

**THE RELATIONSHIP OF HbA1c LEVELS WITH BLOOD SEDIMENTATION RATE VALUES IN TYPE 2 DIABETES MELLITUS PATIENTS****Nili Nataliya, Sulasmi*, Tasrif Ahmad**

Sekolah Tinggi Ilmu Kesehatan Nasional, Jl. Raya Solo - Baki, Bangorwo, Kwarasan, Grogol, Sukoharjo, Central Java 57552, Indonesia

[*sulasmi@stikesnas.ac.id](mailto:sulasmi@stikesnas.ac.id)**ABSTRACT**

Diabetes Mellitus is a group of metabolic disorders characterized by increased blood glucose as a result of impaired insulin production or impaired insulin performance or both. In uncontrolled diabetes patients, it is characterized by high HbA1c levels and causes various complications, both acute and chronic complications. Hyperglycemia affects the inflammatory response and the body's immunity to infection which results in a decrease in the function of the body's immune cells, the infection can manifest more severely. Blood sedimentation rate, one of the benefits of the examination is to find out acute inflammatory reactions both local and systemic as well as inflammation associated with chronic disease. Based on the above, it can be stated that checking HbA1c levels and ESR values can be the first step to prevent DM complications. The aim of this study was to determine the relationship between HbA1c levels and ESR values in type-2 DM patients who underwent HbA1c examinations at the Prodia Clinic laboratory in Sorong. The method used is observational analytic with a cross sectional approach. Data were taken from 35 Prolanis patients with type-2 DM by purposive sampling. Venous blood samples were used, HbA1c levels were checked with the Bio-Rad D10 and LED with the Westergreen method. The data were analyzed using the Spearman correlation test, with a significant p-value of 0.002 (<0.05) with a correlation coefficient (r) of 0.506. It can be concluded that there is a significant relationship between HbA1c levels and ESR values in type 2 Diabetes Mellitus patients with a moderate level of relationship.

Keywords: diabetes mellitus; erythrocytes sedimentation rate; hba1c; type 2 diabetes mellitus

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INTRODUCTION

Diabetes mellitus (DM) is a complex chronic disease, occurring due to abnormalities in insulin secretion, insulin function or both, so that the body experiences disturbances in the metabolism of carbohydrates, proteins and fats. This can have an impact on increasing blood glucose levels or commonly called hyperglycemia (ADA, 2021). In type 2 DM there is impaired sensitivity of pancreatic beta cells which play a role in producing the hormone insulin. This hormone functions to control blood sugar levels in the body. The number of diabetics, especially type 2 DM in developing countries is increasing (Faswita, 2019). Various factors that cause DM include viruses, bacteria, toxins, hereditary history, demographics, and changes in lifestyle (obesity) (Aminah et al., 2023). The International Diabetes Federation (2021) notes that around 537 million adults (aged 20 - 79 years) or 1 in 10 people live with diabetes worldwide. Diabetes also causes 6.7 million deaths or 1 person dies every 5 seconds. According to IDF (2021), in 2021 Indonesia will be ranked fifth in the world with the most DM sufferers, namely 19.5% and it is estimated that this will increase to 28.6% in 2045.

Based on data from Basic Health Research (Riskesdas, 2018), The prevalence of Diabetes Mellitus based on a doctor's diagnosis in residents aged ≥ 15 years in West Papua Province is 1.3% and Sorong City ranks highest in the prevalence of Diabetes Mellitus in West Papua Province, namely 2.82%.

The success of controlling DM can be seen from several criteria, namely checking blood glucose levels, lipid profile and checking HbA1c levels. Several recent studies state that HbA1c can be used to establish and screen for type 2 DM. HbA1c is used as an index of long-term glycemic control to assess the effect of changing drug therapy 2-3 months previously (Maulana, 2020). HbA1c is glycated and subfractionated hemoglobin formed by the attachment of various glucose in the HbA molecule (hemoglobin in adults). HbA1c levels will increase as the average concentration of glucose in the blood increases. The levels are stable based on the age range of around 100 to 120 days of erythrocytes so that this examination can reflect the average blood glucose level over the last 2 to 3 months (Bilous & Donnelly, 2014). HbA1c is the best single test to assess the risk of tissue damage caused by high blood sugar levels (Utomo et al., 2015). HbA1c is declared controlled if the level is $< 7\%$ and uncontrolled if $> 7\%$ (ADA, 2022). Patients who have HbA1c levels $> 7\%$ have a 2 times higher risk of experiencing complications. A 1% decrease in HbA1c levels will reduce the risk of complications of peripheral vascular disease by 43% (Wulandari et al., 2020). Higher HbA1c levels can indicate a high risk of complications (Zulfian et al., 2020).

The Erythrocytes Sedimentation Rate (ESR) is an examination to determine the presence of inflammation (Sitepu, 2018). The Erythrocytes Sedimentation Rate (ESR) is defined as the rate at which erythrocytes settle from a blood sample which is measured using a certain tool, the results are expressed in mm/ hours (Kiswari, 2014). Clinically and technically, ESR can be influenced by several factors including erythrocytes, plasma and technical factors (Nugraha, 2015). The ESR value increases due to tissue damage and inflammation due to acute or chronic infections. This can also increase fibrinogen levels in plasma (Sitepu, 2018). Several studies have been carried out regarding DM and LED values. Research by Bikramjit et al., (2017) states that patients with increased HbA1c levels and ESR values have higher risk factors for lower extremity amputation. Research by Alivameita et al., (2021) shows that there is a moderate correlation ($r=0.422$) between blood glucose levels and the hematological profile of DM patients with diabetic ulcers where the ESR value has a significant relationship with an increase in blood glucose. This is also in accordance with research by Guo et al., (2020) that ESR is independently related to the severity of complications in Type 2 Diabetes Mellitus patients. Research by Ermawati et al., (2022) also shows that there is a strong relationship between HbA1c values and ESR. of 25 patients suffering from DM at Daha Husada RSU, Kediri City. From the studies above, it can be stated that checking HbA1c levels and ESR values can be the first step in preventing DM complications. Based on the background above, researchers are interested in conducting more in-depth research to find out how "the relationship between HbA1c levels and Erythrocyte Sedimentation Rate (ESR) Values in Type 2 Diabetes Mellitus Patients."

METHOD

This research uses observational analytical research methods with a cross-sectional approach. The aim of this study was to determine the relationship between HbA1c levels and erythrocyte sedimentation rate (ESR) values in Type 2 Diabetes Mellitus patients. The research population was all prolanis patients with Type 2 Diabetes Mellitus FKTP dr. Dwi Ayu urged 40 patients to undergo examinations at the Prodia Sorong Clinical Laboratory in March-May 2023.

Samples were taken from Prolanis patients suffering from Type 2 DM FKTP dr. Dwi Ayu urged, who carried out the HbA1c examination, followed by the Blood Sedimentation Rate examination at the Prodia Sorong Clinical Laboratory. There are 35 samples to be collected. Samples were collected from March to May 2023. The number of samples was calculated using the Slovin formula. The sampling limitation criteria are as follows: Age 40-65 years, long suffering from Type 2 DM for ≥ 5 years, for women who are not pregnant and not menstruating.

RESULTS

This research was conducted at the Prodia Sorong Laboratory using primary data, namely data taken from Prolanis FKTP patients, Dr. Dwi Ayu urged, who carried out an HbA1c examination, then continued with a blood sedimentation rate examination. In this study, there were 40 Prolanis patients suffering from type 2 DM who came to Prodia Sorong with a doctor's referral letter to carry out an HbA1c examination. During the registration process, interviews, filling out questionnaires and informed consent for research are also carried out. From the results of the initial screening, there were several who did not meet the research criteria, namely 2 people who had suffered from DM < 5 years and 3 people aged > 65 years, so that the sample involved in this study was 35 patients who were then examined for HbA1c and ESR.

Table 1.
Respondent Characteristics (n=35)

Category	f	%
gender	Male	18
	Woman	17
Age (Years)	41 – 45	2
	46 – 50	3
	51 – 55	8
	56 – 60	22
HbA1c (%)	Controlled DM ($<7\%$)	7
	Uncontrolled DM ($\geq 7\%$)	28

Table 1 above shows 18 male respondents (51.4%) and 17 female respondents (48.6%), controlled DM (HbA1C $<7\%$) 7 patients (20%) and DM uncontrolled (HbA1C $> 7\%$) in 28 patients (68.6%). The data is then tested for normality as shown in table 2 below.

Table 2.
Results of Comparison of LED Values in Controlled and Uncontrolled DM (n=35)

Nilai LED					
DM	f	Min	Max	Mean $\pm$ SD	Nilai P
Controlled DM ($<7\%$)	7	7	46	19,43 $\pm$ 13,3	0,032
Uncontrolled DM ($\geq 7\%$)	28	5	108	40,11 $\pm$ 25,54	

Table 2. The minimum LED value for controlled DM is 7 mm/hour and the maximum value is 46 mm/hour with an average of 19.43 mm/hour. The minimum LED value for uncontrolled DM is 5 mm/hour and the maximum value is 108 mm/hour with an average of 40.11 mm/hour.

Table 3.
Normality test

Variable	Sig	Status
LED(mm/H)	0,004	Abnormal
HbA1c (%)	0,054	Normal

Table 3 results of the normality test in table 3 above for the variable ESR value of 0.004 and the variable HbA1c level (%) of 0.054. This shows that the ESR value data is not normally

distributed while the HbA1c level data shows a normal distribution because the significant value is $p > 0.05$.

Table 4.
Correlation between HbA1C Levels and Blood Sedimentation Rate Values

	HbA1c (%)
LED(mm/H)	r: 0,506 p : 0,002 n=35

Table 4 from the normality test shows that there are data that are not normally distributed, so it is continued with the Spearman test to determine the relationship between ESR levels and HbA1c. The test results showed that there was a relationship between ESR levels and HbA1c ($p : 0.002$), with sufficient correlation strength ($r=0.506$) and a positive correlation direction meaning that the higher the ESR, the higher the HbA1c level.

DISCUSSION

Based on the results of the ESR examination (blood sedimentation rate) in type 2 Diabetes Mellitus (DM) patients, Prolanis FKTP dr. Dwi Ayu urged, as many as 35 patients were male, 18 (51.4%) and 17 female (48.6%). Based on table 1. the most age of patients with DM is between 56-60 years as many as 22 patients (62.9%). This is in accordance with the research by Milita, et al (2021) that DM often appears after someone enters the vulnerable age range (> 45 years). Humans will experience physiological changes, namely experiencing a decrease in body functions at the age of over 40 years. Another study, namely Ermawati et al., (2022) stated that decreased insulin sensitivity and decreased body function for glucose metabolism will be in line with the body's aging process. Apart from that, according to research by Putri et al., (2020) which states that as a person ages, there will be an imbalance between the release of free radicals and antioxidants to ward them off.

The results of a study of 35 samples of type 2 DM patients showed that 28 patients (80%) had uncontrolled HbA1c levels. HbA1c measurement is a good glycemic control to get an overview of blood glucose levels 2-3 months before. HbA1c can also monitor the risk of neuropathy in DM patients (Nugroho et al., 2016). Neuropathy is a disorder of the function of the peripheral nervous system which can be caused by various factors. In DM, neuropathy indicates a complication of microangiopathy in the nerves. Hyperglycemic conditions will increase glycolysis which results in excessive mitochondrial electron transport and the formation of Reactive Oxygen Species (ROS) which will damage peripheral nerves (Hanifah et al., 2021). Hyperglycemia conditions will also increase the hexosamine pathway which has implications for reducing glucose uptake in neurons and the formation of inflammatory lesions (Prawitasari, 2019). HbA1c value can be used to assess the high tissue damage caused by hyperglycemia. Therefore, it is necessary to regularly measure HbA1c to see the severity of type 2 diabetes mellitus sufferers (Driyah & Oemiati, 2020).

Based on table 2, the minimum LED value for uncontrolled DM is 5 mm/hour and the maximum value is 108 mm/hour with an average of 40.11 mm/hour. ESR values can increase due to inflammatory processes, acute and chronic complications and high plasma protein levels (especially globulin and fibrinogen). Increased fibrinogen levels are one of the reasons for increasing ESR values (Herman et al., 2022). With an increase in fibrinogen levels, the ability of erythrocytes to form rouleaux will be faster so that the ESR will increase (Nugraha, 2015). Hyperglycemia will affect the production of erythrocytes, function and physical properties of cells towards physiological functions and have a direct effect on the structure of blood vessels. Chronic DM complications also affect plasma viscosity, life span and deformability of red blood

cells (Alamri et al., 2019). LED results do not always increase in DM sufferers. If the results show high, it is possible that inflammation or inflammation has occurred. However, if the results are normal, it can be ascertained that the patient is living a healthy lifestyle (Sitepu, 2018). Blood sedimentation rate does not indicate the severity of the disease because it is non-specific. However, with the results of the HbA1c examination and the results of the high sedimentation rate, clinicians and patients need to be aware of the risk of infection or inflammation in patients with type-2 diabetes mellitus which can exacerbate complications.

CONCLUSION

Based on the results of the Spearman correlation test, significant $p = 0.002$ was obtained where if the p -value < 0.05 it can be concluded that there is a relationship between HbA1c levels and ESR in Type 2 Diabetes Mellitus Patients with a sufficient level of correlation ($r = 0.506$) and a positive correlation direction meaning that the higher the HbA1c, the higher the LED value

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