 years	150	40.4
61-70 years	46	12.4
>70 years	7	1.9
Education status		
Illiterate	65	17.5
Primary	192	51.8
Secondary	84	22.6
Diploma	6	1.6
Bachelor	22	5.9
postgraduate degree holders	2	0.6
Place of residence		
Rural	87	23.5
Urban	284	76.5
Occupation		
Employment	159	42.9
Unemployment	212	57.1
Mean Age ± SD	52.22 ± 8.25 years	
Mean Height ± SD	1.58 ± 0.06 m	
Mean Weight ± SD	63.68 ± 6.18 kg	
Mean BMI ± SD	25.50 ± 3.01 (kg/m^2)	
Mean FBS ± SD	140.8± 51.1 (mg/dl)	

Data shown as number (N), percentage (%) and mean ± standard deviation; BMI; body mass index, FBS; fasting blood sugar

Table 2. Clinical and Behavioral Characteristics of Study Population (n=371)

Characteristic	Number (n)	Percentage (%)
Duration of T2DM in years		
<6	259	69.8
≥6	112	30.2
Antidiabetic drug use status		
Yes	369	99.5
No	2	0.5
Duration of Antidiabetic drug use in years (n=369)		
<6	259	82.9
≤ 6	110	17.1
Oral contraceptive use (n=170)		
Yes	33	19.4
No	137	80.6
Doing regular physical exercise		
Yes	25	6.7
No	346	93.3
Cigarette smoking		
Yes	71	19.1
No	300	80.9
BMI		
Normal	198	53.4
Overweight	141	38.0
Obese	32	8.6
Blood pressure		
Normal	309	83.3
Abnormal	62	16.7

Data shown as number (N), percentage (%) and mean ± standard deviation; T2DM; type 2 diabetes mellitus; BMI; body mass index.

Table 3. The Mean of Platelets count and MPV in T2DM and comparison of Platelets count and MPV with the duration of T2DM

Variable	Mean ±SD	Mean ±SD		P. Value
		Duration <6 years	Duration ≥6 years	
Platelets count ($\times 10^9$/L)	295.66±90.24	288.78±88.26	311.57±93.14	0.025
MPV (FL)	9.83±1.47	9.86±1.43	9.75±1.56	0.630

Data shown as number (N), percentage (%) and mean ± standard deviation; MPV: mean platelet volume; MPV: mean platelet volume; Fl: femtoliter, p<0.05 is statistically significant

Table 4. Correlation of platelet count and MPVwith the measured parameters

Variable		Platelets count	MPV
MPV	R	-0.203	-
	p. value	0.001	-
Platelet count	R	-	-0.203
	p. value	-	0.001
FBS	R	0.129	-0.051
	p. value	0.013	0.325
BMI	R	0.278	-0.033
	p. value	0.001	0.524
Duration of T2DM	R	0.149	-0.061
	p. value	0.004	0.240

Correlations were performed by Pearson correlation test, r; correlation coefficients; MPV: mean platelet volume; FBS: fasting blood sugar; BMI: body mass index; T2DM: type 2 diabetes mellitus, $p<0.05$ is statistically significant.

explanation is that glycemic control in our cohort may have been relatively adequate, which limited the variation in platelet activation. Similarly, the lack of association between MPV and disease duration is in line with reports by Kodiatte et al. and Hekimsoy et al. [28, 33] highlighting that MPV may be influenced by multiple confounders such as inflammation, drug use, or demographic characteristics, rather than diabetes duration alone.

It is also worth noting that platelet indices are susceptible to preanalytical and technical variability. For example, EDTA-induced clumping, platelet satellitism, and automated misclassification of giant platelets may artificially lower platelet counts, whereas fragmented red cells or microcytosis may falsely increase them [30]. These factors may contribute to heterogeneity across studies.

5. CONCLUSION AND RECOMMENDATION

This study found that the platelet count was significantly higher in patients with longer durations of type 2 diabetes, suggesting a link between chronic hyperglycemia and platelet activation, whereas MPV showed no significant association. These results indicate that platelet count could serve as a simple and affordable biomarker for monitoring disease progression, particularly in resource-limited settings such as ours.

6. RECOMMENDATION

Clinicians are encouraged to incorporate platelet count into routine assessments to support the early detection of complications, whereas MPV should be interpreted with caution. Future longitudinal studies are needed to confirm the prognostic value of platelet indices and to optimize their use in diabetic care.

7. FUNDING

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8. CONFLICT OF INTEREST

The authors declare no conflict of interest.

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