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Evaluation of Creatinine Levels, Ureum Levels, Urine Protein in Diabetes Mellitus Patient as a Predictor of Kidney Failure

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ABSTRACT
Chronic kidney failure is a common microvascular complication of diabetes mellitus, and kidney function is routinely evaluated using creatinine, urea, and urinary protein tests. However, because creatinine and urea testing requires automated laboratory equipment that is often unavailable in primary healthcare facilities, urinary protein testing remains the most accessible screening method for the early detection of kidney function impairment. The purpose of this study is to evaluate creatinine levels, urea levels, and urine protein in patients with Diabetes Mellitus as predictors of kidney failure. This study is a quantitative descriptive study with a cross-sectional approach. The independent variables are creatinine levels, urea levels, and urine protein, while the dependent variable is blood glucose levels. The study sample consisted of 30 individuals using accidental sampling technique. Data collection was conducted using secondary data. The data were analyzed descriptively and with the Pearson chi-square test. The research results showed that 47% of respondents had high creatinine levels, 83% had high urea levels, and 80% had positive urine protein results, including positive levels 1, 2, and 3. The Pearson chi-square test results indicated that all three variables creatinine, urea, and urine protein had a significant relationship with p-values less than 0.05, specifically creatinine at 0.045, urea at 0.037, and urine protein at 0.032. The conclusion that can be drawn from these results is that the examination of creatinine levels, urea levels, and urine protein can serve as predictors of kidney failure in patients with diabetes mellitus. In particular, urine protein levels can be a simple test used to detect kidney conditions in diabetes mellitus patients and can be performed at community health centers.

Keywords: Creatinine Levels, Urea Levels, Urinary Protein, Diabetes Mellitus, Kidney Failure.

ABSTRAK
Gagal ginjal kronis merupakan salah satu komplikasi mikrovaskular yang umum terjadi pada pasien diabetes melitus, dan fungsi ginjal secara rutin dievaluasi melalui pemeriksaan kadar kreatinin, ureum, dan protein urin. Namun, karena pemeriksaan kreatinin dan ureum memerlukan peralatan laboratorium otomatis yang umumnya belum tersedia di fasilitas pelayanan kesehatan tingkat pertama, pemeriksaan protein urin tetap menjadi metode skrining yang paling mudah diakses untuk mendeteksi secara dini gangguan fungsi ginjal. Penelitian ini bertujuan untuk mengevaluasi kadar kreatinin, kadar ureum, dan protein urin sebagai prediktor terjadinya gagal ginjal pada pasien diabetes melitus. Penelitian ini merupakan penelitian deskriptif kuantitatif dengan pendekatan cross-sectional. Variabel independen dalam penelitian ini adalah kadar kreatinin, kadar ureum, dan protein urin, sedangkan variabel dependen adalah kadar glukosa darah. Sampel penelitian berjumlah 30 responden yang dipilih menggunakan teknik accidental sampling. Pengumpulan data dilakukan menggunakan data sekunder. Analisis data dilakukan secara deskriptif dan menggunakan uji Pearson chi-square. Hasil penelitian menunjukkan bahwa 47% responden memiliki kadar kreatinin yang tinggi, 83% memiliki kadar ureum yang tinggi, dan 80% menunjukkan hasil protein urin positif, yang meliputi protein urin positif +1, +2, dan +3. Hasil uji Pearson chi-square menunjukkan bahwa ketiga variabel, yaitu kadar kreatinin, kadar ureum, dan protein urin, memiliki hubungan yang signifikan dengan nilai $p < 0,05$, masing-masing sebesar 0,045; 0,037; dan 0,032. Berdasarkan hasil tersebut dapat disimpulkan bahwa pemeriksaan kadar kreatinin, kadar ureum, dan protein urin dapat digunakan sebagai prediktor terjadinya gagal ginjal pada pasien diabetes melitus. Secara khusus, pemeriksaan protein urin merupakan pemeriksaan yang sederhana untuk mendeteksi kondisi ginjal pada pasien diabetes melitus dan dapat dilakukan di fasilitas pelayanan kesehatan tingkat pertama seperti puskesmas.

Kata Kunci: Kadar Kreatinin, Kadar Ureum, Protein Urin, Diabetes Melitus, Gagal Ginjal.

INTRODUCTION

Diabetes mellitus (DM) is a metabolic disease characterized by hyperglycemia (elevated blood glucose levels >200 mg/dL) resulting from abnormalities in insulin action, insulin secretion, or both (Ojo et al., 2023). A substantial increase in the number of patients with type 2 diabetes mellitus in the coming years. The number of type 2 DM patients in Indonesia will rise from 8.4 million in 2000 to approximately 21.3 million by 2030 (Nano et al., 2020). Predictions from the International Diabetes Federation (IDF) also indicate that between 2013 and 2017 there was an increase in the number of DM patients from 10.3 million, which is expected to reach 16.7 million by 2045 (Wang et al., 2026).

In 2017, approximately 425 million people worldwide were living with diabetes mellitus (DM); among them, 123 million were aged over 65 years and 37 million were aged between 20–64 years. Indonesia ranked sixth globally, along with the United States, Brazil, China, India, and Mexico, with an estimated 10 million people affected (American Diabetes Association, 2021). One of the chronic microvascular complications that can occur in patients with DM is chronic kidney failure. Chronic kidney failure is found in 35–45% of patients with DM and can lead to end-stage renal disease, which is a major cause of mortality among these patients (Nordheim & Geir Jenssen, 2021; Querfeld et al., 2020). This disease can result in disability and is a leading cause of death in patients with DM. Approximately 50% of end-stage renal disease cases are caused by diabetic nephropathy in patients with DM, which begins with damage to the glomerular filtration rate (Umanath & Lewis, 2018).

The glomerular filtration rate (GFR) is considered the main predictor in the diagnosis of chronic kidney failure. Chronic kidney failure leads to increased serum creatinine levels because creatinine can no longer be effectively filtered and excreted by the kidneys, resulting in a decreased GFR (Davies et al., 2022). In addition, persistently high blood glucose levels gradually damage the filtration membrane due to glucose-protein reactions that alter cellular function and structure, including the glomerular basement membrane. Clinically, this condition is characterized by increased urinary protein levels and a decreased glomerular filtration rate (Mauricio & Alonso, 2024). Parameters routinely examined to assess renal excretory function include urea and creatinine levels. Urea is the end product of protein metabolism and must be excreted from the body. Increased urea levels are proportional to the decline in the number of functional nephrons (De Rosa et al., 2023). Creatinine is formed in muscle tissue from creatine phosphate and is a byproduct of muscle metabolism. Almost all creatinine is eliminated from the body through glomerular filtration (Ávila et al., 2025). The amount of creatinine produced by an individual is proportional to skeletal muscle mass. Serum creatinine examination is a specific test and one of the indicators used to assess impaired kidney function (Groothof et al., 2024).

The relationship between urea and creatinine levels and diabetes mellitus is that DM is characterized by high blood glucose levels (hyperglycemia). This condition damages blood vessel walls, leading to obstruction and resulting in microvascular complications, one of which is diabetic nephropathy (Yosa & Wibowo, 2019). Hyperglycemia also plays a role in the development of atherosclerosis, causing narrowing of the vascular lumen and reduced blood flow velocity, which decreases blood supply to the kidneys. This can disrupt the filtration process in the glomeruli and lead to decreased kidney function, as indicated by elevated blood urea and creatinine levels (Chakraborty et al., 2023). Urea is a nitrogenous waste product excreted in the urine, originating from dietary and endogenous proteins. Urea is reabsorbed to a greater extent when urine flow is slow or impaired (such as in dehydration), which can lead to oliguria (Luft, 2021). This condition stimulates the formation of enzymatic hormones, namely renin. Renin then works together with aldosterone and angiotensin hormones to form the renin–angiotensin–aldosterone system (RAAS), resulting in increased blood pressure. Other studies have also examined serum creatinine profiles in patients with type 2 DM based on the duration of the disease, as well as serum creatinine levels in patients with type 2 DM with or without chronic kidney failure and the incidence of microalbuminuria. In addition to creatinine and urea level examinations, urinary protein testing is also one of the assessments used to evaluate kidney condition (Carswell & O'Neil, 2024).

Urinary protein testing is an examination that reflects kidney condition; however, it is used primarily as a screening test because it is less specific as a diagnostic parameter. Urinary protein

serves only as a screening parameter, whereas creatinine and urea function as diagnostic parameters for impaired kidney function (Zeng et al., 2024). Creatinine and urea examinations can only be performed in intermediate or main laboratories because they require semi-automatic or automatic equipment; therefore, not all healthcare facilities are able to conduct these tests. Community health centers (Puskesmas) that only have primary laboratories are not yet able to perform these examinations and can only conduct urinary protein testing. Meanwhile, the number of patients with diabetes mellitus, both in urban and rural areas, continues to increase, and many rural healthcare services or Puskesmas still lack complete laboratory equipment.

These conditions constitute problems or constraints that require special attention, starting from the provision of complete equipment at Puskesmas to the construction of hospitals in every region. However, such efforts cannot be realized quickly and represent long-term solutions. Therefore, although urinary protein testing is still a screening tool, it can serve as a simple and rapid alternative for communities or patients with diabetes mellitus living in remote areas where only Puskesmas are available. Despite the widespread use of creatinine and urea as kidney function markers, the potential utility of urinary protein as an alternative screening biomarker in resource-limited settings has not been thoroughly evaluated in the Indonesian context. A key research gap exists in understanding whether urinary protein testing-which is accessible at primary healthcare facilities shows comparable associations with kidney function impairment as creatinine and urea. This study aims to evaluate creatinine levels, urea levels, and urinary protein in patients with Diabetes Mellitus and their association with kidney function impairment, with the goal of providing evidence to support accessible screening strategies at community health centers.

RESEARCH METHODS

This study is a correlational analytic study using a cross-sectional research design. The aim of this study was to determine whether creatinine levels, urea levels, and urinary protein are associated with kidney function impairment in patients with diabetes mellitus. The study was conducted at Patut Patuh Patju Regional General Hospital, West Lombok, from May to July 2025.

The population of this study consisted of all patients with diabetes mellitus at Patut Patuh Patju Regional General Hospital, West Lombok. The research sample comprised data from patients with diabetes mellitus who underwent creatinine level, urea level, and urinary protein examinations during the period from May to July 2025. The tools used to collect secondary data included computers and laptops for accessing and extracting electronic patient data, electronic medical record software, and observation sheets to record the required data.

Data collection was carried out using accidental sampling, in which data were selected based on predetermined criteria and the availability of data in the hospital's medical records. Accidental sampling was employed due to the retrospective secondary data nature of this study; all available patient records meeting the inclusion criteria during the study period were included. Kidney function impairment in this study is operationally defined as the presence of elevated serum creatinine levels (above the laboratory reference range) and/or elevated urea levels (above the laboratory reference range), consistent with reduced renal excretory function. For the Chi-square analysis, blood glucose levels were categorized as high (≥200 mg/dL, consistent with the DM diagnostic threshold) based on the recorded fasting or random blood glucose values in the medical records. Due to the small sample size (n=30) and cross-sectional design, multivariable analysis to control for potential confounders such as age, sex, duration of diabetes, and hypertension could not be performed; this is acknowledged as a study limitation. Analysis of creatinine levels, urea levels, and urinary protein in patients with diabetes mellitus was conducted using a quantitative descriptive approach. Data analysis in this study was performed using SPSS with the Chi-square statistical test to examine the relationship between creatinine levels, urea levels, and urinary protein and blood glucose levels in patients with diabetes mellitus. This study obtained ethical approval from the Research Ethics Committee of the Politeknik Medica Farma Husada Mataram on January 4, 2025, under approval number 028/KEPK-IA/I/2025.

RESULTS

This study used a sample of 30 participants, consisting of 17 females and 13 males, selected using the accidental sampling technique and secondary data collected from medical records for the period May–July 2025. The characteristics of respondents based on gender and age are presented in Table 1.

Table 1. Characteristics of respondents by gender and age.

Respondent Characteristics	Number (N)	Percentage (%)
Gender		
Male	13	43
Female	17	57
Age (Years)		
42 - 54	12	40
55 - 67	12	40
68 - 81	6	20

Based on Table 1, it can be explained that the majority of respondents were female, totaling 17 individuals (57%), while the smallest proportion consisted of male respondents, totaling 13 individuals (43%). In terms of age characteristics, the most dominant age groups were 42–54 years and 55–67 years, each comprising 12 respondents (40%), while the smallest age group was 68–81 years, comprising 6 respondents (20%).

Table 2. Creatinine levels, ureum, and urinary protein in patients with diabetes mellitus.

Gender	Creatinine Level			Ureum			Urinary Protein				DM
	Low (%)	Normal (%)	High (%)	Low (%)	Normal (%)	High (%)	Neg	+1	+2	+3	High (%)
Male	0	20	23	0	10	33	3	7	13	20	44
Female	3	30	23	0	7	50	17	13	20	7	56
Total	3	50	47	0	17	83	20	20	33	27	100

Based on Table 2, the results of creatinine level examinations in patients with diabetes mellitus (DM) showed that 47% had high levels, 50% were within the normal range, and 3% had low levels. The results of urea level examinations indicated that 83% of patients had high levels and 17% had normal levels. The urinary protein examination results showed that 80% were positive and 20% were negative.

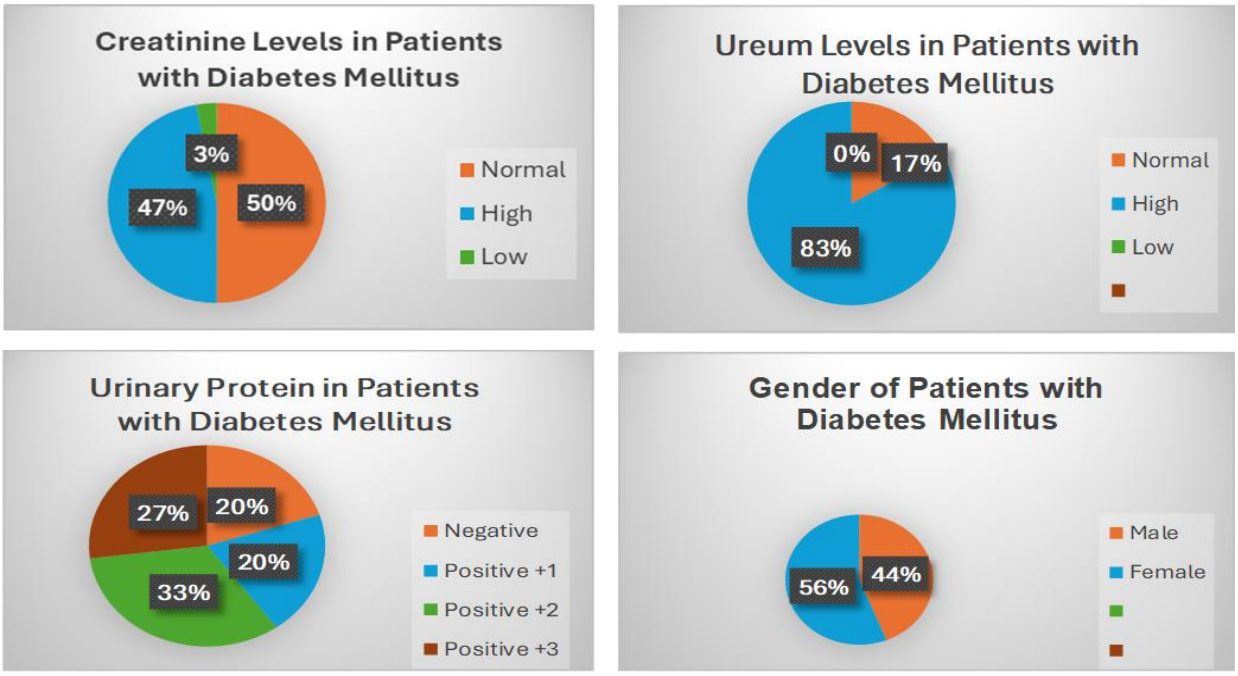

Figure 1. Creatinine levels, ureum, and urinary protein in patients with diabetes mellitus.

Table 3. Results of the Pearson chi-square test.

Measurement Results	p-value
Creatinine Level ><DM	0.045
Urea Level ><DM	0.037
Urinary Protein <>DM	0.032

Based on Table 3, the Chi-square test results indicate that creatinine levels, urea levels, and urinary protein in patients with diabetes mellitus can be used as predictors of kidney failure, as shown by p-values < 0.05, with creatinine at 0.045, urea at 0.037, and urinary protein at 0.032.

DISCUSSION

The results of this study showed that the majority of respondents were female, totaling 17 individuals (57%), while males accounted for 13 individuals (43%). Gender differences can influence the risk and progression of diabetes mellitus (DM). In general, women have a higher risk of developing DM than men, particularly due to hormonal factors and differences in body fat distribution (Delaney & Santosa, 2022). However, other factors such as age, lifestyle, and family history also play important roles in the development of DM in both sexes (Lakerveld et al., 2020; Lambrinou et al., 2019). The respondents' ages were divided into three categories: 42–54 years and 55–67 years, each consisting of 12 individuals (40%), and the smallest group was aged 68–81 years with 6 individuals (20%). This finding is consistent with the previous study that age has a significant influence on the occurrence of DM, especially type 2 diabetes. As age increases, the risk of developing DM also increases, particularly after the age of 45 years, although it may also occur at a younger age (Kim et al., 2020).

Based on creatinine levels, urea levels, urinary protein, and blood glucose levels in patients with diabetes mellitus, the results showed that 47% of respondents had high creatinine levels, 83% had high urea levels, 80% had positive urinary protein, and 100% had high blood glucose levels, as they were categorized as DM patients. Data analysis using the Chi-square test revealed that creatinine levels, urea levels, and urinary protein had significant associations with kidney function impairment, with p-values < 0.05, indicating statistically significant associations between these biomarkers and kidney function parameters in patients with DM. This finding suggests that the two parameters commonly used for diagnostic purposes (creatinine and urea) yield results comparable to urinary protein testing, which is generally considered only a screening test. These results highlight that urinary protein examination, although primarily a screening tool, shows a significant association with kidney function impairment in patients with DM; however, it should be noted that significant associations do not confirm predictive value in the absence of diagnostic accuracy analyses such as sensitivity, specificity, or ROC curve analysis (Gilmour et al., 2021). This finding is supported by previous study which reported increases in creatinine and urea levels in patients with DM. Elevated creatinine, urea, and urinary protein levels may correlate with prerenal conditions or renal tissue damage. The average time from diabetes diagnosis to the development of diabetic nephropathy is approximately 5–10 years. In addition to these parameters, HbA1c testing is used to assess the severity of diabetes mellitus (Peña-Esparragoza et al., 2025).

Patients with long-standing type 2 DM may experience more severe and acute complications due to poor blood glucose control. HbA1c examination plays an important role in assessing the risk of tissue damage caused by prolonged hyperglycemia. Elevated HbA1c levels in uncontrolled DM patients can lead to various chronic complications, both microvascular and macrovascular (Martín Benlloch et al., 2025). Glomerular Filtration Rate (GFR) and urinary microalbumin tests are additional examinations used to evaluate kidney function and detect renal dysfunction caused by type 2 diabetes mellitus. However, these tests are generally available only in at least Type C hospitals, while primary healthcare facilities such as community health centers and primary clinics often lack the equipment to perform creatinine, urea, HbA1c, microalbumin, and GFR tests (Hliel et al., 2025; Salvia & Quatromoni, 2023).

The results of this study provide new information indicating that patients with DM living in remote rural areas who have limited access to hospitals can undergo urinary protein testing to monitor the development of DM complications, particularly chronic kidney failure. Protein is one of the metabolic components that should be reabsorbed back into the human body during the

reabsorption process. However, under certain conditions, such as kidney damage, protein can be excreted in the urine (Wang et al., 2026). Kidney damage may occur due to several causes, including prerenal damage resulting from DM complications, renal damage due to impaired kidney function, and postrenal damage caused by disorders of the urinary tract, ureters, or urethra. Under normal conditions, only a small fraction of plasma proteins is filtered through the glomerulus and are then reabsorbed by the renal tubules (Roche-Gomez et al., 2025). The amount of protein excreted in the urine generally does not exceed 150 mg per hour or 10 mg/dL in a single sample. Urinary protein levels above 10 mg/dL are categorized as proteinuria. Small amounts of protein may be found in the urine of healthy individuals due to physiological changes. Strenuous physical activity, stress, or a high-meat diet can cause an increase in urinary protein levels. Premenstrual conditions and hot water bathing may also trigger increased protein levels. Urinary protein mainly consists of albumin and globulin. Increased albumin excretion is a sensitive indicator of chronic kidney disease caused by glomerular disorders, diabetes mellitus, or hypertension (Leal et al., 2025; Uzun et al., 2025).

Urinary protein in patients with diabetes mellitus who also have positive glucosuria indicates impaired kidney function. This condition occurs due to changes in glomerular permeability, allowing protein to pass into the glomerular filtrate. This filtrate is then reabsorbed by the renal tubules, where cells reclaim substances needed by the body (de Faria et al., 2025). However, when the amount of protein passing through glomerular filtration is too large and cannot be completely reabsorbed by the tubules, some protein will remain and be excreted in the urine. This condition is known as proteinuria (Hall, 2025).

The results of some studies showed a strong relationship between blood glucose levels and proteinuria in patients with DM ($r = 0.93$), with an R^2 value of 0.87, indicating that blood glucose levels contribute 87% to the occurrence of proteinuria. These research findings further support the rationale that urinary protein testing shows significant associations with kidney function parameters comparable to creatinine and urea levels in patients with DM. Patients with DM living in remote areas who only have access to primary laboratories are encouraged to undergo routine urinary protein examinations to prevent the development of complications toward diabetic nephropathy (Ferreira et al., 2025).

The limitation of this study is its cross-sectional design, which only allows the identification of associations between creatinine levels, urea levels, urinary protein, and kidney function impairment in patients with diabetes mellitus. Consequently, the findings cannot establish temporal, predictive, or causal relationships, and further prospective longitudinal studies are needed to confirm the predictive value of these biomarkers, particularly urinary protein, for the early detection of kidney function impairment.

CONCLUSION

Based on the findings of this study, patients with diabetes mellitus generally exhibited elevated creatinine and urea levels, positive urinary protein, and increased blood glucose levels. The analyses demonstrated statistically significant associations between creatinine levels, urea levels, urinary protein, and impaired kidney function in patients with diabetes mellitus. However, these findings were derived from a cross-sectional design and therefore reflect associations rather than predictive or causal relationships. Furthermore, kidney failure was not directly confirmed using validated clinical criteria, such as glomerular filtration rate (GFR), estimated glomerular filtration rate (eGFR), or established nephropathy diagnostic criteria. Urinary protein testing, which is widely available in community health centers and primary laboratories, may serve as a practical initial screening tool for identifying potential kidney function impairment in patients with diabetes mellitus, particularly in resource-limited settings. Future studies should employ prospective designs with larger sample sizes, formal sample size calculations, multivariable analyses, and validated measures of kidney function, including GFR or eGFR, to confirm these associations and further evaluate the clinical utility of urinary protein as an early screening marker. In clinical practice, patients with diabetes mellitus should be encouraged to undergo routine urinary protein screening as an initial assessment while awaiting confirmatory kidney function testing at referral healthcare facilities.

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