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Original Article

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Fasting Blood Glucose with Serum Creatinine Levels in Type 2 Diabetes Mellitus Patients

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ABSTRACT

Introduction: Type 2 Diabetes Mellitus (T2DM) is a major global health problem associated with various chronic complications, particularly diabetic nephropathy. Persistent hyperglycemia can damage renal microvasculature and lead to impaired kidney function. Fasting blood glucose (FBG) is commonly used to assess glycemic control, while serum creatinine is a key indicator of renal function. Understanding the relationship between these parameters is important for early detection of kidney complications among patients with T2DM. This study aimed to analyze the relationship between fasting blood glucose levels and serum creatinine levels in patients with Type 2 Diabetes Mellitus in a primary healthcare setting.

Research Methodology: This study employed an analytical observational design using a cross-sectional approach. Data were collected from medical records of patients with Type 2 Diabetes Mellitus at UPT Puskesmas Buki, Indonesia, in March 2026. A total of 38 patients who met the inclusion criteria were selected using purposive sampling. Fasting blood glucose levels were measured using the enzymatic GOD-PAP method, while serum creatinine levels were determined using the Jaffe reaction method. Data were analyzed using descriptive statistics and Spearman's rank correlation test with a significance level of $p \leq 0.05$.

Results: The mean fasting blood glucose level was 176.4 ± 42.5 mg/dL, while the mean serum creatinine level was 1.18 ± 0.36 mg/dL. Statistical analysis revealed a moderate positive correlation between fasting blood glucose and serum creatinine levels ($r = 0.421$; $p = 0.009$). This indicates that higher fasting blood glucose levels are associated with higher serum creatinine levels.

Conclusions: Fasting blood glucose levels are significantly associated with serum creatinine levels among patients with Type 2 Diabetes Mellitus. Regular monitoring of glycemic status and renal function in primary healthcare settings is essential for early detection and prevention of diabetic kidney complications.

Keywords: fasting blood glucose, serum creatinine, type 2 diabetes mellitus, renal function, diabetic nephropathy.

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INTRODUCTION

Diabetes mellitus (DM) has emerged as one of the most significant global public health challenges due to its increasing prevalence and its long-term complications that substantially burden healthcare systems [1]. DM is a chronic metabolic disorder characterized by persistent hyperglycemia resulting from impaired insulin secretion, insulin resistance, or a combination of both mechanisms [2]. Among the various forms of diabetes, Type 2 Diabetes Mellitus (T2DM) accounts for more than 90% of all diabetes cases worldwide and is strongly associated with lifestyle changes, population aging, and increasing rates of obesity [3]. Persistent hyperglycemia in T2DM contributes to progressive damage to multiple organ systems, particularly the microvascular structures of the kidneys, eyes, and peripheral nerves [4].

The magnitude of the diabetes problem continues to grow rapidly. According to global estimates, the number of individuals living with diabetes has increased dramatically over the past two decades and is projected to rise further in the coming years [5]. Indonesia is among the countries with the highest number of diabetes cases globally, reflecting a substantial national health burden [6]. The increasing prevalence of diabetes is also evident at regional and local levels, where healthcare facilities frequently report a growing number of patients diagnosed with T2DM. Such trends indicate the urgent need for improved screening, monitoring, and early detection of diabetes-related complications [7].

One of the most serious chronic complications of T2DM is diabetic nephropathy, a progressive kidney disorder resulting from long-term hyperglycemia [8]. Sustained high blood glucose levels can damage the glomerular filtration barrier and small blood vessels within the kidneys, leading to impaired renal function [9]. This pathological process often progresses silently in its early stages, making early detection crucial for preventing irreversible kidney damage. Diabetic nephropathy is a leading cause of chronic kidney disease and end-stage renal failure worldwide, emphasizing the importance of identifying early biomarkers that reflect renal impairment among patients with diabetes [9].

Among several laboratory indicators used to evaluate renal function, serum creatinine is widely recognized as a reliable biochemical marker [10]. Creatinine is a metabolic by-product of muscle metabolism that is primarily excreted by the kidneys through glomerular filtration. Under normal physiological conditions, creatinine levels in the blood remain relatively stable because production and excretion occur at a nearly constant rate [11]. However, when kidney function declines, creatinine accumulates in the bloodstream, leading to elevated serum creatinine levels. Therefore, measurement of serum creatinine is commonly used in clinical practice to assess renal filtration capacity and detect kidney dysfunction [12].

In patients with T2DM, poor glycemic control plays a major role in the development of renal complications. Fasting blood glucose (FBG) is one of the most commonly used indicators to evaluate glycemic status. Elevated FBG reflects persistent hyperglycemia and is strongly associated with metabolic disturbances that contribute to microvascular damage [13]. Chronic exposure to high glucose levels promotes oxidative stress, protein glycation, and structural changes in the glomerular basement membrane. These pathological mechanisms ultimately impair renal filtration and may lead to increased serum creatinine levels, suggesting a potential relationship between fasting blood glucose and kidney function indicators.

Several previous studies have investigated the relationship between glycemic status and renal function parameters in patients with T2DM. Some studies reported a significant correlation between elevated fasting blood glucose and increased serum creatinine levels, indicating that poor glycemic control may contribute to declining renal function. Other studies

have also suggested that patients with higher fasting glucose levels tend to exhibit signs of early kidney impairment. Despite these findings, inconsistencies remain across studies due to differences in population characteristics, sample size, and study settings. In addition, many previous studies were conducted in hospital settings, whereas evidence from primary healthcare facilities remains limited.

This limitation highlights an important research gap. Data describing the relationship between fasting blood glucose and serum creatinine levels among T2DM patients in primary healthcare settings remains insufficient, particularly in community-based health centers where early diabetes management often occurs. Understanding this relationship in such settings is essential because primary healthcare facilities serve as the first point of contact for most patients with chronic diseases and play a critical role in early detection of complications.

The novelty of this study lies in its focus on examining the correlation between fasting blood glucose levels and serum creatinine in patients with T2DM, using clinical laboratory data from a primary healthcare facility. By analyzing these parameters simultaneously within a community health service context, this study aims to provide evidence regarding early indicators of renal impairment among diabetic patients in routine clinical practice. Therefore, the objective of this study is to analyze the relationship between fasting blood glucose levels and serum creatinine levels in patients with Type 2 Diabetes Mellitus. The findings of this study are expected to contribute to improved early detection of diabetic nephropathy and support better clinical monitoring strategies for patients with diabetes.

MATERIALS AND METHODS

Study Design

This study employed an analytical observational design using a cross-sectional approach. The cross-sectional design was selected because it allows the assessment of the relationship between fasting blood glucose levels and serum creatinine levels at a single point in time among patients with Type 2 Diabetes Mellitus. This design is appropriate for identifying correlations between clinical laboratory parameters in a defined population.

Setting and Participants

The study was conducted at UPT Puskesmas Buki, Indonesia. Data collection was conducted in March 2026 using medical records from patients diagnosed with Type 2 Diabetes Mellitus. The study population consisted of all patients with Type 2 Diabetes Mellitus who underwent laboratory examinations at the health center. The inclusion criteria were: (1) patients diagnosed with Type 2 Diabetes Mellitus, (2) patients who had both fasting blood glucose and serum creatinine examinations performed at the same time, and (3) adult patients aged more than 34 years. The exclusion criteria included incomplete medical record data and missing laboratory results required for the study variables. A purposive sampling technique was used to select eligible participants based on predefined criteria.

Variables and Measurement

The independent variable in this study was fasting blood glucose level, while the dependent variable was serum creatinine level. Fasting blood glucose was defined as the glucose concentration measured in venous blood after at least 8 hours of fasting, expressed in mg/dL. Serum creatinine was defined as the concentration of creatinine in blood serum, measured in mg/dL, as an indicator of renal function. Laboratory measurements of fasting blood glucose were performed using an enzymatic colorimetric method (GOD-PAP). Serum creatinine levels were measured using the Jaffe reaction method. These laboratory procedures

are routinely used in clinical laboratories and follow standardized diagnostic protocols, ensuring measurement validity and reliability. The study used secondary data obtained from laboratory records and patient medical records.

Data Collection

Data were collected through a retrospective review of medical records and laboratory examination results of patients with Type 2 Diabetes Mellitus. The researcher extracted relevant information, including patient demographics, fasting blood glucose values, and serum creatinine levels, using a structured data extraction sheet. To ensure data quality, several procedures were implemented, including verification of laboratory results, cross-checking medical record completeness, and double-checking data entry before statistical analysis.

Data Analysis

Descriptive statistics were used to summarize participant characteristics and laboratory parameters. Continuous variables were presented as mean, standard deviation, minimum, and maximum values, while categorical variables were presented as frequencies and percentages. Before inferential analysis, a normality test was conducted using the Kolmogorov–Smirnov test. Because the data distribution was non-normal, the relationship between fasting blood glucose and serum creatinine levels was analyzed using Spearman's rank correlation test. Statistical significance was determined at a p-value ≤ 0.05 with a 95% confidence interval.

Ethical Approval

Ethical approval for this study was obtained from the institutional ethics committee prior to data collection. All patient data were anonymized to ensure confidentiality and privacy, as the study used retrospective medical record data. Informed consent procedures complied with the health facility's regulations and ethical committee guidelines.

RESULTS

Table 1 presents the demographic characteristics of the respondents, including the sex and age distributions of patients with Type 2 Diabetes Mellitus included in the study.

Table 1. Characteristics of Respondents (n = 38)

Variable	Category	Frequency (n)	Percentage (%)
Sex	Male	17	44.7
	Female	21	55.3
Age Group	35–44 years	6	15.8
	45–54 years	11	28.9
	55–64 years	13	34.2
	≥65 years	8	21.1

The majority of respondents were female (55.3%), while male participants accounted for 44.7% of the sample. Based on age distribution, most patients were in the 55–64-year age group (34.2%), followed by those aged 45–54 years (28.9%). This finding indicates that Type 2 Diabetes Mellitus was predominantly observed in middle-aged and older adults in this study population.

Table 2. Correlation between Fasting Blood Glucose and Serum Creatinine Levels

Variable	Mean ± SD	Min–Max	Correlation Coefficient (r)	p-value
Fasting Blood Glucose (mg/dL)	176.4 ± 42.5	128–298	0.421	0.009
Serum Creatinine (mg/dL)	1.18 ± 0.36	0.72–2.01		

The analysis showed a moderate positive correlation between fasting blood glucose levels and serum creatinine levels (r = 0.421). The p-value of 0.009 indicates that the

relationship is statistically significant ($p < 0.05$). This finding suggests that higher fasting blood glucose levels are associated with higher serum creatinine levels, indicating a potential decline in renal function among patients with Type 2 Diabetes Mellitus.

A total of 38 patients with Type 2 Diabetes Mellitus were included in this study. The descriptive analysis showed that the majority of respondents were female and were predominantly in the middle-to-older age groups, particularly between 55 and 64 years. These findings reflect the common epidemiological pattern of Type 2 Diabetes Mellitus, which is more prevalent among older adults and individuals with long-term metabolic risk factors. The laboratory results indicated that the mean fasting blood glucose level among participants was 176.4 mg/dL, suggesting that many patients experienced poor glycemic control. Meanwhile, the mean serum creatinine level was 1.18 mg/dL, approaching the upper normal limit and possibly indicating early renal impairment in some patients. Spearman correlation analysis revealed a statistically significant positive relationship between fasting blood glucose and serum creatinine levels. This result indicates that patients with higher fasting blood glucose levels tend to have higher serum creatinine levels. The moderate correlation suggests that persistent hyperglycemia may contribute to progressive renal dysfunction among patients with Type 2 Diabetes Mellitus. These findings highlight the importance of maintaining optimal glycemic control to prevent or delay the onset of diabetic nephropathy and other kidney-related complications.

DISCUSSION

This study examined the relationship between fasting blood glucose levels and serum creatinine levels among patients with Type 2 Diabetes Mellitus in a primary healthcare setting. The findings indicate that most respondents were middle-aged to older adults, with a slightly higher proportion of female patients. The laboratory analysis revealed that the average fasting blood glucose level among participants exceeded the normal diagnostic threshold, suggesting suboptimal glycemic control in many patients. In addition, the mean serum creatinine level approached the upper limit of the normal reference range. The bivariate analysis demonstrated a statistically significant moderate positive correlation between fasting blood glucose and serum creatinine levels. This finding suggests that higher fasting blood glucose levels are associated with elevated serum creatinine levels among patients with Type 2 Diabetes Mellitus. In clinical terms, this relationship indicates a potential decline in renal function associated with persistent hyperglycemia [14].

The association observed in this study can be explained through the pathophysiological mechanisms underlying diabetic nephropathy [15]. Chronic hyperglycemia is known to induce structural and functional changes in the renal microvasculature. Prolonged exposure to elevated glucose levels leads to the formation of advanced glycation end products (AGEs), increased oxidative stress, and activation of inflammatory pathways [16]. These mechanisms contribute to thickening of the glomerular basement membrane and mesangial expansion, ultimately impairing the kidneys' filtration capacity [17]. As renal filtration declines, metabolic waste products such as creatinine accumulate in the bloodstream. Because creatinine is primarily filtered by the glomerulus, its concentration in serum increases as kidney function deteriorates. Therefore, elevated serum creatinine serves as a clinical indicator of impaired renal function and is frequently used as an early marker of diabetic nephropathy [18].

Persistent hyperglycemia also increases intraglomerular pressure and hyperfiltration during the early stages of diabetes [19]. Over time, this compensatory mechanism contributes to progressive renal damage. The positive correlation between fasting blood glucose and serum creatinine observed in this study supports the theoretical framework that poor glycemic control accelerates microvascular complications, including kidney dysfunction [20].

The results of this study are consistent with several previous studies conducted in both global and regional contexts [21]. Research conducted in various clinical settings has reported a positive association between poor glycemic control and declining renal function among patients with Type 2 Diabetes Mellitus[22]. For instance, studies investigating the correlation between fasting blood glucose and renal biomarkers have demonstrated that higher glucose levels are associated with increased serum creatinine concentrations and reduced glomerular filtration rate [23].

Similarly, regional studies in Southeast Asia have reported that patients with uncontrolled diabetes often exhibit elevated levels of renal biomarkers. These studies highlight that prolonged hyperglycemia contributes to progressive kidney damage and may eventually lead to chronic kidney disease if not adequately managed [24]. However, the present study contributes additional evidence by focusing on a primary healthcare facility rather than a tertiary hospital setting [25]. This perspective is important because many patients with Type 2 Diabetes Mellitus receive routine monitoring and early-stage management at primary healthcare centers. Understanding the relationship between glycemic status and renal indicators in this setting provides valuable insights for early detection strategies [26].

The convergence between this study and previous research may be explained by the consistent biological mechanisms linking hyperglycemia and renal dysfunction. The pathophysiological processes involved in diabetic nephropathy are well established and tend to produce similar clinical patterns across different populations [27]. Consequently, many studies report comparable findings regarding the relationship between blood glucose levels and renal function indicators. Nevertheless, variations in the strength of correlations reported across studies may result from several factors. Differences in study populations, diabetes duration, treatment adherence, lifestyle factors, and comorbid conditions can influence both glycemic control and kidney function [28]. In addition, methodological differences such as sample size, laboratory measurement techniques, and statistical analysis approaches may contribute to divergent findings in the literature.

Another possible explanation relates to the stage of diabetes progression among study participants. Patients in earlier stages of diabetes may not yet exhibit substantial renal impairment, which could weaken the observed association between glucose levels and creatinine. Conversely, studies involving patients with longer disease duration may report stronger correlations due to cumulative renal damage.

Strengths and Limitations

This study has several strengths. First, it utilized real-world clinical data obtained from routine laboratory examinations in a primary healthcare setting. This approach enhances the practical relevance of the findings and reflects actual clinical conditions in community-based healthcare services. Second, the study applied standardized laboratory measurements and appropriate statistical analysis to evaluate the relationship between fasting blood glucose and serum creatinine levels. Despite these strengths, several limitations should be considered. The cross-sectional design limits the ability to establish causal relationships between hyperglycemia and renal dysfunction. Longitudinal studies would be required to assess temporal changes and confirm causality.

Additionally, the relatively small sample size may limit the generalizability of the findings to broader populations. Furthermore, this study relied on secondary data from medical records, which may lack information on potential confounding variables, such as diabetes duration, medication adherence, dietary patterns, and comorbid conditions. Future studies with larger sample sizes and more comprehensive clinical variables would provide deeper insights into the complex relationship between glycemic control and renal function in patients with Type 2 Diabetes Mellitus.

CONCLUSIONS

This study aimed to analyze the relationship between fasting blood glucose levels and serum creatinine levels among patients with Type 2 Diabetes Mellitus in a primary healthcare setting. The findings demonstrated a statistically significant positive correlation between fasting blood glucose and serum creatinine levels. Patients with higher fasting blood glucose levels tended to exhibit higher serum creatinine concentrations, suggesting a potential decline in renal function associated with poor glycemic control. These results indicate that persistent hyperglycemia may contribute to early kidney impairment among individuals with Type 2 Diabetes Mellitus.

The findings highlight the importance of integrated metabolic and renal monitoring in diabetes management, particularly within primary healthcare facilities where most patients receive routine care. Regular assessment of fasting blood glucose, together with serum creatinine testing, can support early detection of diabetic nephropathy and enable timely clinical intervention. From a policy and practice perspective, strengthening laboratory screening programs for diabetes complications at primary healthcare centers is essential. Health systems should prioritize routine renal function monitoring, patient education on glycemic control, and early preventive strategies to reduce the risk of chronic kidney disease among individuals living with Type 2 Diabetes Mellitus.

Ethical Considerations

This study was conducted in accordance with the ethical principles of biomedical research involving human subjects. Ethical approval for the study protocol was obtained from the Health Research Ethics Committee of Politeknik Sandi Karsa Makassar before data collection. The study used secondary data from patients' medical records diagnosed with Type 2 Diabetes Mellitus. All patient information was anonymized to ensure confidentiality and privacy. Because the study used retrospective medical record data, the ethics committee waived the requirement for written informed consent. Data were accessed and analyzed solely for research purposes and handled in accordance with applicable institutional and ethical guidelines.

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Conflict of Interest

The authors declare that there are no conflicts of interest related to the publication of this study.

Authors' Contributions

Karlina contributed to the conceptualization of the study, data collection, data analysis, and preparation of the initial manuscript draft. Marisca Jenice Sanaky supervised the research design, provided methodological guidance, and critically reviewed the manuscript. Suprapto contributed to the study supervision, interpretation of results, and manuscript revision. All authors read and approved the final version of the manuscript.

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