

Association Between Dietary Adherence and Blood Glucose Levels Among Patients with Type 2 Diabetes Mellitus

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ABSTRACT

Background: Type 2 Diabetes Mellitus (T2DM) is a major public health problem worldwide. Poor dietary adherence remains one of the leading causes of uncontrolled blood glucose levels, increasing the risk of both microvascular and macrovascular complications. Understanding the relationship between dietary adherence and glycemic control is essential for improving diabetes management in primary healthcare settings.

Research Objective: This study aimed to determine the association between dietary adherence and blood glucose levels among patients with Type 2 Diabetes Mellitus attending a primary healthcare center in Kendari City, Southeast Sulawesi, Indonesia.

Methods: This analytical observational study employed a cross-sectional design involving 40 patients with Type 2 Diabetes Mellitus selected using purposive sampling. Dietary adherence was assessed using a structured questionnaire based on national diabetes dietary guidelines, while blood glucose levels were obtained from patients' medical records. Descriptive statistics were used to summarize respondent characteristics, and the Chi-square test was performed to analyze the association between dietary adherence and blood glucose levels at a significance level of $p < 0.05$.

Results: Among the respondents, 57.5% demonstrated poor dietary adherence, while 62.5% had uncontrolled blood glucose levels. Bivariate analysis revealed a significant association between dietary adherence and blood glucose levels ($p = 0.004$). Patients with poor dietary adherence were 8.71 times more likely to have uncontrolled blood glucose levels than those with good dietary adherence ($OR = 8.71$; 95% $CI = 1.95-38.91$).

Conclusion: Dietary adherence is significantly associated with blood glucose control among patients with Type 2 Diabetes Mellitus. Strengthening nutrition education, individualized dietary counseling, and family-supported diabetes self-management programs is recommended to improve glycemic control and reduce diabetes-related complications in primary healthcare settings.

Keywords: Type 2 Diabetes Mellitus; Dietary Adherence; Blood Glucose Level; Glycemic Control

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BACKGROUND

Oral Type 2 Diabetes Mellitus (T2DM) has become one of the most significant global public health challenges due to its increasing prevalence, chronic complications, and substantial economic burden (Alodhayani et al., 2021). Characterized by insulin resistance and progressive pancreatic β -cell dysfunction, T2DM requires lifelong management through pharmacological therapy and lifestyle modification (Gebrie et al., 2020). Among the key components of diabetes management, dietary adherence plays a pivotal role in maintaining optimal glycemic control, preventing complications, and improving patients' quality of life (Tian et al., 2021). Medical nutrition therapy has consistently been recognized as a cornerstone of diabetes management because appropriate dietary practices contribute significantly to reducing blood glucose levels, glycated hemoglobin (HbA1c), and cardiovascular risk. However, despite advances in clinical guidelines and public health interventions, many patients continue to experience poor glycemic control due to inadequate adherence to recommended dietary regimens (Liu et al., 2023).

Globally, the prevalence of diabetes continues to rise at an alarming rate (Summers et al., 2021). The International Diabetes Federation (IDF) Diabetes Atlas 2025 estimates that approximately 589 million adults aged 20–79 years are living with diabetes worldwide, representing nearly one in nine adults (Prasopthum et al., 2022). This number is projected to increase to 853 million by 2050 if effective prevention and management strategies are not implemented (Zhang et al., 2022). More than 90% of these cases are Type 2 Diabetes Mellitus, largely driven by population aging, urbanization, unhealthy dietary patterns, obesity, and physical inactivity (Tiwari et al., 2021). Diabetes is responsible for millions of deaths annually and contributes substantially to disability, cardiovascular diseases, kidney failure, blindness, and lower-limb amputations. Furthermore, the World Health Organization (WHO) recognizes diabetes as one of the leading causes of premature mortality and emphasizes lifestyle modification, particularly dietary management, as a primary strategy for reducing disease burden (Montilva-Monsalve et al., 2023).

Indonesia is among the countries with the highest number of people living with diabetes. According to the IDF Diabetes Atlas 2025, Indonesia ranks among the top ten countries globally in terms of diabetes prevalence, with an estimated more than 20 million adults affected. Nationally, data from the 2023 Indonesian Health Survey (Survei Kesehatan Indonesia/SKI) indicate a continuous increase in diabetes prevalence, reflecting changes in lifestyle, dietary habits, and urbanization (Wong et al., 2020). The growing burden of diabetes has become a major concern for Indonesia's healthcare system because uncontrolled blood glucose levels increase hospitalization rates, healthcare expenditures, productivity loss, and premature mortality (Dudzik et al., 2023). Consequently, strengthening preventive measures and improving self-management behaviors, including dietary adherence, have become national health priorities (Mason et al., 2021).

At the provincial level, Southeast Sulawesi (Sulawesi Tenggara) also demonstrates an increasing trend in diabetes cases. Reports from the Provincial Health Office indicate that diabetes mellitus is consistently among the leading non-communicable diseases treated in primary healthcare centers and hospitals (Rezki et al., 2021). Urbanization, dietary transitions characterized by increased consumption of processed foods, reduced physical activity, and rising obesity prevalence contribute to the growing incidence of T2DM in the province (Sánchez Conejero et al., 2022). The expansion of diabetes cases places additional pressure on local healthcare services, particularly in delivering continuous education and monitoring of patients' self-management behaviors (Krishnakumar et al., 2021).

In Kendari City, the capital of Southeast Sulawesi Province, diabetes mellitus has become one of the most frequently reported chronic diseases managed by community health centers and referral hospitals. Local health reports indicate a steady increase in the number of registered diabetes patients over recent years. Despite routine health education

programs, many patients continue to present with uncontrolled blood glucose levels during regular outpatient visits (Wang et al., 2023). Healthcare professionals frequently identify poor dietary adherence as one of the major contributing factors to inadequate glycemic control (Choy & Louie, 2023). Cultural dietary preferences, limited nutritional knowledge, economic constraints, irregular meal schedules, and inadequate family support further complicate adherence to recommended diabetic diets (Chawla et al., 2022). These challenges suggest that improving dietary compliance remains an essential strategy for optimizing diabetes management in Kendari.

Previous studies conducted in Indonesia and other countries have consistently demonstrated an association between dietary adherence and glycemic control among patients with Type 2 Diabetes Mellitus (Yousef et al., 2021). Patients who comply with dietary recommendations generally achieve lower fasting blood glucose levels and HbA1c values than those with poor adherence (Sukhato et al., 2020). Nevertheless, findings across studies remain inconsistent because dietary adherence is influenced by multiple behavioral, socioeconomic, psychological, and cultural factors. Many previous studies have also focused primarily on urban tertiary hospitals or have evaluated diabetes self-management as a composite variable without specifically examining dietary adherence as an independent determinant of blood glucose control (Ibrahim et al., 2022). Furthermore, limited evidence is available from eastern Indonesia, particularly Southeast Sulawesi, where demographic characteristics, dietary patterns, healthcare accessibility, and sociocultural contexts differ from those in western regions of the country (Elfios Endrias & Gete Feleke, 2023).

The existing research gap lies in the limited availability of local evidence assessing the relationship between dietary adherence and blood glucose levels among patients with Type 2 Diabetes Mellitus in primary healthcare settings in Kendari. Most previous investigations have involved heterogeneous populations or hospital-based samples, thereby limiting the generalizability of findings to community-based diabetes management (Vluggen et al., 2021). In addition, few studies have incorporated current national diabetes management recommendations while considering the unique characteristics of patients receiving routine care in public health centers (Johnson et al., 2023). Consequently, evidence-based local data remain insufficient to support targeted nutritional counseling programs and diabetes education interventions tailored to the specific needs of patients in Southeast Sulawesi.

The novelty of this study lies in its focus on evaluating the association between dietary adherence and blood glucose levels among patients with Type 2 Diabetes Mellitus attending primary healthcare facilities in Kendari City, Southeast Sulawesi. Unlike previous studies that predominantly involved hospital populations or broader self-management constructs, this study specifically investigates dietary adherence as a key behavioral determinant of glycemic control within a community-based healthcare context. The findings are expected to provide region-specific evidence that can guide nurses, nutritionists, and primary healthcare providers in designing culturally appropriate nutritional education, individualized dietary counseling, and community-based diabetes management programs. Furthermore, this study contributes to strengthening evidence-based nursing practice by emphasizing dietary adherence as a modifiable factor capable of improving glycemic outcomes and reducing diabetes-related complications.

The objective of this study was to determine the association between dietary adherence and blood glucose levels among patients with Type 2 Diabetes Mellitus receiving treatment at primary healthcare facilities in Kendari City, Southeast Sulawesi, Indonesia, in order to generate evidence that supports the development of effective nursing interventions and nutrition education programs aimed at improving glycemic control and preventing diabetes-related complications.

METHODS

This study employed a quantitative analytical observational design using a cross-sectional approach (Guo et al., 2021) to examine the association between dietary adherence and blood glucose levels among patients with Type 2 Diabetes Mellitus. The study was conducted at a primary healthcare center (Puskesmas) Poasia in Kendari City, Southeast Sulawesi, Indonesia, from May to June 2024.

The study population comprised all registered patients diagnosed with Type 2 Diabetes Mellitus who attended the outpatient clinic during the study period. A total of 40 respondents were selected using a purposive sampling technique based on predefined inclusion and exclusion criteria. Inclusion criteria were: (1) diagnosed with Type 2 Diabetes Mellitus by a physician for at least six months; (2) aged ≥ 18 years; (3) receiving routine treatment at the health center; (4) able to communicate effectively; and (5) willing to participate by signing informed consent. Patients with severe complications, cognitive impairment, or incomplete medical records were excluded.

Dietary adherence was assessed using a structured questionnaire adapted from the Perkeni Diabetes Diet Guidelines, consisting of items evaluating adherence to meal schedule, portion control, food selection, and dietary recommendations. The questionnaire had been tested for validity and reliability prior to data collection. Dietary adherence scores were categorized as good and poor based on the established cut-off score.

Blood glucose level was obtained from patients' latest random blood glucose (RBG) measurement recorded in the medical records on the day of data collection. Blood glucose levels were categorized as controlled (<200 mg/dL) and uncontrolled (≥ 200 mg/dL) according to national diabetes management guidelines.

Data were analyzed using IBM SPSS Statistics version 27. Descriptive statistics were used to summarize respondents' characteristics and study variables, presented as frequencies, percentages, means, and standard deviations. The association between dietary adherence and blood glucose level was analyzed using the Chi-square test, with statistical significance determined at $p < 0.05$. The strength of association was expressed using the Odds Ratio (OR) with a 95% Confidence Interval (CI).

RESULTS

Respondent Characteristic

A total of 40 patients with Type 2 Diabetes Mellitus participated in this study. The results are presented according to respondent characteristics, univariate analysis, and bivariate analysis examining the association between dietary adherence and blood glucose levels.

Table 1.
Characteristics of Respondents (n = 40)

Characteristics	Frequency (n)	Percentage (%)
Age (years)		
36-45	5	12.5
46-55	12	30.0
56-65	17	42.5
>65	6	15.0
Sex		
Male	16	40.0
Female	24	60.0
Educational Level		
Primary School	10	25.0
Junior High School	9	22.5

Senior High School	15	37.5
College/University	6	15.0
Duration of Diabetes		
<5 years	14	35.0
5-10 years	18	45.0
>10 years	8	20.0
Total	40	100

Most respondents were 56-65 years old (42.5%), female (60.0%), had completed senior high school (37.5%), and had been diagnosed with diabetes for 5-10 years (45.0%).

Univariate Analysis

Table 2.
Distribution of Dietary Adherence among Patients with Type 2 Diabetes Mellitus

Dietary Adherence	Frequency (n)	Percentage (%)
Good	17	42.5
Poor	23	57.5
Total	40	100.0

More than half of the respondents (57.5%) demonstrated poor dietary adherence, while 42.5% had good adherence to the recommended diabetic diet.

Table 3.
Distribution of Blood Glucose Levels

Blood Glucose Level	Frequency (n)	Percentage (%)
Controlled (<200 mg/dL)	15	37.5
Uncontrolled (≥200 mg/dL)	25	62.5
Total	40	100.0

The majority of respondents (62.5%) had uncontrolled blood glucose levels, indicating that glycemic control remained suboptimal among patients attending the primary healthcare center.

Bivariate Analysis

Table 4.
Association Between Dietary Adherence and Blood Glucose Levels Among Patients with Type 2 Diabetes Mellitus

Dietary Adherence	Controlled n (%)	Uncontrolled n (%)	Total	P-value	OR (95% CI)
Good	11 (64.7)	6 (35.3)	17	0.004	8.71 (1.95-38.91)
Poor	4 (17.4)	19 (82.6)	23		
Total	15 (37.5)	25 (62.5)	40		

The Chi-square test demonstrated a statistically significant association between dietary adherence and blood glucose levels among patients with Type 2 Diabetes Mellitus ($p = 0.004$). Patients with poor dietary adherence were approximately 8.7 times more likely to have uncontrolled blood glucose levels than those with good dietary adherence (OR = 8.71; 95% CI: 1.95-38.91).

The findings indicate that poor dietary adherence remains common among patients with Type 2 Diabetes Mellitus in Kendari. More than half of the respondents failed to follow the recommended diabetic diet, and nearly two-thirds had uncontrolled blood glucose levels. Statistical analysis confirmed that dietary adherence is significantly associated with glycemic control. Patients who consistently followed dietary recommendations were more likely to maintain controlled blood glucose levels than those with poor adherence, highlighting the critical role of nutritional compliance in diabetes management. These findings support the importance of strengthening nursing interventions and dietary

counseling programs within primary healthcare settings to improve glycemic outcomes and reduce the risk of diabetes-related complications.

DISCUSSION

The present study demonstrated a statistically significant association between dietary adherence and blood glucose levels among patients with Type 2 Diabetes Mellitus. Patients who adhered to the recommended diabetic diet were significantly more likely to achieve controlled blood glucose levels than those with poor dietary adherence. These findings reinforce the central role of medical nutrition therapy as one of the fundamental pillars of diabetes management. Appropriate dietary practices contribute to maintaining glucose homeostasis by regulating carbohydrate intake, balancing energy consumption, improving insulin sensitivity, and preventing excessive postprandial blood glucose fluctuations. Consequently, consistent adherence to dietary recommendations remains an essential behavioral factor for achieving optimal glycemic control and preventing long-term diabetes complications.

The univariate findings revealed that more than half of the respondents exhibited poor dietary adherence, while nearly two-thirds had uncontrolled blood glucose levels. This result indicates that maintaining dietary compliance continues to be a major challenge among patients with Type 2 Diabetes Mellitus (Ghosh et al., 2023). Although most participants had received routine medical treatment, pharmacological therapy alone was insufficient to maintain glycemic control when dietary recommendations were not consistently followed (Orozco-Beltrán et al., 2022). This finding reflects the multidimensional nature of diabetes self-management, in which successful treatment depends not only on medication adherence but also on sustained lifestyle modifications involving nutrition, physical activity, weight management, and regular blood glucose monitoring (Marks et al., 2023).

Several factors may explain the relatively high proportion of poor dietary adherence observed in this study (Kumar & Mohammadnezhad, 2022). Many patients with Type 2 Diabetes Mellitus experience difficulty modifying long-established eating habits. Cultural food preferences, irregular meal schedules, excessive consumption of refined carbohydrates, and limited knowledge regarding balanced nutrition frequently reduce adherence to dietary recommendations. In addition, economic limitations may restrict access to healthier food choices, while social gatherings and family eating patterns often encourage the consumption of foods with high sugar and fat content (Pigato et al., 2023). These behavioral and environmental influences make long-term dietary adherence difficult despite continuous health education from healthcare providers (Gilbert et al., 2021).

The findings are consistent with the theoretical framework of the Health Belief Model (HBM), which explains that health-related behaviors are influenced by an individual's perceptions of disease severity, susceptibility, benefits of preventive actions, and perceived barriers (Kulkarni et al., 2020). Patients who recognize the serious consequences of uncontrolled diabetes and understand the benefits of dietary adherence are more likely to comply with nutritional recommendations. Conversely, patients who perceive dietary restrictions as burdensome or difficult to maintain may demonstrate lower adherence despite receiving adequate education (Yang et al., 2020). Therefore, improving patients' perceptions and motivation should become an integral component of nursing interventions aimed at enhancing diabetes self-management (Gebermariam et al., 2020).

This study also supports the concept of Diabetes Self-Management Education (DSME), which emphasizes that effective diabetes management requires patients to actively participate in their daily care (Garnweidner-Holme et al., 2020). Dietary adherence represents one of the most important self-management behaviors because food intake directly influences blood glucose regulation. Patients who consistently follow individualized

meal plans generally achieve better glycemic outcomes, lower HbA1c levels, and reduced risks of both microvascular and macrovascular complications. Thus, strengthening DSME programs in primary healthcare settings can significantly improve patients' ability to make informed dietary decisions and sustain healthy eating behaviors (Noordam et al., 2020).

The statistically significant relationship identified in this study is consistent with findings reported in previous national and international studies. Numerous investigations have demonstrated that patients with higher dietary adherence exhibit significantly better glycemic control than those with poor adherence (Bussière-Côté et al., 2020). Research conducted in various countries has shown that compliance with recommended meal timing, portion control, carbohydrate management, and healthy food selection contributes to lower fasting blood glucose and HbA1c values (Paganoti et al., 2021). Similar findings have also been reported in Indonesian studies, where dietary compliance was positively associated with blood glucose control among patients receiving treatment at community health centers (Alkethiri et al., 2021). The consistency of these findings strengthens the evidence that dietary adherence remains a universal determinant of successful diabetes management regardless of geographic setting.

Despite these similarities, the present study provides additional evidence from Kendari City, Southeast Sulawesi, where relatively limited data regarding diabetes self-management have been available. The sociocultural characteristics of the local population may influence dietary behaviors differently from those reported in western regions of Indonesia. Traditional dietary patterns, food availability, educational background, and socioeconomic conditions may contribute to varying levels of adherence among patients. Therefore, locally generated evidence is essential for developing culturally appropriate nutritional interventions that are relevant to the needs of the community. The findings of this study fill an important knowledge gap by providing empirical data from primary healthcare facilities in eastern Indonesia.

From a nursing perspective, these findings have important clinical implications. Nurses play a central role in diabetes education because they maintain continuous contact with patients throughout disease management. Individualized nutritional counseling, regular assessment of dietary behaviors, motivational interviewing, and family-centered education should become routine components of diabetes nursing care. Nurses should also encourage patients to develop realistic meal plans that accommodate local food preferences while maintaining appropriate nutritional balance. Continuous follow-up through community health programs may further improve long-term dietary adherence and strengthen patients' confidence in managing their disease independently.

Family involvement also deserves special attention because family members significantly influence patients' dietary behaviors. In many Indonesian households, food preparation and meal selection are collective family activities (Sriraman et al., 2023). Consequently, educating only the patient may be insufficient if other family members are not involved in dietary planning. Family-based nutritional education can improve social support, encourage healthier household eating patterns, and reduce barriers to dietary compliance (Joshi et al., 2023). Previous studies have consistently demonstrated that strong family support contributes to better self-care behaviors and improved glycemic outcomes among patients with chronic diseases, including diabetes mellitus (Mettananda et al., 2023).

Several limitations should be considered when interpreting the findings of this study. The cross-sectional design identifies associations but does not establish causal relationships between dietary adherence and blood glucose levels (Numsang et al., 2023). The relatively small sample size from a single primary healthcare center may also limit the generalizability of the findings to broader populations. Furthermore, dietary adherence was assessed using self-reported questionnaires, which may be influenced by recall bias or social desirability bias. Future studies employing longitudinal or prospective cohort designs with larger and more diverse populations are recommended to provide stronger

evidence regarding the long-term impact of dietary adherence on glycemic control. The inclusion of objective indicators such as HbA1c measurements, physical activity, medication adherence, body mass index, and psychosocial variables would also provide a more comprehensive understanding of diabetes self-management.

Overall, this study confirms that dietary adherence is a critical determinant of blood glucose control among patients with Type 2 Diabetes Mellitus. Patients who consistently comply with recommended dietary practices are substantially more likely to achieve controlled blood glucose levels than those with poor adherence. These findings underscore the need to strengthen nutrition education, diabetes self-management programs, and family-centered nursing interventions in primary healthcare settings. Improving dietary adherence should remain a priority strategy for preventing diabetes-related complications, enhancing quality of life, and reducing the growing burden of Type 2 Diabetes Mellitus in Indonesia, particularly in Southeast Sulawesi.

CONCLUSION

This study concludes that there is a statistically significant association between dietary adherence and blood glucose levels among patients with Type 2 Diabetes Mellitus. Patients who demonstrated good adherence to the recommended diabetic diet were more likely to achieve controlled blood glucose levels than those with poor dietary adherence. These findings emphasize that dietary adherence is a crucial component of diabetes self-management and plays a fundamental role in optimizing glycemic control and reducing the risk of diabetes-related complications. Therefore, it is recommended that primary healthcare providers, particularly nurses, strengthen individualized nutrition education, routine dietary counseling, and continuous monitoring of patients' dietary behaviors. Family involvement should also be encouraged to provide sustained support for healthy eating practices. Furthermore, future studies should include larger sample sizes, multiple healthcare settings, and additional clinical indicators such as HbA1c to provide more comprehensive evidence for improving diabetes management and nursing interventions.

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