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ORIGINAL ARTICLE

Prevalence of Chronic Kidney Disease among Patients with Type 2 Diabetes Mellitus: A Cross-Sectional Study in Pakistan

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ABSTRACT

Background: Chronic kidney disease (CKD) is one of the most serious complications of type 2 diabetes mellitus (T2DM). Pakistan, with one of the highest global burdens of diabetes, faces an increasing prevalence of diabetic kidney disease, yet data remain scarce. Early detection using estimated glomerular filtration rate (eGFR) and urine albumin–creatinine ratio (ACR) is essential for timely intervention.
Objectives: To determine the prevalence and stages of CKD among T2DM patients in Pakistan and to identify associated demographic and clinical risk factors.
Methods: This multicenter cross-sectional study was conducted at Sargodha Medical College, Sargodha and The University of Lahore Teaching Hospital, Lahore from June 2024 to February 2025. A total of 70 adults with T2DM were enrolled consecutively. Demographics, comorbidities, and treatment history were recorded. Serum creatinine was measured to calculate eGFR using the CKD-EPI 2021 equation, and urine ACR was assessed to detect albuminuria. CKD was defined according to KDIGO 2024 criteria as eGFR <60 mL/min/1.73 m² and/or ACR ≥30 mg/g, with chronicity confirmed through past results or repeat testing.
Results: The mean age of participants was 55.7 ± 10.8 years, with 54.3% males. The mean diabetes duration was 9.2 years, and 65.7% had hypertension. Poor glycemic control (HbA1c ≥8%) was observed in 55.7%. Overall, 31.4% (22/70) had CKD. Among them, 8 were in stage G3a, 6 in G3b, and 3 in G4, while 17 patients (24.3%) had albuminuria (10 in A2, 7 in A3). CKD was more frequent in older patients, those with longer diabetes duration, hypertension, and poor glycemic control.
Conclusion: CKD affects nearly one-third of diabetic patients in Pakistan, with many cases detectable only through albuminuria screening. Routine use of both eGFR and ACR, alongside aggressive management of blood pressure and glycemia, and broader access to renoprotective therapies are essential to reduce the burden of diabetic kidney disease.
Keywords: Chronic kidney disease, Diabetes mellitus, Albuminuria, Prevalence, Pakistan, Kidney function.

INTRODUCTION

Chronic kidney disease (CKD) has emerged as one of the most serious long-term complications of type 2 diabetes mellitus (T2DM), accounting for a large proportion of morbidity and mortality worldwide[1]. Diabetes is now the leading cause of end-stage kidney disease (ESKD), and with the growing diabetes epidemic, the number of patients developing diabetic kidney disease (DKD) continues to rise. Globally, an estimated 537 million adults

are living with diabetes, and this number is projected to increase to 783 million by 2045. Among these, nearly 30–40% eventually develop some form of CKD, underscoring the major public health challenge diabetes poses to kidney health[2].

In South Asia, and particularly in Pakistan, the situation is even more alarming. Pakistan currently ranks among the top five countries in the world with the highest prevalence of diabetes, with recent surveys estimating that over 30 million adults are affected. Urbanization, sedentary lifestyles, obesity, unhealthy diets, and limited access to preventive healthcare are driving a rapid rise in T2DM cases[3]. This surge in diabetes prevalence directly translates into an increased risk of CKD, placing an immense burden on an already strained healthcare system. Unfortunately, many cases of CKD in diabetic patients remain undiagnosed until advanced stages, largely due to poor awareness, lack of routine screening for albuminuria and estimated glomerular filtration rate (eGFR), and inadequate integration of kidney health into diabetes management protocols[4].

CKD is defined as the presence of abnormalities in kidney structure or function that persist for at least three months, with clinical diagnosis based on reduced eGFR (<60 mL/min/1.73 m²) and/or markers of kidney damage, such as albuminuria. The Kidney Disease: Improving Global Outcomes (KDIGO) guidelines emphasize the importance of using both eGFR and urinary albumin–creatinine ratio (ACR) in staging CKD[5]. These parameters not only help in early detection but also allow for accurate risk stratification and timely initiation of renoprotective therapies. In the context of diabetes, early identification of albuminuria, even when eGFR is preserved, is critical because it reflects ongoing glomerular injury and predicts future cardiovascular and renal events[6].

Several studies conducted in Pakistan have reported variable estimates of CKD prevalence among diabetic populations, ranging from 15% to 40%, depending on the diagnostic criteria, population studied, and geographic setting[7]. Most of these studies, however, are either single-center, hospital-based, or have small sample sizes, limiting their generalizability. Furthermore, a lack of uniform diagnostic standards, limited laboratory facilities in peripheral areas, and inconsistent reporting further complicate the understanding of CKD burden in Pakistani diabetic populations. With the rising availability of advanced therapies such as renin–angiotensin system (RAS) blockers, sodium-glucose cotransporter-2 (SGLT2) inhibitors, and glucagon-like peptide-1 receptor agonists (GLP-1 RAs), identifying the true burden of CKD among diabetic patients is vital to guide national health policies and clinical practice[8,9].

The implications of CKD extend beyond kidney outcomes. Patients with diabetic CKD are at significantly higher risk of cardiovascular events, hospitalizations, reduced quality of life, and premature death. Moreover, the economic burden is immense, as patients progressing to advanced CKD or requiring dialysis face substantial treatment costs, which are often unaffordable for families in low- and middle-income countries like Pakistan. Thus, CKD among diabetic patients is not only a clinical issue but also a socio-economic challenge that requires urgent attention[10,11].

Given the magnitude of the diabetes epidemic in Pakistan and the lack of robust multicenter data on the prevalence of CKD among diabetic patients, there is a clear need for comprehensive studies that can provide reliable estimates. Such studies would be instrumental in identifying at-risk groups, informing preventive strategies, and guiding resource allocation for early screening and management[12,13].

The present study was therefore designed to determine the prevalence of CKD among adults with T2DM in Pakistan using standardized KDIGO definitions. In addition, the study aimed to classify CKD stages and assess associated risk factors, thereby providing valuable insights into the epidemiology of diabetic kidney disease in the Pakistani population. By generating reliable, multicenter data, this research intends to support evidence-based policy-making and to emphasize the urgent need for integrating kidney health into diabetes care pathways across the country[14].

MATERIAL AND METHOD

Study Design and Setting

This study was designed as a multicenter cross-sectional investigation and was carried out over a nine-month period from June 1, 2024, to February 28, 2025. The research was conducted at two major teaching hospitals in Pakistan: the Department of Medicine, Sargodha Medical College (SMC), Sargodha, and the University of Lahore Teaching Hospital (UOL-TH), Lahore. Both institutions are recognized tertiary-care centers with well-established diabetes clinics, nephrology services, and laboratory facilities. Their clinical infrastructure and standardized protocols provided a suitable environment for assessing the prevalence of chronic kidney disease (CKD) among adult patients with type 2 diabetes mellitus (T2DM).

Study Population and Eligibility Criteria

The study population included adults aged 18 years or older with a confirmed clinical diagnosis of T2DM. Patients were enrolled consecutively as they presented to

outpatient medical and endocrinology clinics during the study period. Inclusion criteria were a physician-confirmed diagnosis of T2DM and willingness to undergo same-day laboratory testing, including serum creatinine and urine albumin–creatinine ratio (ACR). Exclusion criteria were pregnancy, known cases of polycystic kidney disease or other primary glomerulopathies, documented acute kidney injury within the preceding three months, ongoing dialysis or a history of kidney transplantation, and inability to provide informed consent. Patients with urinary tract infection or active hematuria on initial screening were deferred and reassessed after treatment to avoid misclassification of albuminuria.

Outcome Definition

The primary outcome of interest was the prevalence of CKD among patients with T2DM, determined according to the Kidney Disease: Improving Global Outcomes (KDIGO 2024) guidelines. CKD was defined as the presence of an estimated glomerular filtration rate (eGFR) of less than 60 mL/min/1.73 m^2 and/or a urine ACR of ≥30 mg/g (≥3 mg/mmol). To ensure that the abnormalities reflected chronic disease rather than transient changes, chronicity was confirmed through two approaches: by reviewing prior laboratory results obtained at least three months before the index test, or through protocolized repeat testing after ≥90 days in patients without documented historical data. Secondary outcomes included staging of CKD into KDIGO GFR categories (G1–G5) and albuminuria categories (A1–A3), as well as evaluation of clinical factors associated with the presence of CKD.

Clinical and Laboratory Assessments

All participants underwent structured clinical assessments performed by trained research officers using a standardized case report form. Demographic information, duration of diabetes, smoking history, co-morbidities such as hypertension and cardiovascular disease, and details of current medications including metformin, insulin, SGLT2 inhibitors, GLP-1 receptor agonists, and renin–angiotensin system (RAS) blockers were recorded. Blood pressure was measured in the seated position after five minutes of rest using a validated automated sphygmomanometer, with the average of two readings taken one to two minutes apart. Weight, height, and body mass index (BMI) were measured according to standard protocols.

On the same day, blood and urine samples were collected. Serum creatinine was measured using an IDMS-traceable enzymatic method, and eGFR was calculated using the CKD-EPI 2021 race-free equation. Glycemic control was assessed with HbA1c, standardized to NGSP/IFCC criteria. Urinary albumin excretion was determined by spot urine ACR testing. Participants with ACR ≥300 mg/g or with hematuria/pyuria underwent additional testing to exclude intercurrent infection. All laboratories at the two sites ran internal quality controls daily and participated in external quality assurance programs to ensure accuracy and comparability.

Sample Size and Sampling Strategy

A total of 70 patients were recruited across both centers, with consecutive enrollment of eligible patients to minimize selection bias. The sample size was determined based on feasibility considerations during the study duration. Assuming an expected CKD prevalence of approximately 30% among diabetic patients, this sample size provided a reasonable estimate with a 95% confidence interval and a precision margin of about ±10 percentage points. The pilot nature of the study was intended to generate preliminary multicenter data that could serve as a foundation for future large-scale epidemiological studies in Pakistan.

Data Management and Quality Control

Data were entered into a secure database with predefined range and logic checks to minimize entry errors. Random double-data entry was performed on 10% of cases to verify accuracy. Laboratory values were imported electronically from the hospital laboratory systems into the study database to reduce transcription errors. Monthly monitoring visits and cross-site calibration of assays ensured standardization.

Statistical Analysis

Continuous variables were described as mean ± standard deviation (SD) or median with interquartile range (IQR) depending on data distribution, while categorical variables were presented as frequencies and percentages. The prevalence of CKD was calculated with 95% confidence intervals. The distribution of participants across KDIGO GFR and albuminuria categories was described. Associations between CKD and potential risk factors such as age, sex, duration of diabetes, HbA1c, hypertension, BMI, and use of kidney-protective medications were explored using chi-square tests or t-tests as appropriate, and multivariable logistic regression was performed to identify independent predictors. Sensitivity analyses were conducted by restricting CKD diagnosis to participants with confirmed chronicity on repeat testing. All analyses were conducted using SPSS version 28.0 and a two-tailed p-value of <0.05 was considered statistically significant.

Ethical Considerations

The study protocol was reviewed and approved by the Institutional Review Boards of Sargodha Medical College and The University of Lahore Teaching Hospital. All

participants provided written informed consent before enrollment, and confidentiality was maintained through coded identifiers. The study adhered to the principles of the Declaration of Helsinki and followed international ethical standards for research involving human participants.

RESULTS

Demographic and Clinical Characteristics of the Study Population

A total of 70 patients with type 2 diabetes mellitus (T2DM) were included in this study from Sargodha Medical College, Sargodha and The University of Lahore Teaching Hospital, Lahore, during the period June 2024 to February 2025. The mean age of participants was 55.7 ± 10.8 years, with a range between 34 and 78 years. There was a slight predominance of males (38 patients, 54.3%) compared with females (32 patients, 45.7%). Most patients belonged to the middle age group (41–60 years), which reflects the peak burden of T2DM in Pakistan.

The mean duration of diabetes was 9.2 ± 5.6 years, with almost half of the participants (n = 34, 48.6%) having diabetes for more than 10 years, and a considerable proportion (n = 18, 25.7%) reporting a duration greater than 15 years. Hypertension was the most common comorbidity, present in 46 patients (65.7%), followed by dyslipidemia in 28 patients (40.0%). Regarding lifestyle factors, 12 patients (17.1%) reported current smoking, while another 15 patients (21.4%) were former smokers. The mean body mass index (BMI) was 28.4 ± 4.3 kg/m², with 41 patients (58.6%) classified as overweight or obese (BMI ≥25 kg/m²).

Glycemic control was generally suboptimal, with the mean HbA1c recorded at 8.3 ± 1.7%. More than half of the participants (n = 39, 55.7%) had HbA1c ≥8%, reflecting inadequate control. In terms of pharmacological management, 58 patients (82.9%) were on metformin, 22 patients (31.4%) on sulfonylureas, and 21 patients (30.0%) were using insulin. Notably, only 12 patients (17.1%) were prescribed SGLT2 inhibitors, while 36 patients (51.4%) were receiving renin–angiotensin system (RAS) blockers. Microvascular complications were also common, with diabetic retinopathy documented in 14 patients (20.0%) and peripheral neuropathy in 18 patients (25.7%).

Table 1 summarizes the baseline demographic and clinical profile of the study participants.

Table 1. Baseline demographic and clinical characteristics of the study population (n=70)

Variable	Value
Age, mean ± SD (years)	55.7 ± 10.8
Age group (years), n (%)	<40: 6 (8.6%), 41–60: 44 (62.9%), >60: 20 (28.6%)
Sex, n (%)	Male: 38 (54.3%), Female: 32 (45.7%)
Duration of diabetes (years), mean ± SD	9.2 ± 5.6
Duration of diabetes ≥10 years, n (%)	34 (48.6%)
Hypertension, n (%)	46 (65.7%)
Dyslipidemia, n (%)	28 (40.0%)
Smoking (current), n (%)	12 (17.1%)
BMI (kg/m²), mean ± SD	28.4 ± 4.3
Overweight/obese (BMI ≥25), n (%)	41 (58.6%)
HbA1c (%), mean ± SD	8.3 ± 1.7
HbA1c ≥8%, n (%)	39 (55.7%)
Medications, n (%)	Metformin: 58 (82.9%), Sulfonylureas: 22 (31.4%), Insulin: 21 (30.0%), SGLT2 inhibitors: 12 (17.1%), RAS blockers: 36 (51.4%)
Diabetic retinopathy, n (%)	14 (20.0%)
Diabetic neuropathy, n (%)	18 (25.7%)

Table 1 provides an overview of the baseline characteristics of diabetic patients included in the study.

Prevalence and Staging of Chronic Kidney Disease

Out of 70 participants, 22 patients (31.4%) were found to have CKD according to KDIGO 2024 definitions, giving a prevalence of approximately one in three patients. Among these, the majority (n = 14, 63.6%) had both reduced eGFR and albuminuria, while 5 patients (22.7%) were identified solely on the basis of albuminuria (ACR ≥30 mg/g) despite preserved eGFR, highlighting the importance of urine testing in addition to serum creatinine measurement. The remaining 3 patients (13.6%) had reduced eGFR <60 mL/min/1.73 m² without significant albuminuria.

When categorized according to eGFR, 8 patients (11.4%) were in stage G3a (45–59 mL/min/1.73 m²), 6 patients (8.6%) in stage G3b (30–44 mL/min/1.73 m²), and 3 patients (4.3%) in stage G4 (15–29 mL/min/1.73 m²). No patient in this study reached stage G5 or end-stage kidney disease. Albuminuria was also prevalent, with 10 patients

(14.3%) in category A2 (30–300 mg/g) and 7 patients (10.0%) in category A3 (>300 mg/g).

Table 2 presents the prevalence of CKD and distribution of participants by KDIGO GFR and albuminuria categories.

Table 2. Prevalence and staging of CKD among diabetic patients (n=70)

Category	n (%)
CKD present (overall)	22 (31.4%)
CKD absent	48 (68.6%)
eGFR categories	
G1 (≥90) with albuminuria	5 (7.1%)
G2 (60–89) with albuminuria	2 (2.9%)
G3a (45–59)	8 (11.4%)
G3b (30–44)	6 (8.6%)
G4 (15–29)	3 (4.3%)
G5 (<15)	0 (0.0%)
Albuminuria categories	
A1 (<30 mg/g)	53 (75.7%)
A2 (30–300 mg/g)	10 (14.3%)
A3 (>300 mg/g)	7 (10.0%)

Table 2 illustrates the distribution of CKD according to KDIGO GFR and albuminuria categories.

The findings of this study demonstrate that CKD is highly prevalent among diabetic patients attending tertiary-care centers in Pakistan. Nearly one-third of the studied population exhibited evidence of kidney disease, with a significant proportion in early stages (albuminuria with preserved eGFR) that would have been missed had urine ACR not been measured. This underscores the critical importance of integrating both eGFR and albuminuria testing into routine diabetes care pathways.

The demographic data showed that patients with CKD were typically older, had a longer duration of diabetes, and were more likely to have hypertension and poor glycemic control. For example, patients with CKD had a mean age of 60.2 years compared to 53.6 years among those without CKD, and almost 70% of CKD patients had diabetes for more than 10 years. Similarly, uncontrolled HbA1c (≥8%) was observed in 72.7% of CKD patients compared to 47.9% in non-CKD patients. Hypertension was almost universal in CKD patients (86.4%), further highlighting its role as a major determinant of kidney disease progression.

These results align with previous regional and international studies reporting a CKD prevalence of around 30% in diabetic populations, reinforcing the fact that diabetic kidney disease is a major public health issue in Pakistan. The stage distribution also emphasizes that a significant fraction of patients are already in moderate-to-advanced CKD (G3a–G4), which carries substantial risks for progression to end-stage kidney disease and cardiovascular complications.

DISCUSSION

The present multicenter cross-sectional study, conducted at Sargodha Medical College and The University of Lahore Teaching Hospital, Lahore, provides valuable insights into the burden of chronic kidney disease (CKD) among adults with type 2 diabetes mellitus (T2DM) in Pakistan[12]. The findings revealed that nearly one-third (31.4%) of patients had CKD, which is consistent with earlier regional estimates, where prevalence rates have ranged between 25% and 40% depending on the diagnostic definitions and study settings. This observation emphasizes that CKD is not only a frequent complication of diabetes in Pakistan but also a neglected clinical entity that often goes undetected until late stages[7,11].

A key strength of this study lies in its use of KDIGO 2024 definitions of CKD, incorporating both estimated glomerular filtration rate (eGFR) and urine albumin–creatinine ratio (ACR). This approach highlighted an important finding: a significant subset of patients were identified solely on the basis of albuminuria despite preserved eGFR. If the evaluation had been limited to serum creatinine alone, these early-stage CKD cases would have remained unnoticed[13]. This finding mirrors international literature, which stresses that albuminuria is a sensitive early marker of glomerular injury and an independent predictor of both renal and cardiovascular outcomes. Therefore, the study underscores the urgent need to integrate urine ACR testing into routine diabetes care in Pakistan, alongside annual eGFR assessment[14].

The demographic and clinical characteristics of the CKD group further support well-established risk factors. Patients with CKD were generally older, had a longer duration of diabetes, poorer glycemic control, and a higher prevalence of hypertension. Almost 70% of CKD patients had diabetes for more than 10 years, and over 85% had coexistent hypertension[15]. These associations are biologically plausible, as prolonged exposure to hyperglycemia and elevated blood pressure accelerates microvascular and glomerular injury, leading to progressive nephron loss. The relationship between uncontrolled HbA1c and CKD in this cohort also reaffirms the central role of glycemic control in delaying the onset and progression of diabetic kidney disease[16].

In terms of treatment patterns, less than one-fifth of the study participants were receiving SGLT2 inhibitors, despite mounting evidence supporting their renal and cardiovascular protective effects. This low uptake likely reflects issues of cost, availability, and prescriber familiarity in Pakistan. Similarly, only half of the patients

were prescribed RAS blockers, although they remain a cornerstone therapy for albuminuric CKD in diabetes[17]. These gaps in pharmacological management highlight areas where national clinical guidelines and health policy interventions could make a substantial difference. Expanding access to cost-effective, kidney-protective therapies would be a rational strategy to reduce the burden of CKD and delay the need for dialysis[18].

The stage distribution of CKD observed in this study is also clinically significant. While most patients were identified in early-to-moderate stages (G1–G3), a notable proportion had already progressed to stage G4. This suggests delayed detection and limited awareness, which may be partly attributable to the lack of systematic CKD screening programs. Once patients reach advanced stages, the options for therapeutic intervention become limited, and outcomes are generally poor. This observation reinforces the call for proactive screening programs at the primary care and community level, where diabetes care is often first delivered[17,19].

Our findings align with regional and global studies. A meta-analysis of South Asian populations estimated CKD prevalence among diabetics to be around 30%, very similar to the rate observed here. Internationally, the prevalence of diabetic kidney disease ranges between 20% and 40% depending on ethnicity and healthcare infrastructure[20]. Thus, the Pakistani data fit within global trends, but the healthcare system's limited capacity to manage chronic diseases makes the consequences more severe. The economic implications are considerable: progression to dialysis or kidney transplantation is unaffordable for most families, resulting in catastrophic health expenditure and increased mortality[4,16].

This study has limitations that must be acknowledged. The sample size was relatively small (n=70), and the study was hospital-based, which may limit the generalizability of the findings to the wider community. Furthermore, while efforts were made to confirm chronicity through repeat testing and past records, not all patients had longitudinal data available, which may have led to under- or overestimation in a few cases. Despite these limitations, the study provides important pilot data that can inform larger, community-based prevalence studies and serve as a catalyst for policy discussion[12,20].

CONLUSION

In summary, this study demonstrated that CKD is highly prevalent among patients with type 2 diabetes mellitus in Pakistan, affecting nearly one in three individuals. The results highlight that many cases occur in early stages, often identifiable only by urine albumin testing rather than reduced eGFR. CKD in this population is strongly associated with older age, longer duration of diabetes, poor glycemic control, and hypertension. The underutilization of renoprotective therapies such as RAS blockers and SGLT2 inhibitors further compounds the risk of progression to advanced disease.There is an urgent need to integrate systematic CKD screening (eGFR and ACR) into routine diabetes management at all levels of care in Pakistan. Early detection, coupled with aggressive management of blood pressure and glycemic control, as well as improved access to cost-effective renoprotective medications, could substantially reduce the long-term burden of diabetic kidney disease. Future large-scale, community-based studies are warranted to confirm these findings and guide national health policy.

DECLARATION

Availability of Data and Materials
The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing Interests
The authors declare that they have no competing interests.

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Authors' Contributions
AT: Study conception, data analysis, manuscript drafting.
MY: Data collection, manuscript review.
FN: Statistical analysis, literature review.
RS: Data acquisition, proofreading.
MH & HHA: Data entry, formatting assistance.

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