BODY MASS INDEX, WAIST-HIP RATIO, AND FASTING BLOOD GLUCOSE LEVEL IN PRE-ELDERLY AT TANJUNG RAMBANG HEALTH CENTER OPERATING REGION

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ABSTRACT

Elevated blood glucose when fasting is among the hazards associated with Diabetes Mellitus (DM). Obesity and diabetes mellitus are tightly associated. Body Mass Index (BMI) and Waist-Hip Ratio (WHR) measurements may be used to determine obesity. Prabumulih is known as city with a DM incidence of 2.02% in 2018, was placed second in South Sumatra. This research aims to investigate the relationship between BMI and WHR and older patient fasting blood glucose level in Tanjung Rambang Public Health Center operating region. Cross-sectional observational analysis is the method used in this study. The pre-elderly (45–59 years old) who resided in Tanjung RambangPublic Health Center working area made up as the population. Purposive sampling was used to choose 190 participants, meeting inclusion and exclusion criteria. This research use univariate and bivariate data analysis (using Chi Square test α=0.05). The majority of respondents (66.8%) are overweight; 53.2% of respondents had abnormal WHR; and 15.3% of respondents still had abnormal fasting blood glucose level. The analysis findings demonstrated no correlation (p=0.633) between BMI and fasting blood glucose level. The association between WHR and fasting blood glucose level is concluded to exist (p=0.001).

Keywords*— Body Mass Index, Diabetes Melitus, Fasting Blood Glucose, Obesity, Waist-Hip Ratio*

INTRODUCTION

Non-communicable diseases are currently the most common cause of death in Indonesia. Non-communicable diseases tend to increase over time. Diabetes Mellitus (DM) or the common people know diabetes is a non-communicable disease that occurs due to increased blood glucose level due to the pancreas not producing enough insulin or when the body cannot work effectively in usingthe insulin it produced (Santoso, etal., 2020). The International Diabetes Federation (IDF) (2021) notes that diabetes has caused 6.7 million deaths worldwide in 2021. This means that there is 1 death every 5 seconds. Indonesia is ranked sixth on this list. The number of deaths due to DM in Indonesia reached 236 thousand.

In 2018, 8.5% of people over the age of 15 had diabetes in Indonesia. DKI Jakarta has the greatest frequency of DM (3.4%). Meanwhile, the incidence of DM in South Sumatra reached 0.9% in 2013 and increased to 1.27% in 2018. With the highest prevalence of DM at the ages of 45-54 (2.75%), 55-64 years (4.50%), and 65-74 years (3.81%) (Republic of Indonesia Ministry of Health Research and Development Agency, 2018). Health Profile Data for South Sumatra Province for 2020 the number of person living with DM is 172,044 people. This case has increased compared to 2019 which attacked 117,733 people.

Risk factors that can cause DM, namely factors that cannot be modified include a family history of DM, age ≥ 45 years, race/ethnicity, having a history of giving birth to a baby with a birth weight > 4000 grams, having a history of gestational DM, history of birth weight low (< 2.5 kg) and modifiable factors, namely obesity, lack of physical activity, hypertension, dyslipidemia, and diet (Widiasari et al., 2021).

Diabetes Mellitus is closely related to obesity, both general obesity and central obesity. Body Mass Index (BMI) generally indicates obesity, and Waist Hip Ratio (WHR) is one anthropometric measure that may be used to identify central obesity. While fasting blood glucose level may be used as indications of the presence of diabetes mellitus. Someone who has BMI that exceeds normal limits will cause an increase in insulin

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resistance, so that blood glucose level increase. Likewise, the larger the WHR, the higher the fasting blood glucose level in person living with DM(Sapang et al., 2018).

Obesity will increase fat tissue in the body, and body tissue and muscles will be increasingly resistant to insulin action, especially if body fat is collected in the central part. Fat blocks insulin action so that glucose cannot be transported into cells and accumulates in the blood circulation. Not only has an impact on health, but obesity also causes a decrease in individual productivity which will then affect a decrease in the productivity of a country's economic wheels (Masrul, 2018). Obesity is caused by many factors, one of which is age. With increasing age, the body will experience various declines such as decreased organ function and physical changes due to the aging process. At the age of ≥ 45 years, the body's metabolism will slow down due to a decrease in muscle tissue mass, additional fat mass, and changes in fat distribution (Solikhah et al., 2020).

According to Luthansa and Pramono (2017) study, the chance of developing diabetes mellitus is 3.29 times greater in those with a BMI that is higher in nutrition. This is in line with study by Adnan etal. (2013), where discovered a connection between type 2 DM, BMI and fasting blood glucose level. As an individual BMI increases, so does their blood glucose level. This also applies to Dewi (2022), there was a robust, unidirectional association between WHR and fasting blood glucose level. The findings of this investigation are corroborated by Karimah (2018) research, which indicates a connection between fasting blood glucose level and WHR.

Based on Riskesdas data (2018) Prabumulih is the second highest city in South Sumatra which has a prevalence of DM in people aged ≥ 15 years with a prevalence of 2.02%. In 2019 the number of DM incidents in the city of Prabumulih reached 754 cases. There were 100 instances of DM patients in 2020, according to statistics from the Tanjung Rambang Public Health Center, andan additional 112 cases in 2021, according to the findings of a field study. There is a higher chance that the number of DM cases will rise given the high incidence of DM in the Tanjung Rambang Public Health Center operational region. Given the afore mentioned circumstances, the researchers wanted to determine how the elderly in the Tanjung Rambang Public Health Center working area related to the measures of body mass index (BMI) and waist hip ratio (WHR) to fasting blood glucose level.

METHOD

This research has been approved by the Research Ethics Committee of the Faculty of Public Health, Sriwijaya University (440/UN9. FKM/TU.KKE/2022). This study employs a cross-sectional, observational analytical research methodology and is quantitative. Both primary and secondary data are used in data collecting. Univariate and bivariate analysis, together with statistical tests, will be used to analyze the acquired data. In this investigation, the Chi-Square test was used. Purposive sampling was used to choose the 190 participants for the sample. The following criteria were used to determine inclusion: the research subject had to have fasted for eight to twelve hours, been willing to participate in the study, signed an informed consent form, and havelived in the Tanjung Rambang PublicHealth Center working area foratleastthe previous year. Additionally, the subject could not have had a prior diagnosis of diabetes mellitus. In February 2023, this study was carried out in nine communities within the Tanjung Rambang Public Health Center operational area. Direct measurements of body weight, height, hip circumference, waist circumference, and fasting blood glucose were the key data gathered. While interviews were used to gather the respondent characteristics. Scales, microtoizes, metline, blood glucose test meters, and examination forms were among the instruments utilized in this investigation.

RESULT AND DISCUSSION

Univariate Analysis

Most of the respondents in this study were female, namely 85.5%. Based on the age of most respondents between 45-52 years, namely 56.3%. Respondents with low education were 65.3%, the rest had secondary education and higher education. There are 60.0% of respondents not working and 92.6% have low income.

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Table1. Characteristics of Respondents

Characteristics	n	%
Gender		
Male	27	14.2
Female	163	85.8
Age		
45-52 year	107	56.3
53-60 year	83	43.7
Education		
Low (Not finished/Finished SD)	124	65.3
Medium (Finished SMP/SMA)	57	30.0
High (Bachelor)	9	4.7
Work		
Doesn't work	114	60.0
Work	76	40.0
Income		
Low (< Rp 3.165.519)	176	92.6
High (> Rp 3.165.519)	14	7.4
Total	**190**	**100**

Table2. Frequency Distribution of Respondents Based on Measurements of BMI, WHR and Fasting Blood Glucose

Measurement	n	%
BMI		
Overweight (>23 kg/m^2)	127	66.8
Normal (18.5-22.9 kg/m^2)	50	26.3
Malnutrition (<18.5 kg/m^2)	13	6.8
WHR		
Abnormal (M≥0.90/F≥0.85)	101	53.2
Normal (M<0.90/F<0.85)	89	46.8
Fasting Blood Glucose		
Abnormal (≥126 mg/dL)	29	15.3
Normal (<126 mg/dL)	161	84.7
Total	**190**	**100**

There were 66.8% who had more nutritional status, normal nutritional status as much as 26.3% and the rest had less nutritional status (6.8%). Based on the WHR, the respondents who were categorized as abnormal were 46.8% and normal (53.2%). As many as 15.3% of respondents had abnormal fastingbloodglucoseand 84.7% were normal.

Bivariate Analysis

Based on Table 3 above with the BMI variable, the results showed that 16.5% of respondents were overweight with abnormal fasting blood glucose and 12.7% had normal nutritional status with

Table 3. Bivariate Analysis

Variable	Fasting Blood Glucose				p-value
	Abnormal		Normal		
	n	%	n	%	0.633
BMI					
Overweight	21	16.5	106	83.5	
Normal	8	12.7	55	87.3	
WHR					0.001
Abnormal	24	23.8	77	76.2	
Normal	5	5.6	84	94.4	
Total	29	100	161	100	

abnormal fasting blood glucose. A p-value of 0.633 was found in the statistical analyses using the chi-square test, indicating no significant correlation between fasting blood glucose level and BMI.

Furthermore, 5.6% had normal WHR and abnormal fasting blood glucose, whereas 23.8% had abnormal WHR and abnormal fasting blood glucose level, according to Waist Hip Ratio (WHR) chart. The Chi-square test statistical findings show a substantial correlation between WHR and fasting blood glucose level, with a p-value of 0.001. The results of the Prevalence Ratio (PR) show that the elderly who have an abnormal WHR of 4.230 times will be at risk for increased blood glucose level (95% CI 1.684-10.618).

Respondent Characteristics

The majority of respondents were pre-elderly women (85.8%). The incidence of type 2 DM is often found in women, this is because physically women have the opportunity for a greater increase in BMI and women have a fairly high life expectancy, therefore more elderly women suffer from type 2 DM. Not only that, because progesterone and estrogen level are lowduring menopause, the insulin response will also be lower. The blood insulin response may be increased by the hormones progesterone and estrogen (Arania et al., 2021).56.3% of study participants were pre-elderly, meaning they were aged 45–52 years, while the remaining participants were aged 53–60 years. year. Increasing age can cause changes in the body's physiology, anatomy, and biochemistry, all of which can contribute to increased insulin resistance (Smeltzer, 2014)

Most of respondents (65.3%) had low education, 30% had secondary education and the rest had higher education. The level ofeducationisrelatedtothe individual ability to receive health information. Education level can increase individual knowledge about health. Education is an individual factor in understanding disease, disease management, self-care, and preventing complications through more appropriate treatment (Prawirasatra et al., 2017).

There are 60.0% of respondents not working and the rest are working. A person's work affects his physical activity, someone who does not work will have less physical activity and therefore can lead to the risk of obesity. The type of work can also determine the severity of the activity carried out so it can be said that a person's work affects his physical activity (Septyaningrum and Martini, 2014).

This study also shows that as much as 92.6% of respondents have low income. The level of family income is related to the ability to meet needs, the selection of types of food, and the amount of food, and influences the family's lifestyle (Rumagit et al., 2017).

Relationship Between Body Mass Index (BMI) and Fasting Blood Glucose Level

Based on 190 respondents' responses, data processing using the chi-square test revealed a p-value = 0.633 (p>0.05), indicating that there is no significant correlation between pre-elderly people's body mass index (BMI) and their fasting blood glucose level in the Tanjung Rambang Health Center's working area. With a 95% Confidence Interval (CI) of 0.611-2.774, the prevalence ratio (PR) is 1.302.The findings indicate that although individuals with higher nutritional status often have higher blood glucose level, those with average nutritional status will be less likely to have elevated blood glucose level. Elevated fasting blood glucose level may indicate the possibility of developing diabetes mellitus early on. According to the study's findings, body mass index (BMI) is unable to characterize the distribution or quantity of body fat, nor does it explain how well the body is metabolizing carbohydrates. There are two categories of risk factors for elevated blood glucose level, which are thefirst indication of diabetes mellitus: those that are unchangeable and those that are modifiable. One modifiable component is the overnutrition status determined by BMI(Anri, 2022).

As many as 83.5% of respondents had BMI which was classified as overweight but normal fasting blood glucose. This may be because the respondents are people who live in rural areas, so they are not too exposed to a large amount of fast food as in big cities. Fast food generally contains high calories, fat, salt, and sugar and is low in vitamins, minerals, and fiber. The high salt content can increase saliva and enzyme secretion, thereby increasing the desire to continue eating. If this is allowed it will increase the risk of obesity. Fast food contains high carbohydrates, when the food enters the body, the body will immediately break down carbohydrates into glucose and put them into the body, this is what can cause the risk of developing diabetes.

This study supports study conducted by Wahyuni et al. (2022)which found no evidence of a significant correlation between fasting blood glucose level and BMI. BMI is a measure of obesity; it does not, however, clearly define how fat is distributed throughout the body. This is consistent with study by Karimah (2018) which found no evidence of a link between fasting blood glucose level and BMI. A person's blood glucose level may be influenced by a variety of things, such as hormones and food consumption. Consumption of carbohydrates is the primary factor influencing blood glucose level during fasting. The findingsofthisinvestigation conflict with those of Santoso et al. (2020) study, which found a substantial correlation between fasting blood glucose level and BMI. Variations in a person's BMI might provide information about changes in their nutritional state. There is a significant correlation between type 2 DM incidence and higher BMI.

Relationship BetweenWaist Hip Ratio (WHR) and Fasting Blood Glucose Level

Based on the results of the study using the chi-square test, showed a p-value = 0.001 (p <0.05), which means that there is a significant relationship between the Waist Hip Ratio (WHR) and fasting blood glucose level in the pre-elderly. Prevalence

Ratio (PR) 4.230 with 95% Confidence Interval (CI) 1.685-10.618. This means that WHR can be used as a sign or risk factor for increased blood glucose level.

WHR is an indicator that can better show the distribution of fat than the amount of total body fat. The results of this study indicate that individuals may experience two types of obesity simultaneously or only one, but individuals who are centrally obese will be at higher risk of experiencing insulin resistance and cardiovascular disease. This means that the higher the WHR, the higher the fasting blood glucose level.

WHR measurement can show the accumulation of fat in the visceral parts of the body. The greater the WHR indicates the presence of excess fat accumulation in the visceral parts of the body which in turn can increase fasting blood glucose level and increase the risk of Diabetes Mellitus and its complications. In people with central obesity, it will cause hypertrophy which has an impact on the development of insulin resistance caused by increased adipose mass resulting in pathological changes in the adipocyte hormone which plays a role in regulating insulin sensitivity(Surywan, 2014).

The findings of this investigation are consistent with the work of (Maria, Rante, and Woda (2020), who found a relationship between blood glucose level and central adiposity. One of the main causes of increased blood glucose levelis insulin resistance, which may be caused by increased body fat. According to research by Septyaningrum and Martini (2014), there is a noteworthy positive correlation between blood glucose and WHR. The research findings of Mulyani and Rita (2016) which found no relationship between WHR and fasting blood glucose level were not supported by this study. However, there is a tendency for people with high blood glucose level to also become fatter people.

CONCLUSION

The majority of respondents (66.8%) were overweight, 53.2% had abnormal WHR, and 15.3% still had abnormal fasting blood glucose levels. The analysis's findings demonstrated that there was no correlation (p=0.633) between BMI and fasting blood glucose level. The association between WHR and fasting blood glucose level is concluded to exist (p=0.001). 4230 PR (1.684-10.618). For seniors who have excess nutritional status and abnormal blood glucose level, maintain their diet by reducing their daily intake of sugar, salt and fat and always monitoring their body weight and blood glucose level to avoid degenerative diseases.

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