

HBA1C LEVELS WITH URINE MICROALBUMIN IN TYPE 2 DIABETES MELLITUS PATIENTS

Luki Marliani¹, Harsismanto J²
Politeknik Kesehatan Kementerian Kesehatan Jambi¹
Puskesmas Pematang Tiga²
harsismanto@gmail.com²

ABSTRACT

This study aimed to determine the correlation between HbA1c levels and microalbuminuria in patients with type 2 diabetes mellitus at the Karang Tinggi Community Health Center. This study used a cross-sectional design. The results showed a positive and significant correlation, categorized as low correlation, between HbA1c levels and microalbuminuria in patients with type 2 diabetes mellitus, with a 2-tailed p-value of 0.031 and a correlation coefficient (r) of 0.333. In conclusion, higher HbA1c levels are associated with higher levels of microalbuminuria.

Keywords: Diabetes Mellitus, Diabetic Nephropathy, HbA1c, Microalbuminuria

INTRODUCTION

Diabetes Mellitus (DM) is a chronic metabolic disease characterized by high blood glucose levels. This condition occurs when the pancreas is unable to produce enough insulin or the body cannot effectively use the insulin it produces. Insulin is a hormone that plays a crucial role in regulating blood sugar levels (WHO, 2020).

In 2022, the World Health Organization (WHO) stated that DM is the most common disease worldwide and ranks fourth among degenerative disease research priorities across all countries. The WHO estimates that more than 346 million people worldwide have diabetes. According to the International Diabetes Federation (IDF), in 2021, 537 million adults, or 1 in 10 people worldwide, had diabetes. Indonesia ranks fifth in the world for diabetes cases after China, India, Pakistan, and the United States, with 19,465,100 out of 179,720,500 (10.6%) of the population aged 20-79 years. In other words, 1 in 9 people aged 20-79 years suffer from diabetes (IDF Atlas, 2021). Meanwhile, the prevalence of diabetes in Bengkulu in 2023 was 23,460 people (Bengkulu Provincial Health Office, 2023). In the Karang Tinggi Community Health Center (Puskesmas) work area of Central Bengkulu Regency, diabetes is among the 10 most common diseases, with DM patients registered in the Chronic Disease Management Program (Prolanis) (RM Puskesmas Karang Tinggi, 2024).

Based on the 2023 Basic Health Research (Riskesdas), the most common type of diabetes is type 2, at 50.2% (Ministry of Health, 2023). Type 2 diabetes mellitus is a metabolic disorder characterized by insulin resistance in muscle and liver cells, as well as pancreatic beta cell failure. Other organs involved in type 2 diabetes include adipose tissue,

the gastrointestinal tract, pancreatic alpha cells, the kidneys, and the brain, all contributing to impaired glucose tolerance (PERKENI, 2021).

Diabetic nephropathy is the leading cause of end-stage renal failure. Approximately 20–40% of people with diabetes will develop diabetic nephropathy. Persistent albuminuria in the range of 30–299 mg/24 hours is an early sign of diabetic nephropathy in type 2 diabetes (PERKENI, 2021).

Early symptoms of diabetic nephropathy include increased urinary albumin excretion, increased glomerular and renal size, and other disorders such as hyperfiltration and mesangial tissue expansion with accumulation of extracellular matrix proteins. Risk factors for diabetic nephropathy are divided into two categories: modifiable factors such as hypertension, poor blood sugar control, dyslipidemia, and smoking, and non-modifiable factors such as race, age, genetics, and gender. Diabetic nephropathy progresses through several stages, starting with thickening of the glomerular basement membrane, mesangial tissue proliferation, and progressing to nodular nephropathy and ultimately end-stage renal failure. Mechanisms involved in the development of diabetic nephropathy include the direct effects of hyperglycemia, impaired renal hemodynamics, inflammation, and fibrosis (Ashidiq et al., 2025).

Research conducted by Rahmadhina et al. (2022) demonstrated a positive association between HbA1c levels and microalbuminuria in patients with diabetes mellitus at the Guci Medika Clinic. These results indicate that increased HbA1c levels tend to be followed by increased microalbuminuria. Conversely, research conducted by Rizki et al. (2022) found no significant association between HbA1c levels and urinary microalbumin in patients with diabetes mellitus.

Based on this background, researchers are interested in conducting research on the relationship between HbA1c values and urinary microalbumin in diabetes mellitus patients at the Karang Tinggi Community Health Center.

RESEARCH METHODS

Research Type and Design

This study is quantitative with secondary data and a cross-sectional design. Two variables were used: HbA1c levels as the independent variable, and urine microalbumin levels as the dependent variable.

Research Location and Time

This study was conducted at the Karang Tinggi Community Health Center from January to June 2025.

Research Population and Sample

Population

The population in this study were patients with Type II Diabetes Mellitus (Prolanis) who underwent routine medical check-ups (MCU) every 6 months at the Karang Tinggi Community Health Center from January to December 2024.

Sample

The sampling technique used in this study was total sampling. The sample consisted of patient examination results or medical records of patients who met the inclusion criteria. Based on the selected sample, which had previously identified characteristics or characteristics of the population, namely DM patients undergoing HbA1c and urine

microalbumin testing, the sample was selected based on the following criteria:

Elderly

Prolanis Diabetes Mellitus patients

HbA1c and Microalbuminuria tests were performed.

Data Collection Method

The collected data were secondary data consisting of respondent characteristics, HbA1c values, and microalbuminuria data.

Data Analysis

The data generated in this study will be analyzed statistically to determine the HbA1c values and microalbuminuria levels. Mean and standard deviation tests were performed if the data were normally distributed. Median and minimum and maximum tests were performed if the data were not normally distributed. Correlation tests were conducted to analyze the relationship between HbA1c values and microalbuminuria. If the data were normally distributed, Pearson correlation tests were used, while Spearman correlation tests were used if the data were not normally distributed. The data generated in this study are presented in tables and graphs.

Research Results

Respondent Characteristics

This study was conducted on 42 patients with Type 2 Diabetes Mellitus who underwent HbA1c and Urine Microalbumin testing from January to December 2024 in the Karang Tinggi Community Health Center (Puskesmas) area. The results show the following characteristics of the respondents:

Table. 1
Characteristics of Respondents of Type 2 Diabetes Mellitus Patients

No	Karakteristik	Frekuensi (n) %	
1	Jenis Kelamin		
	Male	7	17%
	Female	35	83%
	Total	42	100%
2	Age		
	18 -59 year	29	69%
	>60 year	13	31%
	Total	42	100%

Based on table 1, it can be seen that of the 42 research respondents, the majority of respondents were female.

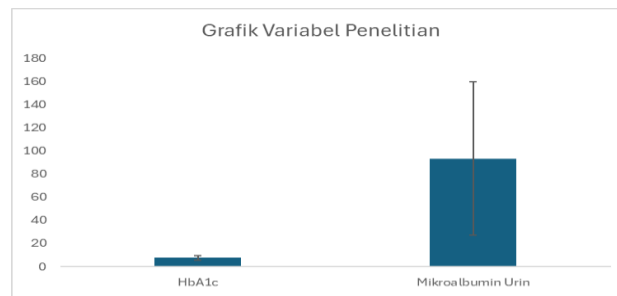
The Relationship Between HbA1c Levels and Urinary Microalbumin in Type 2

Diabetes Mellitus Patients

Table. 2
Descriptive Statistics Results of Research Variables

Variabel	Min Maks	Mean	SD
HbA1c	4.50 11.60	7.542	1.787
Mikroalbumin Urine	4.70 200	93.419	66.333

Based on Table 2, the mean value for the HbA1c variable was 7.542%, and the mean value for the Urine Microalbumin variable was 93.419%. The following graph shows the research variables presented in the table below.



Grafik. 1
Variabel Penelitian

Bivariate Analysis

Bivariate analysis is used to examine the relationship between independent and dependent variables. Before conducting a bivariate analysis, a normality test is first performed. If the data is normally distributed, the Pearson correlation test is used; if the data is not normally distributed, the Spearman correlation test is used.

Table.3
Results of the Hypothesis Test of HbA1c and Urine Microalbumin

Hubungan	P-Value	Koefisien Korelasi
HbA1c dengan Mikroalbumin Urin	0.031	0.333

Based on Table 3, information is obtained that the relationship between HbA1c and Urinary Microalbumin obtained a significance value of 0.031. This value is <0.05 , so H_0 is rejected and H_1 is accepted, indicating a relationship between HbA1c and Urinary Microalbumin. The correlation coefficient figure of 0.333 indicates the level of closeness (correlation) between the HbA1c variable and Urinary Microalbumin is 0.333, or falls within the criteria of low and positive correlation.

DISCUSSION

General Characteristics of Research Subjects

This study aims to determine the relationship between HbA1c levels and microalbuminuria in patients with type 2 diabetes mellitus. Data were collected from January to December 2024, with a total sample of 42 DM patients. The study was conducted at the Karang Tinggi Community Health Center.

The results of the study, which involved 42 respondents, revealed that 83% were female, while only 17% were male. This finding aligns with research by Rahmadhina et al. (2022), which reported that the majority of diabetes mellitus sufferers were female (74 individuals (56.92%), compared to males (56 individuals (43.08%). The risk of developing diabetes mellitus is greater in women than in men, which is thought to be due to physical factors such as a more significant increase in body mass index in women. Conditions such as premenstrual syndrome (PMS) and postmenopausal hormonal changes contribute to a more easily accumulated body fat distribution, thus increasing the risk of diabetes.

Based on Table 4.1, the majority of respondents were in the 46–65 age group, accounting for 66%. This finding aligns with research conducted by Yosimyati (2021) at the Peterongan Community Health Center in Jombang Regency. The study showed that the prevalence of diabetes mellitus tends to be higher in the elderly. A similar finding was also found by Rahmadhina et al. (2022), who showed that respondents aged 46–65 had a higher risk of developing diabetes mellitus. The increased risk in this age group may be due to the aging process, which affects general decline in body function, including reduced insulin sensitivity to blood glucose metabolism.

Relationship between HbA1c Values and Urinary Microalbumin in Patients with Type 2 Diabetes Mellitus

The results of the study of 42 respondents showed that 13 (31%) had HbA1c levels <6.5%, while 29 (69%) had HbA1c levels >6.5%. These results indicate that the majority of respondents have not achieved optimal glycemic control, as HbA1c levels above 6.5% clinically suggest a diagnosis of diabetes mellitus or poorly controlled prediabetes.

These results are consistent with research conducted by Enola et al. (2023), which reported that 87.1% of respondents with type 2 diabetes had HbA1c levels above 6.5%, indicating poor glycemic control. This research supports the findings of this study, which show that diabetes management remains a challenge, particularly in terms of patient adherence to therapy and lifestyle changes.

HbA1c is a key indicator for assessing long-term glycemic control, as it reflects average blood glucose levels over the past 2 to 3 months. An HbA1c value below 6.5% is considered a good threshold for preventing microvascular and macrovascular complications in people with diabetes mellitus (PERKENI, 2019).

The results showed that of the 42 respondents, 5 (12%) had urinary microalbumin levels <20 mg/dL, while 37 (88%) had levels >20 mg/dL. In the group of 7 male respondents, all (100%) had urinary microalbumin levels >20 mg/dL. Meanwhile, of the 35 female respondents, 5 (13.6%) had urinary microalbumin levels <20 mg/dL and 32 (91.4%) had levels >20 mg/dL. These findings are in line with research by Rahmadhina et al. (2022) who reported that 91 respondents (61.6%) in their study had high urinary microalbumin levels. Similar results were also reported by Fandinata (2019), who stated that the presence of microalbuminuria or proteinuria is an indication of endothelial dysfunction, which is

common in patients with type 2 diabetes mellitus.

Microalbuminuria is not only an early indicator of diabetic nephropathy but has also been shown to be an important marker of cardiovascular risk in patients with diabetes mellitus. The presence of microalbuminuria reflects endothelial dysfunction and systemic vascular damage, which increases the likelihood of macrovascular complications such as coronary heart disease, stroke, and peripheral arterial disease. Therefore, early detection of microalbuminuria is crucial, not only to prevent the progression of kidney damage but also as an anticipatory measure against the risk of broader cardiovascular disease. PERKENI (2019).

The results of this study with the title of the relationship between HbA1c levels and urinary microalbumin in patients with Type 2 Diabetes Mellitus using the Spearman test showed that the relationship between HbA1c and urinary microalbumin obtained a significance value of 0.031, this value is <0.05 , so H_0 is rejected and H_1 is accepted, which means there is a relationship between HbA1c and urinary microalbumin in patients with Type 2 Diabetes Mellitus. with Urinary Microalbumin. The correlation coefficient of 0.333 indicates a strong correlation between HbA1c and Urinary Microalbumin, which falls into the low category and is positive, indicating a higher HbA1c level, followed by an increase in urinary microalbumin levels, but the correlation strength is not significant. Rahmadhina et al (2022) found a strong correlation ($r = 0.852$, $p < 0.001$), indicating a strong positive correlation between HbA1c levels and Urinary Microalbumin, while Rizki et al (2022) obtained a p value of 0.350, indicating no significant correlation between HbA1c levels and microalbuminuria. This study is in line with Al Rasyid et al's (2022) study, which found a low correlation between HbA1c levels and urinary microalbumin in Type 2 DM because $r: 0.323$.

This study found a weak correlation between HbA1c levels and microalbuminuria in patients with type 2 diabetes mellitus, with a correlation coefficient (r) of 0.333. Although the strength of the relationship is considered low, this result is still statistically significant, indicating a scientific link between HbA1c levels and urinary microalbumin. This suggests that HbA1c can provide an early indication of the risk of kidney damage. However, because this relationship is not strong, HbA1c is not the sole factor influencing urinary microalbumin levels. Therefore, monitoring HbA1c levels remains important, but it needs to be combined with other factors such as blood pressure, diabetes duration, and other metabolic factors to more comprehensively assess the risk of nephropathy.

The low correlation between HbA1c levels and urinary microalbumin is likely due to the lack of control for confounding variables in this study, such as medication use, duration of diabetes mellitus, and medical history, particularly kidney disorders. Medication use is an important factor because some patients do not regularly take their medications as prescribed by their doctor. It is known that some patients only take medication close to the time of examination or when experiencing certain symptoms, resulting in unstable glycemic control. Furthermore, the duration of diabetes also plays a role, as some patients in this study were recently diagnosed with type 2 diabetes. This condition can cause complications such as decreased kidney function, which has not yet developed, resulting in a significant increase in urinary microalbumin levels (ADA, 2022). Therefore, these variables may contribute to the low strength of the relationship found in this study.

Lack of control of kidney disease is one factor contributing to the low strength of the

relationship between HbA1c levels and urinary microalbumin. This is due to the significant variation in results during the study. Nevertheless, in general, the relationship between HbA1c levels and urinary microalbumin indicates that higher HbA1c levels tend to lead to higher urinary microalbumin levels.

Poor long-term glycemic control in patients with type 2 diabetes mellitus can increase the risk of kidney complications. One early indicator of these complications is increased microalbuminuria, which reflects early kidney damage. Perkeni (2021).

CONCLUSION

The average HbA1c level in patients with type 2 diabetes mellitus was 7.542%.

The average microalbuminuria level in patients with type 2 diabetes mellitus was recorded at 93.419 mg/dL.

A relationship was found between HbA1c levels and microalbumin levels in urine in patients with Diabetes Mellitus.

SUGGESTION

For future research, it is recommended that researchers expand the number of sources and references related to the two variables studied, as well as increase the sample size or consider using different subjects/populations. This is expected to improve the quality of research results and produce more diverse and comprehensive references.

For patients with diabetes mellitus, it is highly recommended to continue implementing promotive and preventive measures to anticipate complications that may arise from hyperglycemia. Given that some of the organ damage caused can be irreversible or cannot be fully reversed, it is crucial for patients to maintain optimal blood sugar control.

BIBLIOGRAPHY

- Al-Rasyid M M, & Endang Widhiyastuti (2022) Hubungan HbA1c Dengan Mikroalbumin Urin Pada Pasien Diabetes Melitus Tipe 2 Di Prolanis Klinik Sehat Setia Brebes (JITK Bhamada Vol. 14, No. 1, April (2023)) p. 70 - 76) <https://ejournal.bhamada.ac.id/index.php/jik/article/view/397>
- American Diabetes Association. (2022). Classification and Diagnosis of Diabetes : Standards of Medical Care in Diabetes. American Diabetes Association, 45 (Suppl), 17–38. https://diabetesjournals.org/care/article/45/Supplement_1/S17/138925/2-Classification-and-Diagnosis-of-Diabetes.
- Ashidiq M F, Lailil M & Budi D S (2025) Deteksi Nefropati Diabetik Pada Pasien Diabetes Melitus Menggunakan Regresi Logistik (Vol. 9, No. 2, Februari 2025,) <https://j-ptiik.ub.ac.id/index.php/j-ptiik/article/view/14478/6452>
- BURROWS, William R.; PRICE, Colin; WILSON, Laurence J. Warm season lightning probability prediction for Canada and the northern United States. *Weather and Forecasting*, 2005, 20.6: 971-988.
- Dewi, J. (2016). Cystatin C, HbA1c, dan Rasio Albumin Kreatinin. *Indonesian Journal of Clinical Pathology and Medical Laboratory*, 19(3), 167. <https://doi.org/10.24293/ijcpml.v19i3.412>
- Dinas kesehatan provinsi Bengkulu. (2023). *profil dinas kesehatan provinsi bengkulu tahun 2023*. 1–23

- Fandinata, S. S. (2019). Perubahan Kadar Protein dalam Urin terhadap Penggunaan Obat Antihipertensi (Valsartan) pada Pasien Nefropati. *Journal of Pharmacy and Science*, 4(1), 1–6. doi: 10.53342/pharmasci.v4i1.121
- Ikizler, T. A., Burrowes, J. D., Byham-Gray, L. D., Campbell, K. L., Carrero, J. J., Chan, W., Fouque, D., Friedman, A. N., Ghaddar, S., Goldstein-Fuchs, D. J., Kaysen, G. A., Kopple, J. D., Teta, D., Yee-Moon Wang, A., & Cuppari, L. (2020). KDOQI Clinical Practice Guideline for Nutrition in CKD: 2020 Update. *American Journal of Kidney Diseases*, 76(3), S1–S107. <https://doi.org/10.1053/j.ajkd.2020.05.006>
- International Diabetes Federation (2021). *International Diabetic Federation Diabetic Atlas 10th edition*.
- International Diabetes Federation. (2019). *IDF Diabetes Atlas Ninth Edition 2019*. Manaf, Asman. "Neuropathic Pain in Diabetes Mellitus." *Bagian Penyakit Dalam Universitas Andalas Padang* (2009).
- P2PTM Kemenkes RI. Penyakit Diabetes Melitus. Kementerian Kesehatan Republik Indonesiaepublik Indonesia Available at: <https://p2ptm.kemkes.go.id/informasi-p2ptm/penyakit-diabetes-melitus>.
- PERKENI. (2019). Pedoman pengelolaan dan pencegahan diabetes melitus tipe 2 di Indonesia. In PERKENI.
- PERKENI. (2021). *Pedoman Pengelolaan dan Pencegahan Diabetes Melitus Tipe 2 Dewasa di Indonesia (1st ed.)*. PB. PERKENI. <https://pbperkeni.or.id/unduh>
- Puskesmas Krang Tinggi. (2023). *Rekam Medik Program Lansia*.
- Putri, R. I. (2015). Faktor Determinan Nefropati Diabetik Pada Penderita Diabetes Mellitus Di Rsud Dr. M. Soewandhie Surabaya. *Jurnal Berkala Epidemiologi*, 3(1), 109–121. <https://media.neliti.com/media/publications/76507-IDnone.pdf>
- Rahmadhina W, (2022). Hubungan Kadar HbA1c Dengan Mikroalbuminuria Pada Pasien Penderita Diabetes Melitus Di Klinik Guci Medika.
- Ramadhan N, Marissa N, Fitria E, Wilya V. Pengendalian Diabetes Melitus Tipe 2 pada Pasien di Puskesmas Jayabaru Kota Banda Aceh. *Media Penelit dan Pengemb Kesehatan*. 2018;28(4):239–46
- Satria, H., Eva, D., & Afriwardi. (2018). Faktor Risiko Pasien Nefropati Diabetik Yang Dirawat Di Bagian Penyakit Dalam Rsup Dr. M. Djamil Padang. *Jurnal Kesehatan Andalas*, 7(2), 149. <https://doi.org/10.25077/jka.v7i2.794>
- WHO. (2020). *Diabetes (Issue June, pp. 1-6)*. WHO. (2022) *Diabetes*.
- WHO.(2019) *Classification of Diabetes Mellitus 2019*.
- Yosdimiyati, Leo. 2021. The Relations hip between Microalbumin Levels and HbA1c in People at Risk for Type 2 Diabetes melitus. *Jurnal STIKES Insan Cendekia Medisa Jombang Vol 4. Issue 2*