

Comparison of Total Serum Glucose and Creatinine Levels in Diabetes Mellitus Patients with Complications and Without Complications of Chronic Kidney Disease

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ABSTRACT

Objective: This study aims to analyze the comparison of fasting blood glucose levels and serum creatinine levels in Diabetes Mellitus patients with and without Chronic Kidney Disease (CKD) complications. **Methods:** The research employed a laboratory experimental design with a quantitative approach. The subjects consisted of 30 Diabetes Mellitus patients aged over 60 years who had CKD complications and 30 Diabetes Mellitus patients without CKD complications. Blood samples were analyzed to measure fasting blood glucose and serum creatinine levels. **Results:** The findings revealed a statistically significant difference in the fasting blood glucose and serum creatinine levels between Diabetes Mellitus patients with CKD complications and those without, with a p -value of 0.00 ($p < 0.05$). **Novelty:** This study highlights the impact of CKD complications on metabolic parameters in elderly Diabetes Mellitus patients, providing crucial insights into the association between kidney function and metabolic dysregulation.

INTRODUCTION

In 2019, the International Diabetes Federation (IDF) estimated that the number of people suffering from diabetes worldwide, in the age group of 20-79 years, reached at least 463 million [1]. According to information contained in the 2018 Basic Health Research (Riskesdas), there is an increase in the prevalence of diabetes mellitus (DM) based on a doctor's diagnosis in the population over 15 years old in Indonesia. The figure increased from 1.5% in 2013 to 2.0% in 2018. This increase in prevalence reflects an increase in health problems related to diabetes mellitus in Indonesia [2].

Diabetes is a chronic metabolic condition, characterized by blood sugar levels that exceed the normal threshold. This increase in blood sugar levels is caused by insulin abnormalities. The number of diabetes cases continues to increase from time to time, becoming a serious public health issue. The potential for diabetes to attack various systems of the human body involves organs such as the eyes, kidneys, nerves, and even the heart, which can result in the appearance of serious complications. Diabetes is divided into three categories, namely type 1 Diabetes Mellitus, type 2 Diabetes Mellitus, and Gestational Diabetes that appears during pregnancy [1].

Kidney failure due to DM is characterized by a slow but progressive increase in albuminuria. Albuminuria is the removal of albumin from the urine. Normal albuminuria levels are less than 30 mg/day, increased albumin levels in DM patients are caused by

kidney damage due to high blood sugar levels. This kidney damage causes the glomerulus, which is the blood-filtering structure in the kidneys, to leak. Albumin that should be filtered by the glomerulus is then wasted in the urine, an increase in albuminuria levels that continues to cause a decrease in kidney function. Decreased kidney function is measured using glomerular filtration rate (LFG). The normal LFG is 90-120ml/min/1.73 m². The patient is said to have failed chronic kidney If the LFG drops below 60 ml/min/1.73 m². Untreated chronic kidney failure will lead to further complications, namely end-stage renal failure (ESRD) [3].

High plasma blood glucose levels can result in thickening of the basal membrane and enlargement of the glomerulus. Kimmelstiel-Wilson's sclerotic nodules appear in the glomerulus, which impede blood flow and can damage the nephrons. A drastic decrease in glomerular filtration can result in kidney failure [4].

Cratinine is a substance that is produced through normal muscle contractions and is released into the bloodstream. This substance then passes through the kidneys to be excreted. The serum creatinine test has special specifications and is an important indicator in evaluating kidney function. Serum creatinine levels are not affected by protein intake and remain relatively constant in urine excreted plasma for 24 hours. The association between creatinine in the blood and individuals with diabetes mellitus is linked to increased blood sugar or hyperkalemia. This condition has the potential to damage the walls of blood vessels, making them vulnerable, and can lead to blockages as well as microvascular problems, including Diabetic Nephropathy. Hyperkalemia can also contribute to the formation of atherosclerosis, which may result in narrowing of blood vessels and decreased blood flow rate. This can interfere with the filtration process in the glomerulus and is followed by increased levels of urea and creatinine in the blood. In addition, external factors such as the intake of foods high in protein, meat, and fish can also lead to increased creatinine levels [1].

Based on a previous study conducted by (Sari & Hisyam, 2014) entitled "The Relationship Between Type II Diabetes Mellitus and the Incidence of Chronic Kidney Failure at PKU Muhammadiyah Yogyakarta Hospital" it was concluded that there is a positive correlation between type 2 diabetes mellitus, which is characterized by high blood sugar levels, and the risk of chronic kidney failure [5]. According to a study conducted by Nanda Dwi Mahara et al in a journal entitled "The Relationship between Serum Creatinine Levels and Fasting Blood Sugar Levels in Type 2 DM Patients at DR Sayidiman Hospital, Magetan Regency in December 2015", it was concluded that there was a significant relationship between serum creatinine levels and fasting blood sugar levels in Type 2 DM patients. The results showed that the higher the fasting blood sugar level, the higher the serum creatinine level in Type 2 DM patients [6].

Based on a study conducted by Syarifatul Ilmi entitled "The Relationship between Fasting Blood Sugar Levels and Creatinine in Type 2 Diabetes Mellitus Patients Who Are More Than 5 Years", it was concluded that the female sex was more indicated for diabetes,

there was a relationship between fasting blood glucose levels and creatinine levels in patients with diabetes mellitus [7].

RESEARCH METHOD

This study uses a laboratory experimental research design, using quantitative methods. The design of this study aims to compare the amount of fasting blood glucose and serum keratinin in diabetic patients with and without complications of Chronic Kidney Disease. The population in this study was obtained from patients with diabetes mellitus with complications and without complications with Chronic Kidney Disease obtained from Dr. Wahidin Sudiro Husodo Hospital, Mojokerto City for 2 months, from April to June 2024. The samples in this study were obtained from patients with diabetes mellitus with complications and without complications of Chronic Kidney Disease using purposive random sampling, the number of samples in this study was 30 patients with diabetes mellitus with complications and 30 patients with diabetes mellitus without complications of Chronic Kidney Disease. The sample criteria used were females aged 60 years and above. This examination uses the Hexokinase and Jaffe examination methods, an examination tool used by the Architect Plus C-4000 clinical chemistry analyzer.

This research has received ethical clearance from Dr. Wahidin Sudiro Husodo Hospital, Mojokero City with number 37/KEPK-RSWH/EA/2024. The independent variables used were diabetes mellitus with complications and without complications of Chronic Kidney Disease. The Bound Variable used in this study is glucose and creatinine levels. To find out the value of glucose and creatinine levels, a laboratory examination was carried out using the Analayzer clinical chemical tool. The data from the analysis used SPSS 25 with Independent T-test statistics.

RESULTS AND DISCUSSION

Results

The number of average values of glucose levels and creatinine levels from 30 patients diabetes mellitus patients with CKD complications and 30 patients diabetes mellitus patients without complications can be seen in table 1.

Table 1. Results of the average test $\pm$ standard deviation (SD) of fasting blood glucose and serum creatinine levels in patients with diabetes mellitus with and without complications *Chronic Kidney Disease*.

Indicators	Mean $\pm$ Standard Deviation (SD)	
	Diabetes Mellitus + CKD (mg/dl)	Diabetic Mellitus Patients (mg/dl)
Glucose	291.43 $\pm$ 41,109	175.03 $\pm$ 52,450
Creatinine	7.50 $\pm$ 1,996	4.67 $\pm$ 1.78

Based on Table 1, the average data on glucose and creatinine values between patients with Diabetes Mellitus complications and without complications of CKD were obtained on average in patients with diabetes mellitus + CKD of 291.43 mg/dl, glucose in patients with Diabetes Mellitus of 175.03 mg/dl and creatinine in patients with Diabetes Mellitus + CKD of 7.50 mg/dl, creatinine in patients with Diabetes Mellitus of 4.67 mg/dl.

To find out the real difference between each, a data normality test was carried out using the Shapiro – Wilk test, from the test results showed significant values in glucose of ($p=0.073$) $p>0.05$ and kratinin of ($p=0.051$) $p=0.05$ which means that it is normally or parametrically distributed so that it can be continued using the Independent T-test.

From the results of the Independent T-test, the significance results were obtained for glucose of ($p=0.000$) $p<0.05$ and for creatinine of ($p=0.000$) $p<0.05$ which means that there is a difference between fasting blood glucose levels in patients with diabetes mellitus with complications and without CKD complications.

Discussion

Glucose, which is the main source of energy from carbohydrates and can be found in the blood, plays the role of the main fuel for most organs of the body the process of transporting glucose in plasma carries it throughout the body, where glucose can be directly used as an energy source in some parts of the body, glucose is absorbed and stored as glycogen glucose processing has a crucial role in utilization, The addition, and distribution of entire metabolic fuels sudden changes in blood sugar levels can significantly impair health function and even endanger life [8].

The result of increasing glucose levels is influenced by several factors, namely physical activity that has an impact on the level of glucose in the blood, where during muscle activity will increase the use of glucose, if the body cannot cope with high glucose needs due to excessive physical activity there can be a decrease in glucose levels in the body (hypoglycemia). On the other hand, if the amount of blood glucose exceeds the body's capacity to store it with minimal physical activity, the blood sugar level will rise above normal levels (hypoglycemia) [7].

High levels of glucose in the blood can result presence of glucose in the urine. High blood glucose levels directly affect the blood vessels in the kidneys. High glucose levels can affect in kidney function and altering the estimated glomerular filtration rate (GFR) [9].

The kidneys cannot withstand high concentration of glucose because the glucose threshold in the blood is 180 mg/dL. Blood glucose absorption can be assessed by GFR (Glomerular Filtration Rate), which is an important indicator in evaluating kidney function. Decrease of GFR values will impact to increased levels of urea and creatinine in the blood [9].

Excess glucose in the blood (hyperglycemia) can be toxic to the body of people with uncontrolled diabetes mellitus, in the long term can lead to impaired kidney function

known as clinical syndrome in diabetes mellitus which is characterized by uremia and microalbuminuria. This condition has the potential to cause the formation of atherosclerosis, which impact in narrowing of blood vessels this reduces blood supply to the kidneys and interferes with the filtration process in the glomerulus, which is characterized by increased of urea and creatinine levels, and decreased kidney function [9].

Creatine is a substance produced through normal muscle contractions and is released into the bloodstream this substance then passes through the kidneys to be excreted. The serum creatinine test has special specifications and is an important indicator in evaluating kidney function. Serum creatinine levels are not affected by protein intake and remain relatively constant in urine excreted plasma for 24 hours. The association between creatinine in the blood and individuals with diabetes mellitus is linked to increased blood sugar or hyperkalemia. This condition has the potential to damage the walls of blood vessels, making them vulnerable, and can lead to blockages as well as microvascular problems, including Diabetic Nephropathy [1].

Increased levels of creatinine in the blood circulation can be triggered by a variety of factors, such as dehydration conditions, excessive fatigue, the use of medications that can harm kidney function, kidney failure caused by infections, uncontrolled high blood pressure, and various kidney diseases. Based on research conducted by Nanda Dwi Mahara (2015), it was concluded that there was a significant relationship between serum creatinine and fasting blood sugar levels in Type 2 DM patients. The results showed that the higher the fasting blood sugar level, the higher the serum creatinine level in Type 2 DM patients [6].

Diabetes is the cause of chronic kidney disease. Diabetes mellitus causes chronic kidney disease. this condition is called diabetic nephropathy. Diabetic nephropathy is characterized by the release of albumin from the urine, glomerular damage, and decreased kidney function. Diabetic nephropathy is the main cause of chronic kidney disease, it can affect 20-40% of people with diabetes [10].

In this study, female patients were taken because the difference in body composition and sexual hormone levels between women and men is the cause of the high incidence of type II DM in women. Men have less fat tissue than women, normal fat levels in men range from 15 to 20% while in women to range from 20 to 25% of body weight [11].

Based on a study conducted by Rulita Ika Fitriyani entitled "The Relationship Between Type 2 Diabetes Melitis and the Incidence of Chronic Kidney Disease at RSI Sultan Agung (study on patients with chronic kidney disease in 2016-2020)", it was concluded that there was a significant relationship between Type 2 Diabetes Mellitus and the incidence of chronic kidney failure at RSI Sultan Agung Semarang [10].

Based on the findings of a study conducted by (Sari & Hisyam, 2014), which shows a positive correlation between type 2 Diabetes Mellitus, which is characterized by high blood sugar levels, and the risk of chronic kidney failure [5].

CONCLUSION

Fundamental Finding : The study confirms a significant relationship between fasting blood glucose and serum creatinine levels in type 2 diabetes mellitus (DM) patients, particularly those with chronic kidney disease (CKD) complications. Patients with DM+CKD demonstrated significantly higher glucose and creatinine levels than those without CKD, indicating that hyperglycemia contributes to kidney damage, characterized by reduced glomerular filtration rate (GFR), increased urea, and serum creatinine levels. **Implication :** These findings emphasize the critical need for stringent blood glucose control in DM patients to prevent or delay CKD complications. Healthcare providers should prioritize early detection and management strategies, including regular monitoring of serum creatinine and fasting glucose levels, to reduce the risk of long-term renal damage and associated healthcare burdens. **Limitation :** This study was limited to a small sample size of 60 female patients aged 60 years and above, restricting the generalizability of the findings to other age groups, genders, or broader populations. Additionally, the study did not account for confounding factors such as dietary habits, medication use, or other comorbid conditions influencing glucose and creatinine levels. **Future Research :** Future research should expand on this study by including larger, more diverse populations, incorporating both genders and different age groups. Further exploration into the role of lifestyle factors, medication adherence, and other biomarkers in the progression of DM-related kidney complications would provide a more comprehensive understanding of disease mechanisms and intervention strategies.

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