

Differences of Blood Glucose Levels in Diabetes Mellitus Patients Consuming Brown Rice and White Rice

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Abstract: Diet is an important determinant that influences the occurrence of insulin resistance. Thus, eating patterns greatly influence the occurrence of DM disease. Micronutrient substances and phytochemicals in brown rice are higher than white rice, so brown rice likely has a protective effect on the incidence of type 2 diabetes. This study used an experimental method using a two-group post-test design with purposive sampling technique. Samples, as many as 32 respondents were divided into two groups of 16 respondents each. The variables of blood glucose levels were analyzed univariately; then subsequently, the bivariate analysis was employed to determine differences in the dependent and independent variables by using the Mann Whitney test with a significance level of 0.05 (5%). The results of this study indicated that the majority of DM sufferers who consumed brown rice had lower blood glucose levels than those who consumed white rice. It was also supported by the results of the Mann Whitney statistical analysis, which obtained a significance value of $0.006 < 0.05$. This study concluded that there were differences in blood glucose levels in patients with type 2 diabetes who consumed brown rice and white rice.

Keywords: blood glucose, diabetes mellitus type 2, brown rice and white rice

1. INTRODUCTION

Diabetes mellitus is a group of metabolic diseases characterized by hyperglycemia that occurs due to abnormalities of insulin secretion, insulin performance, or both (ADA, 2010). The World Health Organization (WHO) defines three types of diabetes, namely: type 1 diabetes, type 2 diabetes, and gestational diabetes (occurs in pregnant women). Despite having similarities related to excess sugar levels in the body, type 1 and 2 diabetes have some fundamental differences. Type 1 diabetes is caused by pancreatic damage, which results in reduced insulin production, while type 2 diabetes is caused by insulin resistance, in the sense that insulin is sufficient but does not work well in controlling blood sugar levels.

Diabetes mellitus cannot be cured, but blood sugar levels can be controlled through diet, exercise, and medication. To be able to prevent chronic complications, good DM control is needed (Perkeni, 2011). The government efforts to overcome DM are by implementing DM control programs, including reducing risk factors by changing lifestyles and counseling about lifestyle changes made by primary service facilities. The establishment of a service post is a place where people ask something related to diabetes mellitus (Widya, 2012).

According to Guyton (2014), the factor of DM, which is multifactorial with genetic and environmental components that make a substantial contribution in the process of DM disease, can be changed partly through lifestyle changes, while others cannot be changed, such as

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genetic factors and environmental risk factors. Diet is an important determinant that affects obesity and insulin resistance. Thus, eating patterns are very influential in the occurrence of DM disease.

The results of Fatimah's study (2015) show that diet or the principle of dietary regulation in people with diabetes is almost the same as food recommendations for the general public, which is a balanced diet and in accordance with the caloric and nutritional needs of each individual. People with diabetes need to stress the importance of regular eating in terms of eating schedules, types, and amounts of food, especially for those who use blood glucose-lowering drugs or insulin. The recommended standard is food with a balanced composition in terms of 60-70% carbohydrates, 20-25% fat, and 10-15% protein. Changes in lifestyle and patterns of consumption of rice with low amylose are still high, which further increases the risk of degenerative diseases, such as Diabetes Mellitus.

According to Suliartini (2011), in Indonesia, there are, among others, rice with a variety of colors, including white rice (*Oryza sativa L*) and brown rice (*Oryza nivara*). Rice is an energy food source that has a high carbohydrate content but low protein. The nutritional content of rice per 100 grams of material is 360 kcal of energy, 6.6 grams of protein, 0.58 grams of fat, and 79.34 grams of carbohydrates. In line with Edi Hernawan's research (2016), that white rice (*Oryza sativa L*) is a staple food for most Indonesian people. The research shows that increasing white rice consumption is associated with an increased risk of type 2 diabetes.

Brown rice (*Oryza nivara*) is another staple food in Indonesia besides white rice (Suliartini, 2011), which has high health content. Besides containing carbohydrates, fats, proteins, fiber and minerals, brown rice also contains anthocyanins. According to food consumption statistics (2015), the Indonesian population consumed rice in 2014 with 84,637 kg/capita/year, sticky rice of 0.1423 kg/capita/year, and other grains of 0.0406 kg/capita/year. Based on the results of research, Nuryani (2016) states that the nutrient content of white rice compared to brown rice will show a significant difference in the number of nutrients. Micronutrient substances and phytochemicals in brown rice are higher than white rice so that brown rice may have a protective effect on the incidence of DM.

2. METHODS

2.1 Tools and materials

Measuring instruments used in this study were Easy touch GCU and glucose sticks. Whereas, the ingredients used were brown rice and white rice.

2.2 Implementation Techniques

Primary data were obtained by researchers from patients with type 2 diabetes aged > 40 years, who later became the respondents, by knowing their blood glucose levels. While secondary data were obtained from the results of the report.

Blood glucose levels in DM patients were measured after they consumed brown rice and white rice, with a decrease of 5-10 mg/dl. Measurements were made using Easy Touch GCU and glucose sticks. DM sufferers consumed red and white rice by cooking it into rice, which the portions were according to calorie requirements through BMI with the formula BMR consumed for one week, with a frequency of 3-4 times a day.

3. RESULTS

3.1 Univariate Analysis

Univariate analysis was used for the frequency distribution of each variable studied. The variables, which were analyzed univariately in this study, were blood glucose levels in patients with diabetes.

1. DM sufferers

The distribution of respondents based on patients with type 2 diabetes can be seen in the Table 1.

Table 1 The distribution of respondent's frequencies based on blood glucose levels (KGD)

No	KGD	Frequency	Percentage
1.	Normal	0	0%
2.	Prediabetes	0	0%
3.	Diabetes	32	100,0%
Total		32	100,0%

Source: Primary Data, Processed in 2018

Based on Table 1, it shows that 32 (100%) of respondents had diabetes.

2. Fasting blood glucose levels of people with diabetes after consuming brown rice is presented in the table below.

Table 2 The distribution frequency of respondents based on blood glucose levels after consuming brown rice

No	KGD	Frequency	Percentage
1.	Normal	0	0%
2.	Prediabetes	7	44,75%
3.	Diabetes	9	56,25%
Total		16	100,0%

Source: Primary Data, Processed in 2018

Based on Table 2, it shows that seven respondents (44%) were prediabetes and nine respondents (56%) were diabetes.

3. Fasting blood glucose levels of people with diabetes after consuming white rice can be seen in Table 3.

Table 3 The frequency distribution of respondents based on blood glucose levels after consuming white rice

No	KGD	Frequency	Percentage
1.	Normal	0	0%
2.	Pre-diabetes	0	0%
3.	Diabetes	16	100,0%
Total		16	100,0%

Source: Primary Data, Processed in 2018

Based on Table 3, it shows that the level of blood glucose levels of 16 respondents (100%) still indicated diabetes.

3.2 Bivariate Analysis

Bivariate analysis was to determine the differences of each independent variable and the dependent variable, by using the Mann-Whitney test with a significance level of 0.05 (5%).

Table 4 The differences in blood glucose levels in patients with DM after consuming brown rice and white rice

No	Difference	Brown Rice	Percentage	White Rice	Percentage
1.	Down	13	81,25	5	31,25
2.	Constantly	3	18,75	11	69,25
Total		16	100,0	16	100,0

Source: Primary Data, Processed in 2018

Based on Table 4, it shows that the majority of respondents, namely 13 respondents (81%), experienced a decrease in blood glucose levels after consuming brown rice, while respondents who consumed white rice, namely five respondents (31%), experienced a decrease in blood glucose levels.

The results of the analysis using the bivariate analysis are to determine the differences of each dependent variable and the independent variables by using the Mann Whitney Test with the condition that the data are not normally distributed with a significance level of 0.05 (5%). Based on Table 4.4, the Mann Whitney test results of a p -value were 0.006. These

results showed p -value less than 0.05, meaning that H_0 was rejected, and H_a was accepted, so there was a significant difference between blood glucose levels in patients with DM after consuming brown rice and white rice.

4. DISCUSSION

4.1 Blood glucose levels in people with diabetes who consume brown rice

Based on the analysis, it is known that all (100%) 32 respondents before consuming brown rice and white rice had diabetes, with a range of blood glucose levels of 127 mg/dl - 416 mg/dl. From 32 respondents (100%), there was a value of blood glucose level with an average of 179 mg/dl.

Glucose is the most important carbohydrate that is mostly absorbed into the bloodstream, and other sugars are converted into glucose in the liver. Glucose is the primary fuel in body tissue and serves to produce energy. Hence, rice is a staple food that has a high carbohydrate value (Amir et al. 2015).

Brown rice is another type of staple food that contains quite a high health value. Patients with type 2 diabetes in the Colomadu district still consumed white rice because many of them did not know the content in brown rice, which can reduce blood glucose levels.

The process of reducing blood sugar levels is by giving a brown rice diet due to the high fiber content in brown rice. These fibers are not only filling and good for digestion but also can increase the viscosity (a statement of resistance of a liquid to flow) lumen in the intestine so that they will reduce the efficiency of carbohydrate absorption and insulin response. With decreased insulin response, the work of the pancreas will be lighter so that it can improve the function of the pancreas in producing insulin. Fiber can also reduce levels of pleated in serum so that it can reduce the increase in blood sugar. Carbohydrates in brown rice are complex carbohydrates that are slow to be absorbed by the body, so that blood sugar does not increase quickly. Brown rice also contains selenium mineral and anthocyanin pigment (red), which functions as an antioxidant and an antidote to various degenerative diseases (diseases that accompany the aging process), including diabetes mellitus (Kuztairi, 2014).

4.2 Blood glucose levels in people with diabetes who consume white rice

Most people with type 2 diabetes in this study consumed white rice. Food intake is needed by everyone to be able to move every day, and also the needs of each person's body is different. Various problems in eating patterns, which are related to excessive calorie intake, high-calorie intake from foods that contain unsaturated fat sources, low fiber intake as well as irregular eating schedules, affect the accumulation of calories or excess body weight (Rumahorbo, 2014).

According to the American Diabetic Association (ADA, 2015), it is stated that seven factors affect blood glucose levels, including carbohydrate consumption, exercise and activity,

drugs, illness, stress, alcohol, and hormones. Carbohydrates are the primary food ingredients that are needed by the body. Carbohydrate consumption can increase blood glucose levels; one hour to two hours after eating, it will increase blood glucose levels. Therefore, to prevent complications, it is necessary to adjust the diet with balanced nutrition as a preventive measure by carrying out the Diabetes Mellitus diet. It aims to adjust the food with the body's ability to use the diet so that patients can do their daily work as usual. The requirements for this diet are the number of calories determined by age, sex, weight and height, activity (Kuztairi, 2014).

Moreover, rice is a food source that contains high carbohydrate values. Carbohydrates are needed for energy sources that contain glucose. In the Colomadu District area, there were still many DM sufferers of type 2 who consumed white rice. White rice is the type of rice most consumed in the Indonesian region.

Researchers obtained the results that the consumption of carbohydrates in patients with DM, who consumed white rice accompanied by Prolanis drugs from *Puskesmas* (Community Health Centers), had high blood glucose levels. The higher blood glucose levels will affect more DM sufferers, and the higher the risk of complications in DM sufferers. It is because of the high consumption of white rice in Indonesia affects more DM sufferers. The lower the consumption of white rice in Indonesia, the lower the DM sufferers in the Indonesian Territory.

4.3 Differences in blood glucose levels in people with type 2 diabetes who consume brown rice and white rice

Based on results obtained, of 16 respondents who consumed brown rice, there were 13 (81.25%) experienced a decrease, and 3 (18.75%) respondents did not experience a decrease. While DM sufferers who consumed white rice from 16 respondents, there were 11 (69.25%) respondents did not experience a decrease, and 5 (31.25%) respondents experienced a decrease.

The results of the Two Group Design post-test analysis showed that the majority of people with DM who consumed brown rice had lower blood glucose levels than those who consumed white rice. It was also supported by the results of the Mann Whitney statistical analysis obtained the significance value (equal to $0.006 < 0.05$). To distinguish between the consumption of brown rice and white rice on blood glucose levels based on research hypotheses that had been compiled, there were differences in blood glucose levels in patients with type 2 diabetes who consumed brown rice and white rice.

Carbohydrates have an essential role in controlling blood glucose. Carbohydrates are the primary nutrients that affect glucose levels; a little carbohydrate consumption will affect decreased glucose levels. In contrast, a lot of carbohydrate consumption will affect the increased glucose levels, or hyperglycemia over a long time or diabetes chronic (Yunir, 2015).

The decrease in blood glucose levels of patients with DM who consumed brown rice was because it has high fiber content, as well as, a low glycemic index content. Thus, it greatly affects the reduction in blood glucose of DM patients who consume brown rice.

For patients with type 2 diabetes who consumed white rice, there was a decrease of 31.25%. It is because dietary settings will also affect a decrease in blood glucose levels. Management of DM consists of drug use, insulin injection, education, exercise, and dietary management. Management of the recommended diet for DM sufferers is known as the 3J diet, including the right amount, right schedule, and the right type. Foods that contain high carbohydrates include rice, cassava, yams, corn, potatoes, wheat, sago, and others.

The amount and type of carbohydrate consumed also affect insulin secretion and blood glucose. Consumption of energy-dense foods (high in fat and sugar) and low in fiber is related to blood glucose levels. High-energy foods are associated with obesity, insulin resistance so that they can spur increased blood glucose levels.

Consumption of fiber has a positive effect on blood glucose levels in Type 2 Diabetes Mellitus. Dietary fiber slows the process of emptying the stomach and absorption of glucose by the small intestine. Rice containing high food fiber will reduce the glycemic response, and the glycemic index tends to be low. According to Almatier, the dietary arrangement of diabetics is that food is divided into three large portions, which are breakfast (20%), lunch (30%), and evening (25%), and 2-3 small portions for snack foods (10 each -15%) as well as complex carbohydrate sources such as rice, bread, noodles, potatoes, cassava, sweet potatoes, and sago.

Rice is a staple food in Asian countries, including in Indonesia. The high consumption of white rice is associated with an increased risk of diabetes mellitus. Increased blood glucose levels occur due to insulin deficiency, which is preceded by the presence of insulin resistance in muscles, fat, and liver (especially in visceral obesity), and at the same time, accompanied by impaired insulin secretion of pancreatic β cells, which gradually becomes a permanent insulin deficiency. Normal blood sugar levels tend to increase lightly, but progressively (gradually) after the age of 50 years. Based on the results of research by Nuryani (2013), brown rice has the potential to prevent and treat diabetes mellitus due to its nutritional and phytochemical content. Brown rice contains high magnesium mineral, which acts as a cofactor of more than 300 enzymes, including enzymes that play a role in the supply of body glucose and insulin secretion. In brown rice, various components have benefits for DM patients; one of the most well-known components found in brown rice is anthocyanin. It is an active substance found in the skin of brown rice and is useful in reducing glucose levels of blood.

5. CONCLUSION

The results of the research showed the differences in blood glucose levels in people with diabetes who consumed brown rice and white rice. All respondents had diabetes with a classification of diabetic blood glucose levels. Subsequent results showed that blood glucose

levels in people with DM after consuming brown rice mostly decreased from the classification of diabetes blood glucose levels to prediabetes blood glucose levels. In contrast, most blood glucose levels in people with diabetes after consuming white rice did not experience a decrease or remained in the classification of diabetes blood glucose levels. Thus, it can be concluded that there were differences in blood glucose levels in people with diabetes who consumed brown rice and white rice.

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