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Relationship between fiber & cholesterol intake, physical activity and nutritional status with blood glucose of Prolanis participants of Kedaton Health Center in 2024

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ARTICLE INFO

Article history:

Received Dec 2, 2024
Revised Dec 15, 2024
Accepted Dec 30, 2024

Keywords:

Cholesterol Intake
Fiber
Nutritional Status
Physical Activity
Prolanis

ABSTRACT

Diabetes mellitus is a metabolic disorder characterized by increased fasting blood glucose. The purpose of this studyto analyze the relationship between nutrient intake, nutritional status and physical activity with blood sugar levels. This research design usescross-sectionalwith a total of 42 respondents. Data on fiber and cholesterol intake usingSQ FFQ. Waist circumference data measured with a measuring tape with an accuracy of 0.1 cm and physical activity data measured using the Physical Activity Scale for the Elderly (PASE). Fasting blood glucose levels were measured using hexokinase. There was a significant relationship between fiber intake (p=0.001), cholesterol intake (p=0.006), and physical activity (0.014) to the increase in fasting blood glucose. However, waist circumference did not have a significant relationship to the increase in fasting blood glucose (p=0.895). Increased blood glucose was related to fiber intake, cholesterol intake, and physical activity, while waist circumference was not significantly related in the prolanis participants of Kedaton Health Center.

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INTRODUCTION

The International Diabetes Federation (IDF) stated that in 2021 there were 537 million diabetes sufferers in the world, aged 20 - 79 years (Soelistijo, 2021). The prevalence of DM in Indonesia increased from 2.1% in 2013 to 8.5% in 2018 (Ministry of Health of the Republic of Indonesia, 2020).

Complications that often occur in DM increase morbidity and mortality rates in DM sufferers, as well as reducing productivity (Soelistijo, 2021). Research on 72 DM patients found that 59.7% experienced complications in the form of acute kidney failure 8.3%, hypoglycemia 11.1%, retinopathy 15.3%, neuropathy 6.9%, cerebrovascular 4.2%, coronary heart disease 11.1% and ulcers 27.8% (Saputri, 2020). Research on 30 type 2 DM patients showed an increase in cholesterol

levels in 19 patients (63%) (Firdayanti et al., 2022). There is a significant relationship between the incidence of hypercholesterolemia and coronary heart disease (Alkhusari et al., 2020).

Complications of diabetes can be prevented by good blood sugar control. Regulating nutrient intake and physical activity are 2 of the 4 pillars of diabetes mellitus management (Soelistijo, 2021). Research on 74 DM patients found that 52.7% had poor blood sugar control, there was a significant relationship between BMI and blood sugar control. While physical activity was not related to blood sugar control ((MG Putri et al., 2022). Different results were shown from meta-analysis research on diabetes sufferers who were physically active would have 2.4 times more controlled blood sugar levels compared to those who were not physically active (Asfaw & Dagne, 2022).

Adding protein to carbohydrate source foods can significantly reduce blood sugar levels 1 hour after eating (Basturk et al., 2021)). Carbohydrate intake and physical activity were significantly associated with fasting blood sugar levels, with carbohydrate intake as the dominant factor ((Werdani & Triyanti, 2014)). Fiber, magnesium and physical activity intakes were significantly associated with fasting blood sugar levels while zinc intake was not (Putri et al., 2021). Quasi-experimental research on 16 DM patients with fast walking treatment showed that fast walking can significantly reduce blood sugar levels (Sriwahyuni et al., 2021).

Hyperglycemia that often occurs in people with diabetes mellitus can induce oxidative stress conditions with the formation of reactive oxygen species (ROS), which are free radicals. Oxidative stress conditions can trigger endothelial dysfunction which facilitates the formation of atherosclerosis and the occurrence of macrovascular and microvascular complications ((Prawitasari, 2019)). Bioactive molecules derived from natural sources have been shown to lower glucose levels. Vitamin E supplementation in type 2 DM can increase antioxidant status and antioxidant enzyme concentrations (Unuofin & Lebelo, 2020).

People with diabetes mellitus have a 2 times greater risk of suffering from coronary heart disease compared to those who do not suffer from diabetes (Husni et al., 2018). Research on 138 samples at Sanglah Hospital found that 42% of them had hypercholesterolemia, 75.4% had increased LDL cholesterol, 67.4% had decreased HDL cholesterol, and hypertriglyceridemia of 54.3%. Blood sugar levels in diabetics correlate with blood triglyceride levels (Siorcani et al., 2022). Dyslipidemia is associated with the incidence of coronary heart disease (Ramadhan Effendi, 2021).

Kedaton Health Center has a Prolanis group, with 40 members suffering from diabetes. The exercise activities held by the Kedaton Health Center Prolanis have not been optimal because members have not attended regularly every week (Aapro et al., 2018). This study aims to analyze the relationship between substance intake, nutritional status and physical activity with blood sugar levels. Information about factors related to blood sugar levels and physical activity can be educational and motivational material for diabetics to control their blood sugar so that the risk of complications can be prevented or slowed down.

RESEARCH METHOD

This study is an observational study with a cross-sectional method. The subjects of the study were all prolanis participants who suffered from diabetes mellitus (DM) at the Kedaton Health Center and were willing to become respondents. The number of respondents in this study was 42 people. Nutrient intake including fiber and cholesterol was obtained from the SQ FFQ form for 1 week. Nutritional status was determined by waist circumference measured with a measuring tape with an accuracy of 0.1 cm. Physical activity was determined by looking at the frequency and duration of physical activity in the last 1 week, using the Physical Activity Scale for the Elderly (PASE) questionnaire. Fasting blood sugar levels using the hexokinase method (Spectrophotometry) were obtained at the time the study was conducted, namely after the prolanis gymnastics. Chi-square analysis was used to determine the relationship between nutritional intake, nutritional status and physical activity with blood sugar levels and blood lipid profiles. This study has received Ethics

approval from the Health Research and Development Ethics Committee of the Tanjung Karang Ministry of Health Polytechnic No: 423 / KEPK-TJK / V / 2024.

RESULTS AND DISCUSSIONS

The increasing prevalence of Diabetes mellitus is causing significant public health problems worldwide (Antar et al., 2023). Central obesity is a condition in which fat mainly accumulates around the abdomen and waist, which can increase the risk of metabolic disorders such as diabetes mellitus (Jin et al., 2023). The relationship between food intake, physical activity, and central obesity has become a major concern in efforts to prevent and address this problem.

Table 1. Respondent characteristics

Characteristics	Number of Respondents	Percentage (%)
Age (years)		
<60	10	23.8
60 - 70	26	61.9
70-80	6	14.3
Gender		
Man	13	31
Woman	29	69
Education		
Did not finish elementary school	1	2.4
Graduated from elementary school	2	4.8
JUNIOR HIGH SCHOOL	9	21.4
SENIOR HIGH SCHOOL	14	33.3
PT	16	38.1
Ever Had Nutrition Counseling	28	66.7
Never	14	33.3
Nutrition Counseling		
Physical Activity	27	64.3
Inactive (<3 times/mg)	15	35.7
Active		
Central Obesity	36	85.7
Central Obesity	6	14.3
Normal		
IMT	28	66.7
Obesity	14	33.3
Normal		
Fasting Blood Sugar	27	64.3
High GDP	15	35.7
Normal GDP		

Table 1 shows that most of the respondents are 60-70 years old with female gender. The level of education is 38.1% is college, 33.3% high school, 21.4% junior high school and a small number have elementary school education and did not graduate from elementary school. Most respondents have never attended nutritional counseling (66.7%). Most respondents (64.3%) have inactive physical activity. Based on nutritional status, most respondents are centrally obese (85.7%) and have an obese body mass index (66.7%). In addition, based on fasting blood sugar levels (FBS), more than half of the respondents have high blood sugar levels, namely 64.3%.

Table 2. Relationship between fiber intake and GDP

Fiber intake	GDP				Total		OR	P value
	Tall		Normal					
	N	%	n	%	n	%		
Insufficient intake	25	80.6	6	19.4	31	100		
Good Intake	2	18.2	9	81.8	11	100	18.70	0.001
Amount	27	64.3	15	35.7	42	100		

Table 2 shows a significant relationship between fiber intake and fasting blood glucose levels. Respondents who have insufficient fiber intake have a risk of 18.70 of increasing blood glucose levels. This is in accordance with previous studies showing that fiber intake has a relationship with increasing fasting blood glucose (Abdurrachim & Annisa, 2018; Tiara, 2021). The role of fiber from natural foods is effective in improving glycemic control and insulin sensitivity in patients with type 2 diabetes. Based on a meta-analysis study, it was shown that consumption of dietary fiber at an average dose of 10 g/day for 8 weeks significantly decreased HbA1c, FBG, fasting insulin, and HOMA-IR.(Mao et al., 2021).

Table 3. Relationship between cholesterol intake and GDP

Cholesterol Intake	GDP				Total		OR	P value
	Tall		Normal					
	N	%	n	%	n	%		
More Intake	22	78.6	6	21.4	28	100		
Good Intake	5	35.7	9	64.3	14	100	6.60	0.006
Amount	27	64.3	15	35.7	42	100		

Table 3 shows a significant relationship between cholesterol intake and fasting blood glucose levels. Respondents who have excessive cholesterol intake have a risk of 6.60 for increasing fasting blood glucose levels. This is in line with previous research that respondents who consume foods high in cholesterol are associated with a 1.15-fold increase in fasting blood glucose levels (Li et al., 2023). This is supported by research that shows that cholesterol intake, especially food sources containing excessive saturated fatty acids, will have an effect on increasing blood glucose levels (Al-Mssallem et al., 2024). High cholesterol intake will affect insulin resistance in diabetes mellitus patients which will result in metabolic system disorders which will result in hyperinsulinemia (Han et al., 2016; Pihlajamäki et al., 2004).

Table 4. The relationship between central obesity and GDP

Waist circumference	GDP				Total		OR	P value
	Tall		Normal					
	N	%	n	%	n	%		
Central Obesity	23	63.9	13	36.1	36	100	-	0.895
Not Obese	4	66.7	2	33.3	6	100		
Amount	27	64.3	15	35.7	42	100		

Table 4 shows no significant relationship between central obesity and fasting blood glucose levels. This is different from previous studies that central obesity has a greater influence on the incidence of diabetes mellitus (Jin et al., 2023). Previous research found that one of the indicators of diabetes mellitus in middle age is central obesity (Yunianto et al., 2015). Most patients with type 2 diabetes show central (intraabdominal) obesity (Chandrasekaran & Weiskirchen, 2024; Papaetis et al., 2015). This is associated with insulin resistance, especially at the level of skeletal muscle, adipose tissue, and liver (Ahmed et al., 2021). The findings showing macrophage infiltration in abdominal adipose tissue and an imbalance in adipocyte cytokine production, also known as adipokines, are important steps towards a better understanding of the molecular mechanisms that regulate the development of insulin resistance (Chait & den Hartigh, 2020; Clemente-Suárez et al., 2023; Guria et al., 2023). In addition, obesity causes cells to take up more non-esterified fatty acids, but this occurs in the absence of subsequent β-oxidation. In turn, this leads to the accumulation of intermediate lipid metabolites, which interfere with the insulin signaling pathway (Jung et al., 2007).

Table 5. The relationship between physical activity and GDP

Physical Activity	GDP				Total		OR	P value
	High GDP		Normal GDP					
	N	%	n	%	n	%		
Not active	21	77.8	6	22.2	27	100	5.25	0.014
Active	6	40	9	60	15	100		
Amount	27	64.3	15	35.7	42	100		

Table 5 shows a significant relationship between physical activity and fasting blood glucose levels. Respondents who have inactive physical activity have a risk of 5.25 of increasing fasting blood glucose levels. This is in accordance with previous studies that physical activity is related to the incidence of type 2 diabetes mellitus (Wardani & Nugroho, 2023). Cohort studies show that physical activity such as brisk walking for 20 minutes a day has a 19% lower risk of developing type 2 diabetes mellitus (Strain et al., 2023). In addition, other studies show that leisure time physical activity of around 22 MET-hours/week or 300 minutes/week can reduce the risk of developing diabetes mellitus (Mutie et al., 2020). Physical activity is the first therapy recommended in the prevention of type 2 diabetes. Moderate to vigorous physical activity for at least 150 minutes per week accompanied by changes in dietary behavior can prevent, delay, or reverse diabetes (Syeda et al., 2023).

CONCLUSION

This study showed that increased blood glucose was significantly associated with low fiber intake, high cholesterol intake and low physical activity. However, central obesity did not have a significant relationship with increased fasting blood glucose.

ACKNOWLEDGEMENTS

The authors would like to thank the Kedaton Health Center and the prolanis participants who have supported their contributions and support for this research. Our gratitude goes to the Poltekkes Kemenkes Tanjung Karang who has funded this research with the Fund " Proposal for Inter-University Cooperation Scheme (PKPT) in collaboration with Aisyah Pringsewu University.

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