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Difference of Dietary Habit on Type 2 Diabetes Mellitus Patients at Perumnas I Public Health Center, West Pontianak

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ABSTRACT

Introduction: In 2019, type 2 diabetes mellitus (DM) at Perumnas I Public Health Center was sixth-placed among the top ten diseases with 1,118 cases. This study aimed to determine the dietary habits of type 2 DM patients based on body mass index (BMI) and fasting blood glucose at Perumnas I Public Health Center, West Pontianak.

Methods: This was an observational analysis study with a cross-sectional design. A total of 78 type 2 DM patients who were treated from January to July 2021 at Perumnas I Public Health Center were involved in this study. This study used a three-day food record questionnaire to get patients' food dishes and the Wilcoxon test for correlation between variables.

Results: Most of the respondents had a calorie deficit for three days straight (70.5% on the first day, 76.9% on the second day, and 71.8% on the third day), a normal BMI (51.3%), and above-normal fasting blood glucose (88.5%). The p-value of the Wilcoxon test that showed dietary habits on the first day, the second day, and the third day with BMI was 0.000. The p-value of the Wilcoxon test that showed dietary habits on the first day, the second day, and the third day with fasting blood glucose was 0.000. This showed a significant distinction between patients' three-day dietary habits and their BMI and fasting blood glucose.

Conclusion: There was a significant difference between nutritional status and fasting blood glucose in three-day dietary habits in type 2 DM patients at Perumnas I Public Health Center, West Pontianak.

Highlights:
1. Good eating habits can control the blood sugar levels and BMI of type 2 DM patients.
2. Good dietary control includes the schedule, amount, and type of food consumed.
3. The schedule recommendation for type 2 DM consists of six meals a day, divided into three large meals and three times breaks.

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Introduction

Diabetes mellitus (DM) is a group of metabolic syndromes with characteristics such as hyperglycemia caused by insulin deficiency produced by the pancreas, ineffective insulin used by the body, or both.[1] Insulin is a hormone that maintains and regulates blood glucose. DM, commonly known as the silent killer, damages multiple organs and leads to various illnesses. An abnormality of insulin leads to an enhancement of blood glucose, known as hyperglycemia.[2] A DM patient with chronic hyperglycemia is associated with long-term damage and dysfunction in several organs.[1] Other consequences of DM are heart disease, vision impairment, cataracts, renal disease, lung infection, stroke, blood vessel disorder, gangrene, diabetic foot ulcers, and other diseases. Therefore, many DM patients undergo amputations on their decayed bodies.[3]

DM classifications based on the American Diabetes Association are type 1 DM, type 2 DM, gestational DM, and other types of DM. Type 1 DM is a lack of insulin by the pancreas with unaccompanied daily insulin. Type 2 DM occurs due to ineffective insulin used by the body, which is formed by the pancreas.[3] Type 2 DM is the most common type of DM, with a prevalence of more than 90-95%.[4] To prevent complications of type 2 DM, blood glucose management is required. Various conditions that lead to an increase in blood glucose include age, gender, genetics, knowledge, nutritional status, stress, lifestyle, and physical activity.[5]

According to the Ministry of Health in 2010, type 2 DM could be prevented or delayed by overcoming the risk factors. There are two types of risk factors for type 2 DM, (1) Unalterable risk factors such as genetics, age, and gender, (2) Alterable risk factors like dietary habits, lifestyle, and physical activity.[6] The most common risk factors for type 2 DM are an unhealthy lifestyle and diet that induce obesity, a lack of physical activity, and an imbalance of nutritional intake, resulting in either under- or overnutrition of the body. Concerning the aforementioned factors that cause nutritional impairment, dietary habit errors such as frequency, timing, and consumption level are important to control. The main purpose of this control was to improve the metabolism of the body.[7]

There was a relationship between dietary habits and blood sugar levels in DM patients as if a poor diet could lead to uncontrolled blood sugar.[8] However, controlled blood sugar in DM patients happens when they have good dietary habits that maintain the consumption of foods containing carbohydrates, fats, and proteins in a balanced amount. Excessive consumption could compound the function of the pancreas in secreting insulin. An American study in Alianatasya, *et al.* (2020) stated that individuals with a body mass index (BMI) >27 are at greater risk of suffering from DM than those with a normal BMI.[9] However, it is also stated that obesity is not always followed by insulin resistance. Individuals who have a BMI in the obese category do not necessarily experience insulin resistance, and individuals with insulin resistance can also have a normal or below-normal BMI. In this study, it was also stated that good dietary control, including the schedule, amount, and type of food consumed, can control BMI and blood sugar levels in DM patients.[9]

Dietary habits are several food arrangements, including the type, amount, and schedule of foods measured for each individual per day. Measuring food consumption surveys aims to provide information on nutritional status assessments indirectly regarding the intake of nutrients in individuals, families, and community groups, which are the targets of food consumption surveys. A food record is a method that focuses on actively recording the food and drink consumed on that day during a certain period performed by the respondent.[10]

According to Perumnas I Public Health Center, in 2019, as the pilot study, DM was placed 6th among the 10 highest diseases, with an amount of 1,118 cases. Following the aforementioned conditions, this study aimed to evaluate the dietary habits of patients with type 2 DM based on the patient's BMI and compare the patients' BMI with fasting blood glucose (FBG). This study hypothesized that there was a difference in dietary habits between nutritional status and FBG in type 2 DM patients. This study can provide information for DM patients to increase public knowledge regarding the importance of dietary habits in controlling blood glucose levels in DM patients and knowledge about DM. It is expected that this study can improve public health services.

Methods

This was an observational analysis with a cross-sectional study held at Perumnas I Public Health Center, Pontianak, West Borneo. The number of subjects in this study was 78 type 2 DM patients over 18 years old recorded at Perumnas I Public Health Center from January to July 2021. Food consumption was obtained by filling out a dietary habit questionnaire, namely a three-day food record (3 x 24-hour food record) on Thursday, Friday, and Saturday through Google Forms.[11] The patients input their identity and food lists at breakfast, lunch, dinner, and snack time. Meanwhile, weight, height, and FBG were obtained from medical records.

On the first day, the author contacted respondents via WhatsApp to explain and remind them to fill out the questionnaire completely.[12] On the second and third day, the author reminded respondents to complete the questionnaire. The results of dietary habits were converted from household measurements (tablespoons, cups, pieces, and so on) to grams, then analyzed with the NutriSurvey application (2007) and the patients' food records.[13] To evaluate the differences between variables, this study used the Wilcoxon test for correlation between variables. This study had received approval for ethical clearance from the Ethics Committee of the Faculty of Medicine, Universitas Tanjungpura, Pontianak.

Results

This study included 78 patients categorized by gender, age, BMI, FBG, and dietary habits, consisting of 37 males

(47.4%) and 41 females (52.6%). The age ranged between 41 and 80 years old, with the highest number of subjects being 21 in the age range of 66-70 years old (26.9%), and the least of all subjects being 1 in the range of 41-45 years old (1.3%). About 40 subjects (51.3%) had a normal BMI, and 69 subjects (88.5%) had an above-normal FBG.

Table 1. Distribution of subject characteristics

Characteristics	n	%
Gender		
Male	37	47.4
Female	41	52.6
Age (years old)		
41 – 45	1	1.3
46 – 50	4	5.1
51 – 55	12	15.4
56 – 60	5	6.4
61 – 65	19	24.4
66 – 70	21	26.9
71 – 75	12	15.4
76 – 80	4	5.1
Body Mass Index		
Underweight	6	7.7
Normal	40	51.3
Overweight	32	41
Fasting Blood Glucose		
Normal	9	11.5
Above normal	69	88.5

Source: Research data, processed

Based on Table 2, the highest number of dietary habit patients in the severe deficit category in a three-day row were 55, 60, and 56 subjects.

Table 2. Distribution of patients' dietary habits

	Consumption Level Classification	Number of Patients		
		Day 1	Day 2	Day 3
Dietary habit	Severe deficit	55	60	56
	Moderate deficit	9	9	13
	Mild deficit	7	5	5
	Normal	7	2	3
	Above requirement number	0	2	1

Source: Research data, processed

Based on Table 3, the largest number of subjects were found on day 1 and 2, with 29 patients with severe deficits and a normal BMI. However, on day 3, 27 patients with severe deficits and overweight had the highest number of subjects.

Table 3. Cross-tabulation of patients' dietary habits and BMI

Dietary Habit	Body Mass Index								
Consumption Level Classification	D-1 (Number of Patients)			D-2 (Number of Patients)			D-3 (Number of Patients)		
	U	N	O	U	N	O	U	N	O
Severe deficit	4	29	22	5	29	26	6	23	27
Moderate deficit	2	1	6	1	4	4	0	10	3
Mild deficit	0	5	2	0	4	1	0	3	2
Normal	0	5	2	0	1	1	0	3	0
Above requirement number	0	0	0	0	2	0	0	1	0

Notes: D = Day, U = Underweight, N = Normal, O = Overweight
Source: Research data, processed

Based on Table 4, the largest number of subjects were found on day 1 (50 patients), 2 (53 patients), and 3 (48 patients) with severe deficits and above-normal FBG.

Table 4. Cross-tabulation of patients' dietary habits and FBG

Dietary Habit	Fasting Blood Glucose					
Consumption Level Classification	D-1 (Number of Patients)		D-2 (Number of Patients)		D-3 (Number of Patients)	
	N	AN	N	AN	N	AN
Severe deficit	5	50	7	53	8	48
Moderate deficit	2	7	1	8	0	13
Mild deficit	2	5	0	5	1	4
Normal	0	7	1	1	0	3
Above requirement number	0	0	0	2	0	1

Notes: D = Day, N = Normal, AN = Above normal
Source: Research data, processed

A normality test was performed by using the Kolmogorov-Smirnov test and showed that there were two groups of abnormal distribution. Therefore, this study used the Wilcoxon test to assess differences between three days of dietary habits with BMI and FBG. This test showed that every single group had a difference in three days of dietary habits. The Wilcoxon test of dietary habits, BMI, and FBG are presented in Table 5. Based on Table 5, there was a difference in three days' dietary habits with BMI and a difference in three days' dietary habits with FBG.

Table 5. Differences in dietary habits, BMI, and FBG

Parameter	Wilcoxon Test (p-value)
Body mass index – Day 1 dietary habit	0.000
Body mass index – Day 2 dietary habit	0.000
Body mass index – Day 3 dietary habit	0.000
Fasting blood glucose – Day 1 dietary habit	0.000
Fasting blood glucose – Day 2 dietary habit	0.000
Fasting blood glucose – Day 3 dietary habit	0.000

Source: Research data, processed

Discussion

The difference between dietary habits and underweight patients on day 1, 2, and 3 was associated with body catabolism. The majority of respondents in this study had severe deficits in dietary habits for three consecutive days. This situation could be understood as a lack of food consumption or inadequate food intake for some time. The body would break glycogen, triglyceride, and protein storage to restore energy.[14] Changes occur in the body due to catabolism, such as protein becoming amino acids and fat becoming adenosine triphosphate (ATP), which reduces the amount of muscle and fat tissue available to decompose proteins and fatty acids.[15] Catabolism of protein and fat would affect body mass, like weight loss, because of the consequences of a significant reduction of muscle and fat tissue. Weight loss would affect BMI, especially in type 2 DM patients who had a calorie deficit and became underweight.[14]

Nutritional deficiency means a lack of energy intake or not acquiring sufficient energy intake every day to fulfill metabolic needs. This can be caused by a shortage of food consumption that the body needs or not being varied enough. Nutritional deficiency in type 2 DM patients also occurs due to a lack of knowledge regarding a balanced diet and essential nutrition intake, swallowing difficulties (dysphagia), digestion difficulties, loss of appetite, nausea, vomiting, discomfort during or after eating, and economic and psychological factors. These factors could lead to weight loss (10% minimum loss of ideal body weight) due to digestion problems, diarrhea, infections, asthenia, functional impairment, impaired healing of wounds, and malnutrition.[16]

Type 2 DM patients had to manage a schedule of six meals a day, divided into three large meals (breakfast, lunch, and dinner) and three breaks. This meal schedule was about smaller meals and more frequent meals throughout the day to maintain glucose levels in the blood and keep them stable. Small amounts of glucose that enter the body are immediately metabolized or stored as insulin while waiting for the next meal.[17] Individuals who consume a high-fat diet without regard to low physical activity could affect the energy balance by storing excess fat in the body and resulting in insulin resistance. In addition to maintaining a high-fat diet, type 2 DM patients could also reduce their consumption of a high-carbohydrate diet to lose weight and lower their FBG levels.[18]

Highly recommended physical exercises for type 2 DM patients were moderate-intensity aerobic exercises such as brisk walking, cycling, jogging, and swimming for 30-45 minutes throughout 3-5 days a week.[19] However, type 2 DM patients were required to measure their blood glucose levels before physical exercise. They expected to postpone physical exercises if blood glucose was 200 mg/dl or over. Other physical activities include daily walking, using stairs, sweeping or mopping, and reducing sedentary habits like watching television. Regular exercise could increase the activity and sensitivity of insulin receptors and increase the use of blood glucose.[20] The results of cross-tabulation among dietary habits and BMI showed that most of the patients had severe deficit diets with normal BMI on the first and second day, while on the third day, most of the patients had severe deficit diets with overweight. Several changes reduce nutritional intake in the elderly, such as the inability to chew properly. Hence, patients tend to reduce hard-textured foods. Inappropriate and undifferentiated food selection affected nutritional value below individual daily needs.[21]

Table 4 showed that most patients had severe deficit diets with above-normal FBG on the first, second, and third day. Theoretically, excessive calorie consumption over needs causes hyperglycemia. However, type 2 DM patients cannot have fewer calories, which can cause hypoglycemia. It could damage nerves and vessels leading to the heart. This situation could cause a heart attack, stroke, kidney failure, blindness due to retinal damage, and other complications. Meanwhile, untreated hypoglycemia could cause loss of consciousness.[17] One of Indonesia's most used meal timing schedules was the time-restricted eating model of intermittent fasting, which means individuals limit their eating schedule to a certain period. This fasting model could help patients lose weight, lower blood pressure, lipids, blood glucose, and improve insulin sensitivity by replacing glucose used in fatty acids and ketone bodies as a source of energy. The body would have an energy deficiency to improve leptin levels, and also increase and activate adenosine monophosphate-activated protein kinase (AMPK) to improve insulin sensitivity and glucose homeostasis.[22]

In this study, most of the respondents had severe deficits in their dietary habits, even though their FBG was above normal. Type 2 DM patients have fewer insulin receptors on the cell surface. Thus, glucose would accumulate in the vascular system even when they had less food or were fasting right before the FBG assessment.[23] FBG enhancement could happen due to an inflammatory process that previously occurred, thereby causing insulin resistance that reduces glucose uptake and hyperglycemia. Furthermore, this could be due to genetics, pharmacological therapy, and dietary patterns, which also affect blood glucose levels.[24]

Strength and Limitations

Due to the high number of cases of type 2 DM at Perumnas I Public Health Center Pontianak, this study can help various parties improve public health and enhance references regarding nutritional status and FBG. The dietary habit data was not performed simultaneously with the BMI and FBG assessments, thereby allowing for bias, such as those data were not an actual data because dietary habits and BMI were performed after FBG. The author suggested to perform the dietary habits, BMI, and FBG at once to represent more accurate eating habit of type 2 DM patients.

Conclusion

There was a significant difference in dietary habits with an underweight BMI on the first, second, and third day. However, there was no significant difference in dietary habits between normal BMI, normal FBG, and above-normal FBG on day 1, 2, and 3 of type 2 DM patients at Perumnas I Public Health Center, Pontianak.

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Conflict of Interest

The authors declared there is no conflict of interest.

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Ethical Clearance
This study had received ethical clearance from the Ethics Committee of the Faculty of Medicine, Universitas Tanjungpura, Pontianak (No. 6905/UN22.9/PG/2021) on 01-11-2021.

Authors' Contributions
Designed the study: AS, AATT. Collected data, drafted the manuscript and performed statistical analysis: AS. Contributed to the interpretation of the results: AS, EAP. Supervised results and discussion: AS, EAP, AATT. All authors reviewed and approved the final version of the manuscript.

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