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RELATIONSHIP OF SUGAR, SALT, AND FAT CONSUMPTION TO RATIO OF WAIST TO HIP AND BLOOD GLUCOSE LEVELS IN TYPE 2 DIABETES MELLITUS PATIENTS

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ABSTRACT

Background: *Diabetes Mellitus (DM) is a chronic hyperglycemia condition that can affect all body systems. This situation is caused due to factors that inhibit insulin work or the amount decreases. Being overweight is also closely related to daily food intake, significantly contributing calories, such as sugar, salt, and fat. An indicator that can determine central obesity is the waist-to-hip ratio.*

Research Methods: *This type of research is a cross-sectional study with an analytic observational study design. The sampling technique uses purposive sampling, and the total is 161 respondents. This research is in Gambirsari Public Health Center, Surakarta, Indonesia, in April 2020. Data on the Consumption of sugar, salt, and fat respondents used a Semi-Quantitative Food Frequency Questionnaire form and 24-hour food recall.*

Research Result: *Test data analysis using Pearson using SPSS 23 software. Sugar consumption (p = 0.004, r = 0.229), salt (p = 0.001, r = 0.454), fat (p = 0.021, r = 0.181) indicates a relationship to the waist-to-hip ratio.*

Conclusion: *Based on statistical analysis, it was found that there was a significant relationship between sugar, salt, and fat intake and the waist-to-hip ratio*

BACKGROUND

According to Perkeni (2011), Diabetes Mellitus (DM) is a group of metabolic diseases with hyperglycemic characteristics that occur due to abnormalities in insulin secretion, insulin action, or both. Meanwhile, according to Price & Wilson (2011), Diabetes Mellitus is a state of chronic hyperglycemia that can affect all body systems. This situation is caused by factors that inhibit insulin action or decreased amount. Indonesia faces very complex health problems. Non-communicable diseases (NCDs) are increasing, while infectious diseases are still dominant. From Riskesdas 2007 to Riskesdas 2013, the prevalence of overweight (BMI≥25) and obesity (BMI>30) in adults 18 years and over increased from 14% and 2.8% to 25.8% and 5, respectively. 6%. Overweight and obesity suffered mainly in the female group. In this period, the proportion of women 18 years and over with overweight increased from 17.5% to 32.3%, while obesity increased from 4.0% to 8.2%.

A sharp increase in Diabetes Mellitus cases occurs in many people with changes in high-fat consumption patterns and low physical activity habits, resulting in increased chances of overweight and obesity. In addition, sedentary people tend to be overweight and obese, which are then associated with an increase in Diabetes Mellitus (WHO, 2013).

According to Gill (2012), obesity is strongly associated with Diabetes Mellitus, especially Type II Diabetes Mellitus. It is an independent risk factor for dyslipidemia, hypertension, and cardiovascular disease, which subsequently becomes a complication and a significant cause of death for someone with Type II Diabetes Mellitus. Diabetes Mellitus disease is more critical than other diseases. The prevalence of Type II Diabetes Mellitus is in line with the increasing prevalence of obesity. About 80% of people with Type II Diabetes Mellitus are obese.

Some indicators to determine obesity include body mass index (BMI), waist circumference, hip waist circumference (RLPP), and body fat percentage. Waist and hip circumference measurements are calculated by dividing the waist circumference by the hip circumference (Nugraha, 2009). Waist circumference is used to determine central obesity and associated metabolic complications. At the same time, the hip is a protective factor against the incidence of cardiovascular disease. Cardiovascular risk factors will appear if the waist and hip circumference ratio are more than or equal to 0.85 in women and 0.90 in men (Andriani & Bambang, 2013).

The role of obesity in insulin resistance is explained in various theories. For example, one theory states that fat tissue is also an active endocrine tissue that can communicate with the liver and muscle (the two insulin target tissues) by releasing intermediary substances that affect insulin action. Therefore, the high accumulation of fat tissue can result in insulin resistance (Fox, 2007). 2011).

The insulin resistance that occurred in the obese group resulted in a decrease in insulin action in the target tissue, making it difficult for glucose to enter the cells. This situation ends with an increase in glucose levels in the blood. Therefore, an increase in blood glucose levels that occurs in conditions of insulin resistance can be detected and measured through examination of blood glucose levels (Fadhilah et al., 2015).

One of the factors that can affect blood sugar levels is excess fat mass. Obesity can reduce or stop the action of insulin in lowering blood glucose levels. Excess energy is a cause of obesity. It is undeniable that fat deposits lodged in the body are caused by residual calories that are not used by the body and are eventually stored as fat. Obesity is one of the factors that can affect metabolism in the body (Lingga, 2012).

Excess weight is also closely related to daily food consumption/intake, especially calorie contributors, such as sugar and fat. In addition, the Consumption of salt also tends to make people eat more food. Unsalted food will taste different from salty food. In the long term, these risk factors will cumulatively cause PTM, such as diabetes mellitus (DM), to increase in all levels of the population (all socioeconomic levels) as well as its complications (WHO, 2013). This prompted researchers to analyze the relationship between sugar, salt, and fat Consumption on blood glucose levels and RLPP.

MATERIAL AND METHODS

The type of research used is a cross-sectional study with an analytical observational research design. The population in this study were all patients with type 2 diabetes mellitus who underwent outpatient treatment at the Gambirsari Health Center and were diagnosed as type 2 diabetes mellitus patients based on clinical symptoms and laboratory examinations. Based on the data obtained, the population of people with type 2 diabetes mellitus at the Gambirsari Health Center in the past year was 394 people. The sample in this study were outpatients with type 2 diabetes mellitus in the working area of the Gambirsari Health Center with the following inclusion and exclusion criteria. Inclusion criteria: (a) Diagnosed with type 2 diabetes mellitus; (b) Able to stand well (without the help of others); (c) Can communicate well; (d) 35-64 years. Exclusion criteria: (a) Type 2 diabetics who have a history of certain diseases (cancer, liver disease, or other serious diseases); (b) Consuming alcohol; (c) Get insulin therapy. Calculation of the estimated number of samples in a population in this study used the Lemeshow formula (1997), and the number of samples was 161 respondents (Lameshow, 1997). The sampling technique in this study used a purposive sampling technique. Purposive sampling technique, namely the determination of the sample based on specific considerations and by the inclusion and exclusion criteria.

Data on Consumption of Sugar, Salt and Saturated Fat respondents used interviews, Semi Quantitative Food Frequency Questionnaire form and 24-hour food recall, with interpretation of measurement results: (a) Excessive sugar consumption if >50 grams/person/day; (b) Enough if <50 gram/person/day; (c) Excessive salt consumption if > 5 grams/person/day (d) Adequate if <5 grams/person/day (e) Excessive fat

consumption if >67 grams/person/day). (f) Enough if <67 grams/person/day). The ratio of waist to hip circumference using a meter (metline) with measurement indicators: (a) No risk of obesity (men < 0.9 and women < 0.85) (b) Risk of obesity (men 0.9 and woman).

Data analysis was performed using SPSS version 23.0. The analysis in this study uses two types of analysis, namely univariate analysis, and bivariate analysis. Univariate analysis was conducted to describe the characteristics of each variable. Univariate analysis in this study resulted in a frequency distribution including sample age, gender, occupation, blood glucose levels, patient intake, categories of Consumption of salt and fat sugar, and waist circumference. Bivariate analysis was used in this study to determine the significant relationship between the independent variable and the dependent variable through statistical tests. In addition, this study was tested using the Pearson test. This test analyzes the relationship between sugar, salt, and fat Consumption with waist-to-hip ratio and blood glucose levels. The Ethics Committee has approved this research of the Jember State Polytechnic No. 9014/PL17/PG/2020.

RESULT

The characteristics of the subjects in this study included age, gender, occupation, smoking habits, and exercise habits. Based on table 1, the number of subjects is more female than male. The most age range is 46-55 years. Most occupations are housewives (68.3%). Smoking habit is dominated by respondents who do not have a smoking habit. Then for exercise habits, many respondents do not have exercise habits. Based on table 2, it can be seen that most of the respondents consume excess sugar (77%) and excess fat (93.8%). In comparison, salt consumption (54%) shows that many respondents know about limiting salt consumption, and the results of salt consumption are in a suitable category. Finally, the results showed that 137 respondents (85.1%) had a waist-to-hip ratio of more than average.

Table 1. Distribution of the characteristics of research respondents

Subject Characteristics	n	%
Age (year)		
35-45	22	13.7
46-55	139	86.3
Gender		
Male	138	14.3
Female	23	85.7
Profession		
Bisinessman	42	26.1
Goverment employees	9	5.6
Doesn't work	110	68.3
Smoking Habit		
Yes	14	8.7
No	147	91.3
Exercise habit		
Yes	41	22.5
No	120	74.5

Source : Primary data 2020

Table 2. Distribution of sugar, salt and fat consumption, waist-to-hip ratio

Parameter	n (%)	Mean ± SD	Min	Max
Sugar consumption				
Enough ≤ 50 gr	37 (23)	69 ± 56.8	20	147
Excess ≥ 50 gr	124 (77)			
Salt consumption				
Enough ≤ 5 gr	87 (54)	6 ± 2.8	1.00	14
Excess ≥ 5 gr	74 (46)			
Fat consumption				
Enough ≤ 67 gr	151 (93.8)	86 ± 15.7	34	141
Excess ≥ 67 gr	10 (6.2)			
Rasio lingkar pinggang-panggul				
Obesity	137 (85.1)	1.8 ± 1.07	0.30	14
Not obesity	24 (14.9)			

Source : Primary data 2020

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Table 3. Analysis of the relationship between sugar, salt and fat intake on waist-to-hip ratio

Variable	Waist to hip ratio	
	p-value	r
Sugar consumption	0.004	0.229
Salt consumption	0.001	0.454
Fat consumption	0.021	0.181

Source : Primary data 2020

DISCUSSION

Consumption of sugar in this study is sugar added to food and sugar derived from fruits. The results of this study indicate that 77% of respondents consume excessive amounts of sugar. Based on the Minister of Health, the amount of sugar consumed per person in a day is 50 grams (Darwin, 2013). The average amount of sugar consumption from the results of this study was 69 grams, with a standard deviation of 56.8 grams. Darwin (2013) stated that sugar is a simple carbohydrate with soluble properties. Darwin (2013) stated that sugar is a simple carbohydrate soluble in water and easily absorbed by the body as energy fuel. In general, simple sugars are divided into monosaccharides (glucose, fructose, & galactose) and disaccharides (maltose, lactose & sucrose). Sugar belongs to the disaccharide group, namely sucrose (glucose and fructose). Sugar content is also found in foods containing simple carbohydrates, such as flour and bread (Indrayana et al., 2014).

Based on the recall of respondents respondents' intake, it was found that the type of sugar consumed by respondents varied, ranging from granulated sugar, brown sugar, honey, packaged drinks, and sweetened condensed milk. Consumption of sugar in average amounts is good for the body because it can provide a balanced energy contribution to maintaining an ideal body weight (Kouno et al., 106).

However, excessive Consumption will result in obesity problems because the sugar will be stored as fat in adipose tissue (Wells et al., 2017) and is correlated with increased blood glucose levels, which is a sign of type 2 Diabetes Mellitus (rabbity et al., 2012). In addition, high Consumption of simple sugars in early adolescents has a 2.6 times greater risk factor for obesity and hypertension (Ramayulis, 2013).

Based on the study results, as many as 54% of respondents consume salt in sufficient quantities. The average amount of salt consumption from the results of this study was 6 grams with a standard deviation of 2.8 grams. Therefore, based on the recall results, most of the food intake comes from foods that are added with salt.

Salt consumption directly affects increasing blood pressure, where blood pressure is a risk factor for diabetes mellitus. Hypertension is one of the predictors of worsening micro and macrovascular complications of diabetes. It can be prevented and treated with weight loss, regular physical activity, reduced alcohol consumption, and dietary regulation (Carter et al., 2013). It is recommended that a diet rich in fruits, vegetables, and low-fat dairy products, including whole grains, fish, and nuts, be reduced and reduce fat from red meat, sweets, and sugar-containing drinks (Carter et al., 2013).

Permenkes (2013) recommends that the limit of fat consumption in a day is 67 grams (Darwin, 2013). The results of this study indicate that the average fat consumption of respondents is 86 (93.8%) grams which is still in the excess category. The highest amount of fat consumption is 141 grams in 1 day. The type and amount of fat most consumed comes from oil. The most consumed cooking oil by respondents because the type of food consumed by respondents in their spare time is cooking oil consumed in as many as 1-2 pieces. In addition, respondents also like to eat snacks such as cassava chips, purple sweet potato chips, and potato chips. The processing techniques used for daily side dishes in daily meals also tend to use oil such as stir fry, fry, and side dishes typical of Padang food stalls. Fats and oils are part of the balanced nutrition needed for a healthy life (Kouno et al., 2016). Oil is a food ingredient with a high energy density, so it is not recommended to be consumed in excess (Jati & Lisya, 2014). High fat consumption can increase total body fat stored in subcutaneous and visceral fat, leading to central obesity, namely fat accumulation in the abdominal area, and affecting dyslipidemia (Parry et al., 2017), a disease that reduces insulin sensitivity. High blood pressure, coronary heart disease, and stroke (Jati & Lisya, 2014). Excess Consumption of fats, especially unsaturated fats of animal origin, can increase blood cholesterol. Cholesterol will stick to the walls

of blood vessels. Over time it will form plaque, and atherosclerosis occurs, which will then cause hypertension (Perkeni, 2015).

Waist-hip ratio is an anthropometric measure that can measure nutritional status, especially in central obesity (Kusteviani, 2015). The results of this study indicate that 24 people have a waist-to-hip ratio that is more than the average value. Based on Table 4.2, it can be seen that 137 people have a waist-hip ratio > 0.8, and 24 people have an abdominal circumference < 0.8 cm. The majority of respondents, on average, have exceeded the regular waist and hip size limits. One of the causes of a large waist-to-hip ratio or central obesity is excessive Consuming simple carbohydrates. Excessive sugar consumption from respondents in this study is suspected to be the cause of central obesity because sugar is one type of simple carbohydrate (Kusteviani, 2015).

Type II diabetes can occur because of central obesity due to fat accumulation in the abdomen. Excessive fat deposits in the body can lead to insulin resistance, affecting blood glucose levels in people with diabetes (Adnan et al., 2013). Theoretically, excessive amounts of fat can cause insulin resistance, one of the main factors causing increased fasting blood glucose levels. However, it is not a factor that significantly determines the increase in blood glucose levels for people with diabetes (Adnan et al., 2013). In addition, waist-to-hip ratio measurements can show fat deposits located in the visceral parts of the body. Therefore, the greater the waist-to-hip ratio indicates the accumulation of excess fat in the visceral body, increasing blood glucose levels.

Based on the analysis results, table 3 shows a significant relationship between sugar consumption and the waist-to-hip ratio ($p<0.05$ and $r = 0.229$). The study results show that most of the samples with central obesity have a habit of consuming cakes, sugar, sweet drinks, and high-energy foods that come from fat. Sweet foods can increase weight and belly circumference. This relationship is thought to be due to fatty foods with sweet foods. Sweet foods are often high in fat. Sugars are classified as simple carbohydrates consisting of carbon, hydrogen, and oxygen. Sugar contains the most energy and contains very few vitamins and minerals. Excess Consumption of simple carbohydrates will be stored in glycogen and fat, which then causes overweight and obesity (Te Morgan et al., 2103). It was found that there was a relationship between salt consumption and waist-to-hip ratio ($p<0.05$ and $r = 0.454$). This is because individuals who have high levels of salt intake also have unhealthy lifestyles. For example, they tend to have low physical activity levels and choose unhealthy foods and poor eating behavior (Larsen et al., 2013). This could contribute to the association of salt intake with increased waist-to-hip ratio through the following: (a) high salt intake promotes thirst and increases fluid intake, which can be compensated for by drinking. Sweets with added sugar (b) salty foods are often high in fat and high calories (c) salty foods taste better and encourage a person to eat more food (Grimes et al., 2103).

The results of the data analysis of the variable level of fat intake with the risk of central obesity showed a significant relationship $p = 0.021$ ($p < 0.05$). The results showed that most of the sample cases were at risk of having a pattern of Consumption of fat that exceeded the requirement, such as the choice of food sources of animal and vegetable protein that was consumed excessively, the tendency to choose preserved foods, and the habit of processing food by frying it with lots of oil.

Central obesity is associated with changes in diet, primarily increased Consumption of fat as an energy source with high energy density. Fat is one of the macronutrients as the primary energy source after carbohydrates and is a very efficient energy reserve in the body. The recommended Consumption of fat ranges from 25 to 30 percent of total daily energy, the saturated fat intake of 10 percent of total daily energy, and cholesterol of 300 mg/day. Consumption of fat and cholesterol samples that exceed the recommended intake comes from fried foods and ready-to-eat foods with a high energy density. This food is widely consumed in the sample as snacks at work and rest. Excess dietary fat intake will increase the distribution and storage of fat in the body in adipose tissue, especially in the abdominal and intra-abdominal areas, leading to central obesity. This is evidenced by the results of research showing that there is a significant relationship between intake of fat, total, saturated fat, and cholesterol with central obesity status in this study sample which is supported by other studies which also state that western foods with high fat and low carbohydrates are associated with obesity. increased fat distribution, central obesity, and metabolic syndrome (Shu et al., 2015).

CONCLUSION

Based on statistical analysis, it was found that there was a significant relationship between sugar, salt, and fat intake with waist to hip ratio.

RECOMMENDATION

Limiting the Consumption of sugar, salt, and fat to prevent weight gain and obesity in patients with type 2 diabetes mellitus is an important strategy to prevent complications, considering that the Consumption of sugar, salt, and fat has a highly significant value on the ratio of waist to hip circumference in patients with type 2 diabetes mellitus. 2.

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