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The Relationship Between Dietary Adherence and Random Blood Glucose Levels in Type 2 Diabetes Mellitus Patients at Malinau Regional General Hospital, North Kalimantan

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ABSTRACT

Type 2 diabetes mellitus (T2DM) is a significant chronic disease characterized by insulin resistance and impaired insulin secretion. It is a leading cause of microvascular and macrovascular complications, including blindness, kidney failure, and cardiovascular disease. Records from Malinau Regional General Hospital in North Kalimantan documented 2,300 cases, a 23% increase from 2022 to 2024. One key strategy in T2DM management is dietary intervention, which plays a critical role in maintaining stable blood glucose levels. This study aimed to analyze the relationship between dietary adherence and random blood glucose levels among patients with T2DM at Malinau Regional General Hospital. An analytical cross-sectional survey design was employed, involving 34 outpatients with T2DM selected by convenience sampling. As accidental sampling is a form of convenience sampling, it inherently introduces selection bias, which serves as a limitation of this study. Dietary adherence was assessed using a questionnaire based on the MMAS-8 and the 2021 PERKENI guidelines. Random blood glucose levels were categorized as normal (< 200 mg/dL) or high (\ge 200 mg/dL). The results showed that patients who adhered to dietary recommendations were more likely to have normal random blood glucose levels ($p < 0.001$), indicating a significant association between dietary adherence and glycemic control.

Key Messages:

- Dietary adherence is influenced not only by knowledge but also by family support, social habits, and environmental conditions; therefore, educational programs should address these factors comprehensively.

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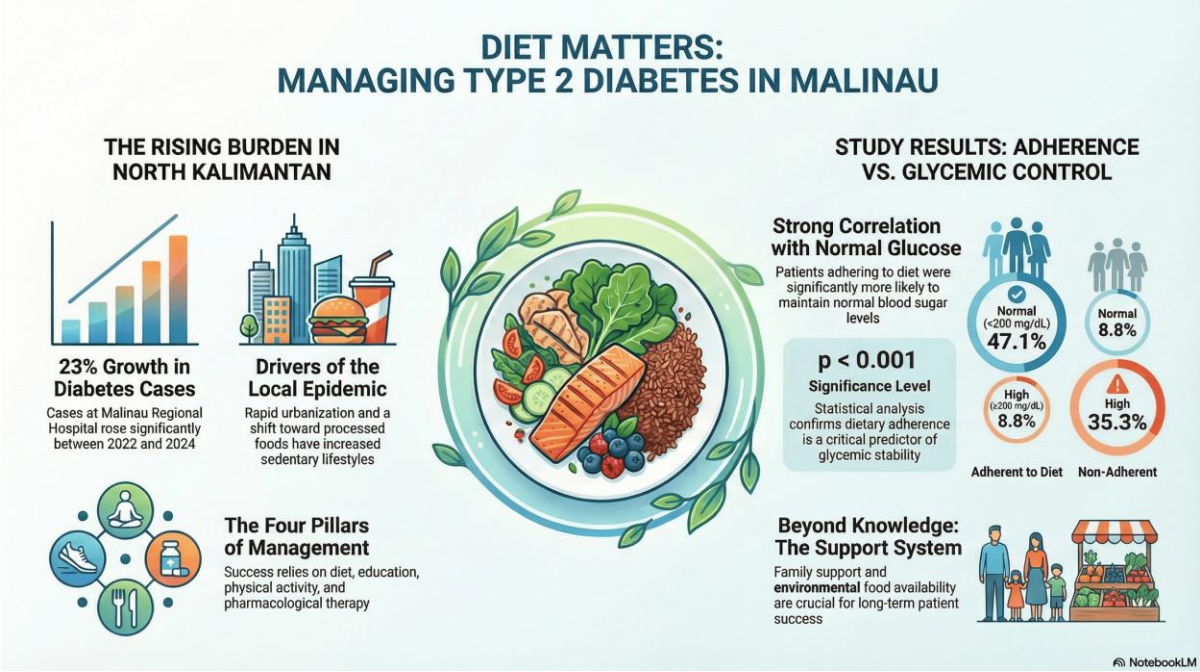
GRAPHICAL ABSTRACT



INTRODUCTION

Rapid modernization, urbanization, and socio-economic growth have improved living standards but have also contributed to unhealthy lifestyle patterns, including increased stress, sedentary behavior, and unbalanced dietary intake (1). Over the past two decades, obesity has emerged as a global pandemic that poses a serious public health threat, affecting nearly all organ systems and becoming one of the most prevalent non-communicable diseases worldwide (2). One of the most significant consequences of obesity is the rising incidence of diabetes, particularly Type 2 Diabetes Mellitus (T2DM). Obesity plays a substantial role in the development of insulin resistance and metabolic disturbances, which are major risk factors for T2DM (3).

Diabetes has become a major global health burden due to its high incidence, associated disability, and mortality, and is projected to rank as the eighth leading cause of death when disability is taken into account (4). Type 2 Diabetes Mellitus is characterized by a heterogeneous and progressive decline in adequate insulin secretion from pancreatic β-cells of the islets of Langerhans through non-autoimmune mechanisms, often accompanied by insulin resistance (IR) and metabolic syndrome (MS) (5). T2DM accounts for more than 96% of all diabetes cases and represents the primary contributor to long-term diabetes-related complications (5). Beyond reducing quality of life and life expectancy, T2DM is a leading cause of both microvascular and macrovascular complications, including blindness, renal failure, myocardial infarction, stroke, peripheral neuropathy, and limb amputation. In addition, diabetes is associated with an increased risk of several malignancies, particularly gastrointestinal cancers and certain cancers specific to women (6).

The economic burden of diabetes is also considerable. In 2021, global expenditure on diabetes care was estimated at US 966 billion and is projected to exceed US 1,054 billion by 2045. Currently, approximately 529 million people worldwide are living with diabetes, with global prevalence increasing from 3.2% in 1990 to 6.1% in 2021, and expected to reach 9.8% by 2045 (3). Consequently, diabetes-related complications represent a critical global health challenge that demands urgent attention through prevention, early detection, and effective disease management.

In Indonesia, the prevalence of diabetes continues to show an upward trend. According to data from the International Diabetes Federation (IDF), there are approximately 88 million diabetes cases in Southeast Asia, and the prevalence of diabetes is projected to increase by 74% between 2019 and 2045. Indonesia is estimated to contribute 21.3 million diabetes cases by 2030 and is expected to rank fourth

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globally, after India, China, and the United States (7). Furthermore, Indonesia is reported to have the second-highest diabetes prevalence in Southeast Asia, following Singapore (8).

In North Kalimantan, approximately 2,300 cases of diabetes have been recorded, with an approximate 23% growth over the past three years at Malinau Regional General Hospital. This increase may be linked to rapid urbanization and shifts in local indigenous diets toward processed foods, alongside the impacts of mining and industrial growth in North Kalimantan, which often lead to more sedentary lifestyles. Consequently, understanding factors influencing glycemic control at the local level is urgent.

Dietary intervention is one of the key strategies in T2DM management and, together with education, physical activity, and pharmacological therapy, constitutes the four pillars of diabetes care. Patient adherence to dietary recommendations is crucial for maintaining glycemic stability and preventing chronic complications (9). A previous study conducted in Bandung demonstrated that poor dietary adherence was strongly associated with elevated random blood glucose levels among patients with T2DM, particularly those who were overweight (10).

Although the relationship between dietary adherence and random blood glucose levels in patients with T2DM has been widely investigated in various regions of Indonesia and other countries, no study to date has specifically examined this association in Malinau Regency. This gap is noteworthy, as patient characteristics, dietary patterns, local culture, access to nutrition education, and availability of healthy foods in this area may differ substantially from those in larger cities or previously studied regions. Moreover, the increasing number of T2DM cases observed at Malinau Regional General Hospital in recent years underscores the urgent need to understand factors influencing glycemic control at the local level. In the absence of local data, dietary and nutrition education interventions may be less effective, as they rely on evidence derived from different populations. Consequently, this study is essential to address the existing knowledge gap in the Malinau region, provide empirical evidence on dietary adherence, and support the development of more effective and context-appropriate T2DM control programs.

Based on these considerations, this study aimed to analyze the relationship between dietary adherence and random blood glucose levels among patients with T2DM at Malinau Regional General Hospital. The findings are expected to provide a scientific basis for more targeted diabetes control strategies and to support efforts to improve T2DM management at the regional level.

METHODS

This study employed an analytic survey with a cross-sectional design to examine the relationship between dietary adherence and random blood glucose levels among patients with Type 2 Diabetes Mellitus (T2DM). The study was conducted from May to June 2025 at Malinau Regional General Hospital (*RSUD* Malinau), North Malinau District, Malinau Regency, North Kalimantan. The study population consisted of 62 patients with T2DM registered at the hospital between January and May 2025. While the sample size is relatively small, it represents the accessible patient pool during the study period and serves as an exploratory analysis of dietary trends in this specific region.

The inclusion criteria were patients diagnosed with T2DM for at least six months, aged 18 years or older, registered and having attended outpatient follow-up within the last month, able to communicate verbally and comprehend educational information, willing to participate as respondents by providing informed consent, and having received dietary or nutritional education within the past 3–6 months. The exclusion criteria included patients with psychiatric conditions affecting their ability to respond to the questionnaire, patients with a history of pregnancy, patients undergoing special diets due to severe comorbid conditions, and those who declined participation or withdrew during data collection.

The study variables comprised dietary adherence as the dependent variable and random blood glucose levels as the independent variable. Dietary adherence was assessed using a questionnaire developed based on the Indonesian Diabetes Association (*PERKENI*) dietary guidelines (2021) and adapted from the Morisky Medication Adherence Scale (MMAS-8) to evaluate dietary compliance. The questionnaire assessed adherence to scheduled meal frequency, avoidance of high-sugar and high-fat foods, consumption of fiber and fruit, and awareness of the importance of dietary regulation. Each item was rated on a four-point Likert scale ranging from “Never” to “Always.” Total scores were categorized as

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adherent (≥80%) or non-adherent (<80%). The instrument had undergone validity and reliability testing prior to use.

Random blood glucose levels were obtained from laboratory results or patient medical records measured by healthcare personnel, expressed in mg/dL, and categorized according to PERKENI (2021) criteria as normal (<200 mg/dL) or elevated (≥200 mg/dL).

Data analysis was conducted using univariate analysis to describe respondent characteristics and bivariate analysis using the Chi-square test to examine the association between dietary adherence and random blood glucose levels, with a significance level set at $\alpha < 0.05$. This analytical approach enabled a systematic and accurate interpretation of the relationship between dietary behavior and glycemic control among patients with T2DM.

RESULTS

Table 1 shows that the majority of respondents were male (61.8%), aged over 51 years (50.0%), employed in the private sector (47.1%), and had completed senior high school or an equivalent level of education (58.8%). In contrast, the minority groups consisted of female respondents (38.2%), those aged 26–40 years (5.9%), and respondents with elementary school education (5.9%) or diploma-level education (2.9%).

Overall, the demographic profile indicates that the study sample was predominantly composed of middle-aged to older adults with a secondary education background and engagement in formal employment. Understanding these respondent characteristics is essential for contextual interpretation of the study findings and may enhance the applicability of the results to populations with similar demographic profiles.

Table 1. Characteristics of Patients with Type 2 Diabetes Mellitus

Characteristics	n	%
Gender		
Male	21	61.8
Female	13	38.2
Age (years)		
18-25	3	8.8
26-40	2	5.9
41-50	12	35.3
> 51	17	50.0
Occupation		
Civil servant	6	17.6
Private-sector employee	16	47.1
Self-employed	5	14.7
Unemployed	7	20.6
Education		
Primary education	2	5.9
Junior high school	5	14.7
Senior high school	20	58.8
Diploma	1	2.9
Bachelor's degree	6	17.6
Total	**34**	**100.0**

Table 2 presents the distribution of random blood glucose levels and dietary adherence among patients with type 2 diabetes mellitus. More than half of the respondents had normal random blood glucose levels (55.9%) and were classified as adherent to dietary recommendations (55.9%). In contrast, 44.1% of respondents exhibited elevated random blood glucose levels and were categorized as non-adherent to

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dietary guidelines. These findings suggest a potential association between glycemic status and dietary adherence, which is relevant for the planning of nutritional interventions and individualized diabetes management strategies.

Table 2. Distribution of Random Blood Glucose Levels and Dietary Adherence among Patients with Type 2 Diabetes Mellitus

Variable	n	%
Random Blood Glucose Level		
Normal	19	55.9
High	15	44.1
Dietary Adherence		
Adherent	19	55.9
Non-adherent	15	44.1
Total	**34**	**100.0**

Table 3 illustrates the relationship between dietary adherence and random blood glucose levels among patients with type 2 diabetes mellitus. The majority of respondents with normal random blood glucose levels (47.1%) were adherent to dietary recommendations, whereas most respondents with elevated random blood glucose levels (35.3%) tended to be non-adherent. Statistical analysis using Fisher's Exact Test demonstrated a highly significant association between dietary adherence and random blood glucose levels ($p = 0.000$), leading to the rejection of the null hypothesis. These results highlight the critical role of dietary adherence in achieving effective glycemic control in the study population.

Table 3. Association between Dietary Adherence and Random Blood Glucose Levels

Random Blood Glucose	Dietary adherence				Total		*p*
	Adherent		Non-Adherent				
	n	%	n	%	n	%	
Normal	16	47.1	3	8.8	19	55.9	0.000
High	3	8.8	12	35.3	15	44.1	
Total	19	43.2	15	34.1	34	100	

DISCUSSION

Effect of Dietary Adherence on Random Blood Glucose Levels

The present study demonstrated a statistically significant association between dietary adherence and random blood glucose levels, with a p value of 0.000. Among respondents who adhered to dietary recommendations, 47.1% had random blood glucose levels within the normal range, whereas 35.3% of non-adherent respondents exhibited elevated blood glucose levels. These findings underscore the critical role of dietary adherence in glycemic control among patients with type 2 diabetes mellitus (T2D). The results are consistent with a study conducted by Febriana and Fayasari (2023) in Tangerang, which reported a strong relationship between dietary compliance and blood glucose levels in patients with diabetes mellitus (11). Adherence to dietary guidelines among individuals with diabetes is essential for maintaining normoglycemia and reducing the risk of long-term complications (12).

Dietary adherence is widely recognized as a key component of effective T2D management. Abose et al. (2024) reported that approximately two-thirds of patients with T2D failed to comply with recommended dietary regimens, with limited diabetes-related knowledge and food insecurity identified as major contributing factors (13). Furthermore, a recent study by Strydom et al. (2025) demonstrated that high adherence to personalized nutrition education—based on glycemic index, glycemic load, and food insulin index (FII)—was associated with improved glycemic control in individuals with T2D (14). These findings support the importance of tailored nutritional interventions in promoting sustainable dietary behaviors and metabolic outcomes.

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Dietary adherence among patients with diabetes mellitus is influenced by multiple interrelated factors. Predisposing factors include individual beliefs, attitudes, and knowledge, while reinforcing factors involve encouragement from healthcare professionals and support from family members. Enabling factors, such as access to adequate healthcare facilities and nutritional resources, also play a substantial role. In the present study, the majority of respondents had a secondary education level (senior high school), accounting for 58.8% of the sample. Patients with higher levels of knowledge tend to demonstrate better self-regulation in managing their condition and are more likely to follow medical recommendations, including dietary prescriptions. Adequate understanding of diabetes-specific dietary guidelines has been shown to enhance adherence, as individuals who recognize the benefits and principles of dietary management are more capable of adopting behaviors that support glycemic control (15). In addition, a positive attitude toward dietary programs—such as the belief that adherence can prevent complications—further reinforces consistent and compliant dietary practices. Collectively, the interaction between knowledge, attitudes, and environmental support is fundamental to improving dietary adherence among patients with diabetes mellitus (10).

Health behavior theories, including the Health Belief Model and Self-Determination Theory, help explain why patients adhere to or deviate from recommended dietary regimens. The Health Belief Model emphasizes individuals' perceptions of their susceptibility to disease and the perceived benefits of preventive actions, while Self-Determination Theory highlights the role of intrinsic motivation in sustaining health-related behaviors. A study by Susanti et al. (2023) demonstrated that education and support group interventions grounded in self-care theory had a significant positive effect on dietary adherence (16). Similarly, recent findings by Wilson et al. (2024) reported that improved nutritional knowledge and stronger social support were associated with better dietary adherence among patients with type 2 diabetes mellitus (T2D) (17).

Based on questionnaire findings, dietary adherence among patients with T2D at Malinau Regional General Hospital showed considerable variation that was associated with differences in random blood glucose levels. Most patients reported adhering to a regular eating schedule of three meals per day and avoiding foods or beverages high in sugar, indicating an adequate understanding of the dietary education provided. Adherence to recommended portion sizes was also observed in the majority of respondents. However, some patients reported difficulties maintaining portion control due to long-standing family eating habits or economic constraints, resulting in inconsistent dietary practices.

Environmental factors posed additional challenges, particularly when patients were outside the home or traveling. Family support emerged as a crucial determinant of adherence, as patients whose families avoided providing restricted foods found it easier to maintain appropriate dietary patterns. This finding is consistent with the study by Febriana and Fayasari (2023), which reported a significant association between family support and dietary adherence among patients with diabetes mellitus (11). Family support plays an important role in shaping individual behavior, lifestyle choices, health outcomes, and overall quality of life.

Overall, this analysis confirms that dietary adherence is influenced not only by patients' knowledge and awareness but also by social and environmental support systems. The findings demonstrate a significant relationship between dietary adherence and random blood glucose levels; patients who followed dietary recommendations were more likely to achieve better glycemic control and maintain blood glucose levels within the normal range compared with those who were non-adherent. These results underscore the importance of dietary adherence as a key component of T2D management and highlight the need for continuous education and supportive interventions. Integrated strategies aimed at enhancing patient motivation, family involvement, and sustained dietary guidance are therefore essential to support optimal glycemic control and prevent long-term complications of the disease.

This study offers novelty by focusing on the relationship between dietary adherence and random blood glucose levels among patients with type 2 diabetes mellitus (T2D) at Malinau Regional General Hospital, a setting that has received limited attention in previous research. Importantly, the study incorporates local contextual factors, including dietary culture, accessibility of healthy foods, and patients' nutritional knowledge, which may differ substantially from those observed in other regions. The strengths

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of this study include its comprehensive study design, the use of valid and reliable instruments to assess dietary adherence and blood glucose levels, and appropriate statistical analyses to identify associations between variables. Consequently, this research makes a meaningful contribution to addressing gaps in the literature on T2D management in North Kalimantan.

Nevertheless, several limitations should be acknowledged. The cross-sectional design precludes causal inference, and self-reported measures of dietary adherence may be subject to reporting bias. In addition, the generalizability of the findings is limited due to the relatively small sample size and the single-center setting. Other external factors, such as psychological stress, social support, and economic conditions, were not assessed and may have influenced the study outcomes.

CONCLUSION

This study demonstrates a significant association between dietary adherence and random blood glucose levels among patients with type 2 diabetes mellitus at Malinau Regional General Hospital. Patients who adhered to recommended dietary guidelines were more likely to exhibit better-controlled blood glucose levels compared with those who were non-adherent. Dietary adherence was influenced by patients' knowledge, family support, and environmental factors, including the availability of healthy foods and prevailing social habits.

These findings underscore the importance of dietary intervention as a central pillar in T2D management and highlight the need for continuous nutrition education and patient support to help individuals maintain healthy eating patterns under varying circumstances. This study provides valuable evidence to inform regional diabetes control strategies in North Kalimantan and contributes to the limited body of literature on dietary adherence among T2D patients in settings with distinct local characteristics.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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