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THE RELATIONSHIP BETWEEN BODY MASS INDEX (BMI) AND ABDOMINAL CIRCUMFERENCE TO THE INCIDENCE OF DIABETES MELLITUS

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ABSTRACT

Diabetes mellitus is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action or both. Factors that influence diabetes mellitus are a person's characteristics (age, sex and genetics), knowledge of nutrition, stress, lifestyle, physical activity, nutritional status both obesity and central obesity. The purpose of this study was to determine the relationship between body mass index and abdominal circumference on diabetes mellitus in patients at the Family Physician Clinic (KDK), Faculty of Medicine, University of Muhammadiyah Palembang. This research is a type of analytic observational research with a cross sectional approach. The research sample was 33 patients at the Family Physician Clinic. Body mass index was measured using a scale and measuring height, as well as abdominal circumference using a tape measure, while diabetes mellitus was found in patients diagnosed with diabetes mellitus at KDK. The results showed that there was no significant relationship between body mass and diabetes mellitus (p value 0.085) and there was a significant relationship between abdominal circumference and diabetes mellitus in patients at the Family Clinic of the Muhammadiyah Faculty of Medicine Palembang (p value 0.014). Abdominal circumference can be one of the risks that cause diabetes mellitus.

Keywords: Diabetes Mellitus, BMI, Obesity

1. INTRODUCTION

Factors that also affect health are unhealthy eating habits that were carried out in the past, which affect the susceptibility to various diseases. This condition implies that an increase in population also has the consequence of increasing the need for services for the population.[1] There are two types of obesity, namely general obesity and abdominal/central obesity. General obesity can be measured using the Body Mass Index (BMI), while central obesity can be measured by abdominal circumference (LP).[2] BMI is the easiest way to estimate obesity and has a high correlation with body fat mass index, and it is also important to identify obese patients who are at risk of medical complications.[3] The number of people with diabetes increased from 108 million in 1980 to 422 million in 2014. Its prevalence is increasing faster in low- and middle-income countries than in high-income countries. Diabetes is the leading cause of blindness, kidney failure, heart attack, stroke, and lower limb amputation. Between 2000 and 2019, there was a 3% increase in diabetes mortality by age. In 2019, diabetes and diabetes-related kidney disease caused about 2 million deaths. A healthy diet, regular physical activity, maintaining a normal weight, and avoiding tobacco use are ways to prevent or delay the onset of type 2 diabetes.[4]

Diabetes can be treated and its consequences avoided or delayed with diet, physical activity, medication and

regular check-ups and treatment for complications.Diabetes mellitus is a group of metabolic diseases characterized by hyperglycemia that occurs due to abnormalities in insulin secretion, insulin action or both.[5] Factors that influence the occurrence of DM are a person's characteristics (age, gender and genetics), nutritional knowledge, stress, lifestyle, physical activity, nutritional status both obesity and central obesity. High blood sugar levels are often associated with obesity, especially central obesity which is significantly associated with metabolic syndrome (dyslipidemia, hyperglycemia, hypertension). A person with central obesity is always associated with insulin resistance. The incidence of central obesity in diabetics can also increase the risk of complications such as cardiovascular disease, stroke and type II DM.[6]

As one of the risk factors for hypertension, obesity is also a health issue in Indonesia. The prevalence of central obesity based on the 2013 Riskesdas was 26.6%.[7] The number of people with Diabetes Mellitus globally is increasing every year, the causes include an increase in population, age, obesity and lack of physical activity. It is estimated that 578.4 million people will have diabetes in 2030 compared to 463 million in 2019 and by 2045 the number will increase to 700.2 million.[8]

2. METHODE

The study was an analytic observational study with a cross sectional approach. This study was conducted at the Family Doctor Clinic, Faculty of Medicine, University of Muhammadiyah Palembang on March 13, 2023-April 09, 2023 with the population at the Family Doctor Clinic, Faculty of Medicine, University of Muhammadiyah Palembang. Samples were taken with total sampling technique. Inclusion criteria in this study were patients who came for treatment at the Family Doctor Clinic who were able to communicate well, and could read and write. Exclusion criteria were patients who refused to be respondents. The IMT measurement method uses a scale and height of the ZT-120 Health Sca brand with a nominal measuring scale, abdominal circumference is measured using a waist ruler brand one with a nominal measuring scale, while for Diabetes Mellitus seen from the diagnosis of doctors at the clinic. Data analysis used Chi Square test with 95% correlation level with SPSS (Statistical Product and Service Solutions) application.

3. RESULT

Based on the data collected by researchers on 33 respondents, the following results were obtained:

Table 1 Frequency distribution of Respondents

Characteristics	n	%
Gender		
Female	18	54,5
Male	15	45,5
Education		
Elementary school	3	9,1
Junior high school	9	27,3
Senior high school	12	36,4
University	9	27,3
Total	33	100

Table 1 shows that the characteristics of respondents according to gender were 18 respondents (54.5%) were female, more than male respondents, namely 15

respondents (45.5%). Based on the last education of the respondents, there were 3 respondents (9.1%) with the last education of elementary school, 9 respondents (27.3%) with the last education of junior high school, 12 respondents (36.4%) with the last education of high school and 9 respondents (27.3%) with the last education of university.

Table 2 Frequency distribution of BMI, abdominal circumference, DM, family history of DM, medication history, history of other diseases

Variable	n	%
BMI		
Underweight	3	9,1
Normal	9	27,3
Overweight	12	36,4
Obese	8	24,2
Obese	1	3,0
Abdominal circumference		
Yes	17	51,5
No	16	48,5
Diabetes Mellitus		
Yes	11	33,3
No	22	66,7
Familiy History		
Yes	15	45,5
No	18	54,5
Treatment History		
Yes	11	33,3
No	22	66,7
Other diseases		
Yes	10	30,3
No	23	69,7
Total	33	100

Based on table 4.2 shows that most respondents fall into the overweight category, namely 12 respondents (36.4%) and obese as many as 17 (51.5%). Most respondents did not have diabetes mellitus, namely 22 respondents (66.7%) while respondents who had diabetes mellitus were 11 respondents (33.3%). History of diabetes mellitus in the family found 18 respondents did not have a family history of diabetes mellitus (54.4%). History of treatment in respondents, it was found that most respondents did not have a history of treatment, namely 22 respondents (66.7%). History of other diseases in respondents, as many as 23 respondents and have no history of other diseases (69.7%).

Table 3 Relationship between Body Mass Index and Diabetes Mellitus

	Diabetes mellitus				P value
	yes		no		
	n	%	n	%	
BMI					0.085
underweight	0	0	3	9.1	
Normal	0	0	9	27.2	
Overweight	7	21.2	5	15.2	
Obese I	3	9.1	5	15.2	
Obese II	1	3.0	0	0	
Abdominal circumference					0.014
Yes	9	27.2	8	24.3	
No	2	6.1	14	42.4	

Based on table 3, it was found that most respondents fell into the normal BMI category and did not have diabetes mellitus. The p value result was 0.085 (p> 0.05) which means there is no relationship between body mass index and diabetes mellitus in patients at the Family Clinic of the Faculty of Medicine, Muhammadiyah Palembang. The proportion of respondents who are included in the central obesity category and have diabetes mellitus is 9 people (27.2%) more than respondents who are included in the central obesity category and do not have diabetes mellitus, namely 8 people (24.3%). Respondents who did not fall into the category of central obesity and had diabetes mellitus were 2 people (6.1%) less than respondents who did not have diabetes mellitus, namely 14 people (42.4%). The results of the chi-square test obtained a p value of 0.014 (p < 0.05). This shows that there is a significant relationship between abdominal circumference and diabetes mellitus in patients at the Family Clinic of the Faculty of Medicine, Muhammadiyah Palembang.

4. DISCUSSION

In this study obtained p value 0.085 (p> 0.05) which means that there is no relationship between body mass index and diabetes mellitus in patients at the Family Clinic of the Faculty of Medicine, Muhammadiyah Palembang. These results are in line with the research of Hairuni found that there is no relationship between BMI and the incidence of diabetes mellitus with a p value of 0.737.[6] A person with a low body mass index can have a risky hip waist circumference ratio if their waist and hip fat stores increase which has an impact on increasing the risk of disease, on the other hand, someone with a high body mass index but the fat distribution is not centered on the waist and pelvis can have a non-risky hip waist circumference ratio. Body fat distribution is more appropriate as a predictor of DM than obesity in general as measured by BMI. BMI measurement cannot show fat distribution[9]. Other factors that affect glucose levels are medication adherence, diet compliance, fat consumption, knowledge related to Diabetes Mellitus and positive family support.[10]

BMI is the most recommended measurement for the evaluation of obesity and overweight in children and adults. This is because in addition to being easy and inexpensive, BMI levels are associated with body fat and risk factors for type 2 DM. Risk factors for diabetes mellitus are overweight (obesity) factors that include lifestyle changes from traditional to western lifestyles, overeating, and sedentary or sedentary living. A normal BMI has 2.09 times the risk of developing DM compared to those who are thin (have a BMI of less).[11,12] Obesity in type 2 DM shows that in a state of excess fat there is a fundamental disorder in the formation of insulin signals. Hasanah also revealed that the cause of diabetes mellitus tends to be caused by obesity related to insulin resistance so that there is an increase in blood glucose levels caused by the accumulation of body fat which can interfere with the work of insulin.[13]

Based on the results there is a significant relationship between abdominal circumference and diabetes mellitus in patients at the Family Clinic of the Faculty of Medicine, Muhammadiyah Palembang. Similar results were obtained in the research of Septyaningrum there is a significant positive relationship between body mass index, abdominal circumference, and waist hip circumference ratio with blood sugar levels. The higher the body mass index, abdominal circumference, and pelvic waist circumference ratio, the higher the blood sugar level, conversely the lower the body mass index, abdominal circumference, and pelvic waist circumference ratio, the lower

the blood sugar level. Abdominal circumference has the strongest relationship because it has the largest correlation coefficient close to 1.[9] Increasing abdominal circumference can have an impact on increasing blood sugar because glucogenesis occurs which can inhibit the work of insulin. Abdominal fat has metabolic products in the form of fatty acids that are released into the hepatic portal vein. Free fatty acids that circulate excessively to the liver will cause oxidation and produce Acetyl CoA. This Acetyl CoA will activate the enzyme pyruvate carboxylase in the liver, which converts pyruvic acid into glucose in the liver, this process is called gluconeogenesis. In addition, the increased levels of free fatty acids circulating in the liver can lead to reduced sensitivity of muscle cells to insulin, resulting in a state of reactive metabolism.[13–15]

The amount of abdominal fat can be estimated with higher accuracy with abdominal circumference measurement for the determination of abdominal obesity which is an important risk factor for the onset of type two diabetes mellitus. The most accurate measurement of visceral/central fat is by using Computed Axial tomography or Magnetic resonance imaging, but it is expensive and impractical, so some researchers use abdominal circumference in the measurement of central obesity.[9] In the metabolic process, insulin plays an important role, namely to enter glucose into cells, which can then be used as fuel. In normal conditions, meaning that insulin levels are sufficient and sensitive, insulin will be captured by insulin receptors on the cell surface, then open the cell entrance, so that glucose can enter the cell to be burned into energy. As a result, blood glucose levels become normal.[16]

5. CONCLUSIONS

The conclusion of this study is that there is no significant relationship between body mass and diabetes mellitus (p value 0.085) and there is a significant relationship between abdominal circumference and diabetes mellitus in patients at the Family Clinic of the Faculty of Medicine, Muhammadiyah Palembang (p value 0.014). People should be able to control diabetes mellitus and maintain a healthy lifestyle and exercise regularly.

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