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The Role of Health Education in Increasing Physical Activity and Diet for Diabetes Mellitus Management at Tambak Wedi Baru Community Health Center, Surabaya

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Abstract: This study analyzed the relationship between physical activity, diet, and blood sugar levels in patients with diabetes mellitus at the Tambak Wedi Baru Community Health Center, Surabaya, from February to May 2025. The study design used was a correlational analytic design with a cross-sectional approach. The sample consisted of 72 respondents aged 20 to 71 years, who were selected randomly. Univariate analysis focused on a single variable through descriptive statistics, presenting data as numbers, ratios, percentages, or prevalence. Bivariate analysis examined the relationship between two variables using non-parametric statistics, such as the Spearman test, to explore associations between diet, physical activity, and blood sugar levels. Findings revealed significant relationships between physical activity and diet and blood sugar levels ($\rho = 0.007$; $\rho = 0.000$). Good physical activity (>1500 MET-min) was associated with normal blood sugar levels, while low physical activity (<600 MET-min) was associated with abnormal blood sugar levels. On the other hand, poor diet (<650 calories) also contributed to high blood sugar levels. This study highlights the importance of multidisciplinary interventions to increase physical activity and healthy eating patterns for the effective management of diabetes mellitus.

Keywords: Blood sugar levels**;** Diabetes mellitus; Meal patterns; Physical activity

Introduction

Diabetes is complex, so managing it requires a multifaceted strategy that includes regular exercise and a balanced diet. Regular exercise can enhance lipid profiles, lower blood glucose levels, and boost insulin sensitivity, according to earlier studies (Hasan et al., 2024; Rrugia & Zavalani, 2022). In addition, a healthy diet, especially one rich in fiber and low in the glycemic index (GI), plays an important role in managing diabetes, helping reduce the risk of further complications (Y. Li et al., 2022; Yuningtyaswari et al., 2021).

Recent developments suggest that lifestyle interventions, including dietary changes and increased physical activity, can lead to significant improvements in glycemic control. One study showed that simple measures such as increasing moderate to vigorous physical activity can reduce the risk of developing diabetes (Laredo-Aguilera et al., 2020). In addition, dietary changes during the COVID-19 pandemic, which caused many individuals to reduce physical activity and adopt less healthy eating patterns, contributed to the undesirable increase in HbA1c values (Hosomi et al., 2021; Ruiz-Roso et al., 2020; Takahara et al., 2021). Therefore, it is important to explore how lifestyle changes, including those resulting from global situations such as the pandemic, may affect glycemic control patterns in patients with diabetes mellitus.

Diabetes is a chronic condition that requires ongoing attention and proper management. Studies show that many patients fail to engage in adequate self-

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management behaviors (Saghir et al., 2021). Stress caused by various conditions, including the pandemic, can negatively impact diet monitoring and physical activity (Hosomi et al., 2021; Mochizuki et al., 2024). Therefore, a deeper understanding of the relationship between physical activity, diet, and blood sugar control is essential for developing effective intervention strategies for managing diabetes mellitus, with the hope of reducing late diagnosis and minimizing complications resulting from inappropriate management.

The goal of this study is to provide greater knowledge of how regular physical activity and a balanced diet can improve blood sugar management. The incorporation of the most recent information on the relationship between lifestyle factors, specifically physical activity and dietary patterns, and glucose control makes this study on physical activity and dietary patterns in connection with blood sugar levels in patients with diabetes mellitus interesting.

Method

Research Design

This study employed a cross-sectional, correlational analytic research design. This method was selected because it is necessary to monitor or assess factors including blood sugar levels, diet, and physical activity in individuals with diabetes. To ascertain the prevalence of the phenomenon under investigation and the correlation between these variables, data were gathered at a specific moment in time.

Population, Place, and Time of Research

This research was conducted from February to May 2025 at the Tambak Wedi Baru Community Health Center in Kenjeran District, Surabaya. This location was selected based on epidemiological phenomena observed in the coastal communities of Kenjeran, which indicate a high prevalence of diabetes mellitus. The population in this study consisted of the community around the Tambak Wedi Baru Community Health Center, totaling 88 respondents with an age range of 20 to 71 years (Handayani, 2020). The respondent selection criteria focused on individuals who exhibited characteristics relevant to the research objectives.

Sample

The sample in this study was drawn using a random sampling method. In this context, the sample was drawn from the public around the Tambak Wedi Baru Community Health Center. A total of 512 respondents were identified, but using the Slovin formula, it was determined that the valid sample size for this study was 72 respondents.

The inclusion criteria for this study were established to ensure that participants could provide relevant and valid data. First, participants must be patients with diabetes mellitus living around Tambak Wedi Baru, to ensure location suitability. Second, participants must be between 20 and 71 years old, encompassing the age range often affected by diabetes mellitus. Third, participants must be in stable health to enable them to participate effectively in the study. Fourth, participants must be willing to participate, demonstrating commitment to the research process. Conversely, exclusion criteria serve to protect the integrity of the research data. Respondents in an emergency condition during the examination were not allowed to participate, to avoid factors that could influence the results. Sudden refusal to participate and inappropriate completion of the questionnaire were also grounds for exclusion, to ensure the reliability of the data obtained and reduce bias in the study.

Sampling Techniques and Variables

This study used a simple random sampling technique. This ensures that the sample taken is representative of the entire population being studied. The independent variables in this study were diet and physical activity, both of which are expected to significantly influence a person's health, particularly in people with diabetes. Diet encompasses the type of food and frequency of consumption, while physical activity refers to the overall level of physical activity. The dependent variable in this study was blood sugar levels in people with diabetes living in the coastal area of Kenjeran, Surabaya.

Research Instruments

Data collection in this study was conducted through several designed instruments to obtain comprehensive information on respondents' characteristics and diabetes-related health conditions. First, a questionnaire was used to collect demographic data, including name, address, age, marital status, education, occupation, income, and health information such as weight, height, and blood sugar levels. The questionnaire also included questions regarding the use of diabetes medications. Second, an observation sheet was divided into two segments focusing on respondents' physical activity and diet, which are key factors in diabetes management. Finally, a glucometer served as a practical tool to directly measure respondents' blood sugar levels, providing objective data for further analysis. The use of these three instruments aimed to support an in-depth analysis of the relationship between demographic factors, lifestyle, and diabetes management.

Data analysis

Univariate Analysis

Univariate analysis was used to analyze data from a single variable. This analysis falls under descriptive statistics, which aims to explain the conditions of the phenomenon being studied. Data were presented in the form of numbers, ratios, percentages, or prevalence.

Bivariate Analysis

A bivariate analysis was carried out to examine the connection between two related variables. The Spearman test and other non-parametric statistics were used in this analysis to find potential correlations between blood sugar levels, physical activity, and dietary patterns.

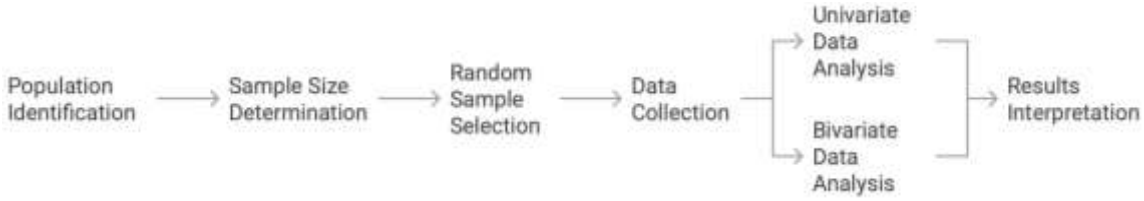

Figure 1. Research process

Results and Discussion

Table 1 presents the characteristics of respondents with diabetes mellitus, including gender, age, marital status, education, occupation, income, body mass index (BMI), history of comorbidities, medication use, physical activity, diet, and blood sugar levels. Of the 72 respondents, the majority were women (90.3%) and were in the elderly age group (55.6%). Most respondents were divorced due to life (54.2%) and had primary education (75%). In terms of occupation, most were housewives (75%). In terms of BMI, 43.1% of respondents were obese, and 70.8% had a history of hypertension. In terms of physical activity, 72.2% of respondents had low levels of activity, and most had adequate diets (59.7%). Respondents' blood sugar levels showed that 81.9% were in the high category (>180 mg/dL), reflecting the significant challenges in managing diabetes in this population.

Table 1. Respondent Characteristics

Variables	N	%
Gender		
Man	7	9.7
Woman	65	90.3
Age		
Early adulthood (20-40)	3	4.2
Middle adulthood (41-60)	29	40.3
Seniors (61-71)	40	55.6
Marital status		
Single	0	0
Marry	31	43.1
Divorce	2	2.8
Divorce by death	39	54.2
Education		
No school	5	6.9
Elementary School	54	75.0
Junior High School	12	16.7
Senior High School	0	0
PT	1	1.4
Work		
housewife	54	75.0
civil servant	1	1.4
Self-employed	16	22.2
Businessman	1	1.4
Income		
There isn't any	54	75.0
< Rp. 1,000,000	0	0.0
Rp. 1,000,000-3,000,000	7	9.7
Rp. 3,000,000-5,000,000	10	13.9
> Rp. 5,000,000	1	1.4
BMI		
Normal range (BMI 18.5- 22.9 kg/m2)	0	0
Overweight (BMI 23-24.9 kg/m2)	21	29.2
Obesity 1 (BMI 25-29.9 kg/m2)	20	27.9

Variables	N	%
Obesity 2 (BMI > 30 kg/m2)	31	43.1
History of Accompanying Diseases		
No history	0	0
disease		
hypertension comorbidities	51	70.8
Gout	21	29.2
Consumption of drugs		
Metformin	0	0
Glibenclamide	19	26.4
Sulfonylureas	53	73.6
There isn't any	0	0
Physical Activity		
High (> 1500	3	4.2
METs/minute)		
Medium (600-1499	17	23.6
METs/minute)		
Low (< 600	52	72.2
METs/minute)		
Dietary habits		
Good (>1300)	9	12.5
Enough (650-1299)	43	59.7
Bad (<650)	20	27.8
Blood Sugar Levels		
Low (< 80 mg/dL)	0	0
Normal (80-179 mg/dL)	13	18.1
High (>180 mg/dL)	59	81.9

Table 2 shows that of the 72 respondents, all individuals who were engaged in high physical activity (>1500) showed normal blood sugar levels (3 respondents). A total of 17 respondents with moderate physical activity (600–1499) had blood sugar levels classified as 23.5% normal and 76.5% abnormal. Meanwhile, for low physical activity (<600), only 11.5% had normal blood sugar levels, while 88.5% were in the abnormal category. The ρ value obtained was 0.007, which indicates that there is a significant relationship between physical activity and blood sugar levels (ρ < 0.05), with a correlation coefficient of r = 0.315 indicating a weak positive relationship. These results indicate that increased physical activity can contribute to the management of blood sugar levels in diabetes.

Table 2. Relationship between Physical Activity and Blood Sugar Levels

Physical Activity	Blood Sugar Levels							
	Low (< 80 mg/dL)		Normal (80-179 mg/dL)		Tall (> 180 mg/dL)		Tall	
	n	%	n	%	n	%	n	%
High (>1500)	0	0	3	100	0	0	3	100
Medium (600-1499)	0	0	4	23.5	13	76.5	17	100
Low (<600)	0	0	6	11.5	46	88.5	52	100
Total	0	0	13	18.1	59	81.9	72	100
ρ value (0.05)				ρ = 0.007				r = 0.315

Table 3 presents the relationship between physical activity and diet with blood sugar levels in people with diabetes mellitus. Data are plotted into three categories of physical activity: good (≥ 1300 kcal), sufficient (650-1299 kcal), and poor (<650 kcal). Of the 72 respondents, in the good physical activity group, 100% had an appropriate diet, while in the sufficient group, 9.3% had a good diet and 90.7% had a poor diet, indicating that most respondents with sufficient physical activity experienced unhealthy diets. In the poor physical activity group, all respondents (100%) showed poor diets, which can contribute to high blood sugar levels. The ρ value (p-value) obtained was 0.000, far below the significance limit of 0.05, indicating a highly significant relationship between physical activity and diet with blood sugar levels. The correlation (r = 0.607) indicates a moderate to strong relationship, reflecting the importance of these two factors in the management of diabetes mellitus.

The population examined consisted predominantly of women (90.3%) and seniors (55.6%), revealing demographic trends that could correlate with heightened diabetes risk due to factors such as age and gender predisposition to diabetes and its complications. Studies have shown that elderly populations often exhibit higher levels of hyperglycemia, particularly when physical activity is low and comorbidities, such as hypertension, are prevalent (Nurvita et al., 2022;

Widyawardani & Safitri, 2022). The high percentage of respondents (72.2%) engaging in low levels of physical activity underscores a crucial area for intervention; both meta-analyses and longitudinal studies have identified insufficient physical activity as a primary contributor to poor glycemic control (Schlesinger et al., 2020).

Table 3. Relationship between Eating Patterns and Blood Sugar Levels

Physical Activity	Blood Sugar Levels						Tall	
	Low (< 80 mg/dL)		Normal (80-179 mg/dL)		Tall (> 180 mg/dL)			
	n	%	n	%	n	%	n	%
Good (> 1300 kcal)	0	0	9	100	0	0	9	100
Sufficient (650-1299 kcal)	0	0	4	9.3	39	90.7	43	100
Poor (<650 kcal)	0	0	0	0	20	100	20	
Total	0	0	13	18.1	59	81.9	72	100
ρ value (0.05)				ρ = 0.000				r = 0.607

In the realm of dietary habits, even though 59.7% of respondents reported adequate diets, the pronounced elevation in blood sugar levels (81.9% above 180 mg/dL) suggests that diet quality may not align entirely with blood sugar management. A balanced diet is essential, as it significantly impacts glucose metabolism. For example, research has indicated that adherence to nutritional guidelines can improve glycemic control among diabetic patients (Gofur et al., 2022). Importantly, while some patients may rely solely on dietary changes, others may require pharmacotherapy in conjunction with lifestyle modifications to achieve effective blood glucose management (Nofal et al., 2023).

The relationship between physical activity and blood glucose levels in diabetes management is well-documented. Physical activity enhances insulin sensitivity and promotes glucose uptake by muscle tissues, resulting in lower fasting blood glucose levels (Sari et al., 2023; Tanzila et al., 2020). Light to moderate exercise has been shown to be beneficial even for individuals with mobility limitations, such as many in the respondent population, which includes a substantial number of elderly housewives (Wiratama et al., 2023). Moreover, a proactive approach to increasing physical activity—even in light of age-related constraints—can result in better management of blood sugar levels through reduced insulin resistance and enhanced metabolic function (Ningrum & Susanto, 2020; Saltar et al., 2023).

Physical activity plays a crucial role in regulating blood glucose levels. Individuals with high physical activity often exhibit normal blood sugar levels, while those with low physical activity tend to present with abnormal levels. Statistical analyses demonstrate a significant association between levels of physical activity and glycemic control, reinforcing the literature consensus that increased physical activity is beneficial for glycemic control in patients with diabetes (Amirudin, 2023).

Regular physical activity is consistently associated with enhanced insulin sensitivity, which helps reduce fasting blood glucose levels and other cardiovascular risk factors (Nurvita et al., 2022; Suprayitna et al., 2022). Scientific literature supports that aerobic exercises significantly lead to lower HbA1c values, demonstrating an overall improvement in long-term glucose management (Fajriyah et al., 2020). Moderate physical activity has been linked to substantial benefits, as seen in studies emphasizing the positive impact of consistent, moderate exercise on metabolic health in diabetes patients (Amirudin, 2023; Xing et al., 2025).

In addition to physical activity, dietary patterns are crucial in glycemia management. The interplay of nutrition and exercise is essential; consuming a balanced diet rich in fiber and low in processed sugars is beneficial for improving glycemic control. Research indicates that specific dietary habits, such as increased fruit intake, can lower diabetes risk (Li et al., 2022). Thus, individuals are encouraged to adopt an integrative approach that combines regular physical activity with prudent dietary choices to optimize blood sugar management (Rosiana et al., 2023).

Moreover, diabetes self-care management encompasses both dietary and physical activity components as critical elements in controlling blood sugar levels. The ability of patients to adhere to recommended exercise routines and dietary guidelines significantly influences their glycemic outcomes (Alodhayani et al., 2021; Dewi et al., 2023). Studies highlight the need for tailored patient education and structured exercise programs that cater to individual lifestyle needs (Xue et al., 2022). Socioeconomic factors and accessibility to recreational spaces also influence the frequency and intensity of physical activity among individuals with diabetes (Tison et al., 2020).

In the management of diabetes mellitus, both physical activity and dietary patterns are essential components that significantly influence blood sugar levels. The evidence suggests a strong correlation between these two lifestyle factors and glucose control in diabetic patients (Kurniasari & Yuniartika, 2024). Regular physical activity has been shown to improve insulin sensitivity and promote glucose uptake by the

muscles, thus helping to lower blood sugar levels (Dewiyuliana & Syah, 2022; Sabita et al., 2024).

Findings reveal that a higher level of physical activity is associated with better dietary choices. In individuals characterized as engaging in "good" physical activity, a significant proportion observed adherence to a balanced diet. In contrast, those categorized as having "sufficient" physical activity showed a lower adherence to healthy dietary habits, with notable percentages reporting poor dietary practices (Bodur et al., 2021). The implications of these dietary patterns are crucial, as diets high in sugar and lacking nutritional value are linked to elevated blood glucose levels, underscoring their relevance in diabetes management (Dafriani et al., 2022; Putri et al., 2024).

Moreover, physical activity plays a pivotal role in diabetes management as it helps not only in weight control but also in achieving better hormonal balance, thereby enhancing the metabolic response to insulin (Dewiyuliana & Syah, 2022; Kasmad et al., 2022). The diabetes literature consistently indicates that structured exercise interventions can lead to notable improvements in glycemic control (Bersch-Ferreira et al., 2024).

Dietary patterns are equally vital, as a balanced diet optimizes glycemic control. Consuming a diet rich in vegetables, fruits, and whole grains, while limiting processed sugars and unhealthy fats, can significantly stabilize blood glucose levels (Schlesinger et al., 2020). Studies emphasize that patients adhering to dietary restrictions and balancing their nutrient intake report better blood sugar management than those with poor eating habits (Kurniasari & Yuniartika, 2024; Putri et al., 2024).

There is a documented relationship between dietary compliance and physical activity levels, indicating that individuals who engage in regular exercise are more likely to maintain a nutritious diet, further contributing to effective diabetes management (Bodur et al., 2021). The interplay between dietary intake and physical activity can create a synergistic effect, enhance overall metabolic health and mitigating complications related to diabetes.

Conclusion

There is a significant relationship between physical activity and diet and blood sugar levels in people with diabetes mellitus. The analysis results showed that the majority of respondents were women with high rates of comorbidities, such as hypertension and obesity. High blood sugar levels (>180 mg/dL) found in 81.9% of respondents highlight the significant challenges in diabetes management in this population. Low physical activity is associated with a high proportion of abnormal blood sugar levels, while high physical activity is associated with normal blood sugar levels. Furthermore, poor diet significantly contributes to high blood sugar levels, indicating the need for multidisciplinary interventions in the management of diabetes mellitus. With a ρ-value showing strong significance ($\rho < 0.05$), the need for increased physical activity and improved diet is crucial in efforts to reduce blood sugar levels in people with diabetes.

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Concept: IF, HM; Methodology and Software: IF, HM; Validation and Formal Analysis: IF, HM; Writing—Original Draft Preparation: IF, HM; Project Administration: IF, HM; Funding Acquisition: IF, HM; Data Acquisition: DA, DE; Analysis: DA, DE; Writing—Review and Editing: DA, DE; Supervision: DA, DE; Resource Management: DA, DE; Project Coordination: AB; Administrative Support: AB; Financial Oversight: AB; Communication with Stakeholders: AB.

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