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Description of Vegetables and Fruits Consumption Patterns and Blood Sugar Level In Type 2 Diabetes Patients at Public Health Center I West Denpasar

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ABSTRACT

Background: Diabetes mellitus is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin performance or both. Every year people with diabetes have increased. Vegetable and fruit consumption patterns are related to blood glucose levels in people with diabetes mellitus. This study aims to describethe pattern of consumption of vegetables and fruit in patients with type 2 diabetes mellitus at Public Health Center I West Denpasar. **Methods**: This type of research is observational research with a cross-sectional design and consecutive techniques. The number of samples studied were 31 samples. **Results**: From the research conducted, samples with the category of consuming less vegetables had uncontrolled blood sugar levels of 68.18%. Samples with a variety of vegetable consumption categories had uncontrolled blood sugar levels of 77.78%. The samples with the category of the frequencyof consuming vegetables is not good has uncontrolled blood sugar levels of 70.59%. Samples with the consumption category of less fruit have uncontrolled blood sugar levels of 70.83%. Samples with consumption categories of typesof fruit that did not vary had uncontrolled blood sugar levels of 72%. Samples with the category of fruitconsumption frequency are not good have uncontrolled blood sugar levels of 67.86%. It is recommended to increase the consumption of vegetables and fruits that contain high fiber.

Keywords: Consumption Patterns; Blood Sugar Levels; Diabetes Mellitus

INTRODUCTION

Non-communicable diseases (NCDs) are diseases that are not caused by microorganism infection but have relation with metabolic syndrome. These diseases are responsible for at least 70% of deaths in the world. The results of Riskesdas in 2007, 2013, and 2018 showed an increasing trend in the prevalence of NCDs such as diabetes, hypertension, stroke, and joint disease. Diabetes mellitus is a group of metabolic diseases characterized by hyperglycemia that occurs due to abnormalities in insulin secretion, insulin performance or both (Perkeni, 2021). Diabetes mellitus (DM) is a metabolic disorder characterized by an increase in fasting blood sugar levels of ≥ 126 mg/dL or 2-hour *postprandial* blood sugar levels of ≥ 200 mg/dL. Based on the 2018 Riskesdas results, the prevalence of diabetes mellitus cases based on physiologist diagnosis at the age of ≥ 15 years was 2.0%. In Bali Province, a total of 52,251 people with diabetes mellitus have received health services out of 53,726 people with diabetes mellitus (Dinas Kesehatan Provinsi Bali, 2021).

Complications arising from DM can include vascular disorders of both large and small blood vessels, as well as nervous system disorders or neuropathy. Large blood vessel complications (macrovascular) usually attack the heart, brain, and blood vessels, while small blood vessel complications (microvascular) can occur in the eyes and kidneys. Diabetics also often experience complaints of neuropathy, both motor neuropathy, sensory, and autonomic neuropathy (Perkeni, 2021).

Patients with Diabetes Mellitus should carry out and pay attention to management the amount of energy needed, the meal schedule that must be followed and the type of food that must be considered so that blood glucose levels are normal. Based on the type of food that is recommended to be consumed is high fiber, which is 25 grams contained in vegetables and fruits. Based on the World Health Organization (WHO)/FAO to prevent non-communicable diseases, it is recommended to consume fruits and vegetables at least 400 grams every day, consisting of 250 grams of vegetables and 150 grams of fruits (WHO, 2012).

METHOD

This study was conducted at Public Health Center I West Denpasar which is located at Jalan Gunung Rinjani No. 65,Tegal Harum. This research was conducted in February-April 2023. The type of research used is observational research, where researchers observe a phenomenon that has occurred without any control from the researcher and the research subject is observed as it is. The research design used was *cross- sectional*. The sampling technique used in this study was *Non Probability Sampling,* ie; the *Consecutive Sampling* method. The population in this study were patients with type 2 diabetes mellitus at Public Health Center I West Denpasar, with a total sample of 31 samples. The types of data collected include sample identity, vegetable and fruit consumption patterns collected using the SQ-FFQ form, weight and height, and blood sugar levels during the research. The data that has been obtained is then analyzed

descriptively.

RESULTS

According to the research result about the sample characteristics based on gender were mostly female with 17 samples (54.84%). Based on the age of the sample, the highest proportion of samples aged 50-65 years was 26 samples (83.87%). The education level of the sample, it is known that the highest level of education is elementary school with 11 samples (35.48%). In terms of sample occupation, the largest number of samples were unemployment, ie; 18 samples (58,06%). There were 16 samples (51.61%) from 31 samples,had overweight or obesity category. The distribution of sample characteristics can be seen in Table 1 below.

Table 1. Distribution of Sample Characteristics

Characteristics		f	%
Gender			
1.	Male	14	45,16
2.	Female	17	54,84
	Total	31	100,00
Age			
1.	30-49 years old	5	16,13
2.	50-65 years old	26	83,87
	Total	31	100,00
Education level			
1.	Not attending school	4	12,90
2.	Elementar School	11	35,48
3.	Junior High School	2	6,45
4.	High School	9	29,03
5.	College	5	16,13
	Total	31	100,00
Occupation			
1.	Civil servant	0	0
2.	Private Employees	10	32,26
3.	Retired Civil Servant	3	9,68
4.	Unemployment	18	58,06
	Total	31	100,00
Nutritional Status			
1.	Less	1	3,23
2.	Normal	14	45,16
3.	Excess	16	51,61
	Total	31	100,00

Consumption patterns are various types of information that provide an overview of the composition consisting of the average type and amount of food consumed per person per day, which is usually consumed by the general public within a certain period of time. Based on the results of the study, data on the distribution of blood sugar levels and vegetable consumption based on the amount are presented in Table 2.

Table 2. Distribution of Blood Sugar Levels Based on the Amount of Total Vegetable Consumption

Total Vegetable Consumption	Blood Sugar Level				Total	
	Controlled		Uncontrolled			
	f	%	f	%	f	%
Sufficient (≥ 250 gram)	4	44,44	5	55,56	9	100
Less (< 250 gram)	7	31,82	15	68,18	22	100
Total	11		20		31	

Based on data from table 2 above, it can be seen that 22 samples whose amount of vegetable consumption was less, there were 15 samples (68.18%) who had uncontrolled blood sugar levels.

Based on the results of the study, the distribution of blood sugar levels and vegetable consumption are presented in Table 3.

Table 3. Distribution of Blood Sugar Based on Vegetables Consumption

Type of Vegetables Consumed	Blood Sugar Level				Total	
	Controlled		Uncontrolled			
	f	%	f	%	f	%
Diverse (≥ 5 types)	7	55,85	6	46,15	13	100
Not diverse (<5 types)	4	22,22	14	77,78	18	100
Total	11		20		31	

Based on the data above, it can be seen that of the 18 samples whose vegetable consumption was not diverse, 14 samples (77.78%) had uncontrolled blood sugar levels. On the hand, distribution of blood sugar levels and vegetable consumption based on frequency are presented in Table 4.

Table 4. Distribution of Blood Sugar Level Based on Vegetable Consumption Frequency

Frequency of Vegetable Consumption	Kadar Gula Darah				Total	
	Controlled		Uncontrolled			
	f	%	f	%	f	%
Good (≥ 3 times/day)	6	42,86	8	57,14	14	100
Not good (≤ 2 times/day)	5	29,41	12	70,59	17	100
Total	11		20		31	

Based on this data, it can be seen that 17 samples whose had frequency of vegetable consumption was not good and there were 12 samples (70.59%) who had uncontrolled blood sugar levels.

The distribution of blood sugar levels and fruit consumption based on quantity are presented in Table 5.

Table 5. Distribution of Blood Sugar Levels Based on the Amount of Total Fruit Consumption

Total Fruit Consumption	Blood Sugar Level				Total	
	Controlled		Uncontrolled			
	f	%	f	%	f	%
Sufficient (≥ 150 gram)	4	57,14	3	42,86	7	100
Less (< 150 gram)	7	29,17	17	70,83	24	100
Total	11		20		31	

Based on the data, it can be seen that of the 24 samples whose fruit consumption was less, 17 samples (70.83%) had uncontrolled blood sugar levels.

The distribution of blood sugar levels and fruit consumption are presented in Table 6.

Table 6. Distribution of Blood Sugar Level Based on Types of Fruit Consumption

Types of Fruit Consumed	Blood Sugar Level				Total	
	Controlled		Uncontrolled			
	f	%	f	%	f	%
Diverse (≥ 5 types)	4	66,67	2	33,33	6	100
Not diverse (<5 types)	7	28,00	18	72	25	100
Total	11		20		31	

Based on the data obtained, it can be seen that of the 25 samples whose types of fruit consumption are notdiverse, 18 samples (72%) have uncontrolled blood sugar levels. The data of blood sugar levels and fruit consumption based on frequency are presented in Table 7.

Table 7. Distribution of Blood Sugar Level Based on Frequency of Fruit Consumption

Frequency of Fruit Consumption	Blood Sugar Level				Total	
	Controlled		Uncontrolled			
	f	%	f	%	f	%
Good (≥ 3 times/day)	2	66,67	1	33,33	3	100
Not good (≤ 2 times/day)	9	32,14	19	67,86	28	100
Total	11		20		31	

Based on the results of the study, it can be seen that of the 28 samples whose frequency of fruit consumption was not good, there were 19 samples (67.86%) had uncontrolled blood sugar levels.

DISCUSSION

A group of metabolic diseases characterized by hyperglycemia due to abnormalities in insulin secretion, insulin action, or both is known as diabetes mellitus (Perkeni, 2021). Diabetes mellitus is a metabolic disorder characterized by an increase in fasting blood sugar levels of ≥ 126 mg/dL or 2-hour *postprandial* blood sugar levels of ≥ 200 mg/dL.

Based on the research that has been done, most of the samples are female, namely 17 samples (54.84%). Women tend to have a greater chance of increasing their body mass index, so they have a higher risk of developing diabetes. Monthly cycle syndrome, *post-menopause* which causes body fat to accumulate easily due to this hormonal process, puts women at risk of developing type 2 diabetes mellitus. In terms of age, most of the samples ranged in age from 50-65 years ie; 26 samples (83.87%). Based on theory, a person aged ≥ 45 years has an increased risk of developing diabetes mellitus and glucose intolerance due to degenerative factors, namely decreased body function to metabolize glucose. As a person ages, they have progressive shrinkage of pancreatic β-cells, so that too little hormone is produced and results in an increase in blood sugar levels (Masruroh, 2018).

In terms of the nutritional status of the samples, most of them had higher nutritional status, ie; 16 samples (51.61%). Body mass index along with other factors have a relationship with the incidence of diabetes mellitus. The effect of body mass index on diabetes mellitus is caused by low physical activity and high consumption of carbohydrates, protein and fat which are risk factors for obesity. This results in an increase in Fatty Acids or *Free Fatty Acid* (FFA) in cells. Increased FFA will reduce the translocation of glucose transporters to the plasma membrane resulting in insulin resistance in adipose muscle tissue (Trisnawati & Setyorogo, 2013).

To overcome the problem of non-communicable diseases (NCDs), or in this study focusing on diabetes mellitus, the Ministry of Health controls it with a holistic approach through the Gerakan Masyarakat Hidup Sehat (GERMAS) Program. GERMAS in 2017 focuses on three main activities such as : regular health check-up, physical activity, and eating vegetables and fruits. According to the *World Health Organization* (WHO)/FAO, to prevent non-communicable diseases, it is recommended to consume fruits and vegetables at least 400 grams per day, consisting of 250 grams of vegetables and 150 grams of fruits. In addition, based on the type of consumption of vegetables and fruits is said to be diverse if consuming ≥ 5 types of vegetables and fruits and is stated to be not diverse if consuming < 5 types of vegetables and fruits (FAO/WHO, 2011). While the frequency of consuming fruits and vegetables is categorized as good if ≥3 times a day, sufficient if 2 times and less if 1 time a day (Dewantari & Widiani, 2011).

In terms of blood sugar levels and consumption patterns of vegetables and fruits based on the amount obtained, the highest number of samples had less consumption of vegetables and fruits and had uncontrolled blood sugar levels. The vegetables and fruits most often consumed by the sample are spinach, mustard greens, carrots, tomatoes, beans, long beans, cabbage, chayote, bean sprouts, and bitter melon. The most consumed fruits were papaya, banana, apple, and orange. Vegetables and fruits consumed are high in vitamins, fiber and antioxidants.

One type of antioxidant is flavonoids. *Flavonoids* are a group of chemical substances found in fruits, vegetables, and plant roots. *Flavonoids* have antioxidant properties that neutralize the effects of free radicals and reduce inflammation. Flavonoids have various mechanisms to lower blood sugar levels in diabetes control by inhibiting metabolic enzymes, increasing insulin secretion, decreasing apoptosis and promotingpancreatic islet cell proliferation, and reducing insulin resistance and oxidative stress. Flavonoids have the potential to prevent diabetes and its complications (Donny Risnanda et al., 2020). Besides antioxidants, vegetables and fruits also contain vitamins such as vitamin C, vitamin E, and β-carotene. The role of vitamin C, vitamin E, and β-carotene will help reduce the risk of pancreatic β-cell damage due to excess *Reactive Oxygen Species* (ROS) thereby reducing the risk of hyperglycemia due to insufficient insulin or insulin resistance (Fitriani et al., 2018).

In terms of blood sugar levels and consumption patterns of vegetables and fruits by type, the highest number of samples whose types of vegetable and fruit consumption are not diverse and have uncontrolled blood sugar levels. This is due to the lack of consumption of vegetables and fruits which are sources of fiber, which can affect blood sugar levels. The mechanism of fiber that can support the reduction of blood sugar levels, especially dietary fiber, especially water soluble fiber, can make food

more viscous (gel-shaped) so that it inhibits food digestion by digestive enzymes. Thicker food can slow down the process of gastric emptying, thus slowing down the process of digesting food. This slow digestion results in a reduced ability to absorb nutrients including glucose. Slowing down the process of gastric emptying and digestion will result in a longer feeling of fullness, leading to reduced food intake. Reduced glucose absorption and reduced food intake results in lower or controlled blood sugar levels. In the next mechanism, fiber that is not digested by digestive enzymes will allow fiber to enter the colon intact. The intact fiber in the colon is then fermented by bacteria in the colon to build SCFA (*Short Chain Fatty Acid*). The formation of SCFA induces the secretion of GLP-1 (Glucagon Like Peptide-1), GIP (Gastric Inhibitory Polypeptide), and PYY (Peptide YY) hormones that can increase insulin sensitivity which ultimately results in a decrease in bloodsugar levels (Sunarti, 2017).

In terms of the description of blood sugar levels and patterns of vegetable and fruit consumption based on frequency, the highest number of samples were obtained, namely samples whose consumption frequency was not good and blood sugar levels were uncontrollable. These results are in line with research conducted by Fatimah (2020) entitled Pola Konsumsi Buah dan Sayur dengan Kejadian Diabetes Mellitus pada Masyarakat Pesisir. Which obtained the results that respondents who consumed 1-2 serving of fruit per day had a probability of 8,094 times greater to prevent diabetes than respondents who did not consume fruit in preventing the incidence of diabetes mellitus (Siregar et al., 2020).

The increase in blood sugar levels is not only caused by vegetable and fruit consumption patterns but there are other factors including the four pillars of diabetes mellitus management including education, diet, physical activity, and pharmacology (Putra & Berawi, 2015). Providing the right knowledge and information can improve patient compliance with a comprehensive treatment program, so that the goal of controlling blood sugar can be achieved. Eating arrangements are a description of eating patterns/eating habits including the type and frequency of meals. Food will increase blood sugar, one to two hours after eating, blood sugar will reach its highest level. By preparing a meal plan that includes the amount, type, and schedule, it is hoped that blood sugar and lipid levels can be kept under control and patients will get optimum nutrition. Exercise is a physical exercise program that aims to reduce insulin resistance so that insulin works better and increases the rate of glucose transport into cells to meet energy needs. The benefits of exercise for diabetics include lowering blood glucose levels, preventing obesity, playing a role with preventing atherogenic complications, blood lipid disorders, preventing hypertension, and blood hypercoagulation. Patient compliance in taking medication is also one of the factors of the patient's blood glucose level. If people with diabetes mellitus do not comply with the implementation of treatment programs that

have been recommended by doctors or other health workers, the condition of the disease can become worse (Putri & Isfandiari, 2013).

CONCLUSION

From the results of research conducted on patients with Diabetes Mellitus at Puskesmas I West Denpasar, it can be concluded as follows:

1. Vegetable consumption patterns of most samples were in the less good category in terms of amount (70.97%), type (58.06%), and frequency (54.84%) of consumption.
2. Fruit consumption patterns of most samples were in the less good category in terms of amount (77.42%), type (80.65%), and frequency (54.84%) of consumption.
3. Most of the samples (64.52%) had uncontrolled blood sugar levels.
4. Samples with the category of consumption of insufficient amounts of vegetables had uncontrolled blood sugar levels (68.18%). Samples with the category of consumption of vegetable types that are not diversehave uncontrolled blood sugar levels (77.78%). Samples with poor vegetable consumption frequency category had uncontrolled blood sugar levels (70.59%).
5. Samples with the category of consuming less amount of fruit had uncontrollable blood sugar levels (70.83%). Samples with the category of consumption of fruit types that are not diverse have uncontrolled blood sugar levels (72%). Samples with poor fruit consumption frequency category had uncontrollableblood sugar levels (67.86%).

It is recommended for people with diabetes mellitus to increase the consumption of vegetables and fruits both in terms of quantity, variety, and frequency of consumption. Especially consumption of high- fiber vegetables and fruits such as carrots, broccoli, spinach, cauliflower, tomatoes, apples, oranges, mangoes, bananas, strawberries, grapes and many more. Consumption of high-fiber foods can help controlblood sugar levels in people with diabetes mellitus.

CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

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