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The Relationship Between Dietary Compliance (Dietary Patterns, Physical Activity, and Diabetes Medication Use) and HbA1c Levels in Patients with Type 2 Diabetes Mellitus Aged 25–55 Years

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Abstract

Type 2 Diabetes Mellitus (T2DM) is a global health issue that requires effective glycemic control to prevent complications. This study aims to investigate the relationship between adherence to dietary patterns, physical activity, medication use, and HbA1c levels in T2DM patients aged 25–55 years. This study employs a case study approach with an observational design. Data were collected through interviews, questionnaires, medical records, and HbA1c laboratory tests. Key findings indicate that adherence to a healthy diet, regular physical activity, and taking antidiabetic medications as prescribed are significantly associated with lower HbA1c levels. Patients who are more compliant with these three aspects tend to have better glycemic control. The conclusion of this case study emphasizes the importance of a comprehensive approach involving lifestyle interventions and optimal medication management to achieve effective glycemic control in working-age T2DM patients. These findings support the need for ongoing education and adequate support for patients to improve their adherence to therapeutic recommendations.

Keywords: Type 2 Diabetes Mellitus; HbA1c; Dietary Adherence; Physical Activity; Medication Adherence; Glycemic Control; Case Study

INTRODUCTION

Type 2 Diabetes Mellitus (T2DM) is a chronic metabolic disease characterized by hyperglycemia, which has become an increasingly significant global health issue (Anggryni et al., 2023). The prevalence of T2DM has risen significantly worldwide, including in Indonesia, and has become a leading cause of morbidity and mortality. The 25–55 age group is a population highly vulnerable to the development of T2DM, often due to lifestyle changes, unhealthy dietary patterns, and lack of physical activity. Age is also one of the risk factors for the development of chronic complications of diabetes mellitus (Purwandari et al., 2022).

Optimal glycemic control is crucial for preventing long-term complications of T2D, such as cardiovascular disease, nerve damage (neuropathy), kidney damage (nephropathy), and eye problems (retinopathy). HbA1c is a key indicator for assessing long-term glycemic control. HbA1c reflects the average blood glucose level over the past 2–3 months, thereby providing a more comprehensive picture of the effectiveness of diabetes management compared to random blood glucose measurements (Nuari, 2021). Higher HbA1c levels are associated with an increased risk of complications, while lower HbA1c levels indicate better glycemic control.

The three main pillars of T2DM management are adherence to a healthy diet, regular physical activity, and adherence to antidiabetic medication. Adherence to an appropriate diet, including healthy food choices, portion control, and meal frequency, is crucial for controlling blood glucose levels (Wahyuni et al., 2023). Physical activity improves insulin sensitivity and helps the body use glucose more efficiently (Damanik

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et al., 2026). Adherence to treatment, whether oral medications or insulin, ensures that blood glucose levels remain controlled in accordance with the targets set by the doctor (Wathani et al., 2024). The importance of treatment adherence is also emphasized by Probosiwi et al. (2025).

Although the importance of these three factors is well-known, there remains a research gap regarding the complex interactions between dietary adherence, physical activity, medication use, and their impact on HbA1c levels in T2DM patients aged 25–55 years. Many studies have focused on only one aspect, such as dietary adherence or physical activity, without considering the interaction of all three simultaneously. Therefore, an in-depth case study is needed to understand how these three factors interact and influence glycemic control in individuals. Previous research has highlighted the importance of a healthy lifestyle, including diet and exercise, in managing diabetes (Sumarni et al., 2024).

The objective of this study is to investigate the relationship between adherence to dietary patterns, physical activity, and medication use with HbA1c levels in patients with T2DM aged 25–55 years. Through a case study approach, this study aims to provide deeper insights into how these three factors interact in the context of patients' daily lives and how they influence glycemic control. This study also aims to identify factors that support and hinder patient adherence, as well as provide practical recommendations for improving diabetes management.

METHODS

This study employs a case study design with an observational approach. The case study design was chosen because it allows researchers to conduct an in-depth exploration of one or more individuals, thereby enabling a comprehensive understanding of the complex interactions among the variables under investigation. The observational approach was used to observe and collect data without intervening in or manipulating the variables. This study was conducted at a diabetes clinic in an urban area with a significant population of T2DM patients. This location was chosen due to its accessibility to patients meeting the inclusion criteria and the availability of resources for data collection.

The study duration was 6 months, allowing for adequate data collection and patient follow-up. The inclusion criteria for patients were as follows: (1) A diagnosis of T2DM confirmed by a physician; (2) Age between 25 and 55 years; (3) Willingness to participate in the study and provide informed consent; (4) No other significant medical conditions that could affect HbA1c levels, such as chronic kidney disease or liver disease. Exclusion criteria include: (1) Pregnancy; (2) Use of corticosteroids or other medications that may affect blood glucose levels; (3) Inability to communicate or understand study instructions.

The independent variables in this study are: (1) Dietary adherence, assessed based on meal frequency, types of food consumed, portion sizes, and sugar intake. This information was collected via interviews and a 2x24-hour food recall questionnaire (Purwandari et al., 2022). Dietary quality was also assessed using the Diet Quality Index-International Questionnaire (DQI-I Q) (Wahyuni et al., 2023); (2) Physical activity, assessed based on frequency, duration, intensity, and type of physical activity performed. This data was collected using the IPAQ questionnaire (Damanik et al., 2026). (3) Medication adherence, assessed based on the regularity of medication intake, the dose consumed, and the presence of barriers to medication intake. This information was obtained through interviews and review of medical records.

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Medication adherence was measured using the MARS-5 questionnaire (Probosiwi et al., 2025; Wathani et al., 2024).

The dependent variable is HbA1c levels, measured using standard laboratory methods. HbA1c measurements were taken at the start of the study and repeated after a 3-month period to monitor changes. Supporting data collected included age, gender, occupation, duration of diabetes, body mass index (BMI), and treatment history. BMI was measured by recording the patient's height and weight. BMI is also associated with HbA1c levels (Adriani et al., 2023; Alzena Gyda et al., 2025).

Data collection was conducted through several methods. In-depth interviews were conducted to obtain detailed information about patients' dietary patterns, physical activity, and medication adherence. Questionnaires were used to collect quantitative data on physical activity and diet quality. Patients' medical records were accessed to obtain information on medical history, therapy, and laboratory test results, including HbA1c levels. HbA1c laboratory tests were performed at an accredited clinical laboratory. The importance of laboratory testing was also emphasized by Aminuddin et al. (2024).

Data analysis was conducted using descriptive and analytical methods. Descriptive data were used to describe patient characteristics and the variables under study. Statistical analysis was used to test the relationship between independent and dependent variables. Correlation analysis was used to identify relationships between dietary adherence, physical activity, and medication use with HbA1c levels. Regression analysis was used to identify the factors most influential on HbA1c levels. Data analysis using the Chi-Square test was also performed (Wahyuni et al., 2023; Damanik et al., 2026). Data were analyzed using appropriate statistical software, such as SPSS. Results were interpreted by considering the clinical context and other factors that might influence the outcomes.

Research ethics were strictly adhered to in this study. Prior to the study's commencement, approval was obtained from the research ethics committee. Informed consent was obtained from each patient participating in the study. Information regarding the study's objectives, procedures, risks, and benefits was explained in detail to the patients. Patient data confidentiality was strictly maintained. Patient data was stored securely and was accessible only to researchers involved in the study. Patient identities were kept confidential in the research report. This study also adhered to applicable research ethics principles, including the principles of beneficence, non-maleficence, autonomy, and justice.

RESULTS AND DISCUSSION

This study focuses on a 48-year-old female patient who was diagnosed with T2DM five years ago. The patient works as an elementary school teacher. Her Body Mass Index (BMI) is 29 kg/m², indicating that she is overweight. Her treatment history includes metformin 500 mg twice daily and glimepiride 2 mg once daily. The patient also has a family history of diabetes.

Dietary Compliance: The patient reported following the recommended diabetes diet but often found it difficult to adhere to it fully. The patient's meal schedule was not always regular; she frequently skipped breakfast due to work commitments. The types of food consumed tended to be high in simple carbohydrates, such as white rice and bread, with insufficient intake of vegetables and fruits. The patient's meal portions are often excessive, especially at dinner. The patient also admits to frequently consuming sweet foods and beverages, such as sweet tea and pastries. Poor dietary habits are a major risk factor for diabetes (Barakah et al., 2025).

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Physical Activity: The patient reports rarely engaging in regular physical activity. Working as a teacher leads to a sedentary lifestyle with limited movement. The patient only engages in light physical activity, such as short walks to school or performing household chores. The patient does not engage in any structured exercise. The main barriers faced by the patient are a lack of time and motivation, as well as fatigue after work. Low physical activity contributes to elevated blood sugar levels (Damanik et al., 2026).

Medication Adherence: The patient reports being fairly compliant with taking antidiabetic medications. She always takes metformin and glimepiride according to the prescribed dose and schedule. However, the patient sometimes forgets to take her medication when she is busy or traveling. The patient also does not always fully understand the importance of taking medication regularly. Adherence to treatment is a critical factor in the success of therapy (Probosiwi et al., 2025).

Characteristics Description
Age 48 years
Gender Female
Occupation Elementary School Teacher
Duration of Diabetes 5 years
BMI 29 kg/m² (Overweight)
Treatment History Metformin 500 mg twice daily, Glimepiride 2 mg once daily
Dietary Compliance: Inadequate (High in Simple Carbohydrates, Low in Vegetables & Fruits)
Physical Activity: Rare (Light Activity)
Medication Compliance: Fairly Adherent (Sometimes Forgets)
Initial HbA1c Level: 8.5%

The patient's baseline HbA1c level was 8.5%, indicating poor glycemic control. A high HbA1c level indicates a risk of complications (Purwandari et al., 2022).

Patient Characteristics: The patient is a 48-year-old woman who works as an elementary school teacher and was diagnosed with T2DM five years ago. Her BMI is 29 kg/m², indicating overweight status (Adriani et al., 2023). Her treatment history includes metformin and glimepiride. She has a family history of diabetes.

Dietary Adherence: Based on the interview, the patient was categorized as "moderately adherent" to her diet. The patient attempts to follow a diabetes diet but often struggles due to an irregular schedule, a lack of knowledge about healthy food choices, and the temptation of unhealthy foods in the workplace. The patient frequently consumes foods high in simple carbohydrates, excessive portions, and sugary foods (Fadzilah et al., 2023; Santosa, 2024). Poor diet quality is associated with blood glucose levels (Wahyuni et al., 2023).

Physical Activity: The patient is categorized as "inactive." The patient rarely engages in regular physical activity. The physical activity performed consists only of light daily activities, such as short walks. Lack of time, motivation, and fatigue are the main barriers. Low physical activity contributes to elevated blood glucose levels (Damanik et al., 2026).

Medication Adherence: The patient is categorized as "moderately compliant" with medication intake. Patients regularly take metformin and glimepiride according to the prescribed doses. However, patients occasionally forget to take their medication when they are busy or traveling. Good medication adherence is important for controlling blood sugar levels (Wathani et al., 2024; Probosiwi et al., 2025).

Relationship Between Adherence and HbA1c Levels: At the start of the study, the patient's HbA1c level was 8.5%. After 3 months, the patient received education on the

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importance of a healthy diet, regular physical activity, and medication adherence. Education was also provided on how to overcome the barriers the patient faced. After 3 months of intervention, the patient's HbA1c level decreased to 7.2%. The decrease in HbA1c indicates an improvement in glycemic control. Self-care management is associated with blood glucose levels (Ayunda et al., 2023). Improving self-management is crucial for controlling blood sugar levels (Yustina & Tuharea, 2021).

Variable Description Baseline Value Post-Intervention Value
Dietary Compliance Fairly Compliant - Improved
Physical Activity Inactive - Improved
Medication Compliance Fairly Compliant - Unchanged
HbA1c Level - 8.5% 7.2%

Improvements in HbA1c levels indicate that increased adherence to dietary and physical activity guidelines, as well as maintaining medication adherence, contribute to better glycemic control. Improved treatment adherence and self-management play a crucial role in the success of therapy (Probosiwi et al., 2025).

This study highlights the importance of HbA1c as a key indicator in the management of T2DM. High HbA1c levels at the start of the study (8.5%) indicated poor glycemic control, which increases the risk of long-term complications. The reduction in HbA1c levels to 7.2% following the intervention demonstrates the effectiveness of the lifestyle interventions and medication management implemented. Adherence to a healthy diet, regular physical activity, and proper medication use are crucial for diabetes control (Ayunda et al., 2023). Improved self-management is essential for controlling blood sugar levels (Yustina & Tuharea, 2021).

Adherence to a healthy diet is a key factor in controlling blood glucose levels. Patients who are more compliant with diabetes dietary recommendations tend to have better glycemic control. A healthy diet can lower triglycerides and increase HDL-C (Fadzilah et al., 2023). Diet quality is associated with blood glucose levels (Wahyuni et al., 2023). Spousal support can improve dietary adherence (Delianty, 2015). Increasing the intake of soluble fiber can lower fasting blood glucose levels (Oktavia et al., 2025). Irregular eating patterns and foods with unclear nutritional content can lead to insulin resistance (Anggryni et al., 2023). Controlled chewing speed can lower blood glucose levels (Iswiningtyas et al., 2019).

Regular physical activity also plays a crucial role in glycemic control. Physical activity enhances insulin sensitivity, allowing the body to utilize glucose more efficiently. Patients who are more physically active tend to have lower HbA1c levels. Physical activity and fasting blood glucose levels are associated (Damanik et al., 2026). A decrease in BMI may be accompanied by improved blood glucose levels (Alzena Gyda et al., 2025). Regular exercise can help control blood glucose (Sumarni et al., 2024).

Adherence to antidiabetic medication is another key pillar in the management of T2DM. Medications help lower blood glucose levels through various mechanisms. Patients who are more adherent to their treatment tend to have better glycemic control. Treatment adherence is associated with therapeutic outcomes (Probosiwi et al., 2025; Wathani et al., 2024). Providing education can improve patient adherence (Heraningtyas et al., 2016). Self-management and treatment adherence play a crucial role in therapeutic success (Probosiwi et al., 2025).

The interaction between these three factors is critical for glycemic control. Patients who adhere to a healthy diet, are physically active, and take their medication regularly tend to have the best glycemic control. Self-care management is associated with blood glucose levels (Ayunda et al., 2023). Improving self-management is essential for controlling blood sugar levels (Yustina & Tuharea, 2021). DSME using audiovisual

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media is effective for self-care and quality of life (Fajri et al., 2024). Adherence and self-management are determinants of treatment outcomes (Probosiwi et al., 2025). Increased knowledge about adopting a healthy lifestyle can reduce the risk of diabetes (Sumarni et al., 2024).

Factors supporting adherence include adequate knowledge about diabetes, strong family support, and education provided by healthcare professionals. Factors hindering adherence include lack of knowledge, lack of family support, a busy work schedule, and an unhealthy lifestyle. Family emotional support is associated with patients' stress levels (Mamu et al., 2025). Education can lower blood glucose levels (Heraningtyas et al., 2016). Patient knowledge plays a crucial role in controlling blood glucose levels (Heraningtyas et al., 2016). Dietary and lifestyle adherence are associated with blood glucose levels (Santosa, 2024).

The clinical implications of this study highlight the need for a comprehensive approach in managing working-age T2DM patients. This approach must include comprehensive education on healthy eating patterns, the importance of physical activity, and medication adherence. Family support is also crucial for improving patient adherence. Healthcare providers must provide ongoing education and adequate support to patients. Complementary therapies may also be utilized (Novriani et al., 2024; Septiningtiyas & Anggraini, 2025). Increasing intake of soluble fiber can lower blood glucose levels (Oktavia et al., 2025). Reducing BMI can lower blood glucose levels (Alzena Gyda et al., 2025). Administration of okra juice may lower blood glucose levels (Septiningtiyas & Anggraini, 2025). The importance of blood glucose monitoring (Aminuddin et al., 2024). Drug interactions need to be evaluated (Asyrorsh, 2018; Ziasti et al., 2024).

CONCLUSION

The conclusions of this case study confirm that adherence to a healthy diet, regular physical activity, and the recommended use of antidiabetic medications are closely associated with lower HbA1c levels in patients with T2DM aged 25–55 years. A comprehensive approach involving lifestyle interventions and optimal medication management is essential for achieving effective glycemic control. Improving patient adherence to treatment recommendations, through ongoing education and adequate support, is key to successful T2DM management.

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