The Relationship between High Glycemic Index Food Consumption and Blood Sugar Levels of Type II Diabetes Mellitus Patients at the Baiturrahman Health Center, Banda Aceh City

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Abstract

Type II diabetes mellitus (DM) is a metabolic disorder characterized by insulin resistance and/or decreased insulin secretion that causes an increase in blood glucose levels. Consumption of foods with a high glycemic index is known to contribute to increased blood sugar levels. This study aims to analyze the relationship between the consumption of foods with a high glycemic index and blood sugar levels in type II DM patients in the working area of the Baiturrahman Health Center, Banda Aceh City. This study uses an analytical descriptive design with a *cross-sectional* approach which was carried out in January–November 2024, with a sample of 42 respondents. Food consumption data was obtained through the 3×24-hour food recall method, while blood sugar levels were measured using a glucometer by health workers. Data analysis was carried out using the Chi-Square test. The results showed that most patients who ate foods with a low glycemic index had normal blood sugar levels (94.2%), while patients who ate foods with a high glycemic index tended to have high blood sugar levels (76%). The results of the statistical test showed a value of $p = 0.003$ ($p < 0.05$), which means that there is a statistically significant relationship between the consumption of foods with a high glycemic index and blood sugar levels in patients with type II DM. It was concluded that the consumption of foods with a high glycemic index was significantly related to an increase in blood sugar levels at the time. Therefore, glycemic index-based dietary arrangements are important in the control of type II DM.

Keywords: glycemic index, blood sugar, type II diabetes mellitus

INTRODUCTION

Type II diabetes mellitus is a metabolic disorder characterized by decreased insulin secretion by pancreatic beta cells or increased blood glucose levels due to insulin dysfunction. Diabetes is a type of degenerative disease that is increasing every year around the world. There are many different types of diabetes, including type I diabetes, type II diabetes, gestational diabetes, and other types of diabetes. The most common form of diabetes is type II diabetes (Padhi et al., 2020).

The prevalence of type II diabetes mellitus is increasing rapidly worldwide. The prevalence of prediabetes and diabetes is more common in the elderly and adults. Globally, 537 million adults are living with diabetes mellitus and 240 million people are undiagnosed. Three out of four adults with diabetes mellitus live in low- and middle-income countries, and 6.7 million people died from diabetes in 2021. It is estimated that 643 million adults will suffer from diabetes mellitus by 2030 (IDF, 2020). Indonesia is among the 10 countries with the highest number of people with diabetes mellitus in 2019 (Ministry of Health, 2020). Based on Riskedas data in 2018, the prevalence of diabetes mellitus in Indonesia has increased significantly over the past five years, reaching

8.5% in 2018 compared to 6.9% in 2013 (IAARD, 2018).

Almost every province experienced an increase in prevalence from 2013 to 2018. One of them is the province of Aceh which has 2.4% diabetes and Banda Aceh is the city with the highest incidence of diabetes in Aceh which is 2.3% (Riskesdas, 2018). In 2020, 7,365 people in Banda Aceh were recorded suffering from type II diabetes and the health center that has the highest number of diabetics is the Baiturrahman Banda Aceh Health Center, which is 1,209 people. (Banda Aceh City Health Office, 2020). Meanwhile, in August 2023, the number of people with type II diabetes mellitus at the Baiturrahman Health Center in Banda Aceh amounted to 74 people. (UPTD Baiturrahman Health Center, 2023).

The high number of diabetes cases does not occur without cause. Factors that can cause type II Diabetes Mellitus according to *the American Diabetes Association* (2020) are genetics, age, gender, weight, stress, physical activity, diet. An unbalanced diet, such as eating foods with a high glycemic index (GI), can also worsen disease progression. Based on preliminary data from the results of a study conducted (Zhafarina, et al., 2022) with 10 DMT2 patients at the Baiturahman Health Center, 8 of them felt that living with diabetes was not easy, they also felt boredom and boredom in the process because blood sugar levels still often went up and down.

Blood sugar levels and high glycemic index food consumption are closely related. The glycemic index measures how quickly a food raises blood sugar levels after consumption. Foods with a high glycemic index tend to cause rapid spikes in blood sugar levels, while foods with a low glycemic index will result in a slower increase. The concept of glycemic index was developed to assess the ability of food ingredients in raising blood sugar levels and is very beneficial for people with impaired glucose tolerance (Amra, 2018). Based on the results of interviews conducted by researchers on 2 DMT2 patients on September 16, 2023 in the work area of the Baiturrahman Health Center, the patient's diet was still consuming foods with a High Glycemic Index such as white rice (IG: 89), potatoes (IG: 78), and gabin biscuits. The higher the glycemic index of a food, the faster it affects blood sugar levels. The effect of foods with a high glycemic index is to accelerate and raise glucose levels in the blood quickly. According to Rimbawan and Siagian (2004), the categorization of food Glycemic Index values is divided into three, namely, the Glycemic Index ≥ 70 is relatively high, while 56-69 is medium and ≤ 55 is low.

Based on Amra's research, (2018) in patients with type II diabetes mellitus, it was seen that most respondents who consumed foods with high glycemic index content had high blood sugar levels. Based on the background description that has been explained above, the researcher is interested in conducting research on the Relationship between High Glycemic Index Food Consumption and Blood Sugar Levels of Type II Diabetes Mellitus Patients in the Working Area of the Baiturrahman Health Center, Banda Aceh.

METHODS

This study is analytical descriptive using *a cross sectional design*, namely to see "The Relationship between High Glycemic Index Food Consumption and Blood Sugar Levels of Type II Diabetes Mellitus Patients in the Working Area of the Baiturrahman Banda Aceh Health Center"

Sampling uses the Purposive Sampling *method* and uses *the Slovin formula.* Based on this formula, a sample of 42 people was obtained.

Data collection of food consumption patterns with a high glycemic index was obtained by interviewing patients using *Food Recall 3x24 Hours.* Data on blood sugar was obtained by examining using a glucometer

device by officers accompanying the researcher.

The data was analyzed using a statistical data processing program. To determine the relationship between independent variables and dependent variables, bivariate analysis is carried out, namely correlation analysis or *chi-square* test with a degree of confidence α = 0.05 or 5%.

RESULTS AND DISCUSSION

Characteristics of Type II Diabetes Mellitus in the Working Area of the Baiturrahman Health Center, Banda Aceh City 2023

The respondents used in this study were type II diabetes mellitus patients in the working area of the Baiturrahman Banda Aceh Health Center in accordance with the inclusion and exclusion criteria that have been determined by the researcher. In accordance with the results of the study, research respondent data was obtained including distribution based on age, gender, education, occupation, BMI and family history of DM.

The distribution of respondent characteristics by gender, age, education and occupation can be seen in Table 1.

Table 1.
Characteristics of Type II Diabetes Mellitus in the Working Area of the Baiturrahman Health Center, Banda Aceh City 2023

Sample	n	%
Age		
35-45 years old	4	9,5
46-55 years old	9	21,4
56-65 years old	29	69,0
Gender		
Male	9	21,4
Women	33	78,6
Education		
Basics	10	23,8
Intermediate	27	64,2
Height	5	12,0
Jobs		
PNS	5	11,9
Private Employees	2	4,8
Self-employed	3	7,1
Labor	2	4,8
IRT	30	71,4
IMT		
Underweight	1	2,4
Normal	14	33,3
Overweight	10	23,8
Obese I	13	31,0
Obese II	4	9,5
DM Family History		
There	22	52,4
None	20	47,6
Total	**42**	**100,0**

Based on table 1, it can be seen that most of the patients with diabetes mellitus are elderly, which is 29 people (69%), most of the patients with diabetes mellitus are female, which is 33 people (78.6%), most of the patients with diabetes mellitus are Secondary Education (SLTA), which is as many as 27 people (64.3%), the daily activities of most people with diabetes mellitus are as IRT, which is as many as 30 people (71.4%), to see the nutritional status of people with diabetes mellitus, judging from the BMI, most of them are in the normal category, namely 14 people (33.3%), and those with a family history of DM are 22 people (52.4%).

Judging from the characteristics of respondents related to the incidence of diabetes mellitus, including gender, age, education, BMI occupation, and family history. Research conducted by Hartani (2016) in the Mataram Health Center Working Area, found that 62.8% of respondents had female gender. The hormones estrogen and progesterone have the

ability to increase the insulin response in the blood. When menopause occurs, the response to insulin decreases due to low estrogen and progesterone hormones. Another factor that affects is that women's weight is often not ideal so this can reduce the sensitivity of insulin response. This is what makes women more often affected by diabetes than men (Meidikiyanti, 2017).

Faktor jenis kelamin dan umur is an irreversible factor. Physiological changes in humans have decreased drastically at the age of over 40 years (Betteng, 2014). Diabetes mellitus often appears after a person enters the vulnerable age range, namely after the age of 45. The results of this study are supported by Sharma's (2015) research, where the largest subjects experienced diabetes mellitus in the age group of 51-60 years.

Education level is also one of the risk factors that have an influential risk in diabetes mellitus. In this study, most people with diabetes mellitus had a high school education of 27 people. People with a high level of education will usually have a lot of knowledge about health. With this knowledge, people will have awareness in maintaining their health. Individuals with low education have a risk of paying less attention to lifestyle and diet as well as what to do in preventing DM (Notoadmodjo, 2011). This is also supported by research by Pahlawati Annisa and Purwo Setiyo Nugroho (2019) that education level has an effect on the incidence of diabetes mellitus.

Education level and type of work are factors that affect the incidence of diabetes mellitus (DM). The type of work is closely related to the level of physical activity that the individual performs in daily life. Low physical activity, especially in sedentary jobs, contributes to an increased risk of insulin resistance and impaired glucose metabolism.

Work as a means of fulfilling the needs of life can be classified into various fields, including farmers, traders, civil servants (PNS), teachers, self-employed, laborers, and housewives (IRT). Each type of work has different environmental characteristics and activity demands, thus having a varied impact on an individual's health status.

The work environment has the potential to affect the risk of disease, both directly and indirectly. Exposure to an inactive lifestyle, uncontrolled diet, and work stress are factors that can increase the risk of diabetes mellitus. Thus, occupational characteristics need to be considered as one of the important determinants in the incidence of DM (Suiroka, 2012).

Patients with diabetes mellitus in this study had a nutritional status of obese I as many as 13 people or in other words had a BMI between 25 – 29.9. Based on the research of Harahap, et al (2020), it was found that there is a meaningful relationship between BMI and KGD in patients with diabetes mellitus in Sisumut village, Kotapinang district. The results of this study show that the greater the BMI value, the greater the KGD value of a person. High BMI values lead to obesity. This is in accordance with the theory that obesity factors include lifestyle changes from traditional to western lifestyles, overeating, and relaxing or lack of movement (Arisman, 2011).

Blood Sugar Levels During Type II Diabetes Mellitus Patients in the Working Area of the Baiturrahman Health Center, Banda Aceh City in 2023

The distribution of blood sugar levels in patients with type II diabetes mellitus can be seen in Table 2.

Table 2.
Blood Sugar Levels During Type II Diabetes Mellitus Patients in the Bait Health Center Working Area

KGD During	n	%
Low	10	23,8
Normal	12	28,6
Height	20	47,6

KGD During	n	%
Total	**42**	**100,0**

Based on table 2, it can be seen that blood sugar levels in patients with diabetes mellitus are most present in the category of high blood sugar levels, namely 20 people (47.6%).

Glycemic Index Food Consumption in Type II Diabetes Mellitus Patients in the Working Area of the Baiturrahman Health Center, Banda Aceh City in 2023

The distribution of glycemic index food consumption in Type II DM patients can be seen in Table

Table 3.
Glycemic Index Food Consumption in Type II Diabetes Mellitus Patients in the Working Area of the Baiturrahman Health Center, Banda Aceh City in 2023

Glycemic Index Food Consumption	n	%
Low	17	40,5
Height	25	59,5
Total	**42**	**100,0**

Based on table 3, it can be seen that the highest glycemic index food consumption of Type II Diabetes Mellitus patients is in the high category, namely 25 people (59.5%).

The Relationship between High Glycemic Index Food Consumption and Blood Sugar Levels During Type II Diabetes Mellitus Patients in the Working Area of the Baiturrahman Health Center, Banda Aceh City in 2023

The results of the test on the relationship between high glycemic index food intake and blood sugar levels can be seen in Table 4.

Table 4.
The Relationship between High Glycemic Index Food Consumption and Blood Sugar Levels During Type II Diabetes Mellitus Patients in the Working Area of the Baiturrahman Health Center, Banda Aceh City in 2023

Glycemic Index Food Consumption	Blood Sugar Levels During						Total		
	Low	%	Normal	%	Height	%	n	%	*P*
Low	8	47,1	8	47,1	1	5,9	17	100	
Height	2	8,0	4	16,0	19	76,0	25	100	0,003
Total	**10**	**23,8**	**12**	**28,6**	**20**	**47,6**	**42**	**100**	

Based on table 4, it can be seen that in diabetes mellitus patients who consume low glycemic index foods, most of them have low and normal blood sugar levels, namely 16 people (94.2%), while diabetes mellitus patients who consume high glycemic index foods mostly have high blood sugar levels, which is 19 people (76%). Based on the results of the *chi-square test* with 95% confidence, it was found that the p value < 0.05 so there is a meaningful relationship between the consumption of high glycemic index foods and blood sugar levels in patients with type II diabetes mellitus in the work area of the Baiturrahman Health Center, Banda Aceh City.

This is due in part to the inaccuracy of the selection of food types. Most Acehnese

people consume more than two glasses of sugary food/drinks a day. Generally, the people of Aceh like sweet coffee, sweet tea and other sweet drinks that are widely available in stalls or cafes. The fans of this sweet coffee are not only men but women are also high coffee consumers in this area.

In addition, the snacks that are available and preferred generally also contain sugar and are made from flour which is a food source of high glycemic index. Acehnese noodles are one of the favorite foods of the Acehnese people, can be consumed three to four times a week. This food is consumed not as a substitute for rice as the main staple food.

Wagustina (2020) explained that other eating habits of the Acehnese people are not fond of consuming vegetables and fruits as the main source of dietary fiber in addition to providing vitamins and minerals needed by the body. In the dishes of the Acehnese people, it can be seen that processed animal protein sources dominate in the daily food menu. It is known that dietary fiber has a very good role in lowering blood sugar levels in people with type II diabetes.

The effect of carbohydrates on blood sugar levels is very complex. Refined sugar *sources* will be absorbed faster than carbohydrates derived from starches or fibrous foods such as cereals or fruits or from complex types of carbohydrates. However, it is necessary to note the effect of glycemia, which is quite large in variability between various foods whose composition appears to be the same. Through the glycemic index, the quantity of glycemia in food can be determined. Foods with a high glycemic index will cause blood sugar levels to rise faster.

Based on the results *of the 3×24-hour food recall*, it was found that the average energy consumption from carbohydrate source foods with a high glycemic index was 15% of the total daily energy intake of patients with diabetes mellitus. This intake contributes around 281 kcal of the average total daily energy of 1,875 kcal. Therefore, patients with diabetes mellitus are recommended to limit the consumption of added sugar to less than 5% of total daily energy to help keep blood sugar levels within normal limits (Edy, 2017).

In line with research conducted by Astuti and Maulani in 2017, at the Jambi City Health Center showed that high glycemic index foods have a significant relationship with blood glucose levels in Type II Diabetes Mellitus patients where patients who consume high glycemic index foods have high blood sugar. As with the research conducted by Rowa et al. (2014) at Salewangang Maros Hospital, it was found that patients who were given low-glycemic DM for 7 days showed a decrease in blood sugar levels at the same time.

As is well known, one of the important steps in managing diabetes mellitus is medical nutrition therapy (TNM). People with diabetes mellitus need to be emphasized the importance of strict eating schedules, types and amounts of foods with calorie content consumed, especially in patients who take drugs to increase insulin secretion. Scientists have found that an increase in blood sugar levels is expected from foods containing a high glycemic index, in addition to the glycemic index of food, it is also necessary to pay attention to the carbohydrate content of food because it will affect the glycemic load.

The glycemic index provides information about the speed of conversion of carbohydrates into blood sugar, but does not provide information about the amount of carbohydrates and the impact of certain foods on blood sugar levels. Glycemic load can provide information about the effect of food consumption on increasing blood sugar levels. Glycemic load is used to assess the impact of carbohydrate consumption by taking into account the glycemic index of food (Etik S, 2017). The lower the carbohydrate content, the lower the glycemic load of the meal, the smaller a food served triggers an increase in blood sugar levels. Patients with Diabetes

Mellitus are expected to be able to choose food products to be consumed that have a low glycemic index.

The glycemic index value of food products is influenced by a number of factors, including dietary fiber content, amylose and amylopectin content, fat and protein content and processing methods. The influencers of these factors are generally not independent, but there are interactions so that it is difficult to determine the most dominant factor that can affect the final glycemic index value (Bin Arif A & Budiyanto, 2014).

The difference in risk between men and women in the incidence of diabetes mellitus (DM) is influenced by age factors and hormonal changes. In women, the risk of DM tends to increase with age, especially after entering the menopausal phase. Decreased production of the hormone estrogen contributes to increased body fat accumulation and an increase in body mass index (BMI), which ultimately increases the risk of obesity. Obesity, especially central obesity, plays an important role in the occurrence of insulin resistance, triggering an increase in blood glucose levels (Nasution et al., 2021).

In addition, postmenopausal women who have a history of premenstrual syndrome also show an increased risk of type 2 DM. The hormonal changes that occur in this phase facilitate the redistribution of body fat in a central direction and increase susceptibility to metabolic disorders, including type 2 diabetes mellitus (Oktavia et al., 2022).

In the context of DM management, dietary regulation is a key component that must be considered. Dietary interventions include regulating the amount of energy that is tailored to individual needs, choosing food types with priority over low-glycemic indexed carbohydrate sources, and setting a regular meal schedule. Therefore, continuous nutrition education is needed so that patients are able to manage consumption patterns independently, so that blood glucose levels can be maintained in the normal range.

CONCLUSION

1. The consumption of high glycemic index foods in patients with type II diabetes mellitus in the working area of the Baiturrahman Health Center, Banda Aceh City, was mostly in the inappropriate category, which was 59.5%.
2. Blood sugar levels during type II diabetes mellitus patients in the working area of the Baiturrahman Health Center, Banda Aceh City were mostly in the high category, which was 47.6%.
3. The results of the statistical test obtained a value of $p = 0.003$ ($p < 0.05$) there was a significant relationship between the consumption of high glycemic index foods and blood sugar levels during type II diabetes mellitus patients in the work area of the Baiturrahman Health Center, Banda Aceh City in 2023.

RECOMMENDATIONS

1. For Health Workers: Improving nutrition education based on glycemic index needs to be carried out in a structured and sustainable manner to encourage changes in patients' eating behavior.
2. For Type II DM Patients: Patients need to limit the consumption of foods with a high glycemic index and adopt a healthy diet to control blood glucose levels.
3. For Puskesmas: Strengthening promotive-preventive programs, such as routine education and monitoring of dietary adherence, is needed to reduce the incidence of hyperglycemia.
4. For Further Investigators: Advanced research with longitudinal designs with larger sample sizes or intervention approaches to strengthen causal

relationships. Consideration of other variables such as physical activity, adherence to therapy, duration of illness, and psychosocial factors is also required. It is recommended to use more objective instruments as well as parameters such as HbA1c to improve the validity of the results.

LIMITATIONS OF THE RESEARCH

This study has several limitations that need to be considered in the interpretation of the results.

1. The number of samples used is relatively small, so it can affect the statistical power and generalization of research results to a wider population.
2. The research design used was *cross-sectional*, so the relationship found between the consumption of high-glycemic indexed foods and blood sugar levels was associative and could not explain the causal relationship definitively.
3. Food intake measurement uses *the 3×24-hour food recall method which depends on the respondents' memory, so that it has the potential to cause information bias (*recall bias*) and inaccuracies in food consumption estimates.*
4. Blood sugar levels were measured only at one time (blood sugar at a time), so they did not reflect long-term glycemic control as can be obtained from an HbA1c test.
5. This study has not optimally controlled other confounding factors that can affect blood sugar levels, such as physical activity, medication adherence, stress, and variations in daily diet.
6. Thus, the results of this study need to be interpreted carefully and require further research with a longitudinal design, a larger sample count, and better control of confounding variables.

THANKS

We would like to thank the leaders and nutrition officers of the Baiturrahman Health Center in Banga Aceh City, Posyandu Cadres, research enumerators and all respondents who have actively participated and helped the implementation of this research well.

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