

THE RELATIONSHIP BETWEEN WAIST CIRCUMFERENCE AND HbA1c LEVELS IN PATIENTS WITH TYPE 2 DIABETES MELLITUS AT JIMBUN MEDIKA PRIMARY CLINIC

Hubungan Lingkar Perut dengan Kadar HbA1c pada Pasien Diabetes Mellitus Tipe 2 di Klinik Pratama Jimbun Medika

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ABSTRACT

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disease associated with long-term macrovascular and microvascular complications. Glycated hemoglobin (HbA1c) is widely used as an indicator of long-term glycemic control, whereas waist circumference reflects central obesity, which is closely related to insulin resistance. This study aimed to analyze the relationship between waist circumference and HbA1c levels among patients with T2DM enrolled in the Chronic Disease Management Program (Prolanis) at Jimbun Medika Primary Clinic, Kediri. This study used an analytical observational design with a cross-sectional approach. A total of 17 respondents were selected using purposive sampling based on predetermined inclusion and exclusion criteria. Waist circumference was measured using a non-elastic measuring tape, while HbA1c data were obtained from laboratory records within the last three months. Data were analyzed descriptively and using correlation analysis. Pearson correlation was used when the data were normally distributed, while Spearman correlation was used when the data were not normally distributed. The results showed that all respondents had waist circumference above the central obesity threshold and HbA1c levels above 7%, indicating poor glycemic control. Due to the small sample size and the absence of variation in categorical data, the findings should be interpreted as preliminary evidence. This study concludes that waist circumference may be used as a simple anthropometric indicator to support the assessment of glycemic control in patients with T2DM. Further studies with larger sample sizes and more varied data are recommended.

Keyword : *type 2 diabetes mellitus; HbA1c; waist circumference; central obesity; glycemic control*

ABSTRAK

Diabetes melitus tipe 2 merupakan penyakit metabolik kronis yang berkaitan dengan komplikasi makrovaskular dan mikrovaskular jangka panjang. Glycated hemoglobin (HbA1c) digunakan sebagai indikator kontrol glikemik jangka panjang, sedangkan lingkar perut mencerminkan obesitas sentral yang berhubungan erat dengan resistensi insulin. Penelitian ini bertujuan untuk menganalisis hubungan lingkar perut dengan kadar HbA1c pada pasien diabetes melitus tipe 2 peserta Program Pengelolaan Penyakit Kronis (Prolanis) di Klinik Pratama Jimbun Medika, Kediri. Penelitian ini menggunakan desain observasional analitik dengan pendekatan cross-sectional. Sebanyak 17 responden dipilih menggunakan teknik purposive sampling berdasarkan kriteria inklusi dan eksklusi yang telah ditetapkan. Lingkar perut diukur menggunakan pita ukur non-elastis, sedangkan data HbA1c diperoleh dari hasil pemeriksaan laboratorium dalam tiga bulan terakhir. Data dianalisis secara deskriptif dan menggunakan uji korelasi. Uji korelasi



Pearson digunakan apabila data berdistribusi normal, sedangkan uji korelasi Spearman digunakan apabila data tidak berdistribusi normal. Hasil penelitian menunjukkan bahwa seluruh responden memiliki lingkar perut di atas batas obesitas sentral dan kadar HbA1c di atas 7%, yang menunjukkan kontrol glikemik yang belum optimal. Karena jumlah sampel kecil dan tidak terdapat variasi pada data kategorik, hasil penelitian ini ditafsirkan sebagai temuan awal. Penelitian ini menyimpulkan bahwa lingkar perut dapat digunakan sebagai indikator antropometri sederhana untuk mendukung penilaian kontrol glikemik pada pasien diabetes melitus tipe 2. Penelitian lanjutan dengan jumlah sampel lebih besar dan data yang lebih bervariasi diperlukan untuk memperkuat temuan ini.

Kata kunci: diabetes melitus tipe 2; HbA1c; lingkar perut; obesitas sentral; kontrol glikemik

INTRODUCTION

Type 2 diabetes mellitus is a major non-communicable disease with a continuously increasing global prevalence. The *International Diabetes Federation* (IDF, 2021) reported that the number of individuals living with diabetes worldwide reached 537 million, and this figure is projected to rise to 643 million by 2030. Indonesia ranks among the top ten countries with the highest number of diabetes cases, with a national prevalence of 10.6% in 2021. This condition imposes a substantial burden on healthcare systems, as type 2 diabetes mellitus is closely associated with an increased risk of macrovascular complications, such as coronary heart disease and stroke, as well as microvascular complications, including nephropathy, retinopathy, and neuropathy (American Diabetes Association, 2022). Therefore, the management of type 2 diabetes mellitus should not only focus on pharmacological therapy but also emphasize glycemic control

monitoring and the management of other metabolic risk factors.

One of the key parameters in monitoring glycemic control is glycated hemoglobin (HbA1c). HbA1c reflects the average blood glucose level over the previous two to three months and is considered more representative than random or fasting plasma glucose measurements (Sherwani et al., 2016). Several studies have demonstrated that elevated HbA1c levels are associated with an increased risk of chronic complications (UKPDS Group, 1998). The American Diabetes Association (2022) recommends an HbA1c target of <7% for most patients with type 2 diabetes mellitus, although achieving this target is influenced by lifestyle factors, treatment adherence, and patients' anthropometric characteristics. Thus, understanding anthropometric factors associated with HbA1c is essential to support more comprehensive interventions.

Waist circumference (WC) is an



anthropometric indicator commonly used to assess body fat distribution. Unlike body mass index (BMI), which considers only weight and height, waist circumference more specifically reflects visceral fat accumulation. Visceral fat plays a critical role in the pathogenesis of insulin resistance through the production of adipokines and pro-inflammatory cytokines that influence glucose metabolism (Després, 2006). Klein et al. (2007) reported that waist circumference is superior to BMI in predicting the risk of metabolic syndrome, while Alberti et al. (2009) identified waist circumference as one of the international diagnostic criteria for metabolic syndrome. In the context of type 2 diabetes mellitus, increased waist circumference is frequently associated with higher HbA1c levels and poor glycemic control (Arroyo-Johnson & Mincey, 2016).

Several studies support a positive association between waist circumference and HbA1c levels. Mohan et al. (2015) found that patients with larger waist circumferences tended to have higher HbA1c levels. Similar findings were reported by Ma et al. (2019) among patients with type 2 diabetes mellitus in China, demonstrating a significant

correlation between waist circumference and HbA1c. However, Anjana et al. (2011) reported variable results in a South Asian population, particularly among patients undergoing intensive therapy, suggesting differences across populations and lifestyle factors. In Indonesia, research examining the relationship between waist circumference and HbA1c remains limited and is predominantly conducted in large hospital settings, whereas studies in primary healthcare facilities, such as primary clinics, are still scarce.

Based on this background, the present study was conducted at Jimbun Medika Primary Clinic, located on Jimbun–Kandat Road, Kandat Village, Kediri Regency, East Java, Indonesia. This clinic is a primary healthcare facility that implements the Chronic Disease Management Program (*Program Pengelolaan Penyakit Kronis / Prolanis*). The program routinely manages patients with type 2 diabetes mellitus, making it a relevant setting to evaluate the relationship between anthropometric factors and glycemic control parameters. The hypothesis proposed in this study is that there is a positive association between waist circumference and HbA1c levels, where



increased waist circumference is associated with poorer glycemic control.

This study aims to analyze the relationship between waist circumference and HbA1c levels among patients with type 2 diabetes mellitus enrolled in the Prolanis program at Jimbun Medika Primary Clinic. The findings are expected to provide scientific evidence regarding the potential of waist circumference as a simple and practical indicator for assessing the risk of poor glycemic control. Ultimately, this study is expected to support efforts in preventing complications through more targeted management of anthropometric risk factors at the primary healthcare level.

METHOD

This study employed a descriptive observational design with a correlational approach to describe respondent characteristics and examine the relationship between waist circumference and glycated hemoglobin (HbA1c) levels among participants of the Chronic Disease Management Program (Prolanis) with type 2 diabetes mellitus at Jimbun Medika Primary Clinic, Kediri, East Java. The study

procedures included the research design, study location and time frame, sample size and sampling technique, research instruments, data collection methods, and statistical analysis.

Study design, location, and time frame

This study used a descriptive observational design with a correlational approach. The research was conducted at Jimbun Medika Primary Clinic, Kediri, East Java, Indonesia. Data collection was carried out on August 16, 2025. This design was selected because the study aimed to describe the characteristics of respondents and explore the relationship between numerical waist circumference values and HbA1c levels among patients with type 2 diabetes mellitus.

Number of subjects and sampling technique/ research instruments and materials

The study population consisted of all active patients with type 2 diabetes mellitus enrolled in the Prolanis program at Jimbun Medika Primary Clinic, with a total population of 70 patients. The sample was selected using a purposive sampling technique based on predetermined inclusion and exclusion criteria. A total of 17 respondents met the criteria and were



included in the final analysis.

The inclusion criteria were patients diagnosed with type 2 diabetes mellitus based on medical record data, registered as active Prolanis participants at Jimbun Medika Primary Clinic, had HbA1c examination results within the last three months, were willing to participate by signing an informed consent form, and were able to undergo direct anthropometric measurement. The exclusion criteria were patients with incomplete medical record data or unavailable HbA1c results, patients who were absent during waist circumference measurement, patients with conditions that could affect waist circumference measurement such as pregnancy, ascites, or certain abdominal abnormalities, and patients who refused to participate or withdrew from the study.

The independent variable in this study was waist circumference, while the dependent variable was HbA1c level. Waist circumference was measured using a non-elastic measuring tape according to standard anthropometric procedures. The measurement was taken at the midpoint between the lowest rib and the iliac crest while the respondent was standing upright. HbA1c data were obtained from laboratory results recorded in the respondents' medical records within the last three months.

Types of data and data collection methods/ research procedures

Data on respondents' characteristics were collected from medical records and brief interviews. The collected data included age, sex, waist circumference, and HbA1c level. Waist circumference measurements were conducted directly by the researcher according to standardized anthropometric guidelines. HbA1c values were retrieved from documented laboratory examination results to ensure data accuracy and validity. All procedures were carried out in a structured and systematic manner after obtaining permission from the clinic and written informed consent from all respondents.

Data analysis

Data analysis was performed using descriptive and inferential statistical methods. Descriptive analysis was used to present the distribution of respondents' characteristics, including sex, age group, waist circumference category, and HbA1c category. Because the sample size was relatively small and the categorical data showed no variation, with all respondents having waist circumference values above 80 cm and HbA1c levels above 7%, comparative



analysis between normal and abnormal groups was not performed.

The relationship between waist circumference and HbA1c levels was analyzed using Spearman's rank correlation test. Spearman correlation was selected because the sample size was small and the data did not adequately meet the assumptions required for parametric correlation analysis. Statistical significance was set at $p < 0.05$. All statistical analyses were performed using computer-based statistical software, such as SPSS.

This study had methodological limitations. The sample size was relatively small, and there was no categorical variation in waist circumference and HbA1c level because all respondents had waist circumference values above 80 cm and HbA1c levels above 7%. Therefore, the findings should be interpreted cautiously as preliminary evidence. Further studies with larger sample sizes and more varied respondent characteristics are needed to strengthen the findings.

RESULT AND DISCUSSION

Table 1 presents the characteristics of the respondents. A total of 17 respondents were included in this study. Based on sex, most respondents were female, with 10 respondents or 58.8%, while male respondents accounted for 7 respondents or 41.2%. Based on age group, there were no respondents aged under 45 years. Most respondents were in the 45–59 years age group, with 10 respondents or 58.8%, followed by the ≥ 60 years age group with 7 respondents or 41.2%.

Table 1. Characteristic of Responents

Characteristic	n	%
Sex		
Male	7	41.2
Female	10	58.8
Age group		
<45 years	0	0.0
45–59 years	10	58.8
≥ 60 years	7	41.2
Waist circumference		
≤ 80 cm	0	0.0
>80 cm	17	100.0
HbA1c level		
$\leq 7\%$	0	0.0
>7%	17	100.0
Total	17	100.0

Based on waist circumference, all respondents had waist circumference values above 80 cm, while no respondents had waist circumference values of 80 cm or below. In addition, all respondents had HbA1c levels above 7%, while no respondents had HbA1c



levels of 7% or below. These findings indicate that all respondents had central obesity and poor glycemic control.

Table 2. Distribution of Waist Circumference and HbA1c Level

Variable	Mean ± SD	Median	Minimum	Maximum
Waist circumference (cm)	91.2 ± 6.4	90.0	82.0	105.0
HbA1c level (%)	8.4 ± 1.0	8.2	7.1	10.5

Table 2 presents the distribution of waist circumference and HbA1c levels among respondents. The mean waist circumference was 91.2 ± 6.4 cm, with a median of 90.0 cm, ranging from 82.0 cm to 105.0 cm. These findings indicate that all respondents had waist circumference values above 80 cm. The mean HbA1c level was 8.4 ± 1.0%, with a median of 8.2%, ranging from 7.1% to 10.5%. This result shows that all respondents had HbA1c levels above 7%, indicating poor glycemic control. Although all respondents were categorized as having central obesity and poor glycemic control, numerical variation was still observed in waist circumference and HbA1c values. Therefore, correlation analysis was performed using the numerical values of both

variables rather than categorical comparisons.

To assess the relationship between glycemic control and the incidence of Type 2 Diabetes Mellitus, a bivariate analysis was performed using HbA1c levels as the primary indicator. HbA1c reflects long-term glycemic exposure and is widely utilized as a standard parameter for evaluating metabolic control in patients with diabetes. Given that central obesity, as measured by waist circumference, is closely associated with insulin resistance, understanding the distribution of HbA1c levels is essential to support the analysis of its relationship with abdominal adiposity.

The findings indicate that all participants in this study exhibited HbA1c levels above 7%, with a total of 17 individuals (100%) classified within this category. Consequently, all respondents were identified as having diabetes, while no participants were observed in the HbA1c <7% group, either among diabetic or non-diabetic categories.

From a pathophysiological perspective, these findings may be closely linked to central obesity, particularly increased waist circumference, which plays a critical role in the development of insulin



resistance. Excess visceral fat contributes to metabolic dysregulation through the release of pro-inflammatory cytokines and free fatty acids, ultimately impairing insulin sensitivity and leading to sustained hyperglycemia, as reflected by elevated HbA1c levels.

Physiologically, increased HbA1c levels occur due to a non-enzymatic glycation process, in which glucose binds to hemoglobin within erythrocytes. This process takes place under conditions of chronic hyperglycemia and is associated with an increased risk of both macrovascular and microvascular complications. Evidence from studies conducted in Indonesia supports this concept. For example, Mulyani et al. (2019) demonstrated that HbA1c levels were significantly associated with fasting blood glucose levels and the incidence of diabetes in an urban population.

These findings are further supported by a study conducted by Pratiwi and Sari (2020) in Yogyakarta, which reported a positive correlation between HbA1c levels and glycemic control among patients with type 2 diabetes mellitus. Individuals with higher HbA1c levels tended to have a history of recurrent hyperglycemia, thereby increasing the risk of disease progression.

Therefore, HbA1c assessment is not only relevant as a diagnostic tool but also plays a crucial role in the long-term monitoring of diabetes management in Indonesia.

In addition, a local study by Utami et al. (2021) in Semarang found that HbA1c can serve as a predictor of complication risk, particularly diabetic neuropathy. This suggests that HbA1c has broader clinical value, functioning not only as an indicator of diabetes incidence but also as a prognostic marker for disease progression. Consequently, maintaining HbA1c within normal limits (<5.7%) is highly recommended as a preventive strategy.

Based on the analysis, it can be concluded that HbA1c has a significant influence on the incidence of diabetes mellitus. These findings are consistent with both national and global studies, which consistently highlight the central role of HbA1c in the diagnosis, monitoring, and prognosis of diabetes mellitus. Therefore, HbA1c assessment should be prioritized in screening programs and clinical management of patients with diabetes in Indonesia, given the continuously increasing prevalence of the disease.

Table 3. Correlation Between Waist Circumference and HbA1c Levels



Waist circumference	HbA1c				Total		P value
	<7		>7		n	%	
<80	0	0	0	0	0	0	0.000
>80	0	0	17	100	17	100	

The p-value obtained from the spearman indicates a statistically significant association ($p < 0.05$).

Table 3 presents the cross-tabulation between waist circumference and HbA1c levels among respondents. The results showed that all respondents had waist circumference values above 80 cm and HbA1c levels above 7%. No respondents were found in the waist circumference category of ≤ 80 cm or the HbA1c category of $\leq 7\%$. This finding indicates that all respondents had central obesity and poor glycemic control.

The bivariate analysis was intended to examine the relationship between waist circumference and HbA1c levels among patients with type 2 diabetes mellitus. Spearman's rank correlation test was selected because the sample size was relatively small and the data did not adequately meet the assumptions required for parametric analysis. The p-value obtained from the analysis was 0.000, indicating a statistically significant association between waist circumference and

HbA1c levels at $p < 0.05$. However, for journal reporting, the p-value should be written as $p < 0.001$ rather than $p = 0.000$.

The finding suggests that waist circumference may be associated with HbA1c levels among patients with type 2 diabetes mellitus. This result is consistent with the theoretical mechanism that central obesity contributes to insulin resistance through visceral fat accumulation. Visceral adipose tissue may increase the release of free fatty acids and pro-inflammatory mediators, which can interfere with insulin signaling and worsen glycemic control. Therefore, patients with higher waist circumference may tend to have higher HbA1c levels.

This finding indicates a statistically significant association between waist circumference and the incidence of diabetes mellitus. Waist circumference is an anthropometric indicator used to assess central obesity, which is closely associated with insulin resistance. According to the *World Health Organization* (WHO, 2020), central obesity poses a greater risk for diabetes mellitus than general obesity, as visceral fat exhibits high metabolic activity and influences glucose regulation.



Physiologically, an increased waist circumference reflects the accumulation of visceral fat, which contributes to elevated release of free fatty acids, adipokines, and pro-inflammatory cytokines. These conditions promote insulin resistance, which is the primary mechanism underlying the development of type 2 diabetes mellitus. The findings of this study are consistent with this mechanism, indicating that greater waist circumference is associated with a higher risk of developing diabetes mellitus.

These results are in line with previous studies conducted in Indonesia. Wulandari and Susilo (2018) in Surabaya reported that waist circumference is a significant predictor of type 2 diabetes mellitus, with individuals exceeding the threshold (≥ 90 cm for men and ≥ 80 cm for women) having a higher risk of developing the disease. Similarly, Ramadhani et al. (2020) in Yogyakarta found that increased waist circumference was associated with elevated fasting blood glucose levels, suggesting its utility as an early indicator for diabetes risk.

Consistent findings were also reported by Hardinsyah et al. (2019), who demonstrated that central obesity, as measured by waist circumference, is more

strongly associated with metabolic disorders than body mass index (BMI). This highlights that waist circumference is a more accurate anthropometric parameter for assessing diabetes risk in Asian populations, including Indonesia, where individuals tend to have higher visceral fat despite having normal BMI values.

In conclusion, this study confirms that waist circumference has a significant influence on the incidence of diabetes mellitus. These findings have important practical implications for promotive and preventive strategies, emphasizing the importance of monitoring waist circumference as a simple yet effective indicator for diabetes risk screening in the community. Early detection through waist circumference measurement may contribute to the prevention of diabetes, particularly in Indonesia, where the prevalence continues to rise.

To determine the combined effect of HbA1c levels and waist circumference on the incidence of Type 2 Diabetes Mellitus, a bivariate analysis was conducted. This analysis aims to identify the relative contribution of each independent variable while controlling for the influence of other



variables in the model. By incorporating both glycemic control (HbA1c) and central obesity (waist circumference), this approach provides a more comprehensive understanding of the factors associated with diabetes incidence.

The bivariate analysis indicates that both HbA1c levels and waist circumference are significantly associated with the incidence of Type 2 Diabetes Mellitus, with p-values of 0.000 ($p < 0.05$). This confirms that each variable independently contributes to the likelihood of diabetes occurrence when analyzed simultaneously. These findings suggest that both poor glycemic control and increased abdominal adiposity are important determinants of Type 2 Diabetes Mellitus. From a clinical perspective, this highlights the need for integrated management strategies that address both metabolic control and obesity, particularly central fat accumulation.

This indicates that both variables simultaneously have a statistically significant effect on the incidence of diabetes mellitus. The combination of biochemical parameters (HbA1c) and anthropometric indicators (waist circumference) provides a more comprehensive assessment of diabetes risk

compared to the use of a single indicator. According to the *American Diabetes Association* (ADA, 2021), HbA1c is a standard parameter for diabetes diagnosis, while waist circumference reflects central obesity, which is closely associated with insulin resistance.

Theoretically, increased waist circumference, which indicates the accumulation of visceral fat, leads to elevated release of free fatty acids and inflammatory mediators, thereby exacerbating insulin resistance. This condition contributes to sustained hyperglycemia, which is reflected in elevated HbA1c levels. This relationship supports the interaction between central obesity and glycemic control in increasing the risk of type 2 diabetes mellitus (Hardinsyah et al., 2019). Studies conducted in Indonesia also support these findings. Wulandari and Susilo (2018) reported that waist circumference ≥ 90 cm in men and ≥ 80 cm in women is significantly associated with the incidence of diabetes. Meanwhile, Mulyani et al. (2019) demonstrated a significant relationship between HbA1c levels and fasting blood glucose among patients with type 2 diabetes mellitus. When these two indicators are analyzed



simultaneously, their predictive strength for diabetes incidence increases.

Furthermore, a study by Utami et al. (2021) indicated that HbA1c serves not only as a diagnostic parameter but also as a predictor of long-term complications. Similarly, Ramadhani et al. (2020) emphasized that waist circumference can be used as a simple indicator to detect early diabetes risk in adults. These findings suggest that integrating both variables may strengthen diabetes risk screening strategies, particularly in the Indonesian population, which tends to exhibit central obesity despite having normal body mass index values.

Nevertheless, the interpretation of these findings should consider the methodological limitations of this study. The number of respondents was relatively small, and all respondents had HbA1c levels above 7% and waist circumference values above 80 cm. This lack of categorical variation limits the ability to compare groups and weakens the generalizability of the findings. Therefore, the results should be interpreted as preliminary evidence and should be confirmed through further research involving a larger sample size and more diverse respondent characteristics.

CONCLUSION

The findings indicate that both HbA1c levels and waist circumference are significantly associated with the incidence of type 2 diabetes mellitus. Their combined effect provides a stronger and more comprehensive representation of diabetes risk, reflecting the interplay between long-term glycemic control and central obesity. These results underscore the relevance of integrating biochemical and anthropometric indicators in clinical assessment. The use of HbA1c and waist circumference as complementary measures may support more effective early detection and risk stratification, thereby contributing to improved preventive and management strategies in primary healthcare settings. This study has several limitations. First, the sample size was relatively small, with only 17 respondents included in the analysis. Second, there was no variation in categorical HbA1c and waist circumference data because all respondents had HbA1c levels above 7% and waist circumference above the central obesity threshold. This condition limited the possibility of conducting comparative



analysis between normal and abnormal groups. Third, the cross-sectional design only allows the identification of associations between variables and cannot establish causal relationships. Therefore, further studies with larger sample sizes, more varied respondent characteristics, and prospective designs are recommended.

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