



The Relationship of HbA1C with Mean Platelet Volume (MPV) in Type 2 Diabetes Mellitus Patients

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ABSTRACT

Diabetes Mellitus (DM) is a chronic disease that occurs due to the failure of the pancreas to produce sufficient insulin. Diabetes Mellitus not only causes death but is also a major cause of blindness, heart disease, and kidney failure. Examination of HbA1c levels in the blood serves to help diagnose diabetes mellitus. A high HbA1c value is used as a measure of the development of diabetes complications. Mean Platelet Volume (MPV) is a marker of platelet function and activation. Platelets in DM patients will synthesize thromboxane in larger quantities than normal platelets. So it is important to check HbA1c and MPV to detect complications. This study aims to determine the relationship between HbA1c and MPV values in type-2 DM patients. The type of research used is observational analysis with a cross-sectional approach. The sampling technique was quota sampling technique, then the results were analyzed using the Spearman correlation test. The results of the Spearman's Rho correlation test in this study showed a significant p-value of 0.100, which means that there is no significant relationship between HbA1c levels and MPV values in patients with type 2 DM.

Keywords: diabetes mellitus II; HbA1C; MPV

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INTRODUCTION

Diabetes Mellitus (DM) is a chronic disease that occurs due to the failure of the pancreas to produce sufficient insulin or the body cannot effectively use the insulin produced (Kurniawaty, 2014). Type 2 diabetes mellitus (T2DM) is a group of metabolic diseases characterized by hyperglycemia, occurring due to abnormalities in insulin secretion, insulin action or both. Ninety percent of diabetes cases are diabetes mellitus (T2DM) with characteristics of impaired insulin sensitivity and/or impaired insulin secretion. T2DM clinically appears when the body is no longer able to produce enough insulin to compensate for increased insulin resistance (Decroli, 2019). The world health agency WHO predicts an increase in the number of type 2 DM patients in Indonesia from 8.4 million in 2000 to around 21.3 million in 2030. Predictions from the International Diabetes Federation (IDF) also show that in 2019 - 2030 there will be an increase in the number of patients DM from 10.7 million to 13.7 million in 2030. 2018 RISKESDAS data explains that the national prevalence of DM is 8.5 percent or around 20.4 million Indonesians diagnosed with DM (Indonesian Ministry of Health, 2018).

The 2018 Riskesdas results show that the prevalence of diabetes mellitus in Indonesia based on doctor's diagnosis in the population aged ≥ 15 years is 2%. Almost all provinces showed an increase in prevalence in 2018, except for East Nusa Tenggara province (0.9%). There are 4 provinces with the highest prevalence, namely DKI Jakarta (3.4%), East Kalimantan (3.1%), DI Yogyakarta (3.1%), and North Sulawesi (3%). Based on gender, the prevalence of diabetes in 2018 was 1.21% for men and 1.78% for women (Indonesian Ministry of Health, 2018).

Examination of HbA1c levels in the blood functions to help diagnose diabetes mellitus sufferers, control long-term blood glucose, and control treatment of diabetes mellitus sufferers and can be used to monitor the effects of diet, excretion and drug therapy on the blood glucose of diabetes mellitus patients (Magdalena et al, 2021). Measuring HbA1c levels is one method to determine the picture of blood glucose levels over the last two to three months. Patients who have HbA1c levels $>7\%$ are at 2 times higher risk of experiencing complications. A 1% reduction in HbA1c levels will reduce the risk of complications from peripheral vascular disease by 43% (Suharni et al, 2021). The condition of hyperglycemia that lasts for a long time in DM sufferers is closely related to the risk of various complications, especially complications in blood vessels or vessels. This increased risk occurs due to a prothrombotic state that supports thrombus formation which can cause vascular occlusion, causing hypoxic organ damage (Nurdin et al, 2022).

In DM patients, atherosclerosis accounts for nearly 80% of all deaths. Platelets play a role in the hemostasis process and have an important role in atherosclerosis and arterial thrombosis. When vascular injury occurs, platelets will adhere to the damaged endothelium to form a platelet plug. Average platelet volume or known as Mean Platelet Volume (MPV) is a marker of platelet function and activation. Platelets in DM patients will synthesize thromboxane in greater quantities than normal platelets. It is found that hyperglycemia causes larger platelets and larger platelets also release more prothrombotic factors such as thromboxane A2. In addition, increased platelet number and size may influence the distribution width of platelets in contributing to the pathogenesis of vascular complications in DM patients. Hyperactive platelets have an important role in cycicylecyaterosclerosis and coronary thrombogenesis (Mus et al, 2020).

There are several things that influence platelet hyperactivity in DM patients, such as hyperglycemia stimulating protein kinase C, thus reducing the platelet stimulation threshold, platelets in DM patients experiencing an absence of signal regulation, resulting in a decrease in the stimulation threshold, inflammation which causes an increase in the concentration and release of intracellular calcium, resulting in Platelet activity increases, platelets in DM patients express more P-selectin and GPIIb/IIIa receptors, so that platelets become more sensitive to very painful stimuli, reducing their number and disrupting insulin function. Platelet function is directly regulated by insulin through associated receptors found on their surface and can play a functional role. (Nurdin et al, 2022). Mus et al's (2020) research entitled *The Relationship between Mean Platelets and HbA1c and Lipid Profile in Diabetes Mellitus Patients* shows that there is a significant relationship between MPV values and HbA1C. This shows that DM sufferers with poor glucose control have higher MPV values compared to those with good glucose control and this can be an indication of poor glycemic control. Based on the background above, it can be concluded that currently there is an opinion that a high HbA1c value carries a risk of diabetic complications including vascular disorders that cause atherosclerosis. The aim of this research is to determine the relationship between HbA1c and MPV values in diabetes mellitus sufferers.

METHOD

This type of research is non-experimental analytical with a cross sectional design to determine the relationship between Hba1c and MPV values in type 2 DM patients. The population in this study is type 2 DM patients at the Prodia Bona Indah Clinical Laboratory from May 24 2023 to May 30 2023. check Hba1c and MPV values. The sampling technique in this study used Quota sampling by determining the number of samples to be analyzed according to the specified inclusion and exclusion criteria, namely 37 patients who met the criteria and filled out the research questionnaire. Data analysis carried out the Spearman correlation test. In this research, ethical clearance has been submitted through the Health Research Ethics Commission of the Muhammadiyah University of Purwokerto and was declared ethically appropriate with a Registration Number. KEPK/UMP/40/VII/2023.

RESULTS

This research was carried out at the Prodia Bona Indah Clinical Laboratory using samples from outpatients who underwent HbA1c examination using the D10 instrument, then continued with examination of the Mean Platelet Volume (MPV) using the Sysmex XN-550 instrument. In this study, there were 37 outpatients suffering from Type 2 Diabetes Mellitus (DM) who came to the laboratory. The patients brought a referral letter from the doctor to carry out an HbA1c examination. The next research carried out an HbA1c examination and continued with an examination of the MPV value. The characteristics of respondents in this study include the gender group of DM sufferers, the age group of DM sufferers, and the length of time they have suffered from DM. The research results obtained were carried out by data processing and data analysis for univariate tests and bivariate tests using IBM SPSS Statistics 26.

Table 1.

Distribution of Research Subject Characteristics

Paramex-ter	f	%
Gender		
Man	23	62,2%
Woman	14	37,8%
Age (Ministry of Health, 2009)		
Late adulthood (36-45 years old)	3	8,1%
Early old age (46-55 years old)	9	24,3%
Late old age (aged 56-65 years)	12	32,4%
Seniors (aged 65 years and over)	13	35,1%
Suffering from DM for a long time		
Short Duration (1-5 years)	3	8,1%
Medium Duration (6-10 years)	23	62,2%
Long Duration (> 10 years)	11	29,7%

Table 1 distribution of research subject characteristics, it was found that of the 37 research subjects used, 23 people (62.2%) were male and 14 people (37.8%) were female. Meanwhile, the age of the research subjects was mostly elderly, namely 13 people (35.1%). The age division used is the age division based on the Ministry of Health (2009). For the duration of suffering from diabetes mellitus (DM), the research subjects used were of medium duration (6-10 years) as many as 23 people (62.2%). The division of duration of DM is based on research by Restada (2016).

Table 2.
Univariate Analysis Table of Research Results

Parameter	f	Minimum	Maksimum	Rerata	Simpangan Baku
HbA1c	37	6,6 %	10,9 %	8,1 %	1,2
Nilai MPV	37	8,5 fL	12,1 fL	10,0 fL	0,9

Tbale 2 statistical test results: the lowest HbA1c level was 6.6%, the highest level was 10.9%, the average was 8.1%, the standard deviation was 1.2. Statistical test results The lowest MPV value is 8.5 fL and the highest value is 12.1 fL, average 10.0 fL, standard deviation 0.9

Data Normality Test

Based on the data in table 2, a data normality test was carried out using SPSS 26 Statistical Software Analysis. The Normality Test was used to determine whether the data population was normally distributed or not. The basis for decision making is: If the Sig. (significance) or a probability value of 0.05, then the data is normally distributed. The results of the data normality test use Shapiro-Wilk, because it uses a number of sample data <50. (Pramesti 2018).

Table 3.
Data Normality Test Results

Variabel	Shapiro Wilk	P-value	Jumlah Data
HbA1c	0,922	0,013	37
Nilai MPV	0,977	0,642	37

The Shapiro Wilk one sample normality test states that data is normally distributed if the significant p-value is > 0.05. In the normality test of the HbA1c data, a significant p-value of 0.013 was obtained, so it was declared that the data was not normally distributed because the p-value was <0.05. Meanwhile, when examining the MPV value, a data normality test was obtained with a significant p-value of 0.642, so it was stated that the data was normally distributed. Because there was one of the data that was distributed abnormally, the Spearman's Rho correlation test was then carried out on the data.

Data Correlation Test

Table 4.
Spearman Data Correlation Test Results

Variabel	Jumlah Data	Koefisien Korelasi	Sig p-value
HbA1c dan Nilai MPV	37	-0,275	0,100

The HbA1c parameters and MPV values were analyzed using the Spearman's Rho Correlation Test. The research hypothesis is rejected if significant results are obtained, the p-value is smaller than 0.025. The results of the Spearman's Rho test in this study were a significant p-value of 0.100, so the hypothesis of this study was accepted, meaning there was no significant relationship between HbA1c levels and MPV values in hospitalized patients with type 2 DM. From the Spearman's Rho correlation test, a significant negative result was obtained, indicating the opposite direction of the relationship. From the data above, it can be concluded that there is no significant relationship between HbA1c levels and MPV values in outpatients suffering from type 2 DM.

DISCUSSION

This study aims to determine the relationship between HbA1c levels and the Mean Platelet Volume (MPV) value in type 2 Diabetes Mellitus sufferers. This study examined HbA1c and MPV values in Diabetes mellitus patients, where the HbA1c examination used the D-10 tool and the MPV value was examined using the Sysmex XN 550 tool. Based on the results of

data distribution, there were 23 male respondents (62.2%) and 14 female respondents (37.8%). The results of the study are in line with Putra et al (2023) with the title "Relationship of HbA1c Levels with Macrovascular Complications in Type 2 Diabetes Mellitus Sufferers at Sanjiwani General Hospital Gianyar" where 53 respondents were studied and 32 respondents who suffered from Diabetes Mellitus were male (60.4%), while women were 21 respondents (39.6%). Nordström (2016) found that men are at higher risk of developing type 2 diabetes mellitus than women. This is because men are more susceptible to android adiposity with greater abdominal adiposity than women who are more likely to show gynoid adiposity.

The research results also show that based on the age group that is most affected by diabetes mellitus, it is the elderly age group (46 - 65 years), namely 21 people (56.8%). The results of this study are in line with Komariah & Sri Rahayu (2020) who studied 143 respondents and those suffering from diabetes mellitus in the 46 - 65 year age group were 93 respondents (69.4%). According to D'Adamo (2008) age is one of the most common factors that predispose individuals to diabetes mellitus. Risk factors increase significantly after age 45 and increase dramatically after age 65. This happens because people at this age are less active, body weight will increase and muscle mass will decrease, causing pancreatic dysfunction. Pancreatic dysfunction can cause an increase in blood sugar levels because insulin is not produced.

The results of the study also showed that based on the group who had suffered from diabetes for a long time, the group with the most diabetes mellitus was the medium duration group (6-10 years). The results of this study are in line with Gapur (2016) who studied 16 respondents and those suffering from diabetes mellitus in the medium duration group (6-10 years) were 6 respondents (31.6%). According to Setyorini (2017), the duration of suffering from DM shows that DM sufferers adhere to the treatment regimen and implement a healthy lifestyle and are able to adapt well to the disease, so they have a low mortality rate. Guidelines for the Management and Enforcement of Type-2 DM in Indonesia in 2021 state that one diagnosis of DM is made based on the results of an HbA1c examination $\geq 6.5\%$. In this study, it can be seen from the 37 respondents examined that the minimum HbA1c level was 6.6% and the maximum was 10.9% with the average HbA1c level being 8.046%. As many as 37 out of 37 respondents (100%) had HbA1c levels above 6.5%. According to the 2021 Type 2 Diabetes Mellitus consensus, it is said that diabetes mellitus control is good if the HbA1c level is $< 6.5\%$, moderate control is 6.5 – 8%, control is poor/uncontrolled if HbA1c is $> 8\%$. The consequences of uncontrolled/poor control of diabetes mellitus will cause various kinds of diabetes mellitus complications.

Based on the results of the hypothesis test analysis using the Spearman correlation test, it can be seen that the sig. (2-tailed) is 0.100, this shows that there is no relationship between HbA1c levels and the Mean Platelet Volume (MPV) value in type 2 diabetes mellitus sufferers. In line with research conducted by Astuti et al in 2014 regarding the relationship between HbA1c levels and MPV values in patients with type 2 diabetes mellitus showed that there was no relationship between HbA1c levels and MPV values with a value of $p=0.907$ ($p>0.05$) and an r table value of 0.018. There is no relationship with this examination because increased platelet reactivity in type 2 diabetes mellitus is influenced by several factors, including metabolic abnormalities, insulin resistance and deficiency, oxidative stress, and inflammation. Metabolic abnormalities include hyperglycemia and dyslipidemia. Hyperglycemia can cause increased platelet reactivity through several mechanisms, dyslipidemia can also cause increased platelet reactivity. The MPV value is a marker of

platelet activity or function and thrombopoiesis in the bone marrow. Platelet activity in type 2 diabetes is not only influenced by hyperglycemia and insulin resistance, but also by the presence of dyslipidemia, inflammation and the presence of comorbidities. Platelet activation in diabetes mellitus accompanied by comorbid conditions will further increase the MPV value, compared to hyperglycemia alone. The difference in this research and the weakness of this research is the weakness related to supporting variables that cannot be controlled and related to research that should use a cohort design.

CONCLUSION

Based on the results of the research that has been carried out, it was concluded that the p-value between HbA1c levels and MPV values was 0.100 ($p > 0.05$) which indicates that there is no significant relationship between HbA1c levels and MPV values in outpatients suffering from type 2 DM.

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