



The Relationship Between *Glycosylated Hemoglobin (HbA1c)* Levels and Serum *Glutamic-Pyruvic Transaminase (SGPT)* Enzyme Activity in Patients with Type 2 Diabetes Mellitus at The Pakuan Baru Community Health Center in Jambi City

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ABSTRACT

Type 2 diabetes mellitus is characterized by persistent *hyperglycemia* that may contribute to metabolic disturbances and liver injury. *Glycated hemoglobin (HbA1c)* reflects average blood glucose control over approximately three months, whereas serum *glutamic-pyruvic transaminase (SGPT)*, also known as alanine aminotransferase (ALT), is commonly used to assess hepatocellular injury. This study aimed to determine the relationship between HbA1c levels and SGPT enzyme activity in patients with type 2 diabetes mellitus at Pakuan Baru Community Health Center, Jambi City. An observational correlational design was applied to 35 adult patients selected according to predetermined inclusion and exclusion criteria. HbA1c levels were measured using an Afinion AS100 analyzer, while SGPT activity was assessed using a DIALAB automated analyzer. Because the data were not normally distributed, the relationship between variables was examined using Spearman's rank correlation test. The participants had a median HbA1c level of 6.80%, with values ranging from 4.4% to 15.0%, and a median SGPT activity of 17.00 U/L, with values ranging from 7 to 47 U/L. The analysis showed a very weak positive correlation that was not statistically significant ($r = 0.054$; $p = 0.759$). Therefore, HbA1c levels were not significantly associated with SGPT enzyme activity in the studied patients with type 2 diabetes mellitus.

INTRODUCTION

Type 2 diabetes mellitus (DM) is one of the noncommunicable diseases whose prevalence continues to increase worldwide. According to the International Diabetes Federation (IDF), in 2021, the number of people with type 2 diabetes worldwide reached approximately 537 million and was expected to continue increasing by 2045. Indonesia ranked fifth globally, with a total of 19.46 million people with diabetes and 237 thousand related deaths (IDF, 2021). According to the Jambi Provincial Health Office (2022), the number of people with DM in Jambi Province was 41,193 in 2021 and increased to 45,641 in 2022. Meanwhile, in Jambi City, the number of people with DM reached 13,623 in 2022. (Yahya et al., 2025) Based on data from the Jambi City Health Office (2022), one of the health centers with the highest number of DM patients in 2022 was Pakuan Baru Community Health Center, with 925 patients. Initial observations at Pakuan Baru Community Health Center showed that the number of DM patients from February to October 2023 reached 1,927 (Agung Gumilar & Widwi Handari Adj, 2023).

Type 2 DM is caused by a combination of two main factors, namely impaired insulin secretion by pancreatic β -cells and the inability of insulin-sensitive tissues to respond adequately to insulin (Alam et al., 2021; Roden & Shulman, 2019). Type 2 DM can affect metabolic processes in the body (Tompsey et al., 2016). Elevated blood glucose levels or hyperglycemia may cause the body to undergo compensatory processes by increasing glucose production in the liver (Yosmar et al., 2018).

People with DM need to control their blood glucose levels to prevent potential complications. One parameter for evaluating blood glucose control is *glycated hemoglobin*, also known as *glycosylated hemoglobin*, which is commonly abbreviated as HbA1c (Rasyid et al., 2020). HbA1c is a test used to measure the percentage of glucose bound to *hemoglobin* in the blood (Widijanti & Ratulangi, 2011). This test reflects average blood glucose levels over approximately three months, corresponding to the lifespan of red blood cells. Increased HbA1c levels may contribute to a higher risk of complications in patients with DM (Rain, 2015).

Uncontrolled *hyperglycemia* can cause damage to various body systems and may lead to liver complications (Reza & Rachmawati, 2017). The liver is one of the primary organs susceptible to oxidative stress caused by *hyperglycemia*, which can result in liver tissue injury. DM can cause excessive accumulation of fat in the liver, leading to fatty liver disease and potentially progressing to nonalcoholic fatty liver disease (NAFLD), nonalcoholic steatohepatitis (NASH), liver fibrosis, cirrhosis, hepatocellular carcinoma, and end-stage liver disease (Mohamed et al., 2016a).

One of the examinations used to evaluate liver function is the assessment of serum *glutamic-pyruvic transaminase* (SGPT) enzyme activity, also known as *alanine aminotransferase* (ALT). SGPT or ALT is an enzyme widely produced in human tissues, with the highest concentration found in the liver. Therefore, SGPT is considered a relatively specific marker for assessing hepatocellular injury and liver function (Nugraha & Adrawi, 2018a).

Previous research by (Levtchenko et al., 2025) showed that ALT levels in individuals with type 2 diabetes were higher than those in healthy individuals. Research conducted by (Shahwan et al., 2019) reported that individuals with uncontrolled DM (HbA1c $\geq 7\%$) had higher average ALT levels. Another study by (Ghimire et al., 2018) also reported a positive correlation between ALT and HbA1c levels (Rosida, 2016; Sifano, 2021). However, Stuart et al. (2019) obtained different results and found no correlation between ALT levels and HbA1c levels.

Several studies examining the relationship between HbA1c values and SGPT enzyme activity in patients with type 2 diabetes have been conducted; however, the findings remain inconsistent. These differences among previous studies provided the rationale for conducting this research, which aimed to determine the relationship between HbA1c values and SGPT enzyme activity in patients with type 2 diabetes at Pakuan Baru Community Health Center, Jambi City.

METHOD

Research Population and Sample

Population

The population in this study consisted of all patients with type 2 diabetes mellitus at Pakuan Baru Community Health Center, Jambi City, who met the predetermined research criteria.

Research Sample

At this stage of the study, the sampling technique used was total sampling. The research sample consisted of patients with type 2 diabetes mellitus who underwent examinations at Pakuan Baru Community Health Center, Jambi City. A total of 35 patients with type 2 diabetes mellitus were selected according to the predetermined inclusion and exclusion criteria.

a) Inclusion Criteria

1. The inclusion criteria for this study were as follows:
2. Patients with type 2 diabetes mellitus who had been diagnosed by a physician.
3. Patients aged more than 18 years.
4. Patients who were willing to participate as respondents by signing informed consent.

b) Exclusion Criteria

RESULTS AND DISCUSSION

Value of HbA1c and Aktivism Enzim SGPT in Penderita DM Type 1 2 in Puskemas Pakuan BKota Jambi

To determine HbA1c levels in patients with type 2 diabetes mellitus at Pakuan Baru Community Health Center, Jambi City, examinations were performed using the Afinion AS100 analyzer. Meanwhile, SGPT enzyme activity in patients with type 2 diabetes mellitus at Pakuan Baru Community Health Center, Jambi City, was assessed using the DIALAB automated analyzer. The research results were then analyzed and presented as follows:

Table 1. Analysis of HbA1c Levels and SGPT Enzyme Activity in Patients with Type 2 Diabetes Mellitus at Pakuan Baru Community Health Center, Jambi City

Variabandl	Mean	Median	SD	Min	Max
HbA1c value	7,75	6,80	2,36	4,4	15
Aktivitas Enzim SGPT	19,91	17,00	10,59	7	47

The analysis results showed that the mean (median) HbA1c level in patients with type 2 diabetes mellitus at Pakuan Baru Community Health Center, Jambi City, was 6.80% with a standard deviation of 2.36%. The lowest HbA1c value was 4.4%, while the highest value was 15%.

The analysis results showed that the mean (median) SGPT enzyme activity in patients with type 2 diabetes mellitus at Pakuan Baru Community Health Center, Jambi City, was 17.00 U/L with a standard deviation of 10.59 U/L. The lowest SGPT enzyme activity was 7 U/L, while the highest SGPT enzyme activity was 47 U/L.

The Relationship Between HbA1c Levels and SGPT Enzyme Activity in Patients with Type 2 Diabetes Mellitus at Pakuan Baru Community Health Center, Jambi City

The normality test results showed that the HbA1c and SGPT enzyme activity data had a significance value of <0.05 , indicating that the data were not normally distributed. Therefore, further analysis was conducted using the Spearman's rank correlation test.

Data analysis was performed to determine the relationship between SGPT enzyme activity and HbA1c levels in patients with type 2 diabetes mellitus at Pakuan Baru Community Health Center, Jambi City. After the analysis was conducted, the results were obtained as follows:

Table 2. Analysis of the Relationship Between HbA1c Levels and SGPT Enzyme Activity in Patients with Type 2 Diabetes Mellitus at Pakuan Baru Community Health Center, Jambi City

Variabandl	City	
	Koefisien Korelasi Spearman (r)	Signifikasi (p)
HbA1c value ofngan Aktivitas Enzim SGPT	0,054	0,759

The results of the correlation test showed a p-value of 0.759 and an r-value of 0.054. Since the p-value = $0.759 > 0.05$, it can be concluded that there was no significant relationship between HbA1c levels and SGPT enzyme activity in patients with type 2 diabetes mellitus at Pakuan Baru Community Health Center, Jambi City.

Respondent Characteristics

The characteristics of 35 respondents with type 2 diabetes mellitus showed that the majority of respondents were female (71.4%). This finding was consistent with a study conducted by Milita et al. (2021), which reported that the prevalence of type 2 diabetes mellitus was higher among females than males. The higher incidence of type 2 diabetes mellitus among females may be associated with physiological changes, hormonal factors, and differences in body composition between males and females. According to Wahyuni et al (Wahyuni et al., 2019). (2019), females have a higher risk of developing type 2 diabetes mellitus due to greater susceptibility to increased body fat accumulation, which may contribute to insulin resistance and affect blood glucose regulation.

The respondents were predominantly aged 56–65 years (57.1%). This finding was consistent with Yosmar et al. (2018), who stated that the prevalence of diabetes mellitus continues to increase with age, particularly among individuals over 50 years. This condition may be attributed to physiological changes associated with aging, including reduced physical activity, changes in body composition, decreased insulin receptor sensitivity, and reduced glucose transporter 4 (GLUT-4) activity, which may contribute to impaired glucose uptake due to decreased insulin sensitivity (Sulastri, 2022).

Based on the results from 35 respondents, 26 respondents (74.3%) had been diagnosed with diabetes mellitus for less than 10 years. According to Selano (2021), the duration of diabetes mellitus is closely related to lifestyle patterns and the ability of patients to control blood glucose levels. Long-term diabetes management requires continuous treatment and lifestyle modifications. The results showed that the majority of patients with diabetes mellitus

at Pakuan Baru Community Health Center had a disease duration of less than 10 years (Maulana, 2015; Milita et al., 2021; Mohamed et al., 2016b).

The majority of respondents regularly underwent routine diabetes control, with 22 respondents (62.9%) reporting regular check-ups. This finding indicated that most respondents routinely monitored their blood glucose levels every month. Regular blood glucose monitoring may help reduce the risk of diabetes-related complications (Fromwi, 2016).

The results showed that the majority of respondents had good medication adherence, with 21 respondents (60%) reporting compliance with diabetes medication use. This finding indicated that respondents had begun to understand the importance of medication adherence for successful diabetes management. One of the major challenges in diabetes treatment is poor medication adherence. Noncompliance with medication regimens may increase the risk of complications caused by chronic hyperglycemia in patients with diabetes mellitus (Rismayawan et al., 2023).

HbA1c Levels and SGPT Enzyme Activity in Patients with Type 2 Diabetes Mellitus at Pakuan Baru Community Health Center, Jambi City

The results showed that the mean HbA1c level among respondents with type 2 diabetes mellitus was 6.80%. Based on the normal reference value for HbA1c examination, the average HbA1c level was classified as elevated. This finding indicated that blood glucose control among patients with type 2 diabetes mellitus over the previous three months was not optimal. This result was consistent with (Tiara et al., 2024), who reported that the majority of patients had HbA1c levels $\geq 7\%$, accounting for 156 patients (85.7%). Elevated HbA1c levels in patients with diabetes mellitus are associated with poor glycemic control. According to Imelda (2019), several significant factors related to HbA1c levels include age, sex, family history, occupation, physical activity, diet, medication adherence, duration of diabetes, medical history, and access to healthcare facilities, all of which may influence glycemic control (Nugraha & Adrawi, 2018b; Patulak et al., 2019a).

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Based on the results from 35 respondents, 26 respondents (74.3%) had suffered from diabetes mellitus for less than 10 years. According to Selano (2021), the duration of diabetes mellitus is closely associated with lifestyle patterns and the ability to control blood glucose levels. Long-term diabetes management requires continuous treatment and lifestyle modifications. The results showed that the majority of patients with diabetes mellitus at Pakuan Baru Community Health Center had a disease duration of less than 10 years.

The majority of respondents regularly performed routine diabetes control, with 22 respondents (62.9%) reporting regular check-ups. This finding indicated that most respondents routinely monitored their blood glucose levels every month. Regular blood glucose monitoring may reduce the risk of diabetes-related complications (Fromwi, 2016).

The results showed that the majority of respondents had good medication adherence, with 21 respondents (60%) reporting compliance with diabetes medication. This finding indicated

that respondents had begun to understand the importance of medication adherence for successful diabetes management. Poor medication adherence remains one of the major challenges in diabetes treatment. Failure to adhere to medication regimens may increase the risk of complications caused by chronic hyperglycemia in patients with diabetes mellitus (Rismayawan et al., 2023).

Relationship Between HbA1c Levels and SGPT Enzyme Activity in Patients with Type 2 Diabetes Mellitus at Pakuan Baru Community Health Center, Jambi City .

The results of the correlation analysis between HbA1c levels and SGPT enzyme activity in patients with type 2 diabetes mellitus at Pakuan Baru Community Health Center, Jambi City, using the Spearman's rank correlation test showed a p-value of 0.759, indicating that there was no significant relationship between HbA1c levels and SGPT enzyme activity.

These findings indicated that most respondents had uncontrolled HbA1c levels, whereas SGPT enzyme activity remained within the normal range. The increase in HbA1c levels was not accompanied by an increase in SGPT enzyme activity. This finding suggested that patients with type 2 diabetes mellitus at Pakuan Baru Community Health Center had suboptimal blood glucose control over the previous three months; however, their liver function remained within normal limits.

This finding was consistent with (Patulak et al., 2019b), who reported no significant correlation between ALT levels and HbA1c levels, with statistical analysis showing $p = 0.237$ and $r = -0.191$. However, these findings differed from Shahwan et al. (2019), who reported that increased ALT levels were associated with patients having HbA1c levels $\geq 7\%$.

Increased HbA1c levels may occur due to poor blood glucose control, unhealthy dietary patterns, and inadequate physical activity. High HbA1c levels reflect poor glycemic control and may increase the risk of diabetes-related complications. However, this condition does not necessarily indicate immediate liver dysfunction because hepatic injury may be influenced by multiple factors.

The absence of a significant relationship in this study may be explained by the fact that the majority of patients with type 2 diabetes mellitus at Pakuan Baru Community Health Center still had normal SGPT enzyme activity (Rifai, 2018). This finding may also be influenced by the relatively short duration of diabetes among most respondents. Based on the study results, the majority of respondents had suffered from diabetes mellitus for less than 10 years. According to (Gohel et al., 2021), patients with diabetes mellitus for less than 10 years had lower ALT levels compared with patients with diabetes duration exceeding 10 years. According to (Suyanto, 2016), longer diabetes duration is associated with reduced pancreatic β -cell function, which may contribute to complications, particularly in patients with diabetes duration of 5–10 years.

The duration of diabetes mellitus may influence increased SGPT enzyme activity. As the duration of diabetes increases, metabolic disturbances may occur, potentially leading to liver damage and the release of hepatic enzymes such as SGPT. In addition, many patients with diabetes mellitus use antidiabetic medications that may have hepatotoxic effects and contribute to increased SGPT levels (Gohel et al., 2021).

CONCLUSION

This study concluded that HbA1c levels were not significantly correlated with serum glutamic-pyruvic transaminase (SGPT/ALT) enzyme activity among 35 patients with type 2 diabetes mellitus at Pakuan Baru Community Health Center, Jambi City. The participants had a median HbA1c level of 6.80% and a median SGPT activity of 17.00 U/L. Spearman's rank correlation analysis showed a very weak positive correlation that was not statistically significant ($r = 0.054$; $p = 0.759$). Thus, elevated HbA1c levels were not necessarily accompanied by increased SGPT activity in this sample. Because most participants had normal SGPT activity, liver enzyme status could not be determined solely based on glycemic control. Nevertheless, the findings should be interpreted cautiously because the small sample size and single-center design limited their generalizability.

Future research should involve larger, multicenter samples and employ longitudinal designs to examine whether prolonged poor glycemic control contributes to changes in liver enzyme activity over time. Subsequent studies should also control for potentially confounding factors, including diabetes duration, age, sex, body mass index, medication use, dietary patterns, physical activity, lipid profiles, alcohol consumption, and nonalcoholic fatty liver disease. Including additional liver function indicators, such as aspartate aminotransferase, gamma-glutamyl transferase, bilirubin, and hepatic imaging findings, would provide a more comprehensive assessment of liver health. Stratifying participants according to HbA1c categories and diabetes duration may further clarify whether specific patient groups are more susceptible to diabetes-related liver dysfunction.

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