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The Relationship between Consumption of Sweetened Beverages and Physical Activity with Blood Sugar Levels in Patients with Type II Diabetes Melitus

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Abstract

Diabetes Mellitus (DM) is a disease with metabolic syndrome characterized by increased blood sugar levels in the body. Normal blood sugar levels are around 200 mg/ dL . The purpose of this study was to determine the relationship between consumption of sweetened beverages and physical activity with blood sugar levels in patients with type II diabetes mellitus at Surya Husadha Hospital, Denpasar. This type of research is observational with a cross-sectional research design. This study was conducted in November 2024. The number of samples in this study were 50 people. The sweetened beverages consumption data were collected using the SQ-FFQ form, physical activity data was collected using the GPAQ (Global Physical Activity Questionnaire) form, blood sugar level data was obtained from medical records after examination. The results showed that 56% had a consumption of sweetened beverages in the poor category, 38% had low physical activity, and 64% had uncontrolled blood sugar levels (>200 mg/ dL). The results of the analysis showed that there was a relationship between consumption of sweetened beverages and blood sugar levels ($p<0.05$).

Keywords: Sweetened Beverages Consumptions, Physical Activity, Blood Sugar Levels

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INTRODUCTION

Diabetes Mellitus (DM) is a metabolic disease characterized by elevated blood glucose levels (hyperglycemia) due to impaired insulin secretion or function. The causes of diabetes mellitus can be divided into two categories: permanent factors such as gender, age, and genetics, and modifiable factors such as physical activity, diet, and body mass index. One cause of increased body mass index is high consumption of sugar-sweetened beverages. According to 2021 data from the International Diabetes Federation (IDF), 537 million people worldwide suffer from diabetes. In Indonesia, this number is recorded at 19.46 million. Based on the health profile of Bali Province, Denpasar City has the highest number of DM sufferers, with 14,353 people.

The causes of diabetes can be divided into those that cannot be changed such as gender, age, and genetics and factors that can be changed such as physical activity and diet as well as body mass index which can be caused by consuming a lot of sweetened drinks or sugar sweetened beverages (Nasution., et al, 2021)

Sweetened drinks (sugar sweetened beverages) are liquids that have simple sugars or artificial sweeteners added during the production process. These drinks are generally high in calories but low in other nutritional content. The Ministry of Health recommends a daily sugar intake of less than 50 grams of sugar, equivalent to four tablespoons. Some popular sweetened beverages in Indonesia include bottled teas such as Teh Botol, Frestea, and Teh Kotak; fruit juices such as Buavita; isotonic drinks such as Mizone and Pocari Sweat; sodas such as Fanta, Sprite, and Coca-Cola; and packaged coffee and milk (Tangan, 2023).

In addition to the consumption of sweetened beverages, most people with diabetes mellitus have a history of unhealthy diets and lack of physical activity, which can affect blood glucose levels. Lack of physical activity can slow the body's secretory function and cause long-term fat accumulation, which can increase the risk of developing diabetes mellitus (Alidya, 2022). Regular physical activity can significantly benefit health, such as improving blood circulation and increasing the body's sensitivity to insulin, thus enabling it to monitor blood sugar levels. With the high prevalence of diabetes mellitus, several treatments are necessary, such as hospitalization to obtain appropriate treatment.

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METHOD

This study was conducted at Surya Husadha Hospital, Denpasar, in November 2024. This type of study was *observational* with a *cross-sectional study design.* The study population was all patients with Type 2 Diabetes Mellitus. The average number of visits by Diabetes Mellitus patients in a month reached 712 patients. The study sample was 50 people obtained by the *consecutive sampling method* . The sample inclusion criteria were aged 40-65 years, had blood sugar level results and were able to communicate. While the sample exclusion criteria were samples with complications. Identity data was collected by conducting direct interviews, physical activity data was collected using the *Global Physical Activity Questionnaire* (GPAQ) form, data on sweetened beverage consumption was collected through filling out the *Semi Quantitative Food Frequency Questionnaire* (SQ-FFQ) form, blood sugar level data was obtained from the results of patient checks after the examination.

Data on sweetened beverage consumption were processed by averaging the consumption of sweetened beverages in weekly consumption and then categorized into good ≤ 5 x / week and bad > 5 x / week. Physical activity data were processed by calculating the results of filling out the GPAQ form with the formula and then obtained three categories, namely, high METs ≥ 3000 minutes / week,moderate 3000 > METs ≥ 600 minutes / week, and low < 600 METs minutes / week. Blood sugar level data is processed using an *Excel application* and categorized into controlled <200 mg/dL and uncontrolled ≥200 mg/dL. Analysis of the relationship between variables using the Spearman Rank test at the level % (α=0,05)

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RESULTS

The characteristics sample from this research can be seen to the Table 1 below.

Table 1. Characteristics Sample

Characteristics	f	%
Gender		
Male	25	50
Female	25	50
Amount	50	100
Age		
40 – 45	2	4
46 – 50	4	8
51 – 55	4	8
56 – 60	12	24
61 – 65	28	56
Amount	50	100
Education		
Elementary School	1	2
Junior High School	2	4
Senior High School	21	42
College	26	52
Amount	50	100
Work		
Doesn't work	17	34
Housewife	18	36
Private employees	11	22
Teacher	1	2
Businessman	3	6
Amount	50	100
Time to Diagnose		
≤5 Years	28	56
>5 Years	22	44
Amount	50	100

Based on results research , sample data obtained various sex man And Woman each there were 25 samples (50%) with group age most namely 61 - 65 years (56%). Based on the last education, the sample was dominated by college graduates (52%), based on the sample's occupation, the majority of the sample were housewives (36%).In this study, it was found that most of the patients were diagnosed ≤ 5 years ago (56%).

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Consumption of Sweetened Beverages

The 50 samples of type 2 Diabetes Mellitus patients at Surya Husadha Hospital, Denpasar, 28 samples (56%) had a consumption of sweetened drinks that was still in the unhealthy category (>5 x/week), where the consumption of sweetened drinks was obtained using *the SQ-FFQ form* . This can be seen in Figure 1.

Figure 1. Sample Distribution Based on Sweetened Beverage Consumption Category

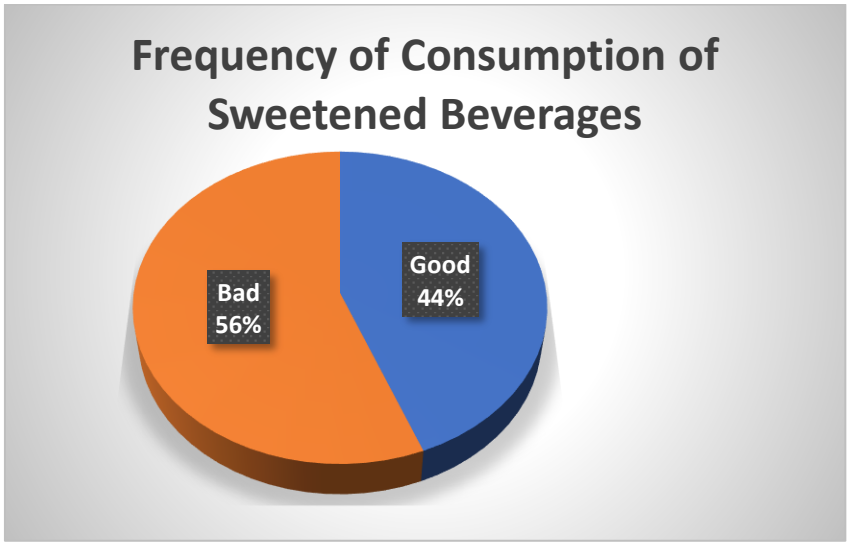

Figure 1. Sample Distribution Based on Sweetened Beverage Consumption Category

Physical Activity

The 30 patients with type 2 diabetes mellitus at Surya Husadha Hospital in Denpasar, 19 (38%) had low levels of physical activity. Physical activity data were obtained through patient interviews using *the GPAQ form* . This can be seen in Figure 2.

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Figure 2. Sample Distribution Based on Physical Activity Category

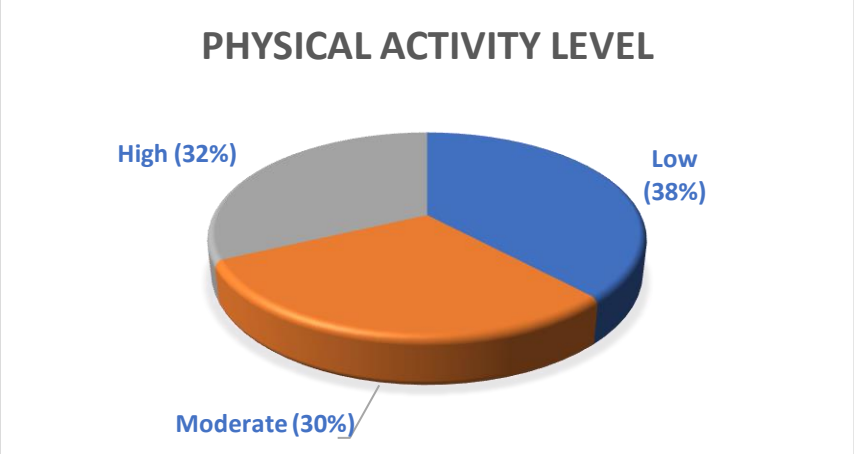

Figure 2. Sample Distribution Based on Physical Activity Category

Blood Sugar Levels

The amount 30 samples, type 2 diabetes mellitus patients had an average blood sugar level of 205.4 mg/dL, with the highest blood sugar level being 320 mg/dL. Blood sugar data revealed that 32 individuals (64%) had uncontrolled blood sugar levels, as seen in Figure 3.

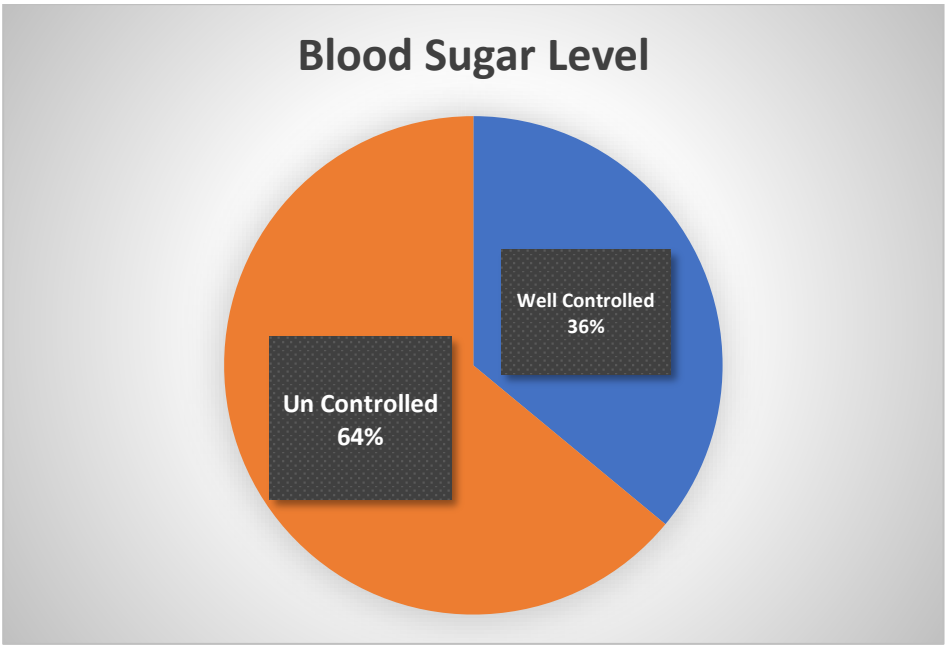

Figure 3. Sample Distribution Based on Blood Sugar Level Category

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Relationship between variables

1. The Relationship Between Sweetened Beverage Consumption and Blood Sugar Levels

Based on the results of a study of 50 samples, the following relationship was found between sweetened beverage consumption and blood sugar levels, as shown in Table 2.

Table 2
Sample Distribution Based on Sweetened Beverage Consumption and Blood Sugar Levels

Consumption Drink Sweetened	Sugar Content Blood				Amount		*P*
	Well controlled		No Uncontrolled				
	n	%	n	%	n	%	
Good	13	72.2	9	28.1	22	44	
No Good	5	27.8	23	71.9	28	56	0.02
Amount	18	100	32	100	50	100	

A cross-sectional table shows that of the 32 samples with uncontrolled blood sugar levels, 23 (71.9%) had a consumption of sweetened beverages in the unhealthy category. Bivariate analysis using the Spearman correlation test yielded a significance value of 0.02 ($p < 0.05$). This result indicates a significant relationship between sweetened beverage consumption and blood sugar levels.

2. Correlation between Physical Activity and Blood Sugar Levels

Based on the results of a study of 50 samples, the following relationship was found between physical activity and blood sugar levels, as shown in Table 3.

Activity Physique	Sugar Content Blood				Amount		*P*
	Well controlled		Uncontrolled				
	n	%	n	%	n	%	
Low	3	16.7	16	50	19	32	
Currently	3	16.7	12	37.5	15	34	0.01
Tall	12	66.7	4	12.5	16	34	
Amount	18	100	32	100	50	100	

Based on the cross-sectional table, it shows that of the 32 samples with uncontrolled blood sugar levels, 16 people (50%) had low levels of physical activity, and 12 people (37.5%) had moderate levels of physical activity. The results of the bivariate analysis using Spearman

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correlation obtained a significance value of 0.01 ($p < 0.05$). These results indicate a significant relationship between physical activity and blood sugar levels.

DISCUSSION

Based on the characteristics of the sample according to gender, each of them was found to have 25 people, diabetes mellitus can be affected equally by men or women (Denggos, 2023). Characteristics based on age showed that the average age of the sample was 60-65 years. According to research (Denggos, 2023), the majority of Diabetes Mellitus sufferers are over 40 years old due to a decrease in the body's metabolic performance (Arania, et al., 2021. Based on the education and occupation of the sample, the highest percentage of those with higher education had completed college (52%) and the highest percentage of those with housewives (36%). A person's level of education tends to influence the work and activities carried out during work (Susanti, 2024). Based on the length of diagnosis, the highest percentage was ≤5 years (56%). The length of time a person suffers from diabetes with continuously rising blood sugar levels results in damage to blood vessels which affects the function of the heart, kidneys, eyes and nerves and results in various serious complications (Prambodo, 2022).

Random blood sugar (GDS) is a blood glucose level test that can be performed at any time without (Rositadinyati. et al., 2020). Most of the sample's blood sugar levels were uncontrolled (64%). The instability of blood sugar levels in diabetes patients can increase or decrease. One factor in uncontrolled blood sugar levels is the consumption of sweetened beverages. In this study, the indicator for measuring sweetened beverage consumption used *the SQ-FFQ form* , where the majority of samples were found to be in the poor category (56%). The sample still consumed sweetened beverages such as packaged tea, packaged coffee, and still consumed carbonated drinks.

If glucose increases, it will trigger the beta pancreas to synthesize insulin. If glucose intake is excessive continuously, it will cause the beta pancreas to release large amounts of insulin and result in a state of hyperinsulinemia, making it difficult for glucose to be absorbed into energy reserves because the insulin receptors do not capture the insulin signal so that it remains in the bloodstream which increases blood sugar levels (Kalthenne, et al., 2021).

From the results of non-parametric analysis using the *Spearman Rank Correlation test* , it was found that there was a significant relationship between the consumption of sweetened beverages and the blood sugar levels of type 2 Diabetes Mellitus patients at Surya Husadha Hospital, Denpasar ($p = 0.02$). In previous research, A study by (Agatha Katherine, 2021) found that the longer a person consumes sweetened beverages containing high levels of sugar, the higher their blood glucose levels, which can lead to diabetes mellitus. The sugar in sweetened beverages is a simple carbohydrate that dissolves easily in water and is converted into energy. Blood glucose levels rise rapidly after a person has just consumed a meal containing predominantly simple carbohydrates. Excessive consumption can cause pancreatic beta cells to become exhausted from producing insulin, leading to a decrease in insulin receptors.

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According to research conducted by (Zakiyah et al, 2021) stated that apart from consumption patterns, diabetes mellitus can also be caused by a lack of physical activity (Zakiyah, 2021). When doing physical activity can increase glucose burning so that it makes it one of the keys in managing diabetes mellitus, especially increasing insulin sensitivity and improving cardiovascular risk factors (Faswita, 2024). The results of research conducted on 50 patients with Diabetes Mellitus showed that 19 people (38%) had a low level of physical activity such as only doing activities at home such as sweeping, gardening and occasionally taking a leisurely walk (Faswita, 2024).

When someone does physical activity such as exercise, the muscles used to move require glucose and fat as an energy source, this causes insulin to increase so that blood sugar levels in the body decrease (Ramadhani., et al., 2022). If the activity is less, it can cause a buildup of accumulated calories so that it can reduce the effectiveness of the pancreas and the food intake that enters the body is not burned and is stored in the body as fat and sugar. Physical activity can contribute 30-50% to reduce the development of type 2 Diabetes Mellitus, physical activity can increase glucose tolerance in the blood so that it can reduce the risk factors for type 2 Diabetes Mellitus (Febnastuti, 2020).

Based on the results of research analysis using non-parametric tests through the *Spearman Rank Correlation test* , there is a significant relationship between physical activity and blood sugar levels in patients with type 2 diabetes mellitus at Surya Husadha Hospital, Denpasar (p = 0.01). Based on previous research conducted by (Akbar & GIyaningtya, 2023) stated that there is a significant relationship between physical activity and blood sugar levels. This physical activity is one of the pillars of Diabetes Mellitus management (Akbar, 2023). According to the Indonesian National Institute of Diabetes Mellitus (PERKENI), the management and prevention of type 2 Diabetes Mellitus stipulates several physical exercise programs that are carried out regularly 3-5 times per week for 30 minutes. In addition, physical activity can reduce the risk of DM through the effects of body weight and insulin sensitivity (Tanzila, 2023).

CONCLUSION(S)

The study results showed that 56% of people with diabetes mellitus had unhealthy consumption of sweetened beverages, 38% had low levels of physical activity, and 64% had uncontrolled blood sugar levels. There was a significant relationship between sweetened beverage consumption and blood sugar levels, and there was a significant relationship between physical activity and blood sugar levels.

Efforts that can be made by hospitals are expected to develop outpatient nutritional care in polyclinics and place a nutritionist to help provide education such as counseling to patients regarding dietary recommendations for Diabetes Mellitus sufferers.

Conflict of Interest

We all authors declare that there is no conflict of interest from this research activity.

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