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Benefit Dietary Fiber Snack for Diabetes Mellitus Patients Type 2 in Palembang Population

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Abstract

Diabetes mellitus is a chronic disease characterized by blood glucose levels exceeding normal, namely when blood glucose levels are ≥ 200 mg/dl. The effectiveness of giving snack-rich fiber to diabetes mellitus patients. This type of research is quantitative with a quasi-experimental research design. This research conducted in May 2023 at the Alang-Alang Lebar Health Center in Palembang. The research sample selected by systematic random sampling with a total sample of 60 respondents. There is an effect of giving snacks rich in fiber to diabetes mellitus patients (p=0.000). The results of statistics showed that there was an effect of giving snacks rich in fiber to diabetes mellitus patients.

Keywords: Diabetes mellitus, Blood glucose, Fiber, Dietary.

Full-length article **Corresponding Author*, e-mail: *muzakar@poltekkespalembang.ac.id* Doi # https://doi.org/10.62877/65-IJCBS-24-25-19-65

1. Introduction

Diabetes mellitus is a chronic disease characterized by blood sugar levels that are higher than normal, namely a blood sugar level of 200 mg/dl and a fasting blood sugar level of ≥ 126 mg/dl [1]. According to the World Health Organization (WHO) and the American Diabetes Association (ADA), diabetes mellitus is categorized into type 1 Diabetes Mellitus (DM) and type 2 DM. Type 2 Diabetes Mellitus is one of the most common metabolic disorders worldwide . Its main development caused by a combination of two main factors, namely defective insulin secretion by pancreatic cells and the inability of insulin tissue to respond to insulin [2]. Type 2 DM known as insulin-non-dependent diabetes mellitus, which is a temporary loss βcells due to genetic predisposition, and mostly occur in obese people and is associated with high blood pressure and high cholesterol levels [3].

According to the International Diabetes Federation (IDF), 2021 reported that 10.5% (536, 6 million people) of the adult population (20-79 years) suffer from diabetes. According to the IDF, diabetes in Indonesia has a prevalence of 10.8% with 19 million cases of diabetes in adults out of a population of 179 million adults. According to Riskesdas in 2018, the prevalence of diabetes mellitus in Indonesia was 2.0% with a population-aged ≥ 15 years, where the prevalence was higher than in 2013, which was 1.5%. Based on the profile of the Palembang City Health Office for 2019-2020, in Alang-Alang Lebar District the number of Diabetes Mellitus sufferers at the Alang-Alang Lebar Health Center in Palembang City had 136 sufferers in 2019 and increased to 381 people in 2020. DM sufferers who treated inappropriately will result in coma, fainting, and even death [4].

Treatment of diabetes mellitus can done in two ways, namely pharmacological and non-pharmacological treatment. Non-pharmacological treatment is a treatment to lower blood sugar levels through the consumption of foods that contain nutrients high in fiber, flavonoids, low glycemic index, and chromium so that they can lower blood sugar levels. Foods that can give to people with type two diabetes mellitus to reduce total blood sugar levels are snack-rich in fiber. Snacks are rich in fiber made from mung bean flour, pumpkin flour, shrimp flour, stevia sugar, and special DM milk, which contain the right nutrients to reduce blood sugar levels. This snack given four pieces a day weighing 50 grams, given as a snack for people with type 2 DM, and given for seven consecutive days.

2. Materials and Methods

The type of research used is quantitative research using a Quasi-Experimental research design. The independent variable is fiber-rich snacks, and the dependent variable is blood sugar levels. In this study, there were two groups: the treatment group and the comparison group. The treatment group was the group that given snacks rich in fiber and received oral hypoglycemic drugs, while the comparison

group was the group that only received oral hypoglycemic drugs.

The research conducted at the Alang-Alang Lebar Health Center in Palembang, South Sumatera Province. The research carried out in May 2023. After being determined using the formula, the number of samples used was 60 respondents, with the division of each treatment group consisting of 30 respondents with type 2 DM and a comparison group of 30 respondents with type 2 DM. Sampling used a systematic random sampling method. The treatment carried out given for seven consecutive days as a snack to respondents. Given 4 pieces a day weighing 50 grams. Statistical data analysis in this study used SPSS. Ethical Approval (No 0789 KEPK/Adm2/XII/2022).

3. Results and Discussions

The distribution of respondents consists of age, gender, occupation, and nutritional status presented in Table 1. According to Table 1, we found that most respondents were home wives, namely 16 people (53.3%) in the treatment group and 13 people (43.3%) in the comparison group. In addition, most of the respondents had normal nutritional status, but some were overweight or obese. Most patients with type 2 diabetes mellitus have more nutritional status (especially obesity). Where type 2 DM sufferers with nutritional status are more likely to have higher blood sugar levels patients with normal nutritional status [5]. This is in line with research conducted [6] which stated that 86.5% of respondents who had nutritional status were overweight or obese. From the results of research that has found, most of the respondents had a family history of diabetes, namely 17 people (56.7%) in the treatment group and 18 people (60%) in the comparison group. According to the results of previous studies, P-value = 0.04; 95% which means there is a relationship between family history and the incidence of DM. Respondents who have a family history of type 2 diabetes Mellitus will 3.78 times more at risk of experiencing abnormal blood sugar levels, compared to respondents who do not have a family history of DM [7].

This is in line with research [8] which states that 68.8% of T2DM patients have a family history of diabetes, of which 25.1% of them have a diabetic mother and 15.3% have a diabetic father. Most of the respondents in this study had good energy intake, namely 25 people (83.3%) in the treatment group and 18 people (60%) had good energy intake in the comparison group. Energy consumption that exceeds the body's needs causes more glucose to exist in the body. Sugar is a source of food and fuel for the body that comes from the process of digesting food. In people with type 2 diabetes, the body's tissues are unable to store and use glucose so glucose levels will rise and become toxic to the body. Some of the respondents in the study, both the treatment group and the comparison group, had sufficient protein intake according to their needs. Based on research conducted by Suprapti, D 2017 shows that a plant-based protein diet has a relationship (p-value = 0.002) with the incidence of DM (OR = 2.737). Excess protein intake not recommended, because it can interfere with protein metabolism in the liver. Foods that are high in protein contain high amounts of fat, which can cause obesity. This is in line with research that high protein intake in the body will disrupt the concentration of blood glucose levels, and then the protein contained in the body will be stored as fat in the body [9]. Most respondents in this study had sufficient fat intake than needed. Still, some people consume excess fat. This is in line with previous studies, which stated that there was a significant relationship between the proportion of excess fat intake, and fasting blood glucose levels in Type 2 DM sufferers (p-value 0.041. Not all types of fat can trigger diabetes Mellitus depending on the source of food and the type of food to bel consumed [10]. Most respondents in this study had more carbohydrate intake than needed. Consuming daily food should not be excessive, especially carbohydrates. Excessive carbohydrate intake, especially simple sugar intake, can increase blood triglyceride levels. It recommended that the consumption of total carbohydrates be limited to 45-65% of daily energy intake [11].

The results of the study by Iroth et al., (2017), based on statistical tests showed that there was a significant relationship between carbohydrate intake and blood sugar levels in type 2 diabetes Mellitus patients, this was indicated by a value (p-value 0.010). Most respondents in this study had enough fiber intake than needed. The function and characteristics of fiber have something to do with the mechanism of fiber in blood sugar metabolism. Water-soluble fiber can absorb liquid and form a gel in the lamb. The gel will slow down the process of gastric emptying and absorption of nutrients. So that the gel can slow down the peristalsis of blood sugar from the small intestinal wall to the absorption area resulting in a decrease in blood sugar levels. A high-fiber diet is beneficial for metabolic health and a fiber-rich diet is beneficial in type 2 diabetes Mellitus because it consists of complete carbohydrates that are resistant to digestion and thereby reduce glucose absorption and insulin secretion [12]. This is in line with research [13] that giving NAMBUIRA pudding which has antioxidant nutritional content and high fiber affects reducing blood sugar levels in patients with type 2 DM (p-value = 0.000).

One of the ingredients in the snack in this study was mung bean flour. Apart from containing quite high protein and fiber, green beans also have a low glycemic index value of 28.87. Pharmacological approaches to improve glycemic control in type 2 diabetes in clinical trials have shown to be beneficial when eating a low GI (glycemic index) diet rather than a high GI. Increasing evidence points to the potential importance of GI/GL in diabetes, CVD, cancer and weight management [14]. This is in line with previous studies, that individuals who consumed a low glycemic index diet with low glycemic index foods had lower postprandial glucose than individuals who consumed a low glycemic index diet with high glycemic index foods [15]. Flavonoids have many positive health effects on metabolic disorders, such as cardiovascular disease, cancer, obesity, and diabetes [16]. Flavonoids that exhibit strong antioxidant activity have suggested to useful in the management of diabetes Mellitus. The ability of antioxidants to protect against the detrimental effects of hyperglycemia and to increase glucose metabolism and absorption should considered as a major alternative in the treatment of diabetes mellitus [17].Pumpkin flour contains flavonoids that function in inhibiting the enzymes a-amylase maltase and a-glucosidase. The principle of inhibition of this enzyme is that it will delay the hydrolysis of carbohydrates and disaccharides, inhibit the absorption of glucose, and inhibit the metabolism of sucrose into glucose and fructose so that blood sugar levels can decrease [18].

Table 1. Characteristics of Respondents

Characteristics of Respondents	Treatment (n=30)		Control (n=30)	
	n	%	n	%
Gender				
1. Man	10	33,3	11	36,7
2. Woman	20	66,7	19	63,3
Work				
1. Retired	8	26,7	3	10
2. civil servant	3	10	4	13,3
3. IRT	16	53,3	13	43,3
4. Private employees	1	3,3	5	16,7
5. Self-employed	2	6,7	5	16,7
Age				
1. 40-50	8	26,7	6	20
2. 51-60	11	36,7	18	60
3. 61-70	11	36,7	6	20
Nutritional status				
1. Thin	0	0	0	0
2. Normal	22	73,3	23	76,6
3. Overweight	6	20	5	16,7
4. Obesity	2	6,7	2	6,7
Family History				
1. There is	17	56,7	18	60
2. There isn't any	13	43,3	12	40

Table 2. Nutritional Intake of Participants

Category	**Group**			
	Treatment (n=30)		**Control (n=30)**	
	n	**%**	**n**	%
Energy Intake				
More	7	23,3	6	20
Good	16	53,3	15	50
Not enough	7	23,3	9	30
Protein intake				
More	7	23,3	6	20
Good	18	60	17	56,7
Not enough	5	16,7	7	23,3
Fat intake				
More	8	26,7	9	30
Good	17	56,7	14	46,7
Not enough	5	16,7	7	23,3
Carbohydrate Intake				
More	7	23,3	8	26,7
Good	16	53,3	15	50
Not enough	7	23,3	7	23,3
Fiber intake				
More	0	0	0	0
Good	17	56,7	9	30
Not enough	13	43,3	21	70

Table 3. Difference of Blood Sugar Level between Before and After Treatment

Category	**Group**			
	Before (n=30)		**After (n=30)**	
	Lowest – High (mg/dL)	**Average (mg/dL)**	**Lowest – High (mg/dL)**	**Average (mg/dL)**
Treatment	210 – 320	251,20	161 - 290	215,40
Control	215-325	258,60	187 - 300	234.73

Table 4. The Effect of Giving Snacks Rich in Fiber on Reducing Blood Sugar Levels

Group	Average Difference	t	*p-values*
GDS Treatment	35.80	8,232	0.000
Control GDS	23.87		

Bivariate Analysis

Table 5. Differences in Average Blood Sugar Levels before and After Treatment

Group	Initial mean	Final means	*p-values*
Treatment	251,20	215,40	0.000
Control	258,60	234.73	0.000

Apart from flavonoids, Pumpkin also contains carotenoids, which are effective antioxidants to protect cells from damaged by free radicals. Consumption of pumpkin flour will increase plasma insulin levels, which results in decreased blood glucose in people with DM [19]. The effect of pumpkin flesh powder in reducing blood glucose and plasma lipid levels in rats when the powder dose increased from five to 15 g showed significant results. Similarly, as the trial duration was extended from the first week to 28 days, these antihyperglycemic and antihyperlipidemic effects became more significant [20]. Many flavonoids reported to have antidiabetic action by acting on biological targets involved in type 2 diabetes Mellitus such as aldose reductase and α-glucosidase [21]. Chromium is an essential micronutrient associated with the regulation of many processes in the human body including glucose homeostasis. Chromium works by activating insulin receptors through chromium oligopeptides to help regulate glucose homeostasis thereby increasing insulin signal transduction and sensitivity. Cr deficiency can lead to glucose intolerance, increased circulating insulin, fasting hyperglycemia, and even impair growth [22].

The milk used is Tropicana Slim High Fiber powdered milk. Tropicana Slim High Fiber is powdered milk containing chromium, which is useful in regulating blood sugar, and is a cofactor in increasing insulin action. Lack of chromium in the body can cause coordination disorders, confusion, weight loss, and the risk of developing diabetes [23]. Apart from milk, shrimp is also a food ingredient that has a high chromium content of 26 mcg per 100 grams of fresh shrimp. Chromium is very important for overcoming insulin resistance and lowering blood sugar levels. The independent t-statistical test that has been carried out shows that there is a significant effect of giving snacks rich in fiber on blood glucose levels in people with type 2 diabetes mellitus. Mung Beans, apart from containing quite high protein and fiber, green beans also have a low glycemic index value of 28.87. Most foods that are high in fiber have a low glycemic index. Foods with a low glycemic index and high fiber lead to lower post-prandial blood glucose levels and insulin response so that they can improve lipid profiles and reduce the incidence of insulin resistance [24].

This is in line with research [13] that giving NAMBUIRA pudding, which has a high nutritional content of fiber, affects reducing blood sugar levels in patients with type 2 DM (p-value = 0.000). In addition to green beans, the ingredients for making snacks in this study were pumpkin flour, where pumpkin flour contains flavonoids that function to inhibit the enzymes a-amylase maltase and a-glucosidase. The principle of inhibition of this enzyme is that it will delay the hydrolysis of carbohydrates and disaccharides, inhibit the absorption of glucose, and inhibit the metabolism of sucrose into glucose and fructose so that blood sugar levels can decrease [18]. Other ingredients contained in the manufacturing of snacks are shrimp flour and milk, which contain chromium, which is beneficial for people with diabetes mellitus. The results of a recent meta-analysis study stated that consumption of chromium supplementation could reduce fasting plasma glucose, hemoglobin A1C, and triglyceride levels while increasing circulating HDL cholesterol in patients with type 2 diabetes Mellitus [25]. The average difference in reducing blood sugar levels after giving snacks rich in fiber. In the treatment group, it was 35, 80 mg/dl and in the comparison group, it was 23, 87 mg/dl. The results of the multivariate analysis show that the nutrient that has the most influence on reducing blood sugar levels is fiber, where the statistical result is p-value = 0,003.

4. Conclusion

The independent t-test shows that there is an effect of providing snacks rich in fiber on blood sugar levels in diabetes mellitus patients (p-value < 0.05, namely 0.000). Multivariate analysis shows that the nutrient that has the most influence on reducing blood sugar levels in fiber-rich snacks is fiber, where the statistical result is p-value = 0.003. For diabetes patients, it recommended to consume foods that are high in fiber, low in glycemic index, and high in chromium. Which comes from everyday food ingredients such as vegetables or beans.

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