Significant Association Between Body Mass Index and Fasting Blood Glucose Levels Among Young Adult Women

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ABSTRACT
Diabetes mellitus is a major public health concern, and abnormal blood glucose levels may occur in younger populations. Anthropometric indicators, including body mass index (BMI) and waist circumference, are commonly used to assess obesity and may be associated with impaired glucose metabolism. This study aimed to examine the association of body mass index (BMI) and waist circumference with fasting blood glucose levels among young adult women. This analytical observational study used a cross-sectional design. A total of 92 undergraduate Midwifery students were recruited using purposive sampling. Data collection was conducted on February 11, 2025. BMI and waist circumference were assessed as independent variables, while fasting blood glucose level was the dependent variable. Associations between variables were analyzed using the Chi-square test. More than half of the respondents were classified as underweight (55.4%), while 77.2% had a normal waist circumference. Most respondents had normal fasting blood glucose levels (64.1%), followed by prediabetes (32.6%) and diabetes mellitus (3.3%). The Chi-square test showed a statistically significant association between BMI and fasting blood glucose levels ($p = 0.035$). However, no statistically significant association was observed between waist circumference and fasting blood glucose levels ($p = 0.209$). In conclusion, BMI was significantly associated with fasting blood glucose levels, whereas waist circumference was not significantly associated with fasting blood glucose levels among young adult women.
Keywords: body mass index; fasting blood glucose; waist circumference

INTRODUCTION
Non-communicable diseases (NCDs) remain a major public health concern worldwide and contribute substantially to premature mortality. Diabetes mellitus (DM) is one of the most important NCDs because of its increasing prevalence and its association with various long-term complications. Diabetes mellitus is a chronic metabolic disorder characterized by persistent hyperglycemia resulting from impaired insulin secretion, impaired insulin action, or both [1].

The prevalence of diabetes mellitus (DM) in Indonesia has increased considerably over the past decade. In Depok City, West Java Province, health office records reported 43,929 individuals with diabetes mellitus in 2023. In addition, prediabetes an important public health concern in Indonesia, affecting approximately 10.2% of the population, equivalent to an estimated 24 million individuals. Diabetes mellitus is a chronic metabolic disorder characterized by persistent hyperglycemia resulting from impaired insulin secretion, impaired insulin action, or both [1]. Prediabetes refers to an intermediate state of hyperglycemia in which blood glucose levels are higher than normal but do not yet meet the diagnostic criteria for diabetes mellitus [2]. According to the Indonesian Society of Endocrinology (PERKENI) 2021 guidelines, prediabetes is diagnosed when fasting plasma glucose ranges from 100–125 mg/dL or when the 2-hour plasma glucose level following an Oral Glucose Tolerance Test (OGTT) indicates impaired glucose regulation.

Glucose is the primary carbohydrate-derived energy source required for normal cellular metabolism [3]. It is produced from the digestion of carbohydrates, including monosaccharides, disaccharides, and polysaccharides, and plays a crucial role in maintaining brain function and supporting metabolic processes [4]. Blood glucose levels can be assessed using several laboratory methods, including random blood glucose, fasting blood glucose (FBG), and the Oral Glucose Tolerance Test (OGTT). Among these methods, fasting blood glucose measurement is widely used to evaluate glycemic status. It is performed after at least eight hours of fasting to minimize the influence of recent food intake on glucose concentration.

Obesity is one of the most important modifiable risk factors for diabetes mellitus. A higher body mass index (BMI) has consistently been associated with elevated blood glucose levels in both men and women. Likewise, central obesity, commonly assessed by waist circumference, is associated with impaired glucose metabolism and an increased risk of hyperglycemia [5]. Central obesity, also known as abdominal obesity, refers to excessive fat accumulation around the abdominal region, particularly visceral fat, which contributes to metabolic disturbances and insulin resistance [6]. Overall obesity is commonly assessed using Body Mass Index (BMI), whereas central obesity is measured using waist circumference.

Young adulthood represents an important period for the early identification of metabolic risk factors. Although diabetes mellitus is commonly associated with older age, metabolic abnormalities may develop earlier in life and can be related to modifiable factors such as excess body weight and central adiposity. Therefore, assessing anthropometric indicators among young adult women may provide useful information for the early identification of individuals who may be at risk of impaired glucose regulation.

Previous studies have reported inconsistent findings regarding the association of BMI and waist circumference with blood glucose levels. Some studies have demonstrated significant associations between BMI and blood glucose levels, whereas others have found no significant relationship. Similar inconsistencies have also been reported for waist circumference and blood glucose levels. These differences indicate that the association between anthropometric indicators and glycemic status may vary across populations and age groups. However, evidence specifically focusing on young adult women, particularly undergraduate midwifery students aged 18–23 years, remains limited. This population is relevant for early metabolic risk assessment because identifying anthropometric and glycemic abnormalities during young adulthood may support preventive efforts before the development of more advanced metabolic disorders.

Therefore, this study aimed to investigate the relationship between body mass index (BMI) and waist circumference and fasting blood glucose levels in young adult women aged 18–23 years.

METHODS
This study employed an analytical observational design with a quantitative approach using a cross-sectional study design. The study was conducted at the F4 Campus of Gunadarma University on February 11, 2025. The study population comprised active undergraduate students at

Gunadarma University. The study sample consisted of undergraduate Midwifery students who met the predefined inclusion criteria. Participants were recruited using a purposive sampling technique. A total of 92 respondents were included in the analysis. The inclusion criteria were undergraduate midwifery students for the 2024/2025 academic year who are willing to serve as respondents. The exclusion criteria were students who are unable to attend are being treated at homegastritis aches and pains.

The dependent variable in this study was fasting blood glucose level. The independent variables were body mass index (BMI) and waist circumference. Body weight was measured using a digital scale (OneMed Model EB 9362) and recorded in kilograms (kg), while height was measured using a OneMed Stature Meter and recorded in meters (m). BMI was calculated by dividing body weight (in kilograms) by the square of height (in meters) (kg/m²). Subsequently, BMI was categorized in accordance with the Regulation of the Minister of Health of the Republic of Indonesia Number 41 of 2014 concerning Balanced Nutrition Guidelines. Waist circumference was measured using an Onemed measuring tape. Measurements were taken at the midpoint between the lower edge of the last rib and the highest point of the anterior iliac crest. Waist circumference was categorized as normal or indicative of central obesity based on the Guidelines for Obesity Prevention and Management for Health Workers in Primary Health Care Facilities (FKTP). Fasting blood glucose levels were assessed after participants had fasted for at least 12 hours. Blood glucose was measured using test strips with the Easy Touch GCU meter. Fasting blood glucose levels were categorized as normal, prediabetes, or diabetes mellitus based on the Guidelines for Obesity Prevention and Management for Healthcare Workers at Primary Health Care Facilities (FKTP).

Data were analyzed using SPSS v.25. Descriptive statistics were used to summarize the characteristics of the respondents and the distribution of BMI, waist circumference, and fasting blood glucose levels. The associations between BMI and fasting blood glucose levels and between waist circumference and fasting blood glucose levels were analyzed using the Chi-square test. The level of statistical significance was set at $p < 0.05$. Before conducting the Chi-square analysis, the assumptions of the test were assessed. If the assumptions for the Chi-square test were not met because of small expected cell frequencies, an appropriate alternative statistical test was considered.

RESULTS

Table 1 presents the distribution of body mass index (BMI), waist circumference, and fasting blood glucose (FBG) levels among the study participants. More than half of the respondents were classified as underweight (55.4%), Most participants had a normal waist circumference (77.2%), Regarding fasting blood glucose, the majority of respondents had normal FBG levels (64.1%).

Most participants were older than 18 years (83.7%). The majority had normal blood pressure (73.9%), were non-smokers (98.9%), and none reported alcohol consumption. In addition, most respondents had no family history of diabetes mellitus (84.8%).

The association between BMI and fasting blood glucose levels is presented in Table 3. The Chi-square test (pearson chi-square) showed a statistically significant association between BMI and fasting blood glucose levels ($p = 0.033$). Among respondents with normal fasting blood glucose levels, 49.2% were classified as underweight, 27.1% as obese, and 23.7% had normal BMI. Among respondents with abnormal fasting blood glucose levels, 66.7% were classified as underweight, 30.3% as obese and 3.0% had normal BMI.

Table 4 presents the association between waist circumference and fasting blood glucose levels. Statistical analysis showed no significant association between waist circumference and fasting blood glucose levels ($p = 0.209$). Among respondents with normal fasting blood glucose levels, 83.1% had a normal waist circumference and 16.9% had central obesity. Among respondents with prediabetes, 66.7% had a normal waist circumference and 33.3% had central obesity. Among respondents with diabetes mellitus, 66.7% had a normal waist circumference and 33.3% had central obesity.

Table 1. Distribution of BMI, waist circumference and fasting blood glucose of the study participants

Demographic characteristics	Frequency	Percentage
Body Mass Index (BMI)		
Normal	15	16.3
Underweight	51	55.4
Obese	26	28.3
Waist circumference		
Normal	71	77.2
Central obesity	21	22.8
Fasting blood glucose		
Normal	59	64.1
Prediabetes	30	32.6
Diabetes mellitus	3	3.3

Table 2. Summarizes the general characteristics of the respondents

Demographic characteristics	Frequency	Percentage
Age		
≤ 18 years	15	16.3
> 18 years	77	83.7
Blood pressure		
Normal	68	73.9
Hypertensi	24	26.1
Smoking status		
No	91	98.9
Yes	1	1.1
Alcohol consuming		
No	92	100
Yes	0	0
Family history of DM		
No	78	84.8
Yes	14	15.2

Table 3. Association between BMI and fasting blood glucose

		Body mass index						p
		Normal		Underweight		Obese		
		Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	
Fasting blood glucose	Normal	14	23.7	29	49.2	16	27.1	0.033
	Abnormal	1	3.0	22	66.7	10	30.3	

Table 4. Association between waist circumference and fasting blood glucose

		Waist circumference				p
		Normal		Central obesity		
		Frequency	Percentage	Frequency	Percentage	
Fasting blood glucose	Normal	49	83.1	10	16.9	0.209
	Prediabetes	2	66.7	10	33.3	
	Diabetes mellitus	2	66.7	1	33.3	

DISCUSSION

The present study found a statistically significant association between body mass index (BMI) and fasting blood glucose (FBG) levels (p = 0.035) among young adult women. These findings indicate that BMI is meaningfully associated with glycemic status in women aged 18–23 years. Increased adiposity may contribute to insulin resistance, a key physiological mechanism underlying impaired glucose metabolism and elevated blood glucose concentrations. The results of this study align with those reported by Suib (2023), who observed that among 50 participants, 42% had a normal BMI while 18% were classified as obese. Similarly, Harahap [7] documented that 56.9% of respondents had an elevated BMI (>25 kg/m²), and 60% experienced hyperglycemia (>199 mg/dL), with Spearman's correlation analysis demonstrating a strong and significant association between BMI and blood glucose levels (p = 0.000; r = 0.925).

However, the present findings differ from those reported by [8], who found no significant association between BMI and blood glucose levels using Spearman's rank correlation test (p = 0.098). Likewise, [9] reported that most senior high school students (64.7%) in Yogyakarta had a normal BMI, and [10] found no significant association between BMI and fasting blood glucose levels among 68 medical students aged 18–24 years. These discrepancies may be attributed to differences in sample size, age distribution, lifestyle factors, and metabolic characteristics across study populations.

In addition, this study found no statistically significant association between waist circumference and fasting blood glucose levels (p = 0.209). Although central adiposity is often linked to insulin resistance, waist circumference alone may not sufficiently explain variations in fasting blood glucose among young adults. This finding is consistent with previous studies by [11], who reported no significant association between waist circumference and blood glucose levels (p = 0.232). Similarly, [12] found no association between waist circumference and blood glucose levels and suggested that glycemic fluctuations are influenced not only by anthropometric characteristics but also by dietary intake, which affects insulin requirements for maintaining glucose homeostasis. Furthermore, [13] reported no significant association between waist circumference and fasting blood glucose levels among 69 undergraduate public health students (p = 0.459), and [11] also found no significant relationship between central obesity and hyperglycemia among 30 respondents (p = 0.232).

In contrast, [14] reported that all 40 outpatients with diabetes mellitus exhibited central obesity, and [15] found a highly significant association between waist circumference and blood glucose levels (p < 0.001) among 158 respondents. Variations in study populations, health status, age range, and diagnostic criteria may explain the inconsistencies observed across studies. Overall, the findings of the present study suggest that BMI may be more strongly associated with fasting blood glucose levels than waist circumference among young adult women.

Limitations

This study has several limitations that should be considered when interpreting the findings. First, the cross-sectional design does not allow for causal inference [16-19], as temporal relationships between BMI, waist circumference, and fasting blood glucose cannot be established. Second, the use of purposive sampling may limit the generalizability of the results to broader populations of young adults [20-22]. Third, the study relied on a single measurement of fasting blood glucose, which may not fully capture day-to-day glycemic variability. Fourth, potential confounding factors such as dietary intake, physical activity, stress levels, and family history of metabolic disorders were not assessed, which may influence glucose metabolism. Finally, the sample consisted exclusively of undergraduate Midwifery students, representing a relatively homogeneous group that may not reflect the metabolic profiles of young women in other educational or occupational settings.

CONCLUSION

This study found a statistically significant association between body mass index and fasting blood glucose levels among young adult women. In contrast, no statistically significant association was observed between waist circumference and fasting blood glucose levels. Further studies involving larger and more diverse populations are needed to investigate additional factors associated with fasting blood glucose levels, including dietary intake, physical activity, family history of diabetes mellitus, and other metabolic risk factors.

Conflict interest and source of funding

-This study received ethical approval from the Health Research Ethics Committee of Gunadarma University (Approval No. 01PKE-150125). All participants were included voluntarily after providing informed consent. The study was conducted in accordance with the ethical principles of respect for persons, beneficence, non-maleficence, and justice.
-There is no conflict of interest related to this publication.
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