

Association Between Blood Sugar Levels and Blood Pressure in Individuals with Diabetes Mellitus: A Cross-Sectional Study

Lusiana Ardila^{1*}, Nur Wahyuni Munir¹

¹Nursing Science Program, Faculty of Public Health, Universitas Muslim Indonesia, Makassar, Indonesia

Abstract

*Corresponding author: **Lusiana Ardila**, Nursing Science Program, Faculty of Public Health, Universitas Muslim Indonesia, Makassar, Indonesia
Email: lusiana.ardila@gmail.com

Article info:
Received: 2025-02-10
Revised: 2025-02-21
Accepted: 2025-02-27

e-ISSN: 3047-6054
Volume 2(1): 12-17, February 2025

Background: Diabetes is a chronic metabolic disease characterized by elevated blood glucose levels, which over time can cause serious damage to the heart, blood vessels, eyes, kidneys, and nerves.

Objective: This study aimed to determine the association between blood sugar levels and blood pressure in individuals with diabetes mellitus in the working area of Tomia Health Center.

Methods: This research was descriptive-analytic in nature and used a cross-sectional design. The sample size was 73 respondents which was determined using Slovin formula. Bivariate analysis employed the Pearson correlation test.

Results: The results showed a significant relationship between blood sugar levels and blood pressure in patients with diabetes mellitus, with a p-value of 0.000 ($p < \alpha$), indicating that the hypothesis (H_a) was accepted.

Conclusion: The fluctuations in blood sugar levels are significantly associated with changes in blood pressure among patients with diabetes mellitus.

Keywords: Blood glucose; blood pressure; diabetes mellitus

Introduction

Diabetes is a chronic metabolic disease marked by persistently elevated blood glucose levels, which over time can cause serious complications affecting the heart, blood vessels, eyes, kidneys, and nerves (WHO, 2020). People with diabetes mellitus (DM) are at higher risk of cardiovascular events such as ischemic heart disease and stroke, with a two- to four-fold increased risk compared to non-diabetics (Luthfiani, Karota, & Sitepu, 2020). According to the International Diabetes Federation (IDF), approximately 463 million adults globally are living with diabetes, and this number is expected to rise in various countries between 2019 and 2045 including from 10.4% to 11.5% in India, and from 16.7% to 18.7% in Malaysia (IDF, 2019). The burden is also high in China and the United States, with projected increases from 89.5 million to higher levels by 2025 (Lin & Xu, 2020).

In Indonesia, WHO estimates an increase in DM cases from 8.4 million in 2000 to 21.2 million by 2030 (WHO, 2020). Similarly, the IDF predicts the number of diabetics in Indonesia to grow from 10.6 million in 2019 to 16.6 million in 2045 (IDF, 2019). According to the Ministry of Health's Basic Health Research (Riskesmas), the prevalence of diabetes based on medical diagnosis increased from 1.1% in 2013 to 2% in 2018, with Jakarta recording the highest prevalence at 3.4%, and East Nusa Tenggara the lowest at 0.9% (Infodatin, 2018). In Southeast Sulawesi Province, the number of reported DM cases rose significantly from 2,436 in 2017 to 3,710 in 2018 (Annual Report of the Southeast Sulawesi Provincial Health Office, 2018).

Diabetes mellitus involves chronic hyperglycemia resulting from insulin deficiency, insulin resistance, or increased hepatic glucose production (Djangga & Sargowo, 2015). Uncontrolled diabetes can lead to disability, amputations, and premature death. It may reduce life expectancy by 5 to 10 years and impose substantial economic burdens on patients, families, and healthcare systems due to high costs of medications, particularly analog insulin, and long-term treatment (Infodatin, 2018).

Preventive strategies such as healthy diets, regular physical activity, smoking cessation, and

control of lipid levels and blood pressure are crucial to reducing complications of diabetes (Infodatin, 2018). One of the most common comorbidities in DM is hypertension. Insulin resistance plays a major role in hypertension pathogenesis by activating the sympathetic nervous system (SNS) and promoting sodium retention by the kidneys. These mechanisms result in increased cardiac output, vascular resistance, and ultimately elevated blood pressure (Think et al., 2015).

At the local level, data from the Tomia Health Center showed a worrying trend in DM cases: 74 cases in 2022, 146 in 2023, and 272 by 2024 indicating a sharp annual increase (Mina, 2020). This growing trend suggests a rising risk of complications such as hypertension, partly due to limited public knowledge about the relationship between blood glucose and blood pressure.

Given the increasing prevalence of diabetes mellitus and its associated risk of hypertension, this study seeks to find the association between blood sugar levels and blood pressure in patients with diabetes mellitus.

Methods

Study Design

This study employed a descriptive analytical method using a cross-sectional design, which aimed to examine the relationship between blood glucose levels and blood pressure measured at a single point in time.

Samples/Participants

The study population consisted of patients diagnosed with diabetes mellitus in the working area of Tomia Health Center. Since the population was fewer than 1,000 individuals, the sample size was determined using the Slovin formula, resulting in 73 participants. Inclusion criteria included patients over 18 years old who had been diagnosed with diabetes mellitus, were able to communicate clearly, and were willing to participate by signing informed consent. Exclusion criteria included patients with cognitive impairments, those unable to complete blood sugar and blood pressure measurements, and patients in critical condition or with severe complications during the study period.

Instruments

The research instruments consisted of observation sheets containing examination results of blood sugar and blood pressure. Blood sugar levels were measured using a glucometer and blood pressure was measured using a digital sphygmomanometer. Both instruments were calibrated to ensure accuracy. The glucometer used had demonstrated reliability with Cronbach's alpha above 0.80 in previous studies (Klonoff, 2012), and the sphygmomanometer complied with clinical standards for blood pressure measurement accuracy (Stergiou et al., 2018).

Data Collection

This study was conducted in 2024. Data collection involved both primary and secondary data. Primary data were obtained through direct physical examinations and short interviews with patients to gather demographic characteristics. Blood glucose and blood pressure were measured on-site using the specified instruments. Secondary data were obtained from patient records available at Tomia Health Center, which provided supporting information for cross-checking and validation purposes.

Data Analysis

Collected data underwent several steps including editing, coding, data entry into SPSS, and data cleaning to ensure accuracy. Univariate analysis was performed to describe the frequency and percentage distribution of respondent characteristics. Bivariate analysis using the Pearson correlation test was conducted to evaluate the relationship between blood glucose levels and blood pressure. A significance level of 0.05 was used, and the results revealed a p-value below this threshold, indicating a statistically significant correlation between the two variables.

Ethical Considerations

This research obtained research permit from Universitas Muslim Indonesia. Throughout the research, ethical principles such as informed consent, anonymity, confidentiality, and non-maleficence were maintained. All participants were informed of the study's aims, methods, potential risks, and their right to withdraw at any time without consequence.

Results

The results of the study, as shown in Table 1, indicated that among the 73 respondents, majority of respondents were elderly which were 50 (68.5%) respondents and female which accounted for 60 (82.2%) respondents. Regarding employment status, over half of respondents were employed, accounting for 43 (54.8%) respondents and all respondents (100%) were married.

Table 1. Distribution of Respondents with Diabetes Mellitus (n= 73)

Characteristics	n	%
Age group		
Adult	23	31.5
Elderly	50	68.5
Gender		
Male	13	17.8
Female	60	82.2
Employment		
Employed	43	54.8
Unemployed	30	45.2
Marital status		
Married	73	100

Based on Table 2, out of 73 respondents, 33 (45.21%) respondents were identified with pre-diabetic blood sugar levels, while 23 (31.51%) respondents were categorized as diabetic. The mean blood glucose level was 192.86 mg/dL (SD= 68.73). Regarding systolic blood pressure, 15 (20.54%) respondents fell into the pre-hypertension category, and 13 (17.80%) respondents were classified as hypertensive, with mean systolic blood pressure of 149.18 mmHg (SD= 24.13). For diastolic blood pressure, 15 (20.54%) respondents were in the pre-hypertensive range and 12 (16.43%) respondents had hypertension. The mean diastolic blood pressure was 95.21 mmHg (SD=13.85).

Table 2. Blood Sugar and Blood Pressure of Respondents (n=73)

Variable	n	%	Mean	SD
Blood Glucose			192.86	68.73
Normal	17	23.28		
Pre-diabetes	33	45.21		
Diabetes	23	31.51		
Systolic Blood Pressure			149.18	24.13
Normal	9	12.32		
Pre-hypertension	15	20.54		
Hypertension	13	17.80		
Diastolic Blood Pressure			95.21	13.85
Normal	9	12.32		
Pre-hypertension	15	20.54		
Hypertension	12	16.43		

As shown in Table 3, the results of the Pearson correlation test revealed a significant relationship between blood sugar levels and systolic blood pressure, with a p-value of 0.000 ($p < 0.05$) and a correlation coefficient (r) of 0.652. This indicates a moderately strong positive correlation between the two variables. Similarly, the correlation between blood sugar levels and diastolic blood pressure was also significant, with a p-value of 0.000 and a correlation coefficient (r) of 0.621, suggesting a fairly strong relationship. These findings demonstrate that higher blood glucose levels are significantly associated with elevated systolic and diastolic blood pressure in patients with diabetes mellitus.

Table 3. Correlation of Blood Glucose with Blood Pressure

Correlation	r	p-value
Systolic Blood Sugar	0.652	0.000
Diastolic Blood Sugar	0.621	0.000

Discussion

The results of this study indicate that 31.51% of respondents had diabetic-level blood sugar, and 34.4% had hypertensive blood pressure. Among those aged over 60 years, the highest proportion of elevated blood sugar was observed. This trend aligns with the understanding that advancing age significantly increases the risk of diabetes mellitus. According to Mahedra et al. (2018), diabetes prevalence is 26% in individuals aged 41–50 years, 32% among those aged 51–60 years, and 34% in those over 60 years. This suggests that individuals above 40 are particularly susceptible to diabetes, even though younger individuals may also be affected.

There are notable differences in the progression of hypertension between patients with type 1 and type 2 diabetes. In type 1 diabetes, blood pressure is usually normal at diagnosis and tends to remain so for 10–15 years, unless complications such as nephropathy occur (Think et al., 2015). In contrast, individuals with type 2 diabetes often present with hypertension at diagnosis, and in many cases, high blood pressure may precede the onset of diabetes itself. These differences reflect the broader pathophysiological mechanisms involved in diabetic hypertension.

The mechanisms contributing to hypertension in diabetes are complex and multifactorial. Regulatory processes such as autonomic function, activation of the renin-angiotensin-aldosterone system (RAAS), insulin resistance, sympathetic nervous system activation, endothelial dysfunction, and arterial stiffness interact simultaneously and contribute to elevated blood pressure in diabetic patients (Think et al., 2015). In type 1 diabetes, the emergence of hypertension may serve as a clinical indicator of early nephropathy. However, in type 2 diabetes, hypertension is more often driven by systemic metabolic dysfunction rather than kidney pathology alone.

This study also showed that fluctuations in blood pressure correlate with blood glucose changes. Elevated blood pressure is often accompanied by increased blood glucose levels, and vice versa. This relationship can be partially attributed to lifestyle and dietary factors. Palmer and Williams (2007) note that high-fat diets common among individuals with diabetes can lead to arterial stiffness, contributing to increased blood pressure. Furthermore, insulin resistance frequently present in type 2 diabetes stimulates sodium retention and sympathetic nervous system activation, both of which elevate blood pressure.

The current findings are consistent with prior research. A study by Putra (2018) reported a significant correlation between blood glucose levels and hypertension in type 2 diabetes patients. Similarly, Fauzian (2018) found a positive correlation between fasting blood glucose and blood pressure, indicating that individuals with blood glucose levels exceeding 100 mg/dL are at higher risk for hypertension and diabetes-related complications. These studies strengthen the evidence that effective glucose control is essential not only to manage diabetes but also to reduce the risk of hypertension and its associated complications.

Overall, the results of this study reinforce the importance of integrated management of blood glucose and blood pressure in patients with diabetes mellitus. Timely interventions targeting both parameters are necessary to prevent further complications and improve long-

term outcomes. Future research should consider longitudinal designs to explore causality and include physiological markers such as insulin sensitivity or inflammatory biomarkers to deepen the understanding of the underlying mechanisms.

Conclusion

This study concludes that there is a statistically significant and moderately strong correlation between blood sugar levels and both systolic and diastolic blood pressure in patients with diabetes mellitus. Among the 73 respondents, those with elevated blood sugar levels tended to also exhibit higher blood pressure, indicating a direct physiological relationship between hyperglycemia and hypertension. These findings reinforce the notion that managing blood glucose is not only essential for preventing diabetic complications but also plays a vital role in blood pressure regulation. The implication for nursing and public health practice is that healthcare professionals should routinely assess both blood sugar and blood pressure levels in diabetic patients as part of a comprehensive care approach. It is recommended that community health centers and clinical settings implement integrated screening programs that monitor these two parameters together. For future research, longitudinal studies are suggested to explore causal pathways between hyperglycemia and hypertension, and to evaluate the effectiveness of integrated intervention models. Additionally, further studies should include broader variables such as insulin resistance markers, physical activity levels, dietary patterns, and psychosocial stressors. Including a larger and more diverse population sample will also enhance generalizability. The ultimate goal is to develop precise, evidence-based strategies for the dual management of diabetes and hypertension in both clinical and community settings.

References

- Aini, Q. (2019). *Analysis of Moringa leaf extract in the treatment of diabetes mellitus*. Syiah Kuala University Press.
- Alifariki, L. O., & colleagues. (2016). *Epidemiology of hypertension: A research-based review*. Jakarta: Aksara Kecil.
- Amirudin, M. A., Danes, V. R., & Lintong, F. (2015). Analysis of blood pressure measurement results between sitting and standing position in students. *Jurnal E-Biomedik (eBm)*, 3(1), 58–63. <https://doi.org/10.35790/ebm.3.1.2015.10042>
- Djangga, R., & Sargowo, D. (2015). *Endothelial dysfunction*. UB Press.
- Fauriza, C. E. (2018). *A study on the relationship between blood sugar levels and blood pressure in patients with type 2 diabetes mellitus over 45 years old at Dr. Soetomo Hospital Surabaya* [Undergraduate thesis, Universitas Airlangga]. <https://repository.unair.ac.id/70700/>
- International Diabetes Federation. (2019). *IDF diabetes atlas* (9th ed.). <https://diabetesatlas.org/data/>
- Luthfiani, N., Carroll, E., & Stephens, N. F. (2020). *Health counseling guidelines in efforts to prevent diabetes mellitus*. CV Budi Utama.
- Palmer, A. J., & Williams, B. (2007). *A simple blood pressure guide*. Erlangga.
- Pikir, B. S., Aminuddin, M., Subakjo, A., Darmadjati, B. B., Suryawan, I. R., & Eko, J. N. (2015). *Hypertension comprehensive management*. Airlangga University Press.
- World Health Organization. (2020). *Country and regional data on diabetes*. <https://www.who.int/diabetes/country-profiles/en/>
- Infodatin. (2018). *Situasi dan analisis diabetes*. Pusat Data dan Informasi Kementerian Kesehatan RI. <http://www.pusdatin.kemkes.go.id/resources/download/pusdatin/infodatin/infodatin-diabetes-2018.pdf>
- A. Karim, M., Syamsuddin, F. ., & Pakaya, A. W. . (2024). The Effect of Green Color Therapy on Lowering Blood Pressure in the Elderly with Hypertension. *Omni Health Journal*, 1(1), 14-20. <https://omnijournal.id/index.php/health/article/view/11>

- Takdir, Sunarsih, & Supodo, T. (2024). Sleep Quality and Blood Glucose Levels in Patients with Type 2 Diabetes Mellitus. *Omni Nursing Journal*, 1(1), 25-29. <https://omnijournal.id/index.php/nursing/article/view/3>
- American Diabetes Association. (2018, June 19). *What is diabetes?* <https://www.diabetes.org/diabetes>
- American Diabetes Association. (2018, June 20). *Complications and treatment of diabetes.* <https://www.diabetes.org/diabetes/complications>
- World Health Organization. (2020, April 7). *World Health Day: Diabetes.* https://www.who.int/health-topics/diabetes#tab=tab_1
- Mina, W. (2020, June 26). *Annual report of the Tomia Health Center* [Interview by L. Ardila].