



Research Article

Factors Influencing HbA1C Values In Patients With Diabetes Mellitus At Mojowarno Christian Hospital

Christian Dion Saelan¹ | Muhamad Rizal Hadi Pratama^{2*} | Rizky Trimaulidia² | Bayu Bagus Maulana² | Saski Yasmin Alfina³

¹Department of Internal medicine, Mojowarno Christian Hospital, Indonesia

²Internship doctor, Mojowarno Christian Hospital, Indonesia

³Internship doctor, Siti Khodijah Muhammadiyah Sepanjang Hospital, Indonesia

*Corresponding Author:

Muhamad Rizal Hadi Pratama, Internship doctor, Mojowarno Christian Hospital, Indonesia

Email:

drmuhamadrizalhadipratama@gmail.com

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ABSTRACT

Diabetes mellitus (DM) is a metabolic disorder characterized by elevated blood sugar levels. It is a chronic condition that cannot be cured but can be effectively managed. Hemoglobin A1c (HbA1c) measurement is the gold standard for long-term monitoring of blood sugar levels. This study aims to explore the relationship between HbA1c levels and the characteristics of diabetic patients.. The research employed a cross-sectional design at Mojowarno Christian Hospital in Jombang, conducted from November 2023 to January 2024. A total of 72 samples were collected using a purposive sampling technique. Data from questionnaires were analyzed using Spearman's Test and Multiple Logistic Regression Test. The findings indicate that education level, diabetes empowerment, quality of life of patients, and knowledge regarding DM are significantly associated with individual HbA1c values. Among these factors, education emerged as the most influential. Education plays a crucial role in influencing HbA1c levels in individuals with diabetes, highlighting the importance of knowledge and awareness in managing this condition effectively.

Keywords: Diabetes mellitus, HbA1C, education

INTRODUCTION

Diabetes mellitus (DM) is a metabolic disorder characterized by the body's inability to produce sufficient insulin or utilize it effectively. This condition leads to elevated blood sugar levels, known as hyperglycemia. Diabetes mellitus is a chronic illness that cannot be cured but can be managed effectively. Continuous care is essential for patients with DM to enhance their quality of life (Soelistijo et al., 2021).

According to data from the Ministry of Health of the Republic of Indonesia in 2021, there were 19.47 million individuals diagnosed with diabetes mellitus, placing Indonesia sixth globally in terms of prevalence. The International Diabetes Federation (IDF) reported that in 2021, the prevalence of diabetes in Indonesia was 10.6% among a population of 179.72 million. The Basic Health Research (Riskesdas) indicated an increase in prevalence from 6.9% in 2013 to 8.5% in 2018, with the number of diabetes patients in Indonesia surpassing those suffering from heart



attacks, strokes, and other conditions (Ministry of Health RI, 2018). In East Java Province, the East Java Provincial Health Service reported that out of a population of 40,156,672, there were 929,535 cases of diabetes mellitus (2.3%) in 2021 (East Java Provincial Health Office, 2022). The Performance Report of the Directorate of P2PTM revealed that in 2023, the incidence of DM in Jombang District, East Java Province, reached 655,752. Jombang District exhibits the eighth highest prevalence of diabetes mellitus among all age groups diagnosed by healthcare professionals, according to Risesdas data for East Java from 2018. Risesdas East Java (2018) further identified the cities of Madiun, Mojokerto, Sidoarjo, Surabaya, Gresik, Probolinggo, Pasuruan, and Jombang as having the highest prevalence of DM (Ministry of Health RI, Research and Development Agency for Health Humaniora and Health Management Puslitbang, 2018).

The high prevalence of diabetes mellitus each year is influenced by several factors, including age, gender, education, complications, family history, duration of diabetes, patient perceptions of treatment, patient empowerment, quality of life, knowledge about diabetes, and self-management behavior (Fortuna, T. A., et al 2023; Velasco, 2019). In Indonesia, diabetes mellitus is diagnosed when random blood sugar (RBS) exceeds 200 mg/dl, accompanied by symptoms such as excessive thirst, frequent hunger, and weight loss. Additionally, a diagnosis can be made if fasting blood sugar (FBS) is 126 mg/dl or higher. Type 2 diabetes patients can reduce the risk of microvascular complications by adhering to strict glycemic control measures (Soelistijo et al., 2021).

For diabetic patients, measuring hemoglobin A1c (HbA1c) is the gold standard for long-term blood sugar monitoring, as it reflects the average blood sugar levels over the preceding three months. Ideally, all diabetic patients should have HbA1c measured at initial assessments and throughout ongoing care. Previous studies suggest that blood sugar control and various patient characteristics—including age, gender, education, complications, family history, diabetes duration, patient empowerment, quality of life, knowledge, and self-management—may impact HbA1c control (Fortuna, T. A., et al 2023; Velasco, 2019). A good quality of life is often linked to healthier lifestyle choices, such as maintaining a balanced diet and engaging in regular physical activity. Conversely, a lower quality of life may lead to unhealthy eating habits and reduced physical activity, which can result in elevated HbA1c levels (Cheng, L., et al, 2019). This study aims to investigate the relationship between HbA1c levels and the characteristics of diabetic patients. By understanding this relationship, clinicians can more effectively tailor education and treatment strategies to their patients' specific characteristics.

MATERIAL AND METHODS

This study employed a correlational research design with a cross-sectional technique, which involves a single observation (Pratiknya, 2014). The Ethics Committee of Mojowarno Christian Hospital approved the research, granting ethical clearance with the number 015/RSKM/Diklat/II/2024. Participants were selected through a purposive sampling method from November 2023 to January 2024. The inclusion criteria for this study required participants to be at least 18 years old, diagnosed with diabetes mellitus, have undergone an HbA1C examination within the last 3 months, and be willing to participate by signing a consent form. Exclusion criteria included non-cooperative patients, those who refused to participate, patients with mental health issues, those in a coma, and pregnant individuals. The pregnant population was excluded because insulin sensitivity increases in early pregnancy, which elevates glucose uptake into fat stores in preparation for the energy demands of pregnancy. However, as pregnancy progresses, hormonal surges,

including estrogen, progesterone, leptin, cortisol, placental lactogen, and placental growth hormone, trigger insulin resistance (Plows, J. F., 2018).

A total of 183 patients with type 2 diabetes mellitus who were undergoing treatment at Mojowarno Christian Hospital and had HbA1C checks in the last three months were identified. Using the Slovin formula, the minimum required sample size for the research was determined to be 65 respondents. Data collection was conducted using questionnaires that had been tested for validity and reliability. The questionnaires were distributed to respondents while they waited for the service. The data obtained were processed, coded, and tabulated. Following this, data analysis was performed using the Spearman correlation test. If the Spearman test indicated a $p\text{-value} < 0.05$, further analysis using multiple logistic regression could be conducted. The purpose of the multivariate analysis was to identify the factors most strongly influencing HbA1C levels at Mojowarno Christian Hospital. The analysis was conducted using IBM SPSS Statistics 25.

RESULTS AND DISCUSSION^[K1]

Respondent Characteristics

Table 1 presents the total number of participants in this study, consisting of 72 individuals diagnosed with type 2 diabetes mellitus (DM). The majority of participants were aged 18-59 years (51.4%), predominantly female (61.4%), and most had completed secondary education (Junior High School-Senior High School) (43.1%). Additionally, 54.2% had a family history of diabetes mellitus, while 45.8% reported sufficient diabetes empowerment. The participants generally exhibited a moderate quality of life (52.8%) and moderate knowledge of diabetes mellitus (43.1%). Furthermore, 52.8% demonstrated good self-management behavior, yet a significant portion had uncontrolled HbA1C levels ($\text{HbA1C} > 7\%$) (70.8%).

This study indicates that a notable proportion of patients with type 2 DM are aged 18-59. This finding aligns with previous research in Riau, where the majority of patients with diabetes mellitus were aged 56-57, accounting for 38.7% of the total sample. Such trends may be attributed to physiological changes in the human body that affect pancreatic cells responsible for insulin production (Haryati & Tyas, 2022).

Furthermore, the predominance of female diabetes mellitus patients is consistent with earlier studies, which found that women constituted 55.6% of the total sample. Women may be at an elevated risk for developing DM due to factors such as hormone-related menstrual cycles and body mass index associated with fat accumulation (Haryati & Tyas, 2022).

Lastly, this study reveals that a significant majority of respondents exhibited uncontrolled HbA1C levels ($\text{HbA1C} > 7\%$). This finding corroborates previous research that highlighted that 94.4% of patients also had uncontrolled HbA1C levels (Haryati & Tyas, 2022).

Table 1. Respondent Characteristics (n=72)

Variabel	f	%
HbA1C		
<7%	21	21 (29.2%)
7% or more	51	51 (70.8%)
Age		
adult (18-59 years old)	37	37 (51.4%)
Advanced age (60 years old and more)	35	35 (48.6%)
Gender		
male	18	18 (25%)

female	54	54 (75%)
Education [K2]		
Elementary school	30	30 (41.7%)
Secondary education	31	31 (43.1%)
College	11	11 (15.3%)
Complication		
No complication	36	36 (50%)
With complication	36	36 (50%)
Family history		
No family history	33	33 (45.8%)
With family history	39	39 (54.2%)
Duration of diabetes		
Less than 5 years	36	36 (50%)
More than 5 years	36	36 (50%)
Diabetes Empowerment Scale		
Less	21	21 (29.2%)
Enough	33	33 (45.8%)
Good	18	18 (25%)
Quality of life [K3]		
Low	9	9 (12.5%)
Moderate	38	38 (52.8%)
High	25	25 (34.7%)
Level of knowledge about DM		
Low	20	20 (27.8%)
Moderate	31	31 (43.1%)
High	21	21 (29.2%)
Self management		
Poor	3	3 (4.2%)
Moderate	31	31 (43.1%)
Good	38	38 (52.8%)

Correlation Analysis Test of Participant Characteristics and HbA1C

Table 2. Bivariate Correlation Analysis Test of Participant Characteristics and HbA1C

Variable	P value	The coefficient correlation value
Age	0.258	-0.135
Gender	0.301	-0.123
Education	0.000*	0.494
Complication	0.444	-0.92
Family History	0.481	-0.084
Duration of diabetes	0.444	-0.092
Diabetes Empowerment	0.016*	0.282
Quality of life	0.001*	0.369
Level of knowledge about DM	0.000*	0.639
Self management	0.034*	0.251

*significant

Table 3. Multivariate Analysis Test Between Variables and HbA1C

Variable	Sig.	Exp(B)	95% CI. for EXP(B)	
			Lower	Upper
Step 1 ^a				
Education	.037	4.719	1.095	20.340
Diabetes Empowerment Scale	.421	.570	.145	2.240
Quality of life	.088	3.160	.844	11.834

Level of knowledge about DM	.001	13.113	2.763	62.247
Self management	.238	2.890	.496	16.833
Constant	.000	.000		

From Table 2, significant Spearman's rho correlation coefficients were observed for education, diabetes empowerment, patients' quality of life, and level of knowledge about DM. This study also indicates that variables such as age, gender, complications, family history, and duration of illness are not related to HbA1C levels. Table 3 shows that, according to the multivariate analysis, patients' knowledge of diabetes mellitus is the most influential variable in controlling HbA1C levels (HbA1C <7%). The SPSS analysis also revealed that the higher the level of knowledge about diabetes mellitus, the greater the likelihood of controlled HbA1C levels, with a 13.113-fold increase compared with patients with lower knowledge.

Discussion^[K4]

In the correlation coefficient analysis for education, a value of 0.494 was obtained, indicating a statistically significant positive correlation. It means that as the education level increases, HbA1C tends to be better controlled. The correlation coefficient between education and HbA1C is moderate. This finding aligns with previous research indicating that education indirectly affects an individual's risk of diabetes mellitus. Education influences healthy lifestyle patterns, consumption habits, and food choices (Hariawan et al., 2019; Haryati & Tyas, 2022; Wang et al., 2023).

For the correlation coefficient measuring diabetes empowerment, a value of 0.282 was identified, indicating a statistically significant positive correlation. It suggests that as diabetes empowerment increases, the HbA1C levels tend to be better controlled. However, the correlation coefficient between diabetes empowerment and HbA1C is weak. Diabetes empowerment entails providing education to patients with type 2 diabetes mellitus (DM) to enhance their self-management skills. Previous research has shown similar results, indicating that empowerment interventions can positively influence the therapeutic outcomes for individuals with type 2 DM. This effect may stem from education fostering greater independence in managing both the informational and psychological aspects of blood sugar control (Fitzgerald et al., 2015).

Regarding the correlation coefficient for the patient's quality of life, a value of 0.369 was obtained, indicating a statistically significant positive correlation. This finding indicates that as an individual's quality of life improves, their HbA1C levels are also likely to be better controlled. The correlation coefficient between quality of life and HbA1C also shows a weak association. Quality of life encompasses an individual's subjective satisfaction related to their capabilities, psychological well-being, social relationships, and environment, all of which play crucial roles in coping with illness. This study is consistent with previous research showing that higher life satisfaction is associated with lower HbA1C levels, reflecting the connection between mental and physical well-being among patients with diabetes (Ławnik et al., 2023).

The correlation coefficient for knowledge of diabetes mellitus was 0.639, indicating a statistically significant positive correlation. It suggests that as knowledge about diabetes mellitus increases, HbA1C levels tend to be better controlled. The strong correlation between knowledge of diabetes and HbA1C levels suggests that enhanced understanding can improve HbA1C control by approximately 11.798 times. This finding aligns with prior research indicating a relationship between diabetes knowledge and HbA1C levels, which also relates to an individual's educational

background and their ability to assimilate new information. Therefore, there is a pressing need to enhance knowledge of diabetes to improve health outcomes and alleviate the burden of the disease (Wang et al., 2023).

Regarding self-management, the correlation coefficient was 0.251, indicating a statistically significant positive association. It indicates that as a patient's self-management improves, their HbA1C levels are likely to be better controlled. However, the correlation between self-management and HbA1C is considered weak. Self-management encompasses an individual's efforts to navigate stressors from both internal and external sources. This study aligns with previous research demonstrating a connection between self-management and HbA1C levels, which are closely tied to lifestyle patterns. Thus, it is essential to provide support for diabetes patients in their self-management efforts (Wibowo et al., 2022).

This study also highlights the concept of diabetes distress, which refers to the concerns diabetes patients experience regarding self-management, family support, emotional burdens, and nursing care. Effective self-management can help individuals mitigate diabetes distress, which is associated with improved control over HbA1C levels (Wibowo et al., 2022). This study presents findings different from previous research due to variations in age groups and an uneven distribution of sample ages. It reveals that there is no significant relationship between gender and an individual's HbA1C levels, consistent with prior studies that found no substantial difference in HbA1C levels by gender. While some research suggests a potential link between gender and HbA1C levels, these studies tend to focus on lifestyle factors associated with each gender rather than biological differences (Ahmed et al., 2023).

Furthermore, this study indicates that there is no correlation between HbA1C control and the complications associated with diabetes mellitus. This finding diverges from established theories and previous research that assert effective HbA1C control reduces the likelihood of diabetes-related complications. This discrepancy may stem from respondents' varying levels of knowledge about diabetes mellitus, with most demonstrating only a low to moderate understanding of the condition. Many were only familiar with more severe complications, such as stroke and gangrene. Additionally, this study measured HbA1C at a single point in time, whereas earlier research monitored controlled HbA1C levels over periods exceeding 5 years (Boye et al., 2022).

This study reveals no significant relationship between family history of diabetes and HbA1C values. These findings contrast with previous research, which indicated a link between family history and HbA1C levels. Earlier studies have suggested that a family history of diabetes not only raises HbA1C values in diabetic patients but may also elevate HbA1C values in non-diabetic individuals. It could be attributed to poor lifestyle habits such as smoking, alcohol consumption, obesity, and metabolic factors like BMI, blood pressure, and cholesterol levels (Lee et al., 2018). The differing results in this study may stem from respondents who were unaware of their family disease history and therefore claimed not to have family members with diabetes. Additionally, these respondents typically demonstrated low to moderate knowledge about health, suggesting that family members might not be adequately informed to seek health checks. Consequently, their assertions about not having a family history of diabetes remain questionable.

Furthermore, this study demonstrates that there is no significant relationship between the duration of a patient's diabetes mellitus (DM) and their HbA1C levels. The length of time an individual has been diagnosed with DM largely depends on how effectively they manage their blood sugar levels through lifestyle choices. While DM is not curable, it can be controlled with lifelong treatment. Interviews conducted by the researcher with patients revealed that the duration of

diabetes does not necessarily impact HbA1C levels, as individual motivations and adherence to treatment can vary widely. Some patients who have recently been diagnosed with diabetes are highly motivated to control their blood sugar levels, using both pharmacological and non-pharmacological approaches, such as lifestyle modifications. In contrast, some newly diagnosed patients, feeling demotivated, may be reluctant to pursue treatment. Additionally, patients with a long-standing diagnosis of diabetes might feel complacent about their health and become disinclined to undergo routine checks.

Based on multivariate analysis, findings indicate that patient knowledge is the most significant factor in managing HbA1C levels. A comprehensive understanding of diabetes enables individuals to manage their condition more effectively. Patients who are adept at monitoring their blood sugar, comprehend the importance of a nutritious diet, and recognize the effects of stress and physical activity tend to better adhere to their treatment plans and implement essential lifestyle changes. Additionally, this knowledge empowers patients to identify warning signs of complications, allowing for prompt intervention (Lopez, L. V. et al 2023).

CONCLUSION AND SUGGESTION

The results of this research demonstrate that several key factors play a crucial role in regulating HbA1C levels, particularly education, diabetes empowerment, quality of life, and a comprehensive understanding of diabetes mellitus (DM). Among these, the most critical factor in effectively managing HbA1C levels is the level of knowledge individuals have about their condition. To build on these findings, we recommend that future studies explore various treatment strategies and develop continuous action plans to maintain HbA1C levels within target ranges. This approach could enhance patient outcomes and improve overall health management for individuals living with diabetes.

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CONFLICT OF INTEREST

There is no conflict of interest.

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