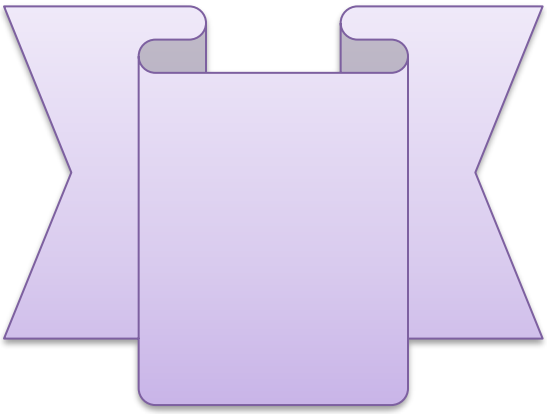
International Journal of Medical Arts

Volume 5, Issue 1, January 2023

https://ijma.journals.ekb.eg/



Print ISSN: 2636-4174

Online ISSN: 2682-3780

Available online at Journal Website
https://ijma.journals.ekb.eg/
Main Subject [Internal Medicine]

Original Article

Platelet Indices as Predictors of Diabetic Kidney Disease in Type 2 Diabetes Mellitus

Ahmed Mahrous Elsayed [1]*, Mahmoud Mohamed Mousa Bazeed [2], Youssef A. Nassar [2], Nesreen Hamdy [3]

[1] Department of Internal Medicine, National Institute of Diabetes and Endocrinology, Cairo, Egypt.
[2] Department of Internal Medicine, Faculty of Medicine, Al-Azhar University, Cairo, Egypt.
[3] Department of Clinical Pathology, National Institute of Diabetes and Endocrinology, Cairo, Egypt.

Article information

Received: 28-12-2022

Accepted: 14-03-2023

DOI: 10.21608/IJMA.2023.184143.1586.

*Corresponding author

Email: drahmed9192@gmail.com

Citation: Elsayed AM, Bazeed MMM, Nassar YA, Hamdy N. Platelet Indices as Predictors of Diabetic Kidney Disease in Type 2 Diabetes Mellitus. IJMA 2023 January; 5 [1]: 2991-2996. doi: 10.21608/IJMA.2023.184143.1586.

ABSTRACT

Background: Type 2 diabetes [T2D] is characterized as a complicated and varied group of metabolic conditions. The disorder's defining feature is increased blood sugar level brought on by a malfunction in insulin action and/or secretion.

Aim of the Work: To evaluate Platelet indices as predictive biomarkers for diabetic nephropathy in diabetes type 2.

Patients and Methods: This study included 60 diabetic subjects and 30 healthy subjects as control group. Participants were classified into three groups: Group I: 30 diabetic subjects without nephropathy. Group II: 30 diabetic subjects with nephropathy. Group III: 30 healthy non diabetic subjects.

Results: Our study showed that there was statistically significant increase in platelet distribution width [PDW] and mean platelet volume [MPV] among diabetic nephropathy participants than in non-diabetic nephropathy subjects. Also, our study showed that obesity had negative impact on renal functions in diabetic patients, we observed statistically significant increased body mass index [BMI] in diabetic patients with and without nephropathy when compared with BMI of non-diabetic patients. We noted that diabetic nephropathy is considerably more likely in people with poor glycemic control, there was statistically significant increased glycated hemoglobin [HbA1c] in diabetic nephropathy when compared to those without diabetic nephropathy.

Conclusion: Our study showed that patients with diabetic nephropathy [DN] have higher levels of platelet indices like PDW and MPV when compared to those without diabetic nephropathy. Hence PDW and MPV can be used as inexpensive and simple biomarker of diabetic nephropathy.

Keywords: Diabetes Mellitus; Platelet Indices; Diabetic nephropathy.

INTRODUCTION

Type 2 diabetes [T2D] is characterized as a complicated and varied group of metabolic conditions. The disorder's defining feature is increased blood sugar level brought on by a malfunction in insulin action and/or secretion. Numerous complications associated with diabetes, such as nephropathy, retinopathy, ischemic heart disease, and stroke [1].

Along with the rise in diabetes, Diabetic nephropathy [DN] is a prominent chronic microvascular sequel of T2DM patients, has increased in prevalence [2]. DN is currently the main reason for end-stage renal disease [ESRD] in industrialized nations and throughout the world. It is characterized by chronic albuminuria and hypertension [3]. The relation between increased PDW and MPV with diseases connected to endothelial dysfunction including diabetes, coronary artery disease [CAD], and cancer has been shown in numerous studies [4]. In some recently published research, patients with diabetic nephropathy had higher platelet indices such as PDW and MPV [5].

The aim of this work is to evaluate Platelet indices as predictive biomarkers for diabetic nephropathy in diabetes type 2.

PATIENTS AND METHODS

It is a cross sectional study was conducted on 60 T2 diabetic patients and 30 healthy volunteers [normoglycemic subjects with normal renal functions] as control group. Patients were chosen at random from the National Institute of Diabetes and Endocrinology's internal medicine department [NIDE]. This study took place in the period from April 2022 to December 2022.

Patients who were to be accepted in this study were selected after obtaining the ethical approval of the faculty of medicine, Al-Azhar University ethical committee. Participants were divided into 3 groups. Group I: 30 diabetic patients without nephropathy [ACR <30 mg/g]. Group II: 30 diabetic patients with nephropathy [ACR >30 mg/g]. Group III**:** 30 healthy non diabetic subjects. According to American Diabetes Association [ADA] recommendations, the diagnosis of diabetes was defined as fasting blood glucose ≥126 mg/dl and/or glycosylated hemoglobin ≥ 6.5% [6].

The definition of diabetic nephropathy is based on four main criteria: a decline in renal functions, diabetic retinopathy, persistent albuminuria, and a reduction in GFR. Patients with diabetes should be screened annually for DN. Initial screening should commence 5 years after diagnosis of type 1 diabetes, whereas it must be performed at diagnosis in type 2 diabetes. The early morning spot urinary ACR of less than 30 mg/g, between 30 and 300 mg/g, and more than 300 mg/g, respectively, were considered normal, microalbuminuria, and macroalbuminuria.

Inclusion criteria: All patients proved as having type 2 diabetes mellitus and the age range was be in between 18 and 60 years.

Exclusion criteria: Subjects with renal transplantation, end stage renal disease on regular dialysis, malignancies, autoimmune diseases, as [SLE], history of hematological disorders that affect platelets indices as myeloproliferative diseases and hypersplenism, history of drugs causing bone marrow suppression, blood transfusion history within the last 14 days, patients with anemia, patients on antiplatelets drugs, pregnant women, patients with ischemic heart diseases and type 1 diabetes mellitus .

The following were applied to all patients: Complete history taking from the patient which include history of smoking status, symptoms of renal disease with the onset, course, and duration of the presenting symptoms, history of other comorbid conditions such as hypertension, cardiac diseases, thyroid dysfunctions and malignancies. The clinical examination included assessment of general condition with stress on the level of consciousness and vital signs. Abdominal, chest and heart examination were assessed with focus on manifestations of chronic renal disease. Body mass index [BMI] was calculated, and electrocardiogram was done [ECG] to exclude ischemic heart diseases.

The following investigations were done: Complete blood count [CBC] included platelet count and platelet indicators such as mean platelet volume [MPV] , platelet crite [PCT] and platelet distribution width [PDW] by using an automatic blood counter [CBC Analyzer Sysmex XP300, Germany] in addition to hemoglobin concentration [Hb%], red blood cells [RBCs] and white blood cells [WBCs], HbA1C, Fasting blood sugar [FBS],2 hours post

prandial blood sugar [2HPPBS], Lipid profile ,serum creatinine ,serum urea, C-reactive protein [CRP], erythrocyte sedimentation rate [ESR]. Glomerular filtration rate [eGFR] was be measured using the MDRD equation**,** eGFR= 186 x [serum creatinine]-1.154 x [Age] -0.203 x 0.742 [Multiplied by 0.742 only in females] [7]. Urine samples were collected at the same time for calculating creatinine and albumin, then albumin to creatinine ratio [ACR] was calculated [8].

Statistical Analysis: Statistical Program for Social Science [SPSS] version 24 was employed to analyze the data. Quantitative information was presented as mean ±SD. Frequency and percentage were used to express qualitative data. The following tests were done: When comparing between more than two means, the Kruskal-Willis test [KW] was employed. Chi-square test was used when comparing among to non-parametric data.

RESULTS

Using ACR, patients were divided into three groups. Group I: 30 diabetic patients without nephropathy [ACR <30 mg/g]. Group II: 30 diabetic patients with nephropathy [ACR >30 mg/g]. Group III: 30 healthy non diabetic subjects [Table 1].

The current study's findings revealed a statistically significant [p-value 0.001] increase in MPV in group II [11.46 ± 0.82] when compared with group I [8.75 ± 0.52] and group III [7.94 ± 0.31], and statistically significant [p-value < 0.001] increase in PDW in group II [19.44 ± 1.79] when compared with group I [15.39 ± 1.25] and group III [13.25 ± 2.05] .There was no statistically significant difference [p-value = 0.616] between the studied groups in terms of PCT [Table 2].

We observed that obesity had negative impact on renal functions in diabetic patients. There was statistically significant [p-value < 0.001] increased BMI in group I [31.8 ± 5.2 kg/m2] and group II [32.05 ± 5.2 kg/m2] when compared with BMI of group III [26.5 ± 2.9 kg/m2] [Table 3].

Results of current study showed that diabetic nephropathy is considerably more likely in people with poor glycemic control, there was statistically significant [p-value < 0.001] increase in HbA1C in group II [8.2 ± 1.0] when compared with group I [6.5 ± 0.7] and group III [5.3 ± 0.3] [Table 4].

Table [1]: Comparisons between studied groups as regard kidney function tests.

		Groups			Stat. test	P-value
		Group I [n = 30]	**Group II [n = 30]**	**Group III [n = 30]**		
ACR [mg ALB/g Creat]	**Mean**	18.6	185.7	17.5	KW = 60	**<0.001**
	±SD	7.4	53.9	9.9		
Urea [mg/dl]	**Mean**	20.5	38.9	20.5	KW = 34.9	**<0.001**
	±SD	4.1	12.0	4.1		
Creat [mg/dl]	**Mean**	1.0	1.3	0.9	KW = 25.8	**<0.001**
	±SD	0.2	0.4	0.2		
eGFR [ml/ min/1.73 m²]	**Mean**	96.7	63.2	93.4	KW = 34.1	**<0.001**
	±SD	14.9	22.0	13.8		

Table [2]: Comparisons between studied groups as regard platelet indices.

		Groups			Stat. test	P-value
		Group I [n = 30]	**Group II [n = 30]**	**Group III [n = 30]**		
MPV	**Mean**	8.75	11.46	7.94	**KW = 73.2**	**< 0.001**
	±SD	0.52	0.82	0.31		
PCT	**Mean**	0.22	0.22	0.23	KW = 0.97	0.616
	±SD	0.01	0.01	0.01		
PDW	**Mean**	15.39	19.44	13.25	**KW = 60.5**	**< 0.001**
	±SD	1.25	1.79	2.05		

Table [3]: Comparisons between studied groups as regard BMI and hypertension

		Groups						Stat. test	P-value
		Group I [n = 30]		**Group II [n = 30]**		**Group III [n = 30]**			
BMI [kg/m²]	**Mean**	31.8		32.05		26.5		F = 14.5	**< 0.001**
	±SD	5.2		5.2		2.9			
Hypertension	**No**	23	76.7%	19	63.3%	26	86.7%	X^2 = 4.5	0.108
	Yes	7	23.3%	11	36.7%	4	13.3%		

Table [4]: Comparisons between studied groups as regard FBS and HbA1C

		Groups			Stat. test	P-value
		Group I [n = 30]	Group II [n = 30]	Group III [n = 30]		
FBS [mg/dl]	**Mean**	154.6	207	92.03	KW = 75.9	**<0.001**
	±SD	17.4	24.9	8.7		
HbA1C [%]	**Mean**	6.5	8.2	5.3	KW = 65.4	**<0.001**
	±SD	0.7	1.0	0.3		

DISCUSSION

Due to the persistent hyperglycemia and insulin resistance that result in endothelial and pericyte damage, DM is regarded as a "prothrombotic condition". Diabetes has been associated with altered platelet morphology and function, which has been shown as increased platelet activity, which may be a factor in in the process of this prothrombotic condition [9].

Results of current study showed that there was statistically significant increase in MPV in group II [11.46 ± 0.82] when compared with group I [8.75 ± 0.52] and group III [7.94 ± 0.31], and statistically significant increase in PDW in group II [19.44 ± 1.79] when compared with group I [15.39 ± 1.25] and group III [13.25 ± 2.05] and no statistically significant difference [p-value = 0.616] between studied groups as regard PCT. In accordance with the present study, **Walinjkar *et al.*** showed that diabetics had considerably higher platelet indices such PDW and MPV than did controls of the same age. Additionally, when compared to diabetics without microvascular complications, the rise in MPV and PDW was more substantial in diabetic subjects with microvascular complications. PCT does not demonstrate a major aberration in diabetics with and without microvascular complications [10].

Results of current study were in agreement with a meta-analysis performed by **Liu *et al.***, where the authors looked into the relationship between PDW and MPV with DN compared to patients without DN. PDW and MPV were increased in patients with DN. These results suggest that PDW and MPV can be used as inexpensive and simple biomarker of diabetic nephropathy [11].

Atak *et al.* investigated the correlation of PDW with DN and they noted that patients with T2DM had PDW that were substantially higher than those of healthy control subjects. Patients with diabetic nephropathy had significantly higher PDW and HbA1c levels than diabetic subjects without diabetic nephropathy according to a subgroup analysis of T2DM patients [p < 0.001 for both HbA1c and PDW] [12].

Dwivedi *et al.* conducted another study, there were 210 people with diabetes mellitus. Diabetic complications affected 74.7% [157 of 210] of the patients. When patients with diabetes problems were compared to patients without complications, there was a statistically significant difference in platelet indices between the groups [MPV, PDW and PLCR]. Diabetic nephropathy patients had the highest platelet indices values. Those with poor glycemic control exhibited greater platelet indices than patients with glycemic managed diabetes, and this difference was statistically significant [13]. A cross sectional study done by **Abd El-Ghany *et al.*** to evaluate platelet indices on One-hundred thirty-five participants, ranging in age from 35 to 60, were classified into 3 groups. 55 people with type 2 diabetes and micro-vascular complications are in Group A. Group B consists of 45 individuals with type 2 diabetes without complications. Group C consists of 35 normal healthy subjects. The study showed that PDW and MPV were significantly higher among subjects with diabetic nephropathy, than other subjects without diabetic nephropathy [14].

Rabeek *et al.* conducted a cross-sectional study on 30 non-diabetic controls with normal HbA1C, 30 diabetics, and 30 prediabetic individuals aged 18-35 years. According to HbA1C concentration, the groups were classified. Diabetics and prediabetics were reported to have higher levels of platelet indices including PDW and MPV than non-diabetics. Platelet indices and creatinine show a favorable relationship in patients with pre-diabetes and diabetes who are at risk of developing diabetic nephropathy. As a result, platelet indices should be regarded as inexpensive indicators of diabetic nephropathy [15]. **Sushma and Rangaswamy** conducted a cross sectional study on 70 diabetic individuals with vascular complications and 70 diabetic patients without vascular complications. Depending on whether microvascular problems were present in the patients, they were split into cases and controls

[retinopathy, nephropathy and neuropathy]. In diabetic subjects with nephropathy in comparison to diabetic without nephropathy, MPV and PDW were significantly greater [16].

In an Egyptian study, 50 diabetes patients with no problems, 50 diabetic patients with nephropathy, and 50 healthy age and sex-matched volunteers served as controls. The author stated that diabetic patients had considerably greater MPV and PDW than control participants with [P= 0.001]. When compared to diabetics without nephropathy, diabetic patients with nephropathy had higher MPV. Platelet indicators, particularly MPV, differed between controls and diabetics, as did diabetic nephropathy. The majority of patients with nephropathy could be classified using discriminant analysis utilizing MPV and PDW[17].

Results of current study showed that obesity had negative impact on renal functions in diabetic patients. We observed statistically significant [p-value < 0.001] increased BMI in group I [31.8 ± 5.2 kg/m^2] and group II [32.05 ± 5.2 kg/m2] when compared with BMI of group III [26.5 ± 2.9 kg/m^2].

According to the findings of the present study, **Chen *et al*.** in China conducted a study involving 264 patients with type 2 diabetes and DN was confirmed by renal biopsy. Patients with DN were 53.1± 9.06 years old on average. Patients were divided into three groups based on their BMI: obese ≥ 28.0 kg/m2, overweight [25–30 kg/m2], and lean [18–25 kg/m2]. The three groups' median ages, sex ratios, average blood pressure and history of therapy were comparable. A high BMI was found to be substantially linked with the development of diabetic nephropathy [18].

In another observational prospective longitudinal follow-up study with 1077 type 2 diabetic patients in total. Mean age of type 2 diabetic patients was 58.3 years and duration of diabetes was 11 years. The prevalence of nephropathy was 90.7%. Multiple logistic regression analysis revealed that obesity had negative impact on renal functions in diabetic patients [19].

Results of current study showed that diabetic nephropathy is considerably more likely in patients with poor glycemic control, there was statistically significant [p-value < 0.001] increase in HbA1C in group II [8.2 ± 1.0] when compared with group I [6.5 ± 0.7] and group III [5.3 ± 0.3]. In accordance with the current study, **Al-Rubeaan *et al.*** conducted a cross-sectional, random observational study in which a total of 54,670 type 2 diabetes patients aged >25 years, were chosen from the Saudi National Diabetes Registry [SNDR] and assessed for the existence of diabetic nephropathy. Nephropathic patients had considerably higher HbA1c than non-nephropathic patients based on inadequate glycemic control, as indicated by the percentage of patients with HbA1c greater than 8% [p value = 0.0001] [20].

An analysis by **Demirtunc *et al.*** that contrasted two groups of T2DM patients supported our findings. Based on their glycated hemoglobin levels, patients were separated into two groups. Group A for values under 7% and group B for values over 7%. Patients with lower glycemic control exhibited higher MPV values. Additionally, 86% of patients' MPV values dropped with the right diet and medication within 3 months [21].

In a cross-sectional study conducted by **Bhattacharjee *et al.*** on 100 diabetics and 100 healthy controls, HbA1C levels and platelet indices including MPV and PDW were evaluated. When compared to non-diabetics, platelet indices were shown to be considerably greater in diabetics. They were also found to be higher in patients with inadequate glycemic control [HbA1C > 7%] compared to patients with excellent glycemic control [HbA1C < 7%]. Diabetics have much higher platelet indices than non-diabetics, and the magnitude of the rise is greater in those with poor glycemic control [22].

Conclusion: Our study showed that patients with diabetic nephropathy [DN] have higher levels of platelet indices like PDW and MPV when compared to those without diabetic nephropathy. Hence PDW and MPV can be used as simple and inexpensive biomarker of diabetic nephropathy.

Conflict of Interest and Financial Disclosure: None.

REFERENCES

1. American Diabetes Association. 2. Classification and Diagnosis of Diabetes: Standards of Medical Care in Diabetes-2021. Diabetes Care. 2021 Jan;44[Suppl 1]:S15-S33. doi: 10.2337/dc21-S002.

2. Zhang L, Long J, Jiang W, Shi Y, He X, Zhou Z, *et al*. Trends in Chronic Kidney Disease in China. N Engl J Med. 2016 Sep 1;375[9]:905-6. doi: 10.1056/NEJMc1602469.

3. Guariguata L, Whiting DR, Hambleton I, Beagley J, Linnenkamp U, Shaw JE. Global estimates of diabetes prevalence for 2013 and projections for 2035. Diabetes Res Clin Pract. 2014 Feb 1;103[2]: 137-49. doi: 10.1016/j.diabres.2013.11. 002.

4. Buch A, Kaur S, Nair R, Jain A. Platelet volume indices as predictive biomarkers for diabetic complications in Type 2 diabetic patients. J Lab Physicians. 2017 Apr-Jun;9[2]:84-88. doi: 10. 4103/0974-2727.199625.

5. Taderegew MM, Woldeamanuel GG, Emeria MS, Tilahun M, Yitbarek GY, Zegeye B. Platelet Indices and Its Association with Microvascular Complications Among Type 2 Diabetes Mellitus Patients in Northeast Ethiopia: A Cross-Sectional Study. Diabetes Metab Syndr Obes. 2021 Feb 25;14:865-874. doi: 10.2147/DMSO.S300460.

6. American Diabetes Association. Diagnosis and classification of diabetes mellitus. Diabetes Care. 2012 Jan;35 Suppl 1[Suppl 1]:S64-71. doi: 10.2337/dc12-s064.

7. Stevens LA, Coresh J, Greene T, Levey AS. Assessing kidney function--measured and estimated glomerular filtration rate. N Engl J Med. 2006 Jun 8;354[23]:2473-83. doi: 10.1056/ NEJMra054415.

8. Miller WG, Jones GRD. Estimated Glomerular Filtration Rate; Laboratory Implementation and Current Global Status. Adv Chronic Kidney Dis. 2018 Jan;25[1]:7-13. doi: 10.1053/j.ackd.2017.09. 013.

9. Zaccardi F, Rocca B, Pitocco D, Tanese L, Rizzi A, Ghirlanda G. Platelet mean volume, distribution width, and count in type 2 diabetes, impaired fasting glucose, and metabolic syndrome: a meta-analysis. Diabetes Metab Res Rev. 2015 May;31[4]:402-10. doi: 10.1002/dmrr.2625.

10. Walinjkar RS, Khadse S, Kumar S, Bawankule S, Acharya S. Platelet Indices as a Predictor of Microvascular Complications in Type 2 Diabetes. Indian J Endocrinol Metab. 2019 Mar-Apr;23[2]: 206-210. doi: 10.4103/ijem.IJEM_13_19.

11. Liu J, Liu X, Li Y, Quan J, Wei S, An S, Yang R, Liu J. The association of neutrophil to lymphocyte ratio, mean platelet volume, and platelet distribution width with diabetic retinopathy and nephropathy: a meta-analysis. Biosci Rep. 2018;38 [3]:BSR20180172. doi: 10.1042/ BSR20180172.

12. Atak BM, Duman TT, Aktas G, Kocak MZ, Savli H. Platelet distribution width is associated with type 2 diabetes mellitus and diabetic nephropathy and neuropathy. Nat J Health Sci. 2018;3[3]:95-8.

13. DwiveDi T, DavangeRi R. Variation of Platelet Indices among Patients with Diabetes Mellitus Attending Tertiary Care Hospital. J Clin Diagnos Res. 2018 Nov 1;12[11]:22-26. doi: 10.7860/ JCDR/2018/36486.12306.

14. Mi AE, Abdallah N, Eldars W. Mean Platelet Volume and Platelet Distribution Width Correlate with Microvascular Complications in Egyptian People with Type 2 Diabetes Mellitus. Curr Diabetes Rev. 2021;17[8]:e080621193947. doi: 10.2174/1573399817666210608121024.

15. Rabeek JM, Shanthi B, Anton MC. Platelet Indices as Indicator of Diabetic Nephropathy among Patients Attending a Tertiary Care Centre in South-India. J Pharm Res Int. 2021 Dec 2;33[52B]:169-73. doi: 10.9734/jpri/2021/ v33i52B33614.

16. Sushma KL, Rangaswamy M. Study of platelet indices in type 2 diabetic patients and its correlation with vascular complications. Ann Pathol Lab Med. 2017 Oct 30;4[5]:591-8.

17. Besada MS, Elsayed AA, Ali AE, Hashem AA. Platelet indicies as an indicators of diabetic nephropathy. SVU-Int J Med Sci. 2021 Jan 1;4[1]:41-8. doi: 10.21608/svuijm.2021.112026.

18. Chen HM, Shen WW, Ge YC, Zhang YD, Xie HL, Liu ZH. The relationship between obesity and diabetic nephropathy in China. BMC Nephrol. 2013 Mar;14:69. doi: 10.1186/1471-2369-14-69.

19. Abougalambou SS, Abougalambou AS, Barghash SS. A study evaluating the prevalence of nephropathy among Type 2 diabetes patients attending a teaching hospital in Malaysia. J Clin Nephrol Ren Care. 2016;2[1]:2-6.

20. Al-Rubeaan K, Youssef AM, Subhani SN, Ahmad NA, Al-Sharqawi AH, Al-Mutlaq HM, David SK, AlNaqeb D. Diabetic nephropathy and its risk factors in a society with a type 2 diabetes epidemic: a Saudi National Diabetes Registry-based study. PLoS One. 2014 Feb 21;9[2]:e88956. doi: 10.1371/journal.pone.0088956.

21. Demirtunc R, Duman D, Basar M, Bilgi M, Teomete M, Garip T. The relationship between glycemic control and platelet activity in type 2 diabetes mellitus. J Diabetes Complications. 2009 Mar-Apr;23[2]:89-94. doi: 10.1016/j.jdiacomp. 2008.01.006.

22. Bhattacharjee DA, Debbarma RK, Das SK. Platelet indices in diabetics and influence of glycemic control–a hospital based study in North-East India. Int J Med Res Rev. 2016 Dec;4[12]: 2186-92. doi: 10.17511/ijmrr.2016.i12.18.

International Journal of Medical Arts

https://ijma.journals.ekb.eg/
Print ISSN: 2636-4174
Online ISSN: 2682-3780