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CORRELATION BETWEEN HEMOGLOBIN A1c (HbA1c) LEVELS AND MICROALBUMINURIA IN DIABETES MELLITUS PATIENTS AT PRODIA SUNTER

HUBUNGAN KADAR HEMOGLOBIN A1c (HbA1c) DENGAN MIKROALBUMINURIA PADA PASIEN DIABETES MELITUS DI PRODIA SUNTER

Maylina Putri [1], I Gusti Putu Agus Ferry Sutrisna Putra[2], Diah Prihatiningsih[3]
[1]Program Studi Teknologi Laboratorium Medis Program Sarjana Terapan, STIKES Wira Medika Bali
Email: putrimaylina72@gmail.com
[2]Program Studi Teknologi Laboratorium Medis Program Sarjana Terapan, STIKES Wira Medika Bali
Email:ferryvikana@gmail.com
[3]Program Studi Teknologi Laboratorium Medis Program Sarjana Terapan, STIKES Wira Medika Bali
Email:diahciprik@gmail.com

*email Koresponden: putrimaylina72@gmail.com

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Abstract

Diabetes Mellitus (DM) is a disease caused by pancreatic failure in performing its function of producing insulin. A lack of insulin will lead to an increase in blood glucose levels, also known as hyperglycemia. Hemoglobin A1c and microalbuminuria are screening examinations used to detect the early onset of diabetic nephropathy. Diabetic nephropathy is defined as a clinical syndrome in diabetes mellitus patients characterized by persistent albuminuria, an irreversible decrease in glomerular filtration rate, and increased arterial blood pressure. The purpose of this study is to determine the relationship between Hemoglobin A1c and microalbuminuria in diabetes mellitus patients at Prodia Sunter. The research method used is quantitative analytic with a cross-sectional approach. The data collected were secondary data from the period of January–July 2024 with a total of 60 samples. Sampling was conducted using purposive sampling and met the inclusion criteria, namely patients over 60 years of age, Hemoglobin A1c value ≥7, diagnosed with diabetes mellitus, no history of thalassemia, and who had undergone Hemoglobin A1c and microalbuminuria examinations. The results of this study show a significant unidirectional positive relationship with a very strong correlation between Hemoglobin A1c levels and microalbuminuria in diabetes mellitus patients, with sig (2-tailed) = 0.000 and correlation coefficient value = 0.892. The relationship between Hemoglobin A1c levels and microalbuminuria is unidirectional positive, meaning that the higher the Hemoglobin A1c levels, the higher the microalbuminuria levels.

Keywords : Diabetes Mellitus, Hemoglobin A1C, Microalbuminuria

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Abstrak

Diabetes Melitus (DM) adalah penyakit yang dikarenakan pankreas mengalami kegagalan dalam menjalankan fungsinya yaitu memproduksi insulin. Kurangnya insulin akan menyebabkan meningkatnya kadar glukosa di dalam darah atau disebut juga dengan hiperglikemia. Hemoglobin A1c dan Mikroalbuminuria merupakan pemeriksaan skrining guna mendeteksi awal terjadinya nefropati diabetik. Nefropati diabetik didefinisikan sebagai sindrom klinik pada pasien diabetes melitus yang ditandai dengan albuminuria menetap, penurunan kecepatan filtrasi glumerulus yang tidak fleksibel dan peningkatan tekanan darah arterial. Tujuan dari penelitian ini untuk mengetahui adanya hubungan antara Hemoglobin A1c dan Mikroalbuminuria pada pasien diabetes melitus di Prodia Sunter. Metode penelitian ini adalah analitik kuantitatif dengan pendekatan cross sectional. Data yang diambil merupakan data sekunder periode Januari-Juli 2024 dengan jumlah sampel 60 orang. Pengambilan sampel menggunakan purposive sampling dan sudah memenuhi syarat data inklusi yaitu pasien berusia di atas 60 tahun, nilai Hemoglobin A1c ≥7, pasien diabetes melitus, tidak memiliki riwayat thalasemia dan pasien melakukan pemeriksaan Hemoglobin A1c dan Mikroalbuminuria. Hasil dari penelitian ini yaitu terdapat hubungan positif searah yang signifikan dengan korelasi sangat kuat antara kadar Hemoglobin A1c dengan Mikroalbuminuria pada pasien diabetes melitus dengan sig (2-tailed) = 0,000 dan nilai koefisien korelasi = 0,892. Hubungan antara kadar Hemoglobin A1c dengan Mikroalbuminuria bersifat positif searah yang berarti semakin tinggi kadar Hemoglobin A1c semakin tinggi pula kadar Mikroalbuminuria .

Kata Kunci : Diabetes Melitus, Hemoglobin A1C, Mikroalbuminuria

1. INTRODUCTION

Diabetes Mellitus (DM) is a metabolic disorder characterized by the pancreas' inability to produce insulin optimally. This insulin deficiency leads to an increase in blood glucose levels (hyperglycemia), which, over the long term, can cause damage to blood vessels and the nervous system. Diabetes Mellitus is one of the most significant global health problems. It ranks fourth among the leading causes of death worldwide, after cardiovascular diseases, cancer, and chronic lung diseases (Kurniawati et al., 2021).

According to the World Health Organization (WHO) in 2010, Diabetes Mellitus ranked as the sixth leading cause of death globally (Suharto et al., 2019). The number of deaths due to Diabetes Mellitus reached approximately 1.3 million, with 4% of these occurring before the age of 70. The age group most affected by Diabetes Mellitus-related deaths is between 45-54 years old. Furthermore, the prevalence of Diabetes Mellitus is higher in urban areas compared to rural areas (Widyasari, 2017). Based on data from the International Diabetes Federation (IDF), DM is expected to become the seventh leading cause of death in the world by 2030. The prevalence of DM in adults increased from 4.7% to 8.5% since 1980 (Pebryani et al., 2024).

Indonesia ranks seventh among the countries with the highest number of DM sufferers, following China, India, the United States, Brazil, Russia, and Mexico (Ferino, 2018). According to IDF data from 2015, the number of DM patients in Indonesia had reached around 10 million people. DM cases are now also found in children and adolescents, in addition to adults (Nasution et al., 2021).

Microangiopathic complications, such as diabetic nephropathy (DN), are among the primary complications in DM patients. According to data from the Epidemiology of Diabetes

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Interventions and Complications (EDIC), microalbuminuria is detected in about 25% of DM patients after 10 years of having the disease. Microalbuminuria is defined as albumin excretion in the urine between 20–200 mg/day. If left untreated, this condition can progress to macroalbuminuria and eventually lead to end-stage renal disease (ESRD) (Rahmadhina et al., 2022).

Chronic hyperglycemia is marked by an increase in Hemoglobin A1c (HbA1c) levels. A reduction of HbA1c by 1% has been proven to reduce the risk of microvascular complications. Additionally, hypertension, particularly diastolic blood pressure above 90 mmHg, also plays a role in increasing the risk of proteinuria. High blood pressure tends to be associated with higher albumin levels in the urine. The prevalence of microalbuminuria in DM patients with hypertension ranges from 4.7% to 40%. Persistently high glucose levels can also cause glycation of proteins and collagen in the blood vessel walls, forming irreversible bonds (Hermawan et al., 2020).

One laboratory test recommended by the American Diabetes Association (ADA) to support the diagnosis of DM is the Hemoglobin A1c test. This test is an important indicator for monitoring long-term glycemic control as it reflects the average blood glucose levels over the last 2 to 3 months, or approximately 120 days (Sartika & Hestiani, 2019).

One critical complication of DM is diabetic nephropathy, which is the damage to the kidney glomerulus, leading to protein leakage, such as albumin, into the urine. An increase in albumin excretion reflects the degree of vascular damage. Microalbuminuria is an early sign of kidney disease due to DM, as well as an indicator of progressive blood vessel damage. The normal value for albumin excretion is <30 mg/L. Monitoring HbA1c and microalbumin levels is essential because both are key parameters in managing DM (Enola et al., 2023). Based on this background, the researcher observed an increase in HbA1c levels, which is consistently accompanied by an increase in microalbuminuria, potentially leading to kidney failure (diabetic nephropathy). Therefore, the researcher is interested in conducting further research.

2. RESEARCH METHOD

The research uses an observational analytic method with a cross-sectional approach. Observational analytic is a survey aimed at providing an explanation of risk factors and causes of diseases. Risk factors are elements or conditions that influence the development of a disease or a specific health status.

This study uses a qualitative approach with a literature review design to analyze and synthesize relevant literature related to the application of descriptive statistics in both quantitative and qualitative research (Bowen, 2009; Creswell & Creswell, 2018). A literature review was chosen because it is suitable for integrating various findings from previous literature, allowing for the development of a systematic practical guide. Data were collected from various sources, including academic reference books, peer-reviewed journal articles, research reports, and dissertations. The literature search was conducted using the Google Scholar database with keywords such as "descriptive statistics," "quantitative research," "qualitative research," and "statistical errors." Literature selection was based on relevance to the topic, publication quality, and source credibility, prioritizing peer-reviewed literature (Bowen, 2009).

Cross-sectional research is a study conducted to examine the dynamic correlation between risk factors and disease causes that occur in the research subjects, with data collected simultaneously at the same point in time (Notoatmodjo, 2005). This study aims to determine

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the relationship between Hemoglobin A1c levels and microalbuminuria in patients with diabetes mellitus at the Prodia Sunter Clinical Laboratory in North Jakarta.

3. RESULTS AND DISCUSSION

Results

1. Characteristic of the Research Subjects

Table 1. Respondent Characteristics Based on Gender

Respondent Characteristics Gender	Number	Percentage (%)
Male	23	38.3
Female	37	61.7
Total	**60**	**100**

Based on the research conducted, it was found that the majority of the subjects in this study were female, with a total of 37 individuals (61.7%), while 23 individuals (38.3%) were male.

Table 2: Respondent Characteristics Based on Age

Respondent Characteristics	Number	Percentage (%)
Elderly (60 - 75 years)	54	90
Older Elderly (76 - 90 years)	6	10
Total	**60**	**100**

Based on the research conducted, it was found that the age group that dominated this study was the elderly group, with 54 individuals (90%) aged 60-75 years (elderly) and 6 individuals (10%) aged 76-90 years (older elderly).

2. Characteristics of Hemoglobin A1c Levels Based on Gender

The Hemoglobin A1c values of the respondents obtained from secondary data (patient medical records) of diabetes mellitus patients during the period of January-July 2024 are as follows:

Table 3: Hemoglobin A1c Levels Based on Gender

HbA1c Level	Frequency (People)	Percentage (%)
≥7 (HbA1c Male)	23	38.3
≥7 (HbA1c Female)	37	61.7
Total	**60**	**100**

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Based on the research conducted, it was found that the results of the Hemoglobin A1c tests with HbA1c levels ≥7% showed that 23 male individuals (38.3%) and 37 female individuals (61.7%) had levels ≥7%.

3. Characteristics of Microalbuminuria Levels Based on Gender

Table 4: Microalbuminuria Levels Based on Gender

Microalbuminuria Level	Frequency (People)	Percentage (%)
<20 (Microalbuminuria Male)	7	11.7
>20 (Microalbuminuria Male)	16	26.7
<20 (Microalbuminuria Female)	11	18.3
>20 (Microalbuminuria Female)	26	43.3
Total	**60**	**100**

Based on the research conducted, it was found that the test results with a reference value of Microalbuminuria < 20 mg/dL showed that 7 male respondents (11.7%) and 11 female respondents (18.3%) had levels below 20 mg/dL. The test results with Microalbuminuria levels > 20 mg/dL showed that 16 male respondents (26.7%) and 26 female respondents (43.3%) had levels above 20 mg/dL.

4. Relationship Between Hemoglobin A1c and Microalbuminuria Tests

In the descriptive statistical test results, it was found that the number of male respondents was 23 (38.3%) and the number of female respondents was 37 (61.7%). The lowest age of the patients was 60 years, and the highest age was 85 years, with a standard deviation of 5.674. The lowest HbA1c value was 7.1%, the highest was 13.6%, with an average of 8.7167% and a standard deviation of 1.643. The lowest microalbuminuria value was 3.49 µg/mg, the highest was 3745.57 µg/mg, with an average of 290.6218 µg/mg and a standard deviation of 640.174.

Before conducting the correlation test, a normality test was first performed to determine whether the data followed a normal distribution. The normality test used was the Kolmogorov-Smirnov test. The following are the results of the normality test:

Table 5: Normality Test

Kolmogorov-Smirnov	Sig.	Remarks
HbA1c	0.000	Not Normal
Microalbuminuria	0.000	Not Normal

In the Kolmogorov-Smirnov normality test, the data is considered normal if the Sig. value is >0.05, and not normal if the Sig. value is <0.05. The HbA1c and Microalbuminuria values

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both resulted in a significant p-value of 0.000, indicating that the data are not normally distributed.

Next, the correlation test was performed using Spearman's rank correlation, as the data were not normally distributed. The results of the test are as follows:

Table 6: Correlation Test Results Between Hemoglobin A1c and Microalbuminuria

Kadar HbA1c			**Microalbuminuria Level**
HbA1c	Correlation Coefficient	1,000	0,892
	Sig. (2-tailed)		0,000
Microalbuminuria	Correlation Coefficient	0,892	1,000
	Sig. (2-tailed)	0,000	

Based on the correlation test performed using Spearman's test, as shown in the table above, the significance value (2-tailed) is 0.000. Since the significance value (2-tailed) of 0.000 is less than 0.05, it indicates a significant relationship between the Hemoglobin A1c and Microalbuminuria variables. The correlation coefficient obtained is 0.892, which shows a very strong correlation between the Hemoglobin A1c and Microalbuminuria variables. The positive correlation coefficient of 0.892 means that there is a direct relationship between these two variables, meaning that as the Hemoglobin A1c level increases, the Microalbuminuria level also increases, and vice versa: as the Hemoglobin A1c level decreases, the Microalbuminuria level also decreases.

Discussion of Results

First, based on the Hemoglobin A1c levels in diabetic patients, the results of this study indicate that all respondents had HbA1c levels ≥7%, with an average of 8.72%. This value reflects poor glycemic control, where patients failed to maintain blood glucose levels within the recommended range over the past three months. According to Begley, HbA1c is an important parameter for assessing long-term glucose control and can be used to evaluate the risk of microvascular complications in diabetic patients (Begley, 2012).

The high HbA1c levels in this study align with the pathophysiological theory of type 2 diabetes mellitus, which involves insulin resistance and pancreatic beta-cell dysfunction. When insulin does not work optimally or its production declines, blood glucose levels increase, which is reflected in the rise of HbA1c levels. A study by Klara N. Elnora showed that high HbA1c is significantly associated with an increased risk of microvascular complications such as diabetic nephropathy. In her study, she explained that long-term hyperglycemia causes damage to the glomerular capillaries through the accumulation of advanced glycation end-products (AGEs), oxidative stress, and the activation of inflammatory pathways that disrupt kidney

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structure and function. This is marked by increased glomerular permeability, resulting in albuminuria (Elnora, 2022).

Another study by Supri H. Dalam supports this. Supri stated that uncontrolled HbA1c levels are a major risk factor for diabetic nephropathy and other microvascular complications. The process of advanced glycation end-product (AGE) formation that damages vascular and kidney tissues begins with chronic hyperglycemia, which is determined by high HbA1c levels (Supri, 2016).

However, not all literature agrees. A study by Yusnita et al. found that HbA1c does not always reflect accurate glycemic control in patients with specific conditions such as anemia or hemoglobinopathies, because HbA1c is influenced by erythrocyte age and other hematological statuses. Therefore, there is a possibility that high HbA1c levels may not fully reflect hyperglycemia, although this is not dominant in the general population (Yusnita et al., 2019).

The relationship between respondent characteristics in this study strengthens these findings. The majority of respondents were women (61.7%), all of whom were over the age of 60. According to Nova et al., postmenopausal women experience hormonal changes that contribute to decreased insulin sensitivity. Furthermore, as people age, physical activity tends to decline, and there are changes in body composition that increase the risk of insulin resistance (Nova et al., 2018).

Based on these results, a combination of age, hormonal changes, and possibly low awareness of glycemic control contributes to the high HbA1c levels. Moreover, limitations in routine HbA1c monitoring due to economic factors, lack of education, or access to healthcare services are also suspected to worsen diabetes management in this group.

Second, based on the Hemoglobin A1c levels in diabetic patients at Prodia Sunter, this study showed that the average microalbuminuria level in diabetic patients reached 290.62 µg/mg, which is well above the normal microalbuminuria limit (<30 µg/mg). Microalbuminuria is the excretion of small but abnormal amounts of albumin in the urine and is an early indicator of diabetic nephropathy. This condition is crucial to detect because it remains reversible if addressed properly.

Physiologically, continuous increases in blood glucose levels cause oxidative stress, the activation of the polyol pathway, and the formation of advanced glycation end-products (AGEs). These mechanisms lead to damage to the glomerular endothelial cells and the thickening of the glomerular basement membrane, which increases permeability to albumin molecules. This results in albumin, which should be retained by the kidneys, leaking into the urine, resulting in microalbuminuria (Woro et al., 2020).

According to research by Heptaningrum, Pratiwi, and Nugroho, microalbuminuria is often found in diabetic patients even before clinical symptoms of kidney damage appear and serves as an early indicator of kidney and cardiovascular complications. This finding suggests that microalbuminuria screening should be routinely performed in patients with poor glycemic control (Heptaningrum et al., 2020).

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However, in a study by Putri, Handayani, and Wijaya, it was noted that not all patients with high HbA1c levels develop microalbuminuria. They suggested that genetic factors, protein intake, hydration status, and blood pressure could also be factors influencing microalbuminuria, making HbA1c not the only valid predictor (Putri et al., 2017).

The relationship with respondent characteristics shows that women are more likely to experience microalbuminuria than men. This aligns with the higher HbA1c levels, which were also more prevalent in women in this study. According to Nova et al., postmenopausal women are more vulnerable to vascular damage due to hormonal changes and increased insulin resistance (Nova et al., 2018).

Based on the studies above, the high microalbuminuria values are strongly associated with poor long-term glycemic control. Additionally, low patient awareness of the importance of regular kidney function checks, as well as the limited integration of complication monitoring services in primary care systems, exacerbates the risk of nephropathy development without being noticed.

Third, based on the Spearman correlation analysis in this study, there is a very strong and significant relationship between HbA1c levels and microalbuminuria ($r = 0.892$; $p < 0.001$). This positive correlation indicates that the higher the HbA1c level, the higher the detected microalbuminuria levels, which suggests an increased risk of early kidney damage.

Pathophysiologically, chronic hyperglycemia triggers various mechanisms that damage kidney structures, such as glomerulosclerosis and arteriolar hyalinosis. High HbA1c levels reflect prolonged glucose exposure, which eventually leads to a decrease in the selectivity of the glomerular membrane towards proteins. Thus, HbA1c is not only an indicator of glucose control but also a predictor of microvascular complications such as diabetic nephropathy (Mogensen, 2000).

According to Susan, Andayani, and Hutabarat's research, HbA1c levels are meaningfully correlated with the degree of microalbuminuria and can be used to assess the risk of kidney complications in diabetic patients (Susan et al., 2020). A study by Prithvi, Sharma, and Thomas also supports that HbA1c levels can serve as an efficient screening tool to detect microalbuminuria in type 2 diabetic patients. Their study found that patients with higher HbA1c levels had a significantly higher prevalence of microalbuminuria compared to those with lower HbA1c levels (Prithvi et al., 2017).

This indicates that HbA1c not only reflects blood glucose control but can also be used to predict the risk of early kidney complications. Therefore, regular HbA1c monitoring is important, not only to control glucose but also to detect potential kidney damage that has not yet shown clinical symptoms.

However, a different result was reported by Mulyani, Suryani, and Lestari, where no significant correlation was found between HbA1c and microalbuminuria in patients with diabetes duration of less than five years. This study concluded that disease duration and blood pressure status play a larger role in determining the early development of nephropathy (Mulyani et al., 2018).

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The characteristics of the respondents in this study reinforce the positive correlation findings, as all subjects were over 60 years old and had high HbA1c levels. In the elderly population, poor glycemic control rapidly worsens kidney function due to the physiological decline in nephron reserves.

Based on the aforementioned study, measuring HbA1c levels can be used not only for glucose therapy monitoring but also as an early predictive indicator for possible kidney damage. Therefore, HbA1c and microalbuminuria screenings should be conducted simultaneously in the management of diabetic patients.

4. CONCLUSION

Based on the data analysis regarding the relationship between HbA1c levels and microalbuminuria in diabetic patients conducted at Prodia Sunter, the following conclusions were drawn: The average result of Hemoglobin A1c testing in diabetic patients was 8.72%, with the minimum value being 7.1% and the maximum value 13.6%. The average result for microalbuminuria in diabetic patients was 290.62 µg/mg, with the minimum value being 3.49 µg/mg and the maximum value 3745.57 µg/mg. There is a significant positive correlation between HbA1c levels and microalbuminuria in diabetic patients, with a very strong correlation coefficient of 0.892 and a p-value (2-tailed) of 0.000. The relationship between HbA1c levels and microalbuminuria is positive, meaning that the higher the HbA1c level, the higher the level of microalbuminuria.

5. REFERENCES

Amalia, R. F. (2014). Faktor risiko kejadian diabetes mellitus pada lansia di Puskesmas Kecamatan Mampang Prapatan Jakarta Selatan tahun 2014. Naskah Publikasi, Universitas Indonesia. Tersedia dari: lib.ui.ac.id

American Diabetes Association (ADA). (2020). Standards of medical care in diabetes. Diabetes Care, 43(Suppl 1), S1–S212.

Anggeria, E. (2021). Perawatan diri pada pasien diabetes mellitus. Publish Buku UNPRI Press, 1(1).

Enola, K. N., Djohan, H., & Kamilla, L. (2023). Hubungan kadar HbA1c dan mikroalbumin pada pasien Prolanis di Kota Pontianak. Innovatives: Journal of Social Science Research, 3(6), 2588–2595.

Destiani, A. B., & Chondro, F. (2018). Hubungan kadar hemoglobin A1c dengan kualitas tidur pada pasien diabetes mellitus tipe 2. Jurnal Biomedika dan Kesehatan, 1(1), 93–100.

Dewi Prasetyani, S. (2017). Analisis faktor yang mempengaruhi kejadian diabetes mellitus tipe 2. Jurnal Analisis Kesehatan, 2(2), 1–9.

Febrianto, D., & Hindariati, E. (2021). Tata laksana ketoasidosis diabetik pada penderita gagal jantung. Jurnal Penyakit Dalam Indonesia, 8(1), 46–53.

Multidisciplinary Indonesian Center Journal (MICJO)
Journal page is available to
https://e-jurnal.jurnalcenter.com/index.php/micjo
Email: admin@jurnalcenter.com

Ferino, F. (2018). Hubungan antara kadar HbA1c dengan kadar kreatinin serum pada pasien diabetes mellitus tipe 2 (Skripsi).

Firani, N. K., Fatonah, S., Arsana, P. M., Waafi, A. K., & Kristyoadi, S. A. (2023). Deteksi kelainan hemostasis pada penderita diabetes mellitus tipe 2 dengan metode tromboelastografi. Universitas Brawijaya Press.

Elnora, K. N. (2022). The relationship between HbA1c levels and early diabetic nephropathy. Journal of Diabetic Complications.

Hardianto, D. (2020). Telaah komprehensif diabetes mellitus: klasifikasi, gejala, diagnosis, pencegahan, dan pengobatan. Jurnal Bioteknologi dan Biosains Indonesia, 7(2), 304–317.

Heptaningrum, E., Pratiwi, F. I., & Nugroho, H. (2020). Mikroalbuminuria sebagai indikator awal komplikasi diabetes. Jurnal Penelitian Gizi dan Makanan, 43(1), 45–52.

Hermawan, G. M., Luse, L., Chriestya, F., & Steffanus, M. (2020). Hubungan kadar HbA1c dengan albuminuria pada pasien DM tipe II di RS Atma Jaya. Journal of the Indonesian Medical Association, 70(2), 4–9.

Kurniawati, T., Lestari, D., Rahayu, A. P., Syaputri, F. N., & Tugon, T. D. A. (2021). Evaluasi profil penggunaan obat antidiabetes pada pasien diabetes mellitus tipe 2 rawat jalan di salah satu rumah sakit Kabupaten Bogor. Journal of Science, Technology and Entrepreneur, 3(1).

Nasution, F., Andilala, A., & Siregar, A. A. (2021). Faktor risiko kejadian diabetes mellitus. Jurnal Ilmu Kesehatan, 9(2), 94–102.

Notoatmodjo, S. (2005). Metodologi penelitian kesehatan. Jakarta: Rineka Cipta.

Nuraisyah, F. (2017). Faktor risiko diabetes mellitus tipe 2. Jurnal Kebidanan dan Keperawatan Aisyiyah, 13(2), 120–127.

Pebryani, A., Amin, F. A., & Arifin, V. N. (2024). Pengaruh gaya hidup terhadap kejadian penyakit diabetes mellitus tipe II pada masyarakat di wilayah kerja Puskesmas Ladang Rimba Kabupaten Aceh Selatan tahun 2024. Jurnal Kesehatan Tambusai, 5.

PERKENI. (2021). Pedoman pengelolaan dan pencegahan diabetes tipe 2 di Indonesia. PB PERKENI.

Putri, I. W., Handayani, L., & Wijaya, R. (2017). Perbedaan mikroalbuminuria pada penderita DM tipe 2 berdasarkan kadar HbA1c. Jurnal Ners dan Kebidanan, 4(2), 102–108.

Multidisciplinary Indonesian Center Journal (MICJO)
Journal page is available to
https://e-jurnal.jurnalcenter.com/index.php/micjo
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Prithvi, R., Sharma, K., & Thomas, R. (2017). Glycated hemoglobin as a predictor of microalbuminuria in patients with type 2 diabetes mellitus. International Journal of Diabetes and Clinical Research, 4(3), 1–5.

Malkani, S., & Morde, J. P. (2011). Implications of using hemoglobin A1c for diagnosing diabetes mellitus. American Journal of Medicine.

Mulyani, R., Suryani, E., & Lestari, I. (2018). Korelasi kadar HbA1c dan mikroalbuminuria pada pasien diabetes mellitus. Jurnal Keperawatan Padjadjaran, 6(3), 165–172.

Nova, N. D., Rachmawati, N., & Sari, Y. (2018). Risiko resistensi insulin pada wanita pasca menopause. Jurnal Kedokteran Universitas Airlangga, 10(2), 75–80.

Que, A., Yasa, I., & Lestari, A. A. W. (2015). Gambaran hasil pemeriksaan kadar HbA1c pada penderita diabetes mellitus di Laboratorium RSU Surya Husadha tahun 2013. E-Jurnal Medika Udayana.

Qurratuaeni. (2009). Faktor-faktor yang berhubungan dengan terkendalinya kadar gula darah pada pasien diabetes mellitus di RSUP Fatmawati (Skripsi). UIN Syarif Hidayatullah, Jakarta.

Rahmadhina, W. (t.t.). Hubungan kadar HbA1c dengan mikroalbuminuria pada pasien penderita diabetes mellitus di Klinik Guci Medika.

Salsabila, N. S. (2025). Hubungan kadar HbA1c dengan kadar kreatinin serum pada pasien diabetes mellitus tipe 2 di Rumah Sakit Umum Daerah Dr. H. Abdul Moeloek Provinsi Lampung bulan Januari–Desember tahun 2023.

Sartika, F., & Hestiani, N. (2019). Kadar HbA1c pada pasien wanita penderita diabetes mellitus tipe 2 di RSUD Dr. Doris Sylvanus Palangka Raya. Borneo Journal of Medical Laboratory Technology, 2(1), 97–100.

Saedi, P., Petersen, I., Salpe, P., Malanda, B., Karuranga, S., Unwin, N., et al. (2019). Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: Results from the International Diabetes Federation Diabetes Atlas. Diabetes Research and Clinical Practice, 157, 107843.

Sherwood, L. (2012). Human physiology: From cells to systems (8th ed.). Brooks/Cole.

Sudoyo, A. W., Setiyohadi, B., Alwi, I., Simadibrata, M., & Setiati, S. (2009). Buku ajar ilmu penyakit dalam (Jilid II, ed. 5). Interna Publishing.

Sugiyono, F. X. (2017). Neraca pembayaran: Konsep, metodologi dan penerapan (Vol. 4). PPSK Bank Indonesia.

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Suharto, I. P. S., Lutfi, E. I., & Rahayu, M. D. (2019). Pengaruh pemberian jahe (Zingiber officinale) terhadap glukosa darah pasien diabetes mellitus. Care: Jurnal Ilmiah Ilmu Kesehatan, 7(3), 76.

Supri, H. (2016). Hubungan kadar HbA1c dengan komplikasi mikrovaskular pada pasien diabetes mellitus. Indonesian Journal of Clinical Pathology and Medical Laboratory, 22(1), 41–46.

Susan, R., Andayani, M., & Hutabarat, E. (2020). Korelasi HbA1c dengan mikroalbuminuria pada penderita DM tipe 2. Indonesian Journal of Endocrinology and Metabolism, 5(1), 23–29.

Syafi'i, I., & Rosyidah, L. (2022). Model pengembangan kurikulum adaptif pada sekolah inklusif. Jurnal Penelitian Medan Agama, 13(2), 67–72.

Ulfah, R., & Syahrizal, S. (2023). Hubungan kadar GDP, kreatinin, dan ureum dengan kadar HbA1c pada penderita diabetes mellitus tipe 2. Jurnal Cahaya Mandalika, 3(2), 457–466.

Utomo, M. R. S., Wungouw, H., & Marunduh, S. (2015). Kadar HbA1c pada pasien diabetes mellitus tipe 2 di Puskesmas Bahu Kecamatan Malalayang. E-Biomedik (eBM), 3(April), 3–11.

Wardhana, A., Mahmuda, I. N. N., Sulistyani, S., Ermawati, S., Puspitasari, M., & Binuko, R. S. D. (2024). Hubungan HbA1c, mikroalbuminuria dan kolesterol dengan estimasi glomerular filtration rate (GFR) pada pasien diabetes mellitus tipe 2. Journal of Innovation Research and Knowledge, 4(2), 775–786.

Widyasari, N. (2017). Hubungan karakteristik responden dengan risiko diabetes mellitus dan dislipidemia di Kelurahan Tanah Kalikedinding. Jurnal Berkala Epidemiologi, 5(1), 130–141.

Wiener, K. (1999). Age does not influence levels of HbA1c in normal subjects. QJM: An International Journal of Medicine, 92, 169.

Woro, S. N., Purwaningsih, D., & Anindita, R. (2020). Mikroalbuminuria sebagai prediktor awal nefropati diabetik. Jurnal Ilmu Kesehatan Masyarakat, 11(1), 62–68.

Yosmar, R., Almasdy, D., & Rahma, F. (2018). Survei risiko penyakit diabetes mellitus terhadap kesehatan masyarakat Kota Padang. Jurnal Sains Farmasi dan Klinis, 5(Agustus), 134–141.

Yusnita, R., Fauziah, A., & Hakim, A. (2019). Ke$tidakakuratan HbA1c pada pasie$n ane$mia kronik. Jurnal Kesehatan Andalas, 8(2), 115–121.