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**THE RELATIONSHIP BETWEEN LIFESTYLE AND BLOOD GLUCOSE LEVELS IN
PATIENTS WITH DIABETES MELLITUS AT WONOKROMO PUBLIC HEALTH
CENTER**

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Abstract

Background: Diabetes mellitus is a chronic condition with rising global prevalence and is strongly influenced by lifestyle behaviors.

Objective: This study examined the association between lifestyle factors and blood glucose levels among patients with diabetes mellitus at the Wonokromo Public Health Center.

Methods: The study included 216 patients with diabetes mellitus, of whom 141 were selected using purposive sampling. A correlational analytic design with a cross-sectional approach was employed. Data were collected using a lifestyle questionnaire and the respondents' most recent blood glucose measurements. Statistical analysis was conducted using the Spearman rank test.

Results: Nearly half of the respondents reported a moderate lifestyle pattern, and most had blood glucose levels within the normal range. The analysis yielded a p-value < 0.001 with a correlation coefficient ($r = 0.385$), indicating a significant association between lifestyle and blood glucose levels.

Conclusion: The findings demonstrate that lifestyle is significantly related to blood glucose control in patients with diabetes mellitus. These results highlight the importance of adopting healthy lifestyle practices, including balanced diet, regular physical activity, stress management, and avoidance of smoking, to help maintain optimal blood glucose levels.

INTRODUCTION

Diabetes mellitus (DM) is one of the most prevalent chronic diseases worldwide, with the number of affected individuals increasing steadily each year. In everyday life, it is commonly referred to as a "sugar disease" or "sweet urine disease" (Ulpah et al., 2023). One of the main factors contributing to the rising prevalence of diabetes is an unhealthy lifestyle. Lifestyle behaviours such as high-calorie dietary patterns, lack of physical activity, chronic psychological stress, and smoking habits have been proven to impair blood glucose control (Laela Sari et al., 2025). The transition toward a modern lifestyle, marked by reduced physical activity and increased consumption of high-sugar, high-fat, and low-fiber foods, has become a major risk factor for this condition. These lifestyle shifts have collectively contributed to the growing burden of non-communicable diseases, particularly diabetes mellitus.

This issue is also evident at the Wonokromo Public Health Center, where the number of patients seeking diabetes treatment has continued to rise. Preliminary observations indicate that most diabetic patients in this facility exhibit unhealthy lifestyle behaviours, including high-calorie diets, low levels of physical activity, poor stress management, and smoking habits. Meanwhile, blood glucose level serves as a key indicator for assessing the metabolic condition of diabetic patients and is strongly influenced by lifestyle. However, limited research has specifically examined the relationship between lifestyle and blood glucose levels among diabetic patients in this area. Therefore, this study was conducted to analyse the relationship between lifestyle and blood glucose levels among patients with diabetes mellitus at the Wonokromo Public Health Center.

According to data from the International Diabetes Federation (IDF, 2021), an estimated 537 million adults (10.5%) worldwide were living with diabetes, and this number is projected to increase dramatically to 783 million by 2045. Southeast Asia ranks third globally in diabetes prevalence, with approximately 90.2 million cases. Within the region, Indonesia ranks fifth among countries with the highest number of diabetic patients, after China, India, Pakistan, and the United States—with a total of 19.5 million cases (Asriani, 2024). East Java Province is among the five provinces with the highest diabetes prevalence in Indonesia. Based on *Riskesdas* (2022), the prevalence of diabetes mellitus in East Java reached 2.6%, showing an increase from 2.1% in 2018. The 2021 East Java Health Profile reported that Surabaya City recorded the highest number of diabetes mellitus cases in the province, with 96,280 patients—representing approximately 10.35% of all cases across 38 districts and cities (Kartika, 2022). Moreover, data from the Wonokromo Public Health Center in March 2025 documented 216 patient visits related to diabetes mellitus.

Type 2 diabetes mellitus is commonly triggered by a combination of unhealthy lifestyle factors, particularly physical inactivity and poor dietary habits (Elisabeth et al., 2024). Lifestyle plays a crucial role in blood glucose regulation, both in individuals at risk and those already diagnosed with type 2 diabetes. Poor dietary patterns, especially excessive carbohydrate consumption, can disrupt blood glucose stability. Continuous exposure to high glucose levels may lead to decreased insulin sensitivity, a condition known as insulin resistance, which underlies the pathophysiology of type 2 diabetes mellitus (Ulpah et al., 2023). On the other hand, insufficient physical activity reduces the body's ability to respond to insulin effectively, leading to elevated blood glucose levels (Abidin, 2025).

Although genetic factors play a role in the development of diabetes, environmental and behavioural factors are equally critical in its prevention and management. Adopting a healthy lifestyle is therefore essential for maintaining metabolic balance and reducing diabetes risk. This includes consuming a balanced diet rich in fruits and vegetables while limiting sugar, salt, and fat intake; maintaining an ideal body weight; engaging in regular physical exercise; managing stress effectively; and quitting smoking, as tobacco compounds can impair metabolic function. Adequate hydration, portion control, and regular blood glucose monitoring are also vital for preventing fluctuations in blood sugar levels and detecting metabolic disturbances early (Iswahyuni et al., 2024).

Objective: To analyze the relationship between lifestyle and blood glucose levels among diabetic patients at the Wonokromo Public Health Center.

METHODS

Study Design

This study employed a correlational analytic design with a cross-sectional approach. The purpose of the study was to examine the relationship between lifestyle and blood glucose levels among patients with diabetes mellitus. The independent variable in this research was lifestyle, while the dependent variable was blood glucose level.

Settings

The research was conducted at the Wonokromo Public Health Center (Puskesmas Wonokromo), Surabaya, East Java, Indonesia. Data collection took place in July 2025.

Research Subject

Based on data from August to October 2025, the population in this study consisted of 216 patients diagnosed with diabetes mellitus who were registered at the Wonokromo Public Health Center, Surabaya. Based on the Slovin formula, a total of 141 respondents were selected using a purposive sampling technique. This technique was chosen because the researcher aimed to select participants who met the specific characteristics relevant to the research objectives.

Inclusion criteria were as follows: patients with diabetes mellitus who were *compos mentis* (conscious and able to communicate well), patients who were visiting the Wonokromo Public Health Center at the time of data collection, patients who underwent examination for diabetes mellitus at the health center, and patients who were willing to participate and provided informed consent.

Exclusion criteria were as follows: patients with diabetes mellitus who had complications (such as diabetic ulcers, renal failure, or other severe conditions) and patients with diabetes mellitus who were uncooperative during the data collection process.

The sample size of 141 respondents was obtained from a total population of 216 diabetic patients registered at the Wonokromo Public Health Center. The sample size was determined based on the feasibility of recruitment and accessibility during the research period and was considered adequate for the analysis using the Spearman rank correlation test.

Instruments

The instruments used in this study consisted of a structured questionnaire and patients' blood glucose examination records, designed to assess two main variables: lifestyle and blood glucose levels.

The lifestyle questionnaire contained several domains, including dietary habits, physical activity, smoking behavior, and stress management. Each item was measured using a Likert-type scale, with response categories indicating the frequency or consistency of each behavior. The total score obtained from all items was then categorized into three levels of lifestyle quality: good, moderate, and

poor. Prior to use, the questionnaire underwent a validity and reliability test to ensure its accuracy and consistency in measuring lifestyle behaviors among diabetic patients.

The blood glucose variable was measured using the most recent fasting blood glucose results obtained from patients' medical records at the Wonokromo Public Health Center. Blood glucose levels were classified according to standard clinical categories: normal (<200 mg/dL) and high (≥ 200 mg/dL).

All instruments were reviewed for ethical compliance and assessed for content validity to ensure that the data collected accurately represented the respondents' lifestyle behaviors and glycemic status.

Data collection

The data collection process in this study was conducted systematically to ensure ethical compliance and data reliability. The research was carried out at the Wonokromo Public Health Center, Surabaya, in July 2025, after obtaining formal approval from the Faculty of Nursing and Midwifery, Universitas Nahdlatul Ulama Surabaya, as the academic institution overseeing the study. Official permission to collect data was also granted by the Head of the Wonokromo Public Health Center.

Data were collected using two main sources: a structured lifestyle questionnaire and the respondents' most recent blood glucose examination results recorded in the health center's medical database. The lifestyle questionnaire covered several domains, including dietary habits, physical activity, smoking behavior, and stress management. Each item was rated using a Likert-type scale, and the total score categorized respondents' lifestyles into good, moderate, or poor. Before use, the instrument was tested for validity and reliability to ensure the accuracy and consistency of measurement.

The researcher directly distributed the questionnaires to diabetic patients who met the inclusion criteria and were visiting the health center during the data collection period. Each respondent was informed about the study's objectives, procedures, confidentiality, and voluntary participation rights. After providing written informed consent, respondents completed the questionnaire independently under the researcher's supervision. Meanwhile, blood glucose level data were obtained from the respondents' most recent laboratory test results as documented in their medical records.

Data Analysis

Data analysis in this study was performed using the *Statistical Package for the Social Sciences* (SPSS) version 25.0. The analytical procedure consisted of several systematic steps to ensure data accuracy and validity. First, an editing and coding process was conducted in which all completed questionnaires were reviewed for completeness, consistency, and accuracy. Each response was then coded and entered into SPSS for statistical analysis. Next, univariate analysis was applied using descriptive statistics to summarize respondents' demographic characteristics, lifestyle categories, and blood glucose levels, which were presented in frequencies and percentages. Finally, bivariate analysis was conducted using Spearman's rank-order correlation (*Spearman's rho*) to examine the relationship between lifestyle and blood glucose levels. This nonparametric test was selected because the variables were ordinal and did not assume a normal data distribution. A significance level (α) of 0.05 was set as the threshold for determining statistical significance. The analysis yielded a p -value < 0.001 and a

correlation coefficient (r) = 0.385, indicating a statistically significant positive correlation between lifestyle and blood glucose levels among patients with diabetes mellitus.

Ethical Consideration

This study received ethical approval from the Ethics Committee of Universitas Nahdlatul Ulama Surabaya (Certificate No. 0222/EC/KEPK/UNUSA/2025). Official permission was also granted by the Head of the Wonokromo Public Health Center. All participants were informed about the study's purpose and procedures and were assured of confidentiality and their right to withdraw at any time. Written informed consent was obtained from each participant, and anonymity was maintained throughout the research process.

RESULTS

Characteristics of Respondents

Table 1. Characteristics of Respondents

Characteristics	Frequency (f)	Percentage (%)
Age, (Mean$\pm$SD)	58.52 $\pm$ 9.26	
Gender		
Male	42	29.8
Female	99	70.2
Education level		
Primary	45	31.2
Secondary	81	57.4
Higher	15	10.6
Occupation		
Working	50	35.5
Not working	91	64.5
Duration of living with DM		
1-2 years	49	34.8
2-3 years	18	12.8
3-5 years	35	24.8
>6 years	39	27.7
Lifestyle		
Poor	62	44.0
Moderate	64	45.4
Good	15	10.6
Blood Glucose Levels		
High	57	40.4
Normal	84	59.6

Sources: Questionnaire Data, 2025.

A total of 141 patients with diabetes mellitus who completed the questionnaire were included in the analysis. The explanation of Table 1 indicates that the majority of respondents were female (70.2%) and were predominantly older adults, with a mean age of 58.52 $\pm$ 9.26 years. Most participants had

completed secondary education (57.4%) and were not employed (64.5%). Concerning the duration of living with diabetes, the largest proportion had been diagnosed for 1–2 years (34.8%), followed by those who had lived with the condition for more than six years (27.7%). In terms of lifestyle, the most frequently reported category was moderate (45.4%). Blood glucose assessment showed that most respondents had levels within the normal range (59.6%), while the remaining 40.4% exhibited elevated glucose levels.

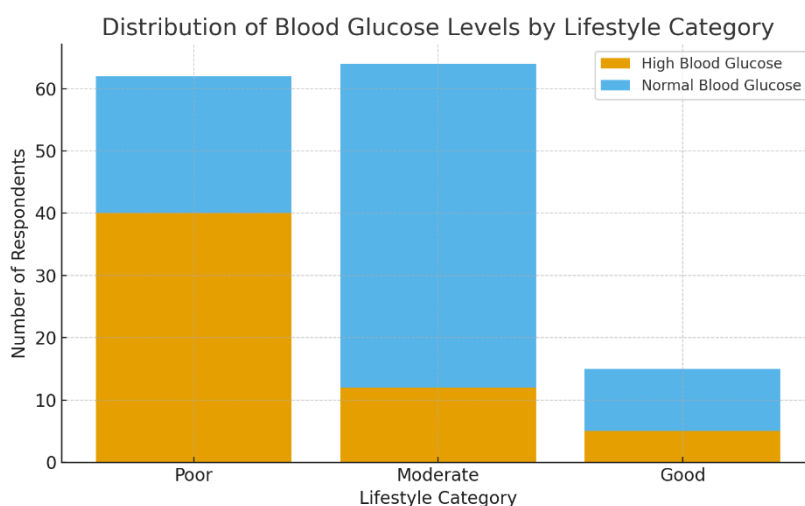


Figure 1. Blood Glucose Levels Across Lifestyle Categories

Figure 1 illustrates the distribution of blood glucose levels across different lifestyle categories among patients with diabetes mellitus. The chart shows that respondents with a poor lifestyle exhibited the highest proportion of elevated blood glucose levels, with 40 individuals classified in the high category. In contrast, those with a moderate lifestyle predominantly demonstrated normal blood glucose levels, with 52 respondents falling within the normal range. Meanwhile, participants with a good lifestyle also showed a tendency toward normal glucose levels, although their overall numbers were smaller. These visual patterns support the statistical findings indicating an association between healthier lifestyle behaviors and better glycemic control.

Table 2. Crosstabulation of Lifestyle and Blood Glucose Levels Among Patients With Diabetes Mellitus

Lifestyle Category	High Blood Glucose n (%)	Normal Blood Glucose n (%)	<i>p</i>	<i>r</i>
Poor lifestyle	40 (64.5)	22 (35.5)		
Moderate lifestyle	12 (18.8)	52 (81.3)		
Good lifestyle	5 (33.3)	10 (66.7)		

Sources: Questionnaire Data, 2025.

Table 2 showed a statistically significant association between lifestyle categories and blood glucose levels ($p = 0.001$; $r = 0.385$). Respondents with poorer lifestyle profiles were more likely to

exhibit elevated blood glucose, whereas those with healthier lifestyle behaviors tended to show normal glycemic status. The positive correlation coefficient indicates that improvements in lifestyle corresponded with better blood glucose control. Although the strength of the correlation was moderate, the findings suggest that lifestyle patterns play a meaningful role in glycemic regulation among patients with diabetes mellitus.

DISCUSSION

Lifestyle of Patients with Diabetes Mellitus

The results showed that almost half of the respondents had a moderate lifestyle (45.4%), while 44.0% demonstrated a poor lifestyle, and only 10.6% had a good lifestyle. This indicates that most diabetic patients at the Wonokromo Public Health Center have not yet fully implemented optimal healthy lifestyle behaviors. These findings are consistent with those of Norlita et al., (2024) and Cristinawati et al., (2025), who reported that the majority of diabetic patients were in the moderate lifestyle category. According to the researchers, this condition may be influenced by the increasing public awareness of health importance, though such awareness has not yet been translated into consistent behavioral changes. This suggests that many patients may possess adequate knowledge about healthy living but still struggle to apply it in daily life, especially in maintaining balanced nutrition and regular exercise. Continuous education and behavioral reinforcement are therefore needed to promote better lifestyle adherence among diabetic patients.

Lifestyle is one of the most important factors in the management of Diabetes Mellitus (DM) and includes dietary habits, physical activity, treatment adherence, and daily health behaviors. Based on the level of implementation, the lifestyle of DM patients can be categorized into three levels: good, adequate, and poor. A good lifestyle is characterized by the patient's ability to consistently practice healthy behaviors in daily life. Patients with a good lifestyle consume a balanced diet low in sugar and saturated fats while being rich in fiber, with well-controlled portion sizes and regular meal patterns. They routinely engage in physical activity for at least 150 minutes per week and maintain an ideal body weight. Treatment adherence is also very good, as shown by regularly taking medications or insulin as prescribed, monitoring blood glucose levels independently, and attending scheduled health check-ups (Ayse Sahin RN, 2021). Additionally, these patients demonstrate strong self-care awareness, including foot care, maintaining personal hygiene, managing stress effectively, and refraining from smoking and alcohol consumption.

An adequate lifestyle is identified when the patient has some understanding of healthy living, but the application is not yet optimal. In this category, patients try to choose healthy foods but still occasionally consume high-sugar or high-fat foods, and portion control remains inconsistent. Physical activity is present but irregular, such as exercising only once or twice a week. Treatment adherence is moderate, with occasional missed doses and infrequent blood glucose monitoring. Personal health care is practiced but not routinely, and stress management varies.

In recent years, the prevalence of diabetes mellitus (DM) has increased significantly among people of productive age, typically between 18 and 59 years. This contrasts with the previous assumption that diabetes mellitus (DM) is primarily a degenerative disease affecting older adults. However, epidemiological data from various countries indicate that most cases of type 2 DM occur among people who are still working and carrying out daily activities. (Strati et al., 2024).

The productive age population is at high risk of developing DM due to a combination of poor lifestyle behaviors, unhealthy dietary patterns, low physical activity, work-related stress, and low awareness of health screening (Samant et al., 2025). Lifestyle interventions through education, health promotion, and workplace policies that support physical activity are essential to prevent the continued rise of DM cases in this age group.

In contrast, a poor lifestyle is observed when the patient does not apply the basic principles of healthy living in DM management. Patients in this category tend to consume foods high in sugar, saturated fats, and low in fiber without considering portion sizes. Physical activity is minimal or absent, which increases the risk of weight gain and metabolic complications (Rietz et al., 2022). Treatment adherence is low, as indicated by frequently missing medications and not monitoring blood glucose levels. Poor health behaviors are evident through the lack of self-care practices, lack of awareness of warning signs or complications, poor stress management, and continued smoking or alcohol consumption.

Blood Glucose Levels of Patients with Diabetes Mellitus

The majority of respondents had normal blood glucose levels (59.6%), while 40.4% exhibited high blood glucose levels (hyperglycemia). This shows that, in general, patients have made sufficient efforts to control their blood glucose, although glycemic control remains inconsistent across individuals. These results are in line with the theory proposed by Soelistijo (2021), which states that blood glucose levels are influenced by diet, physical activity, stress, and smoking habits. However, some respondents with good lifestyle scores still had high blood glucose levels. This may be attributed to other contributing factors such as age, obesity, genetic predisposition, or frequent consumption of high-sugar and high-fat foods. Thus, while lifestyle plays a crucial role in blood glucose regulation, it should be complemented with proper medical treatment, stress management, and regular monitoring to achieve optimal glycemic outcomes.

Relationship Between Lifestyle and Blood Glucose Levels

The statistical analysis revealed a significant relationship between lifestyle and blood glucose levels ($p < 0.001$) with a moderate positive correlation ($r = 0.385$). The positive direction of correlation indicates that the better the lifestyle, the greater the likelihood of achieving controlled blood glucose levels. This finding reinforces the theory of the American Diabetes Association, (2021), which emphasizes that lifestyle modification is a primary step in diabetes management.

It is also consistent with the research of Mustika et al., (2024), which reported that healthy lifestyle practices significantly affect the overall quality of life of diabetic patients, both physically and psychologically.

Based on the findings, it can be concluded that lifestyle contributes significantly to blood glucose control. Although most respondents exhibited a moderate lifestyle, interventions such as health education, nutrition counseling, and structured physical exercise programs remain necessary to improve glycemic control.

Improving lifestyle quality not only helps regulate blood glucose levels but also serves as an effective preventive measure against long-term complications of diabetes mellitus. Nurses, therefore, play a vital role in empowering patients through continuous lifestyle education and behavioral modification strategies in community health settings.

LIMITATION

This study had several limitations that should be considered when interpreting the findings. First, respondents did not attend the health center at the same time, which extended the duration required for data collection. The researcher had to adjust to respondents' schedules to ensure data completeness. Second, some respondents had hearing difficulties, requiring repeated explanations and more intensive communication during the data collection process. This condition may have affected the respondents' understanding of several questionnaire items and, consequently, the accuracy and consistency of their responses.

Despite these limitations, efforts were made to minimize their impact by providing clear instructions, verifying each questionnaire item, and maintaining consistency throughout the data collection process.

CONCLUSION

This study concludes that there is a significant positive relationship between lifestyle and blood glucose levels among patients with diabetes mellitus at the Wonokromo Public Health Center. The findings revealed that nearly half of the respondents demonstrated moderate or poor lifestyle habits, while most maintained normal blood glucose levels. The statistical result ($p < 0.001$; $r = 0.385$) indicates that individuals with healthier lifestyles—characterized by balanced nutrition, regular physical activity, effective stress management, and avoidance of smoking—are more likely to achieve stable blood glucose levels.

These findings are consistent with the Health Promotion Model by Nola J. Pender, which asserts that health-promoting behaviors are influenced by individual perceptions, motivation, and environmental support. The model proved to be a useful and adequate theoretical framework for understanding the relationship between lifestyle behaviors and physiological outcomes in diabetic

patients. The data strongly supported the conceptual assumption that behavioral modifications contribute directly to improved glycemic control.

In practical terms, this study underscores the importance of nursing interventions focused on lifestyle modification as a key strategy in diabetes management. Nurses and health practitioners are encouraged to enhance health education, nutrition counseling, and community-based exercise programs to help patients adopt and maintain healthier behaviors. Furthermore, stress management and smoking cessation counseling should be integrated into regular diabetes care to optimize outcomes and prevent complications.

This study contributes new empirical evidence from the primary healthcare setting in Indonesia, highlighting how daily lifestyle patterns influence metabolic control among diabetic patients. Although most participants demonstrated moderate lifestyles, ongoing education and behavioral reinforcement remain necessary to achieve optimal health outcomes. Future research should explore additional factors such as body mass index, family history, and comorbid conditions, which may also affect glucose regulation, and consider longitudinal or interventional approaches to strengthen causal interpretation.

AUTHOR CONTRIBUTION

Maulidia Ajeng Wulandari: Conceptualization, study design, data collection, data analysis, and manuscript writing.

Rusdianingseh: Conceptualization and study design, manuscript writing, review and editing, supervision.

Faridah Umamah: Review and editing, supervision.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the conduct of this research or the preparation of this manuscript. All procedures were carried out independently and ethically, without any influence from external parties, funding sources, or institutions that could affect the objectivity of the findings. Ethical approval for this study was obtained from a university research ethics committee before data collection.

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