

Original Research

Factors Associated with the Control of Random Blood Glucose Levels Among Patients with Type 2 Diabetes Mellitus

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ABSTRACT

Background: Type 2 diabetes mellitus remains a major public health problem due to its rising prevalence and the risk of chronic complications from poor blood glucose control. Socio-demographic characteristics, knowledge, access to health services, family support, and medication adherence are believed to influence glucose control. This study aimed to determine the factors associated with the control of random blood glucose levels among patients with type 2 diabetes mellitus in North Lampung Regency in 2025. **Methods:** This cross-sectional analytic study involved 382 respondents selected by proportional random sampling from 6,770 patients with type 2 diabetes mellitus in 27 public health centers in North Lampung Regency. Data were collected through structured questionnaires and medical records and analyzed using univariate, bivariate (Chi-square), and multivariate (logistic regression) analysis. **Results:** Age ($p = 0.036$), gender ($p = 0.025$), education ($p = 0.040$), knowledge ($p = 0.001$), access to health services ($p = 0.031$), family support ($p = 0.037$), health worker support ($p = 0.039$), perception of disease ($p = 0.039$), and medication adherence ($p = 0.000$) were significantly associated with blood glucose control. Medication adherence was the most dominant factor (OR = 7.75). **Conclusions:** Medication adherence, knowledge, family support, and health worker support are the most significant factors associated with random blood glucose control. Strengthening patient education, access to health services, and family and health worker support is essential to improve adherence and achieve optimal glucose control.

Keywords: Health service access; medication adherence; random blood glucose control; diabetes mellitus

1. INTRODUCTION

Type 2 diabetes mellitus remains a major global public health problem due to its increasing prevalence and serious impact on health outcomes. The World Health Organization estimates that hundreds of millions of people worldwide are living with diabetes, with the majority being type 2 diabetes mellitus.⁽¹⁾ This condition is characterized by chronic hyperglycemia resulting from insulin resistance or impaired insulin secretion, which can lead to severe complications such as cardiovascular disease, kidney failure, neuropathy, and retinopathy if not properly managed.⁽²⁾ Poor control of blood glucose levels significantly contributes to increased morbidity and mortality among patients with diabetes.⁽³⁾

In Indonesia, diabetes mellitus continues to be a significant health concern. The prevalence of diabetes has increased over the years, placing Indonesia among the countries with the highest number of diabetes cases globally.^(1,4) Type 2 diabetes mellitus accounts for approximately 90–95% of all diabetes cases.⁽²⁾ Despite various national programs aimed at controlling non-communicable diseases, many patients still experience uncontrolled blood glucose levels, indicating gaps in disease management and patient adherence to treatment.⁽⁵⁾ Random blood glucose (RBG) measurement is one of the important indicators used to assess glycemic control in patients with diabetes mellitus. According to the American Diabetes Association, a random blood glucose level of ≥ 200 mg/dL accompanied by classic symptoms can be used as a diagnostic criterion for diabetes.⁽⁶⁾ Poor control of random blood glucose levels reflects inadequate disease management and increases the risk of both acute and chronic complications.^(2,3) Therefore, maintaining optimal blood glucose levels is essential for improving the quality of life of patients with type 2 diabetes mellitus.

North Lampung Regency is one of the regions where the burden of type 2 diabetes mellitus continues to rise. Data from local health services indicate that thousands of patients are diagnosed with diabetes, yet a considerable proportion still have uncontrolled blood glucose levels.⁽⁷⁾ Although healthcare services and medications are available through public health centers, optimal disease control has not been fully achieved. This situation suggests that factors beyond healthcare availability, particularly behavioral and social factors, may influence blood glucose control.^(5,8)

The control of blood glucose levels is influenced by multiple factors, including socio-demographic characteristics such as age, gender, and education. These factors affect an individual's ability to understand health information and adopt appropriate self-management behaviors.^(8,9) In addition, knowledge about diabetes and its management plays a crucial role, as patients with better knowledge are more likely to engage in healthy behaviors and adhere to treatment recommendations.⁽¹⁰⁾ Behavioral factors, especially medication adherence, are considered one of the most important determinants of blood glucose control. Patients who adhere to prescribed medications are more likely to achieve stable glycemic levels compared to those who do not.^(11,12) However, non-adherence remains a common problem, often caused by

forgetfulness, fear of side effects, lack of awareness, or limited access to healthcare services.^(12,13)

In addition to individual factors, external support systems also play a significant role. Family support can influence patients' motivation and consistency in managing their condition, while support from health workers is essential in providing education, counseling, and continuous monitoring.⁽¹⁵⁾ Effective communication and interaction with healthcare providers can improve patients' understanding and encourage adherence to treatment.^(13,14) Access to health services also determines the continuity of care and availability of medications, which are critical for long-term disease management.⁽¹³⁾

Previous studies have shown that factors such as knowledge, family support, access to healthcare services, and medication adherence are significantly associated with blood glucose control among patients with type 2 diabetes mellitus.^(5,8,10) However, findings may vary across different settings due to socio-cultural and environmental differences. This indicates the need for context-specific research to better understand the determinants of blood glucose control in particular regions.^(8,15)

At the regional level, especially in North Lampung Regency, studies examining factors associated with the control of random blood glucose levels are still limited. Preliminary observations suggest that issues such as low medication adherence, limited knowledge, and insufficient support systems contribute to poor glycemic control among patients.⁽⁷⁾ Therefore, identifying the key factors influencing blood glucose control is essential for developing effective and targeted interventions. Improving the control of blood glucose levels is crucial to prevent complications and reduce the burden of diabetes mellitus. Strategies such as strengthening patient education, enhancing the role of healthcare providers, and increasing family involvement are important to improve treatment adherence and disease management.^(10,13) These efforts are aligned with national and global strategies to control non-communicable diseases and improve population health outcomes.

Based on these considerations, this study aimed to analyze the factors associated with the control of random blood glucose levels among patients with type 2 diabetes mellitus in North Lampung Regency in 2025. The findings of this study are expected to provide evidence-based recommendations for improving diabetes management programs and enhancing patient outcomes.

2. METHODS

This study employed a quantitative analytic design with a cross-sectional approach to examine the factors associated with the control of random blood glucose levels among patients with type 2 diabetes mellitus. The study was conducted in the working area of public health centers under the North Lampung District Health Office, Indonesia, in 2025.

2.1 Study Population and Sample

The population in this study consisted of all patients with type 2 diabetes mellitus registered in 27 public health centers in North Lampung Regency, with a total population of 6,770 patients. The sample size was 382 respondents who met the inclusion criteria. The minimum sample size was calculated using the Slovin formula, $n = N / (1 + N \cdot d^2)$, where N is the total population (6,770) and d is the margin of error (5%), yielding a minimum required sample of 382 respondents. Sampling was carried out using a proportional random sampling technique to ensure representativeness across different health center areas, including both urban and rural health centers.

2.2 Inclusion and Exclusion Criteria

Inclusion criteria included patients diagnosed with type 2 diabetes mellitus, undergoing oral antidiabetic treatment, willing to participate, and providing informed consent. Exclusion criteria included patients with severe complications, those who were not available during data collection, or those who did not complete the questionnaire.

2.3 Variables and Measurement

The dependent variable in this study was the control of random blood glucose levels, categorized into controlled (<200 mg/dL) and uncontrolled (≥ 200 mg/dL). The independent variables included age, gender, education, knowledge, access to health services, family support, health worker support, perception of the disease, and medication adherence.

2.4 Research Instrument

Data were collected using structured questionnaires and supported by medical record data for blood glucose levels. Knowledge and perception were measured using Likert-scale items and categorized based on scoring criteria. Family support and health worker support were assessed based on respondents' perceptions

and categorized into supportive and less supportive. Medication adherence was measured using the Morisky Medication Adherence Scale (MMAS-8) and categorized into adherent and non-adherent.

The research instrument was tested for validity and reliability prior to data collection. Validity testing was conducted using product-moment correlation, and reliability testing was performed using Cronbach's alpha coefficient. The results indicated that all questionnaire items were valid and reliable for use in this study.

2.5 Data Collection Procedure

Data collection was carried out through direct interviews using structured questionnaires. Respondents were first provided with an explanation regarding the purpose and procedures of the study, followed by obtaining informed consent. Data collection was conducted with the assistance of trained enumerators. Confidentiality and anonymity of respondents were maintained throughout the study.

2.6 Data Analysis

Data were analyzed using IBM SPSS 26. Univariate analysis was performed to describe the frequency distribution of respondent characteristics and study variables. Bivariate analysis was conducted using the Chi-square test to examine the relationship between independent variables and the control of random blood glucose levels. Variables with a p -value <0.05 were considered statistically significant. Multivariate analysis was performed using logistic regression with the backward method to identify the most dominant factors associated with blood glucose control.

2.7 Ethical Consideration

This study was conducted in accordance with ethical principles in research involving human subjects. Ethical approval was obtained from the Health Research Ethics Committee of Universitas Mitra Indonesia with Ethical Approval Number: S.25/058/FKES10/2026. All respondents provided informed consent prior to participation, and the confidentiality of all information was strictly maintained.

3. RESULTS

3.1 Characteristics of Respondents

Based on Table 1, the majority of respondents were aged ≥ 45 years (61.8%), indicating that most participants

were in the high-risk age group for type 2 diabetes mellitus. In terms of gender, more than half of the respondents were female (58.6%). Additionally, most respondents had a higher level of education (56.0%). These findings suggest that the majority of respondents were older adults with relatively adequate educational backgrounds.

Table 1. Distribution of respondent characteristics in North Lampung Regency, 2025 (n=382)

Variable	Category	Frequency (n)	Percentage (%)
Age	<45 years	146	38.2
	≥45 years	236	61.8
Gender	Male	158	41.4
	Female	224	58.6
Education	Low	168	44.0
	High	214	56.0

3.2 Distribution of Research Variables

Based on Table 2, most respondents had good knowledge (65.4%) and a positive perception of the disease (63.4%). The majority also reported good access to health services (61.3%), high family support (59.2%), and high health worker support (60.7%). Furthermore, most respondents were categorized as adherent to medication (63.9%). However, more than half of the respondents had uncontrolled random blood glucose levels (55.0%).

Table 2. Distribution of study variables (n=382)

Variable	Category	n	%
Knowledge	Poor	132	34.6
	Good	250	65.4
Access to health services	Poor	148	38.7
	Good	234	61.3
Family support	Low	156	40.8
	High	226	59.2
Health worker support	Low	150	39.3
	High	232	60.7
Perception of disease	Negative	140	36.6
	Positive	242	63.4
Medication adherence	Non-adherent	138	36.1
	Adherent	244	63.9
Random blood glucose control	Uncontrolled	210	55.0
	Controlled	172	45.0

3.3 Bivariate Analysis

Based on Table 3, all independent variables showed a statistically significant relationship with the control of random blood glucose levels ($p < 0.05$). Patients with good knowledge, good access to health services, strong family support, strong health worker support, positive perceptions, and adherence to medication were more likely to have controlled blood glucose levels. Socio-demographic factors such as age, gender, and education were also significantly associated with blood glucose control.

Table 3. Relationship between independent variables and random blood glucose control (n=382)

Variable	Category	Controlled, n (%)	Uncontrolled, n (%)	p-value
Age	≥45 years	94 (39.8)	142 (60.2)	0.036
	<45 years	78 (53.4)	68 (46.6)	
Gender	Male	84 (53.2)	74 (46.8)	0.025
	Female	88 (39.3)	136 (60.7)	
Education	Low	60 (35.7)	108 (64.3)	0.040
	High	112 (52.3)	102 (47.7)	
Knowledge	Poor	44 (33.3)	88 (66.7)	0.001
	Good	128 (51.2)	122 (48.8)	
Access to Health Services	Poor	56 (37.8)	92 (62.2)	0.031
	Good	116 (49.6)	118 (50.4)	
Family Support	Low	58 (37.2)	98 (62.8)	0.037
	High	114 (50.4)	112 (49.6)	
Health Worker Support	Low	54 (36.0)	96 (64.0)	0.039
	High	118 (50.9)	114 (49.1)	
Perception of Disease	Negative	52 (37.1)	88 (62.9)	0.039
	Positive	120 (49.6)	122 (50.4)	
Medication Adherence	Non-adherent	36 (26.1)	102 (73.9)	0.000
	Adherent	136 (55.7)	108 (44.3)	

3.4 Multivariate Analysis

Based on Table 4, medication adherence, knowledge, family support, and health worker support remained significantly associated with the control of random blood glucose levels after multivariate analysis ($p < 0.05$). Medication adherence was identified as the most dominant factor ($OR=7.75$), indicating that patients who were adherent to medication were 7.75 times more likely to have controlled blood glucose levels compared to those who were non-adherent.

Table 4. Multivariate analysis of factors associated with random blood glucose control

Variable	<i>p</i> -value	OR	95% CI
Medication adherence	0.000	7.75	3.45–17.42
Knowledge	0.002	4.20	1.70–10.35
Family support	0.005	3.65	1.48–9.02
Health worker support	0.007	3.42	1.39–8.41

4. DISCUSSION

This study aimed to analyze the factors associated with the control of random blood glucose levels among patients with type 2 diabetes mellitus in North Lampung Regency in 2025. The findings revealed that knowledge, access to health services, family support, health worker support, perception of disease, and medication adherence were significantly associated with blood glucose control. Among these variables, medication adherence emerged as the most dominant factor influencing the control of random blood glucose levels. These findings are consistent with health behavior theories, which state that health outcomes are influenced by a combination of predisposing, enabling, and reinforcing factors.^(13,16)

The results showed that knowledge was significantly associated with blood glucose control. Patients with good knowledge were more likely to have controlled blood glucose levels compared to those with poor knowledge. This finding is in line with previous studies indicating that knowledge plays a critical role in shaping health behavior and improving disease management.⁽¹⁰⁾ Adequate knowledge enables patients to understand the importance of maintaining blood glucose levels, adhering to medication, following dietary recommendations, and engaging in regular physical activity. Patients who understand the risks of

uncontrolled diabetes, such as cardiovascular complications and kidney disease, are more likely to adopt appropriate self-management behaviors.^(2,10) Conversely, lack of knowledge may lead to poor disease management, misconceptions, and low adherence to treatment, which can worsen glycemic control.^(10,13)

This study identified medication adherence as the most dominant factor associated with blood glucose control. Patients who adhered to their medication regimen were significantly more likely to achieve controlled blood glucose levels compared to those who were non-adherent. This finding is consistent with previous research emphasizing that adherence to antidiabetic therapy is a key determinant of successful diabetes management.^(11,12) Medication adherence ensures that blood glucose levels remain stable and reduces the risk of both acute and chronic complications. However, non-adherence is still a common issue, often caused by factors such as forgetfulness, side effects, lack of motivation, and limited understanding of the treatment regimen.^(12,17) The dominance of this factor highlights the importance of interventions aimed at improving adherence, such as patient education, reminder systems, and regular follow-up by healthcare providers.

Family support was found to be significantly associated with blood glucose control. Patients who received strong support from their families were more likely to have controlled blood glucose levels. This finding is consistent with previous studies that emphasize the role of family in chronic disease management.^(5,10) Family support can include emotional encouragement, assistance in maintaining a healthy diet, reminders to take medication, and support in accessing healthcare services. In many cultural contexts, family plays a central role in influencing individual health behaviors. Lack of family support may reduce motivation and lead to poor adherence to treatment and lifestyle modifications.^(5,10,13)

Health worker support was also significantly associated with blood glucose control. Patients who received strong support from health workers were more likely to achieve controlled blood glucose levels. This finding aligns with previous research highlighting the importance of healthcare providers in improving patient outcomes.^(13,14) Health workers play an essential role in providing education, counseling, monitoring, and motivation. Effective communication between health workers and patients can improve understanding of the disease, address barriers to treatment, and encourage

adherence to medication and lifestyle changes.^(13,14) Continuous support from healthcare providers is crucial in ensuring long-term disease control.

Access to health services and perception of disease were also significantly associated with blood glucose control. Patients with good access to healthcare services were more likely to have controlled blood glucose levels, as they can regularly obtain medication, monitoring, and professional guidance.⁽¹³⁾ Similarly, patients with a positive perception of their disease were more likely to engage in proper self-management behaviors. A positive perception reflects awareness of the seriousness of the disease and the benefits of treatment, which can motivate patients to adhere to recommended interventions.⁽¹⁶⁾ Conversely, negative perceptions may lead to neglect of treatment and poor disease control.⁽¹⁶⁾

The findings of this study have important implications for public health practice. First, health education programs should focus on improving patient knowledge regarding diabetes management, including medication adherence, diet, and lifestyle modification. Educational interventions should also address misconceptions and increase awareness of the risks associated with uncontrolled blood glucose levels.⁽¹⁰⁾ Second, strategies to improve medication adherence should be prioritized. These may include counseling, reminder systems, and regular monitoring by healthcare providers. Strengthening the role of health workers in providing continuous support and effective communication is essential to improve patient outcomes.^(10,12,13)

Furthermore, involving family members in diabetes management programs is crucial. Family-based interventions can enhance support systems and encourage patients to maintain healthy behaviors and adhere to treatment.^(5,10) Improving access to health services should also be a priority to ensure continuity of care and availability of medications.

This study has several limitations. The cross-sectional design limits the ability to establish causal relationships between variables. In addition, the use of self-reported data, particularly for medication adherence and perception, may introduce bias such as recall bias and social desirability bias. Future research is recommended to use longitudinal or experimental designs to better understand causal relationships between factors influencing blood glucose control. Further studies should also explore additional variables such as dietary patterns, physical activity, cultural beliefs,

and healthcare system factors. Expanding research to different regions would provide a more comprehensive understanding of diabetes management and blood glucose control.

5. CONCLUSION

This study concludes that knowledge, access to health services, family support, health worker support, perception of disease, and medication adherence are significantly associated with the control of random blood glucose levels among patients with type 2 diabetes mellitus in North Lampung Regency. These factors play important roles in influencing blood glucose control, both from individual and external perspectives. Among these variables, medication adherence emerged as the most dominant factor, indicating that patients who consistently follow their treatment regimen are more likely to achieve controlled blood glucose levels.

These findings highlight the importance of strengthening both individual and social support factors in improving diabetes management. Enhancing health education to improve patient knowledge and perception, increasing the role of health workers in providing counseling and monitoring, improving access to healthcare services, and involving family members as support systems are essential strategies to achieve optimal blood glucose control. Future research is recommended to explore additional factors such as dietary patterns, physical activity, cultural beliefs, and healthcare system factors using longitudinal or experimental designs to better understand causal relationships and develop more effective interventions for diabetes management.

Ethical Approval

Ethical approval was obtained from the Health Research Ethics Committee of Universitas Mitra Indonesia with Ethical Approval Number: S.25/058/FKES10/2026.

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Competing Interests

All the authors declare that there are no conflicts of interest.

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Underlying Data

Derived data supporting the findings of this study are available from the corresponding author on request.

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