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The effect of coconut sugar on blood glucose level in prediabetes patients

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ABSTRACT

Background: *Diabetes not only causes premature deaths worldwide. This disease is also a major cause of blindness, heart disease and kidney failure. Prevention and control of diabetes mellitus in Indonesia is carried out so that healthy individuals remain healthy and people who already have risk factors can control them so that they do not fall ill with diabetes. Individuals with a history of impaired glucose tolerance (IGT) or the pre-diabetic group need to adopt a healthy lifestyle by paying attention to food and drink intake, especially sweet foods and doing physical activity, so that it does not progress to diabetes mellitus.*
Objectives: *To determine the effect of coconut sugar on blood sugar levels in prediabet sufferers in the Sleman Regency, Special Region of Yogyakarta. This research is focused on promotive and preventive efforts in efforts to prevent non-communicable diseases such as diabetes mellitus so as to achieve optimal levels of public health.*
Methods: *This research was Quasy experimental research design, carried out by giving pre-diabetic sufferers 30 grams of coconut sugar a day for 2 weeks on selected respondents with blood sugar levels of 100 – 126 mg/dl. Respondents who met the criteria were then divided into 2 groups. The intervention group given 30 grams of coconut sugar per day for 2 weeks and the control group consume food and drinks as usual.*
Results: *Based on comparative research of blood sugar levels before and after giving coconut sugar among prediabetes, the results showed that there was a significant decrease in blood sugar in the intervention group after giving with the level blood sugar average is 17.39 mg /dl and in the control group blood sugar level average is 6.83 mg/dl*
Conclusions: *There is significant effect of coconut sugar to decrease level of blood sugar among prediabetes patients.*

KEYWORD : *blood sugar; coconut sugar; prediabetes*

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INTRODUCTION

Diabetes mellitus (DM) is a metabolic disorder that occurs due to the pancreas not producing enough insulin or the body not being able to use the insulin it produces effectively, resulting in an increase in glucose concentration in the blood, known as hyperglycemia (1). Currently, diabetes has attack people in developing countries, including Indonesia. The International Diabetes Federation (IDF) organization estimates that at least 463 million people aged 20-79 years in the world suffered from diabetes in 2019 or equivalent to a prevalence rate of 9.3% of the total population of the same age (1). Based on gender, the IDF estimates that the prevalence of diabetes in 2019 is 9% in women and 9.65% in men. The prevalence of diabetes is estimated to increase as the population ages to 19.9% or 112.2 million people aged 65-79 years. The figure is predicted to continue to increase until it reaches 578 million people in 2030 and 700 million people in 2045. In the Southeast Asia region, Indonesia is ranked 3rd with a prevalence of diabetes sufferers of 11.3% (1). Indonesia is the only country in Southeast Asia with a high prevalence of diabetes sufferers (2).

Yogyakarta Special Region is ranked 3rd in the province with the highest prevalence of diabetes mellitus in Indonesia (3.1%), although this data is like an iceberg phenomenon, many sufferers do not yet know that they have diabetes (3). The pattern of consuming sweet foods and drinks is an important risk factor for diabetes. It is illustrated in the Badan Kebijakan Pembangunan Kesehatan, (2023) that the majority of respondents consume sweet food consumption behavior 1-6 times per week with a prevalence of 47.8%. The high prevalence of consumption of sweet foods and drinks can contribute to the high incidence of diabetes. Prevention and control of diabetes mellitus in Indonesia is carried out so that healthy individuals remain healthy and people who already have risk factors can control them so that they do not fall ill with diabetes. Individuals with a history of impaired glucose tolerance (IGT) or the pre-diabetic group need to adopt a healthy lifestyle by paying attention to food and drink intake, especially sweet foods and doing physical activity, so that it does not progress to diabetes mellitus (2).

The people of the Special Region of Yogyakarta are known for their preference for sweet foods and beverages, which contributes to the high prevalence of diabetes mellitus in the region. According to data from the Indonesian Ministry of Health and Basic Health Research (Riskesdas, 2023), the prevalence of diabetes mellitus in Yogyakarta is among the highest in Indonesia (4). Therefore, efforts are needed to identify healthier sugar alternatives that can help control blood glucose levels and reduce the risk of developing diabetes mellitus. One potential alternative is coconut sugar. Coconut sugar has a lower glycemic

index (GI) compared to granulated sugar, with a GI value of less than 55, making it potentially safer for individuals with prediabetes and diabetes. Research conducted by Patel and Navale (2024) found that consuming 2-6 teaspoons of coconut sugar per day for two weeks among prediabetic individuals significantly reduced blood glucose levels (5). Similarly, a study by Pathirana et al. (2022) demonstrated that blood glucose levels decreased significantly after the consumption of 25 grams of palm sugar compared to granulated sugar (6). However, despite the growing evidence regarding the benefits of coconut sugar, several research gaps remain. First, most previous studies were conducted outside Indonesia, where dietary patterns, genetic predisposition, and lifestyle factors differ from the Indonesian population, particularly the people of Yogyakarta who have unique dietary habits characterized by high sugar consumption.

Therefore, the generalizability of previous findings to the Yogyakarta population remains limited. Second, there is still insufficient evidence comparing the effectiveness of coconut sugar as a preventive nutritional intervention within the framework of promotive and preventive healthcare programs in Indonesia. Therefore, identifying culturally acceptable and locally available dietary interventions is essential to support diabetes prevention programs.This study aims to determine the effect of coconut sugar consumption on blood sugar levels among prediabetes patients in the Special Region of Yogyakarta. This research supports the Indonesian government's health transformation agenda, particularly the transformation of primary healthcare services focusing on promotive and preventive strategies to reduce the incidence of non-communicable diseases such as diabetes mellitus and to improve overall public health outcomes.

MATERIAL AND METHODS

This research is a quantitative descriptive study using the Quasy Experiment method with pre-test post-test with two group design conducted at Puskesmas Gamping II Sleman Yogyakarta at 2 Village from October to November 2024. The research sample was pre-diabetes sufferers with an age range of 30 – 70 years in the Gamping II Community Health Center area, Sleman Regency, Yogyakarta Special Region. The research sample was determined using a simple random sampling technique.

The sample inclusion criteria were prediabetes with a blood sugar screening test of 100-125 mg/dl, willing to be respondents. This research was carried out by giving pre-diabetic sufferers 30 grams of coconut sugar a day for 2 weeks. Researchers recruited respondents from data on prediabet sufferers obtained from community health centers. Researchers carried out fasting blood sugar (FBS)

examinations directly on selected respondents using a standardized glucometer. The instrument used in this study was a calibrated glucometer that had met international standards for blood glucose monitoring devices, such as ISO 15197:2013. The fasting blood sugar measurement was conducted after respondents had fasted for at least 8-10 hours to ensure accurate assessment of baseline blood glucose levels. Capillary blood samples were obtained from the respondents' fingertips using sterile lancets and analyzed immediately using a digital glucometer. Respondents with blood sugar levels of 100-126 mg/dl will be recruited. Respondents who met the criteria were then divided into 2 groups.

The intervention group will be given 30 grams of coconut sugar per day for 2 weeks and the control group will consume food and drinks as usual. After 2 weeks, both groups had their blood sugar levels checked. The analysis in this research was carried out using the help of a computerized program. Univariate analysis was carried out to see the distribution of respondents' characteristics, namely age, gender, education, occupation, sweet drinking habits, family history of diabetes. Categorical data is presented by calculating frequencies and percentages. Bivariate analysis was carried out to test the relationship between two variables, namely each independent variable and the dependent variable. This research uses parametric tests because the data scale is numerical. Using the paired T test because it has a normal distribution. The confidence level is determined to be $\alpha = 0.05$ and the confidence interval is 95%. The ethical exemption was granted by the Ethical Health Research Committee of Politeknik Kesehatan Kementerian Kesehatan Yogyakarta (No.DP.04.03/e-KEPK.1/818/2024).

RESULTS AND DISCUSSION

This research was conducted at the Gamping II Sleman Yogyakarta Community Health Center area. Gamping II Sleman Community Health Center serves people from three sub-districts, namely Banyuraden, Nogotirto and Trihanggo sub-districts. Gamping II Sleman Health Center has two supporting health centers located in Trihanggo Village and Nogotirto Village, and has ten Posbindu. Posyandu services for the elderly and toddlers are available in every hamlet. This research was carried out in the Gamping II Community Health Center area, Sleman Regency which includes 2 villages, namely Kanoman ham as the intervention group and Salakan village as the control group.

The two villages were selected based on data from the Community Health Center which a month earlier had implemented Posbindu by measuring the community's health status, including checking blood sugar levels. Researchers sorted the data from the posbindu data results and found

that there was a village with an average value of blood sugar levels showing that the majority had pre-diabetes, Kanoman village which is approximately one (1) kilometer from the Gamping II Community Health Center which was then used as an intervention group and Salakan village is approximately four (4) kilometers from the Gamping II Community Health Center and was then used as a control group.

Characteristics of respondents according to gender, the majority of respondents were women, namely 50 people (83.3%), while only 10 men (16.7%). Characteristics of respondents based on age showed that the majority of respondents were aged 61-70 years, namely 25 respondents (41.7%). Based on education, most of the respondents had a high school education, namely 27 respondents (45.0%) Most of the respondents were employed, namely 47 people (78.3%) with the average job being self-employed and private. Most of the respondents stated that they had the habit of drinking or eating sweets, namely 37 people (61.7%), while only 15 respondents (25%) had a history of DM in the family. Detail the results of the study are described in **Table 1**.

Table 1. Characteristic of respondence at Gamping Health Centre

Variable	n	%
Gender		
Male	10	16.7
Female	50	83.3
Age		
30 - 40 year	10	16.7
41– 50 year	10	16.7
51 – 60 year	15	25
61 – 70 year	25	41.7
Job		
Working	47	78.3
Not Working	13	21.7
Sweet eating habits		
Often	37	61.7
Rare	16	26.7
Never	7	11.67
History of DM in Family		
Yes	15	25
No	45	75

Source : Primary data 2024

The comparison of score blood glucose level among prediabetes patient before and after consuming coconut sugar in experiment and control group can be seen in the analysis below.

The results of **Table 2** the analysis show that there is a significant difference in the average score of prediabetes fasting blood sugar levels in pre-test and post-test giving coconut sugar in the experiment group (n=28).

Table 2. Results of the experimental group paired T-Test

Variable	Pre-test Mean ± SD	Post-test Mean ± SD	*t*	CI : 95 %	*ρ value*
Fasting blood glucose	110.43	93.04	6.43	1.9 – 2.8	,000

The results of **Table 2** the analysis show that there is a significant difference in the average score of blood sugar levels before and after being given coconut sugar for two weeks with a level of 30 grams a day every day for two weeks ρ value (<0.05). The average value of blood sugar levels before the intervention was given 30 grams of coconut sugar per day for 2 weeks was 110.4286 and after the intervention was given 93.0357. It can be concluded that in the treatment group there was a decrease in fasting blood glucose levels of 17.39.

The results of **Table 3** the analysis show that there is no a significant difference in the average score of prediabetic fasting blood sugar levels before and after giving coconut sugar in the control group (n=30).

Table 3. Results of the control group paired T-Test

Variable	Before Mean ± SD	After Mean ± SD	*t*	CI : 95 %	*ρ value*
Fasting blood glucose	105.3	112.13	-1.677	1.9 – 2.8	0.104

ρ value >0,05 based on Paired T-test

The results of **Table 3** the analysis show that there is no a significant difference in the average score of prediabetes fasting blood sugar levels before and after giving coconut sugar in the intervention group (n=30). Comparison of the average scores of fasting blood sugar levels before and after given coconut sugar for the experiment group and the control group can be seen in the table below.

The results of **Table 4** the different test scores for the average level of blood sugar prediabetes patients before and after the consuming coconut sugar in the treatment group and control group (n=60).

Table 4. Results of the Independent T-Test

Variable	Group	n	*Mean rank*	t	*ρ value*
Fasting blood glucose	Intervention	30	93.04	-6.05	0
	Control	30	112,13	-5.99	,000

ρ value <0,05 based on Paired T-test

The results of the analysis of the difference in blood sugar levels in the treatment group and the control group show a significant difference, (ρ<0.05), so it can be concluded that there is a significant difference in the blood sugar levels of the treatment group and the control group after being treated with sugar. 30 grams of coconut a day for 2 weeks. Thus, there was an effect of giving coconut sugar on reducing blood sugar levels in the treatment group compared to the control group.

The results of research conducted on 60 respondents who were divided into 2

groups, namely 30 respondents in the intervention group and 30 respondents in the control group, showed that there was a significant decrease in fasting blood sugar in the intervention group (ρ value (<0.05) after being given coconut sugar with level of 30 grams within 2 weeks (7). There was a significant difference in the results of blood sugar tests before and after the procedure. Analysis of the results of blood sugar levels before administering coconut sugar obtained an average value of 110.43 (mg/dL) with a standard deviation of 6. 85. And the decrease in blood sugar levels after 2 weeks of giving coconut sugar obtained an average value of 93.04 (mg/dL) with a standard deviation of 13.70, resulting in a decrease in blood sugar of 17.39 (mg/dl). significant results were obtained in the pre and post tests.

After 2 weeks without treatment and the respondents consumed food and drinks as usual, the average value of blood sugar levels in the pre test was 105.30 with a standard deviation of 21.19, after 2 weeks the results of the blood sugar examination were 112.13 with a standard deviation of 10.19, resulting in an increase in blood sugar levels of 6.833 (mg/dl). The pre and post homogeneity test results for coconut sugar were 0.776, which means the data was homogeneous and the T test value for pre and post administration of coconut sugar was 0.000 with a decrease in blood sugar levels of 17.39 mg/dL, which means there was a significant difference. In the results of the research above, there was a significant decrease in blood sugar levels from pretest and posttest when given coconut sugar. This is in accordance with the theory which states that there will be a decrease in blood sugar levels by giving pure carbohydrates to prediabetes sufferers, although the level of decrease varies depending on the glycemic index and quantity (Soegondo et al, 2009). In his research, Soejarwo (2022) stated that increasing blood sugar is greatly influenced by consumption of carbohydrates, both pure and complex carbohydrates. Pure and complex carbohydrates each have varying glycemic indexes.

Diabetes Mellitus (DM) is a chronic disease that occurs when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces. This causes an increase in glucose concentration in the blood. In our daily lives we cannot escape the use of sugar. Sugar is always used to make food and drinks sweet. Sugar from sugar cane is often avoided by diabetes patients because the glucose content in the sucrose compound is easily broken down by the body. If you look closely, sugar cane juice contains saccharants, non-starch polysaccharide compounds, which have antidiabetic properties. However, the polysaccharide compound breaks down during the heating process to become sucrose which can trigger diabetes, so many people switch to using other natural

ingredients, such as coconut sugar. Coconut sugar contains a fiber known as insulin which helps the slow absorption of glucose down, which is great for people with diabetes problems because it contains about 15 calories and 4 grams of carbohydrates. The benefit of coconut sugar for diabetes sufferers is that it can reduce glucose. Glucose is the level of sugar in the blood that triggers diabetes. Coconut sugar contains 70-79 percent sucrose.

Coconut sugar has a lower glycemic index than other sweeteners. The glycemic index (IG) is a number that describes the impact of food on increasing a person's blood sugar levels. The glycemic index of coconut sugar is 54, while the glycemic index of granulated sugar is 65. Therefore, it is natural that coconut sugar is often consumed by pre-diabetic sufferers as a substitute for white sugar. Another benefit of coconut sugar is that it helps increase blood glucose levels and prevent conditions such as low blood sugar or hypoglycemia. Hypoglycemia can make sufferers feel hungry, tremble, sweat, dizziness, nausea, seizures, and even coma.

Another benefit of coconut sugar is that it helps increase blood glucose levels and this is because after consuming coconut sugar the plasma rises from the 30th to the 60th minute and experiences a rapid decrease 2 hours after eating normal blood glucose levels, namely 120 mg/dL (8). This is because sugar with a low glycemic index is digested slowly so it is also stored slowly (9). Extra glucose will remain available because glycogen is slowly stored. Consuming white sugar is a group of disaccharides containing carbohydrates with a high glycemic index, thereby increasing blood sugar levels quickly (10). Coconut sugar is safer to consume and does not cause a significant spike in blood sugar, because coconut sugar does not directly break down glucose in the blood, but releases energy slowly so that there will be no sudden increase or decrease in sugar levels (11). The glycemic index (Glicemic Index) is a scale or number given to certain foods based on how much they increase blood sugar levels. Based on research in the Journal of Functional Foods, coconut sugar has a lower glycemic index (GI) score than white sugar, which is around 35-42 compared to 65 (12).

Increased glucose levels after eating will increase insulin secretion levels and stimulate the liver to store glucose in the form of glycogen so that cells (especially in the liver and muscles) can become saturated with glycogen, the excess glucose will then be stored in the form of fat (13). The pancreas reduces insulin secretion when blood sugar levels decrease, and increases glucagon secretion. The liver and muscles will respond to this hormonal signal. So it degrades glycogen stores and releases glucose into the bloodstream so that blood glucose levels can be maintained within normal limits (14). Sarpong et al., (2024) from the results of his research

stated that giving coconut sugar as a substitute for granulated sugar in prediabetes will have a beneficial effect because the GI of coconut sugar 35 is converted into glucose slowly so that the pancreas does not need to work hard to produce a lot of insulin. In this situation the pancreas works more easily so that its condition and function are maintained properly (16). Aini et al., (2022); Zidan and Azlan, (2022) stated that consuming coconut sugar will be beneficial for the body because its ingredients are natural and made without chemicals. Apart from that, coconut sugar contains lots of vitamins because it is processed naturally so that the natural content is not wasted. Coconut sugar contains a lot of ribovlafin, thiamin, niacin, ascorbic acid, calcium which are important substances for the human body.

CONCLUSION AND RECOMMENDATION

In conclusion, this study achieved its objective of determining the effect of coconut sugar consumption on blood sugar levels among individuals with prediabetes. The findings demonstrated that respondents who consumed 30 grams of coconut sugar daily for two weeks experienced a significant reduction in fasting blood sugar levels, with an average decrease of 17.39 mg/dL compared to the control group. These results indicate that coconut sugar may serve as a healthier alternative sweetener due to its lower glycemic index compared to granulated sugar. The study also highlights the importance of dietary management among prediabetes patients, particularly in controlling the intake of sugar and high-carbohydrate foods such as rice and flour, which can influence blood glucose levels. Therefore, the findings support the need for health promotion and education programs conducted by healthcare workers to increase public awareness regarding the benefits of coconut sugar as a substitute for granulated sugar.

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