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DOI: [10.31965/infokes.Vol21Iss1.878](https://doi.org/10.31965/infokes.Vol21Iss1.878)Journal homepage: <http://jurnal.poltekkeskupang.ac.id/index.php/infokes>**RESEARCH****Open Access****Abdominal Circumference as A Predictor of Type II Diabetes Mellitus in Young Women**Siti Choirul Dwi Astuti^{1a*}, Yohana Putri Apryanti^{1b}¹ Department of Midwifery, Politeknik Kesehatan Kementerian Kesehatan Gorontalo, Gorontalo City, Gorontalo Province, Indonesia² Department of Midwifery, Institut Kesehatan Sumatera Utara, Medan City, North Sumatera, Indonesia^a Email address: sitichoirul13@yahoo.co.id^b Email address: yohanasembiring2804@gmail.com

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Abstract

Obesity is becoming one of the main factors in the increase in non-communicable diseases globally. In Indonesia, the prevalence of central obesity at 15 years and over continues to increase. The increase in visceral fat is related to abnormal metabolisms, such as a decrease in glucose tolerance and insulin sensitivity, causing an increase in blood sugar levels, a risk factor for diabetes. To predict the incidence of type 2 diabetes mellitus, the abdominal circumference is a better predictor than BMI against type 2 diabetes mellitus. This study aims to determine the relationship between abdominal circumference to blood sugar levels in young women. This research is an observational analytical study using the cross-section method. Sampling in this study used a consecutive sample, which was taken based on inclusion and exclusion criteria in the population. The overall subjects of the study amounted to 70 respondents. The results showed a meaningful relationship between the abdominal circumference and fasting blood sugar levels ($p = 0.000$) with a moderate correlation ($r = 0.440$) and a significant relationship between abdominal circumference to blood sugar levels 2 hours after glucose loading ($p = 0.030$) with a weak correlation ($r = 0.259$). This study concluded that there is a relationship between abdominal circumference and blood sugar levels using an oral glucose tolerance test in young women. As a recommendation, young women should maintain their lifestyle and keep their abdominal circumference not exceeding 80 centimeters to prevent diabetes.

Keywords: Abdominal Circumference, Diabetes Mellitus, Young Women.***Corresponding Author:**

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1. INTRODUCTION

Globally, obesity has been a major contributor to the growth of noncommunicable diseases (Adnyana et al., 2020). Obesity develops when the accumulation of extra fat increases health hazards. The body mass index (BMI) and abdominal circumference are two of the body fat measurement methods (Alves et al., 2021). According to the *World Health Organization* (WHO), individuals are obese if their BMI is more than or equal to 27 kg/m² Indonesia (Angullo-Martínez et al., 2021).

The threshold values for abdominal circumference measurements vary by area. In Indonesia, a person is considered obese if his or her belly circumference is larger than 90 centimeters for men and 80 centimeters for women (Asiah, 2016). Obesity is one of the most prominent problems in the world today. In Indonesia, the prevalence of obesity continues to rise, particularly obesity in adults aged 18 and older (Bolla et al., 2020). Obesity can raise a person's risk of morbidity and death. Increased visceral fat is associated with aberrant metabolisms, including decreased glucose tolerance and insulin sensitivity, which is a risk factor for the development of diabetes (Bonora et al., 2021b).

It is known that abdominal circumference is a better predictor than body mass index (BMI) on the incidence of type 2 diabetes mellitus (Bonora et al., 2021a). Compared to body mass index (BMI), abdominal circumference tends to be more accurate for diagnosing central obesity. Central obesity is a condition of excess fat in the abdomen. Therefore, it is crucial to measure the waist circumference occasionally. Diabetes mellitus is a metabolic disorder with various etiologies (Ametembun, 2017). It is characterized by hyperglycemia resulting from the pancreas not producing enough insulin or the insulin produced cannot be used by the body effectively (Carrasco-Sánchez et al., 2021). Hyperglycemia can be defined as a condition in which blood sugar levels exceed normal limits (Arise et al., 2021). If this situation occurs continuously, it can result in diabetes mellitus. One way that can be used to establish diabetes mellitus is through oral glucose (GDO), which is more sensitive and specific than fasting plasma glucose testing (Burda et al., 2013). Diabetes mellitus has a long-term effect, damaging the heart, blood vessels, eyes, kidneys, and nerves. These complications are the result of uncontrolled diabetes. (Chan et al., 2021) The long course of the disease to become a complication causes diabetes mellitus to often go undiagnosed at the beginning; therefore, blood sugar checks need to be done to diagnose diabetes (Cheng et al., 2021).

In 2020, the number of Indonesians aged 15 and older with diabetes is projected to reach 12,191,564, with an estimated 8,485,334 individuals undiagnosed (Chikowore et al., 2021). In 2021, the prevalence of diabetes in the population aged 15 and older rose from 1.1% in 2020 to 2.1% (Burda et al., 2012). Genetics, a family history of diabetes, being overweight or obese, a poor diet, a lack of physical activity, and smoking are all risk factors for diabetes. The greatest risk factor for type 2 diabetes mellitus is excess body fat caused by a healthy diet and regular exercise (Cuschieri et al., 2022).

The prevalence of obesity and diabetes mellitus continues to rise, along with the association between obesity, particularly central obesity, and diabetes mellitus (Chen et al., 2020). Gorontalo is one of the regions with the greatest prevalence of obesity. The prevalence of obesity in adult males is 25.5%, whereas in females it is greater at 47.5%. Obesity occurs not just in metropolitan regions but also in rural ones. It is crucial to recognize the initial rise in blood sugar levels in young women as the onset of insulin resistance (Das et al., 2017). Hence, researchers wish to determine if belly circumference may be utilized as an alternative predictor of type II diabetes in young women.

2. RESEARCH METHOD

This is an analytical cross-sectional study in which both constrained and unconstrained variables are observed at a single time. The investigation was conducted at the Kabila Health Center between February and June 2022. This study collected primary data by measuring participants' blood sugar and belly circumference. Blood sugar is sugar or glucose in the blood that comes from eating and is transported to all body cells through blood vessels.

Blood glucose (blood sugar) is an indispensable health indicator. Consistently high blood sugar levels (hyperglycemia) will cause disorders such as diabetes and vice versa. In addition to causing a person to faint, hypoglycemia (low blood sugar) can also lead to low blood sugar levels. The target population consists of young women in good health at the Kabila Health Center in Gorontalo Province. In December 2021, 70 young women between the ages of 10 and 18 were surveyed at the Kabila Health Center to compile the sample population. The sampling method employs the sequential sampling methodology, in which samples are drawn from a population based on inclusion and exclusion criteria. The inclusion criteria are being willing to participate in research and signing informed consent. Exclusion criteria include research participants who are ill, using medications that impact blood glucose levels (metformin/glibenclamide), or participating in a diet program, abdominal circumference can be affected by disease (tumors, hepatomegaly). Data analysis was carried out with the SPSS program. Following the collection of data, the information is processed. This research already has a permit by the Research Ethics Commission of the Health Polytechnic of the Ministry of Gorontalo, numbered LB.01.01/KEPK /177/2022.

3. RESULTS AND DISCUSSION

Table 1. Displays the findings of the study, which illustrates the age distribution, family history of diabetes, and education levels of the 70 young women who participated in the study as respondents.

Table 1. Respondent Characteristics (n=70).

Characteristics	Frequency Distribution		p-value
	n	%	
Age			0,001
10 Years Old	16	23	
11 Years Old	4	6	
12 Years Old	12	17	
13 Years Old	9	13	
14 Years Old	3	4	
15 Years Old	7	10	
16 Years Old	9	13	
17 Years Old	6	9	
18 Years Old	4	5	
Family History of Diabetes Mellitus			0,013
Yes	30	42,9	
No	40	57,1	
Education			0,804
Primary School	44	63	
High School	26	37	

According to table 1, the number and percentage of respondents were the highest in ten years, with 16 respondents (23%) receiving the most responses. In contrast, only three respondents (4%) were aged 14 years or younger. According to table 1, the number and percentage of respondents with a junior high school education were 44 (63%) and the number and percentage of respondents with a high school education was 26 (37%). The number and proportion of respondents without a family history of diabetes mellitus, namely 40 respondents (57.1%), are also presented. The number and proportion of respondents with a family history of diabetes mellitus were 30 (42.9%), as shown in Table 1. The number and proportion of respondents without a family history of diabetes mellitus, namely 40 respondents (57.1%), are also presented.

Table 2. Respondents' blood sugar (n=70).

Numeric Variables	Blood Sugar			
	Median	Min-Max	Mean±SD	p-value
Fasting Blood Sugar	87	74-112	86,97-8,45	0,001
Oral Blood Sugar	111	66-358	115,71-37,02	

According to table 2, the average level of fasting blood sugar among the 70 people who participated in this research was 86.97, and the standard deviation was 8.45. The minimal level of sugar in the blood during fasting is 74, and the maximum level of sugar in the blood while fasting is 112. In this particular investigation, the figure of 87 was determined to be the median for the participants' fasting blood sugar values. The average glucose level in the blood two hours after eating 70 grams was 115.71, with a standard deviation of 37.02 among the 70 people who participated in this study. Two hours after ingesting 70 grams of glucose orally, the lowest possible value for blood sugar is 66, and the highest possible value for blood sugar is 358. Both of these values are reached via glucose loading. In this particular investigation, the figure of 111 was determined to be the median for the respondents' fasting blood sugar values.

Table 3. Respondent's abdominal circumference (n=70).

Numeric Variables	Abdominal Circumference			
	Median	Min-Max	Mean±SD	p-value
Fasting Blood Sugar	79	63-111	82,23-12,711	0,008
Oral Blood Sugar	90	66-127	90,13-15,38	

According to table 3, the average abdomen circumference of participants at the time of fasting blood sugar was 82.23 with a standard deviation of 12,711, the minimum abdominal circumference was 63 and the highest abdominal circumference was 111, with a median abdominal circumference of 79. The average abdomen circumference of respondents following oral administration of 70 grams of glucose was 90,13 with a standard deviation of 15.38, the lowest abdominal circumference being 66 and the highest abdominal circumference being 127, with an average abdominal circumference of 90.

Table 4. Test Results of Spearman's Rank Correlation of Abdominal Circumference to blood sugar (n=70).

Numeric Variables	Significance	Correlation Coefficient R
Fasting Blood Sugar	0,0001	0,440
Oral Blood Sugar	0,030	0,259

In table 4, based on the findings of the Spearman's rank correlation test between abdomen circumference and fasting blood sugar, a significant value (p-value) of 0.0001 was achieved, indicating that the value was less than (0.05). This result demonstrates that the obtained data

yielded substantial results. In addition, the correlation coefficient R has a value of 0.440. It also reveals a modest association between stomach circumference and fasting blood sugar. In table 4, based on the findings of the Spearman's rank correlation test to the variables of belly circumference and blood sugar 2 hours after receiving 70 grams of glucose, a significant value (p-value) of 0.030 was obtained, indicating that the deal was less than (0.05). This score indicates that the obtained data has produced substantial results. In addition, the correlation coefficient R has a value of 0.259. It demonstrates a slight association between belly circumference and blood sugar 2 hours after 70 grams of glucose ingestion.

This study's conclusions are based on a bivariate analysis utilizing Spearman's Rank correlation. It was determined that abdomen circumference and fasting blood sugar showed a significant relationship (p-value = 0.000) and moderate correlation (correlation coefficient r , which is 0.440). It was also shown that the abdominal circumference and blood sugar 2 hours after receiving 70 grams of glucose showed a weak but significant relationship (p-value = 0.030) (correlation coefficient r , 0.259). On the basis of the two obtained outcomes, it is possible to infer that the null hypothesis (H_0) was rejected and the alternative hypothesis (H_a) was accepted. Thus, the oral glucose tolerance test revealed a correlation between young women's abdomen circumference and blood sugar levels.

Obese individuals are known to decrease the function of β in the pancreas (Dom et al., 2021). The β have an essential role in regulating insulin production. Decreased function of β due to obesity can result in inflammation of the pancreas, which causes the proliferation of macrophages in the pancreas (Dubey et al., 2022). These macrophages will interact with β , where it is known that direct contact between the macrophages and the β results in damage to the β (Engel, 2014). The occurrence of damage to this β can result in abnormal tolerance of fasting glucose can occur.

The study on the association between BMI (body mass index), abdominal circumference, and RLPP (the ratio of pelvic waist circumference) and blood sugar levels revealed that BMI was associated with blood sugar levels (p=0.007; r=0.345), abdominal circumference was associated with blood sugar levels (p=0.001; r=0.424), and RLPP was associated with blood sugar levels (p=0.002; r=0.392) (Grimes et al., 2015). It indicates a connection between anthropometrics and blood sugar levels, particularly belly circumference, which has the highest correlation with blood sugar levels compared to other factors (Harbuwono et al., 2021).

Because gluconeogenesis can stop insulin from working, a bigger waistline can make it harder to control blood sugar (Kargar et al., 2021). Fatty acids are released into the port vein of the liver as a waste product of the fat in the abdomen (Kh. Albashr et al., 2022). When there are too many free fatty acids in the liver, they oxidize and make Acetyl CoA. This turns on the liver enzyme pyruvate carboxylase, which turns pyruvic acid into glucose. Gluconeogenesis is the name for this process (Kuok et al., 2016). Also, having more free fatty acids circulating in the liver can make muscle cells less sensitive to insulin, which can lead to insulin resistance (Kushwaha et al., 2022). Therefore, muscle cells require more insulin for blood glucose into the muscles (Lu et al., 2018). In a study entitled the relationship between the abdominal circumference and the ratio of pelvic abdominal circumference to fasting blood sugar levels in soldiers, a sample of 73 respondents was obtained (Lukito et al., 2020). The results of this study's correlation test between waist circumference and fasting blood sugar were p = 0.000 and r = 0.525. This showed that waist circumference and fasting blood sugar have a meaningful relationship and a moderate correlation (Ninomiya et al., 2022). In the chi-square test, men with an abdominal circumference of 90 cm or less and women with an abdominal circumference of 80 cm or less were labeled as having central obesity. Men and women with abdominal circumference of more than 90 cm and 80 cm were labeled as having non-central obesity (Pathiranage et al., 2022). Fasting blood sugar levels are categorized into regular blood sugar (<90 mg/dL) and rise (\geq 90 mg/dL) (Pressman et al., 2021). The value of p = 0.038 for the chi-

square test between the abdominal circumference and fasting blood sugar showed that there was a meaningful relationship between the abdominal circumference and fasting blood sugar, and OR = 3.167 showed that people with central obesity were three times more likely to have fasting blood sugar than people who were not obese (Purnami et al., 2015).

The insulin sensitivity of fat persons will be diminished. There is an increase in the release of Nonesterified Fatty Acid (NEFA) in obese persons, which can lead to insulin resistance (Sarvazad et al., 2020). Based on studies on the relationship between diabetes and insulin resistance (Sheehan et al., 2019), this study used a cross-sectional research design, with one method of measuring the distribution of adiposity using abdominal circumference (Sukkriang et al., 2021) and in the analysis using *Pearson's* correlation between the abdominal circumference and blood sugar levels 2 hours after glucose loading, a $p < 0.0001$ value was obtained with a value of $r = 0.20$ to show that abdominal circumference has a meaningful relationship with sugar levels 2 hours after glucose loading with correlation strength, which is weakly correlated (Seibert et al., 2018).

4. CONCLUSION

It is possible to classify women as having central obesity based on their average abdomen circumference. The intermediate fasting blood sugar level is the same as the regular one. The intermediate blood sugar level two hours after eating can be the same as the blood sugar level two hours after a typical glucose loading. A correlation was found, according to a bivariate study's results, between young women's abdominal circumference and blood sugar levels. It is advised that more studies be carried out to investigate further potential risk factors that might induce alterations in blood sugar levels in young women. It is suggested that members of the community, particularly young ladies, always keep their posture to prevent developing central obesity. One of the ways this can be accomplished is by leading a healthy lifestyle, which will also help reduce the risk of developing diabetes mellitus.

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