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Research Article

Diabetic kidney disease in Bangladesh: a cross-sectional study on screening, treatment and prevention practice

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Abstract

Background and objectives: Diabetic kidney disease (DKD) is a leading complication of diabetes, contributing significantly to global cases of end-stage renal disease (ESRD). In Bangladesh, the rising prevalence of diabetes has made DKD a growing public health concern. An estimated 21.3% of diabetic patients in Bangladesh have some form of kidney impairment. The Diabetic Association of Bangladesh (BADAS) operates a network of healthcare centers that provide diabetes management across the country. Despite these efforts, significant gaps exist in DKD screening, patient education, and the use of renoprotective medications. This study aims to evaluate DKD in BADAS-affiliated healthcare centers, focusing on screening practices, management and patient education.

Materials and Methods: This cross-sectional study was conducted in 8 BADAS-affiliated healthcare centers, representing diverse regions of Bangladesh. A total of 320 type 2 diabetic patients were selected using multi-stage sampling methods. Data were collected using structured questionnaires which included socio-demographic characteristics, clinical histories, comorbidities, body mass index (BMI), glycemic control status, blood pressure levels, medication usage, and diagnostic criteria for DKD.Blood samples were obtained to determine serum creatinine and HbA1c levels, and spot urine samples were collected to measure the urine albumin-to-creatinine ratio (uACR).

Results: The prevalence of DKD was found to be 34.1%, with most cases in the early stages (Stage1:33% and Stage2: 45%). Screening practices were inadequate, as 52.5% of participants had never been tested for uACR or eGFR. Only 21.1% of participants with DKD were receiving renoprotective medications like ACE inhibitors or ARBs, and 35.8% were using SGLT2 inhibitors. Glycemic and blood pressure control were also suboptimal, with 81.9% of total participants having HbA1c levels ≥7% and 69.1% having uncontrolled hypertension. Of the entire study population, only 0.3% met all six prevention targets.

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***Conclusion**:* DKD is prevalent among diabetic patients in BADAS-affiliated healthcare centers, with poor screening practices and underutilization of renoprotective medications. Systematic improvements in DKD management, including enhanced screening, medication use, and patient education, are essential to prevent progression to ESRD.

Introduction

Diabetic kidney disease (DKD) is one of the most severe complications of diabetes, contributing significantly to global cases of end-stage renal disease (ESRD). It is estimated that DKD affects approximately 30-50% of diabetic patients worldwide, posing a substantial burden on healthcare systems, especially in low- and middle-income countries (LMICs) like Bangladesh [1,2]. DKD refers to the occurrence of chronic kidney disease (CKD) in individuals with diabetes. It is typically characterized by the presence of persistent albuminuria, a reduced glomerular filtration rate (GFR), and an elevated risk of cardiovascular disease [3]. The progression of DKD can be mitigated through early diagnosis and management of modifiable risk factors such as hyperglycaemia, hypertension, and lifestyle [4,5].

Bangladesh, with its rising diabetes prevalence, is facing a growing challenge of DKD. In 2021, an estimated 13.1 million people in the country were diagnosed with diabetes, and this number is projected to increase to 22.3 million by 2045 [6]. Among diabetic patients, the prevalence of DKD has been reported to be approximately 21.3%, underscoring the critical need for effective screening and management [7]. Despite the scale of this challenge, current screening protocols areinconsistent,and many healthcare facilities lack the necessary infrastructure for early diagnosis and specialized care.

The Diabetic Association of Bangladesh (BADAS) operates 133 healthcare centers, including tertiary hospitals, which provide diabetes care across the country. Of these affiliated centers 61 at the district level and 29 at the Upazila level, collectively serving a total of 3,674,407 registered patients. These centers play a vital role in DKD management, yet significant gaps exist in patient education, screening practices, and the use of renoprotective medications [8]. Systematic interventions to address these gaps could substantially improve patient outcomes and reduce the long-term burden of DKD on Bangladesh's healthcare system.

This study aimedto evaluate the prevalence and management of DKD at diabetic healthcare centers in Bangladesh, focusing on key indicators such as screening practices, medication use, and patient education. The findings wouldbe useful for improvement ofcurrent management practice in DKD care by identifying the lapses.

Material and methods

The study was conducted from May 15 to July 31, 2024.The study was approved by the institutional ethics and review board. Informed consent was obtained from all participants prior to the enrolment in the study. Data privacy and patient confidentiality were maintained.

Study place and population: This cross-sectional study was conducted across 8healthcare centers affiliated with BADAS. 1center was randomly selected from each of the 8 divisions in Bangladesh to ensure regional diversity ofthe study participants. These centers provide essential diabetes care services, with varying infrastructure in terms of diagnostic and patient care facilities. Centers offering tertiary care services were excluded. The study included 40 participants conveniently selected from each of the 8centers. The inclusion criteria were all registered type 2 diabetic patients, regardless of renal status, who had been receiving care at BADAS-affiliated centers for at least one year. Patients with kidney disease due to other causes, pregnancy, or acute illness were excluded.

Data collection tools and procedures: Data was collected using structured questionnaires which included socio-demographic characteristics, clinical histories, comorbidities, body mass index (BMI), glycemic control (measured via HbA1c), blood pressure levels, medication use, and diagnostic practices related toDKD. Blood samples were obtained to measure serum creatinine and HbA1c levels, while spot urine samples were collected to assess the urine albumin-to-creatinine ratio (uACR). All biochemical analyses were performed using

standardized procedures to ensure accuracy and reliability.

The presence of DKD was assessed by determining estimated glomerular filtration rate (eGFR) and urinary albumin creatinine ratio (uACR). Estimated glomerular filtration rate (eGFR) was calculated using the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) equation. Patients with an eGFR of less than 60 mL/min/1.73 m² and/or signs of kidney damage, indicated by albuminuria (estimated via uACR), were classified as having DKD. Single urine and blood samples were collected from each enrolled participants for estimation of eGFR and uACR.

Results

Center information and facilities: The study involved 8 healthcare centers affiliated with BADAS, all situated in urban districts. Among these centers, only 3(37.5%) offered inpatient care, while 5(62.5%) were equipped to conduct uACR tests. Half of the centers (50%) had nephrologists or endocrinologists available for consultation; the remainder depended on general practitioners. The average patient-to-doctor ratio stood at 22:1, with a range from 10 to 45 patients per doctor.

Sociodemographic characteristics: Among the 320 participants, there was a higher proportion of females (60.3%) compared to males (39.7%). The average age of the participants was 55.3 years, and majority (56.6%) was within the 41 to 60 age group. Socio-economically, 42.5% of the participants were categorized as "rich," while 17.5% were classified as "poor." Notably, a significant portion (31.3%) had no formal education. Housewives constituted the largest occupational group, comprising 52.2% of the participants (Table-1).

Table-1: *Socio-Demographic characteristics of theparticipants*

Variable	Categories	Number (%)
Age group	18 - 40 years	76 (23.8)
	41 - 60 years	181 (56.6)
	More than 60 years	63 (19.7)
Gender	Male	127 (39.7)
	Female	193 (60.3)
Socioeconomic status	Poor (<12,900 BDT/m)	56 (17.5)
	Middle class (12,900-21,500 BDT/m)	128 (40.0)
	Rich (>21,500 BDT/m)	136 (42.5)
House type	All thatched	14 (4.4)
	Tin roof	5 (1.6)
	Tin roof and wall	94 (29.4)
	Brick wall/roof/floor	93 (29.1)
	All brick	114 (35.6)
Educational status	No formal education (Illiterate/ Can sign only)	100 (31.3)
	Basic literacy (Can only read and write)	7 (2.2)
	Primary education	108 (33.7)
	Secondary education	71 (22.2)
	Higher education	34 (10.6)
Occupation	Housewife	167 (52.2)
	Business	43 (13.4)
	Service	35 (10.9)
	Farmer	26 (8.1)
	Driver	6 (1.9)
	Teacher	10 (3.1)
	Other (various)	33 (10.3)

Note: BDT: Bangladesh Taka

Clinical characteristics and comorbidities: The average duration of diabetes among participants was 8.61 years, and for hypertension, it was 6.83 years. Hypertension was the most common comorbidity, affecting 37.8% of participants, followed by peripheral neuropathy, which was observed in 37.2%of cases. Diabetic retinopathy was present in 35.6% of participants, and smaller proportions had ischemic heart disease (12.2%) or chronic kidney disease (4.4%) (Table-2).

Table-2: *Prevalence of comorbidities amongthe study participants*

Comorbidity	Yes n (%)	Don't Know n (%)
Hypertension (HTN)	121 (37.8)	9 (2.8)
Chronic kidney disease	14 (4.4)	15 (4.7)
Ischemic heart disease	39 (12.2)	15 (4.7)
Diabetic retinopathy	114 (35.6)	7 (2.2)
Stroke	16 (5.0)	5 (1.6)
Peripheral neuropathy	119 (37.2)	10 (3.1)

Lifestyle factors and risk behaviours: The analysis of lifestyle factors revealed that 9.4% of participants were current smokers, while 14.4% used smokeless tobacco. Alcohol consumption was rare, with only 1 participant (0.3%) currently using alcohol and 6 (1.9%) were past users.

Anthropometric measurements, blood pressure and glycemic status: Detail anthropometric, blood pressure and glycemic status of study participants are shown in Table-3 and 4. The mean BMI of participants was 25.23 ± 4.75 kg/m², with 47.5% classified as obese and 21.6% as overweight. Obesity is a significant risk factor, contributing to both poor blood pressure and glycemic control. Nearly half of the participants were obese, which likely exacerbates the suboptimal control observed.Blood pressure control was inadequate, with 221 participants (69.1%) having uncontrolled hypertension (BP ≥130/80 mm Hg). Among those not previously diagnosed with hypertension, 63.3% (126 out of 199) had uncontrolled BP, indicating possible undiagnosed cases. The issue was more pronounced among known hypertensive individuals, with 78.5% (95 out of 121) unable to control their BP.

Glycemic control was similarly suboptimal. Only 57 participants (17.9%) had optimal glycemic control (HbA1c<7%). The majority, 262 participants (82.1%), had elevated HbA1c levels (≥7%), with 100 participants (31.3%) having severe hyperglycemia (HbA1c >10%). The mean HbA1c was 9.33 ± 2.35% for males and 9.11 ± 2.22% for females.

Table-3: *Mean anthropometric and blood pressure status of the total study participants (n=320)*

Parameter/Variable	Mean ± SD
Anthropometric measurements	
Height (m)	1.55 ± 0.10
Weight (kg)	60.66 ± 11.26
BMI (kg/m²)	25.23 ± 4.75
Blood pressure	
Systolic BP (mmHg)	121.7 ± 14.88
Diastolic BP (mmHg)	77.24 ± 9.24

Table-4: *Anthropometric, blood pressure and glycemic status of the study participants (n=320)*

Parameter/Variable	Number (%)
BMI categories	
Underweight (BMI <18.5)	10 (3.1)
Normal (BMI 18.5–22.9)	89 (27.8)
Overweight (BMI 23–24.9)	69 (21.6)
Obese (BMI ≥25)	152 (47.5)
Uncontrolled BP (≥130/80 mmHg)	
All study subjects(n=320)	221 (69.1)
Known hypertensive(n=121)	95 (78.5)
Not known hypertensive(n=199)	126 (63.3)
Glycemic status(n=319) *	
HbA1c levels < 7%	57 (17.9)
HbA1c levels 7-7.99%	51 (16.0)
HbA1c levels 8-10%	111 (34.8)
HbA1c levels > 10%	100 (31.3)

**One sample was damaged during processing for HbA1c*

Prevalence and staging of diabetic kidney disease (DKD): Out of 320 study participants, 109 (34.1%) had DKD, based on either a reduced eGFR or elevated uACR (Table-5). Of these, 24 individuals(7.5%) had a reduced eGFR, 102 (31.9%)

Table-5: *Levels of uACR, eGFR, and CKD stages of in the study population*

Variables	n (%)	Mean uACR ± SD (mg/gm)	Mean eGFR ± SD ml/min/1.73 m²
Gender			
Male	127 (39.7)	61.96 ± 131.78	85.87 ± 19.22
Female	193 (60.3)	106.11 ± 299.58	90.68 ± 21.83
Total	320 (100)	88.59 ± 247.68	88.77 ± 20.94
Staging of CKD cases			
Stage 1	36 (33)		
Stage 2	49 (45)		
Stage 3	20 (18.3)	--	--
Stage 4	3 (2.8)		
Stage 5	1 (0.9)		
Total DKD cases	**109 (34.1)**		

had an elevated uACR while 17 (5.31%) exhibited both a reduced eGFR and elevated uACR. The majority of cases (n=85, 78%) were in the early stages of CKD (Stages 1 and 2), underscoring the critical need for early detection and timely intervention.

Management of diabetes and screening practicesfor hypertension and DKD: The study revealed significant gaps in the screening and management of diabetes, hypertension, and diabetic kidney disease (DKD) among the 320 participants. Only 18.8% had undergone HbA1c testing in the past year, and 62.8% were unaware of their blood pressure status.

DKD screening was similarly inadequate. Of the total participants, 52.5% had never been tested for DKD. Among those who had been screened, only 48% received annual tests. Serum creatinine testing was notably underutilized, with just 3.4% of participants having undergone this diagnostic test, and none had been tested for eGFR or 24-hour urine protein. Of the 109 individuals diagnosed with chronic kidney disease (CKD) in the study, only 14 were previously aware of their condition, highlighting a significant gap in DKD screening. Furthermore, 42.9% of these 14 CKD patients were not under nephrology care, indicating limited access to specialized services and underscoring the need for improved screening and referral systems.

Medication and management practices: Out of 320 participants, 208 (65%) were using anti-diabetic medications. There was notable underutilization of renoprotective therapies. Only 21.1% of DKD patients were prescribed ACE inhibitors or ARBs, and 35.8% were using SGLT2 inhibitors, both of which were essential for reducing proteinuria and slowing CKD progression. Additionally, despite the critical role of statins in managing cholesterol and reducing cardiovascular risks, only 27.5% of the CKD population were on statins. In contrast, known DKD patients had higher rates of ACE inhibitor/ARB (64.3%) and statin (57.1%) use (Table-6).

Patient knowledge about DKD: Table-7 shows the overallknowledge and knowledge acquired from the diabetes healthcare centers of the study participantsaboutDKD. The knowledge was generally low, despite 83.75% recognizing that diabetes can harm the kidneys. Only 41.56% recognized the importance of urine albumin testing, and just 30% were aware that frothy urine might indicate kidney damage. Knowledge of critical DKD risk factors, such as high blood pressure and poorly controlled blood sugar, was also suboptimal. Notably, most participantsregardless of their knowledge levelacquired their information from healthcare centers, highlighting the essential role these centers play in patient education. This suggests that enhancing the availability and quality of information provided at these centers could significantly improve patients' overall understanding of DKD (Table-7).

Table-6: *Medication use by the study populations*

Medication	Study population(n=320) n (%)	Total DKD population (n=109) n (%)	Known DKD population(n=14) n (%)
Anti-diabetic medications	**208 (65)**		
Insulin	153 (47.8)	70 (64.2)	9 (64.3)
Metformin	179 (55.9)	53 (48.6)	7 (50.0)
Gliptin	204 (63.7)	70 (64.2)	9 (64.3)
Sulfonylurea	105 (32.8)	29 (26.6)	4 (28.6)
GLP-1 Agonist	2 (0.6)	1 (0.9)	1 (7.1)
Antihypertensive medications	176 (55)		
CCB	49 (15.3)	18 (16.5)	6 (42.9)
Non-dihydro CCB	3 (0.9)	2 (1.8)	0 (0.0)
Betablocker	26 (8.1)	11 (10.1)	5 (35.7)
Alpha adrenergic blocker	4 (1.3)	2 (1.8)	0 (0.0)
Thiazides	2 (0.6)	0 (0)	0 (0.0)
Loop diuretics	5 (1.6)	0 (0)	1 (7.1)
Anti-proteinuric medications	96 (30)		
SGLT2i	118 (36.9)	39 (35.8)	6 (42.9)
ACE Inhibitors or ARBs	63 (19.7)	23 (21.1)	9 (64.3)
Anti-lipid medications	77 (24)		
Statins	74 (23.1)	30 (27.5)	8 (57.1)
Fibrate	3 (0.9)	1 (0.9)	0

Note: CCB= Calcium channel blockers, GLP-1 Agonist =Glucagon-like peptide-1 receptor agonists

Table-7: *Knowledge of DKD among the study participants (n=320)*

Question	Overall positive response n (%)	Knowledge from Center n (%)
Diabetes can damage the kidneys.	268 (83.8)	252 (78.8)
Swelling in the ankles and legs can be a symptom of DKD.	223 (69.7)	203 (63.4)
Increased urination, especially at night, can be a symptom of DKD.	207 (64.7)	190 (59.4)
Frothy urine, indicating protein leakage, as a symptom of DKD.	96 (30)	79 (24.7)
A simple urine test (urine albumin) can detect DKD.	133 (41.6)	123 (38.4)
High blood pressure increases the risk of DKD.	166 (51.9)	161 (50.3)
Poorly controlled blood sugar increases the risk of DKD.	186 (58.1)	179 (55.9)
Family history increases the risk of DKD.	150 (46.9)	135 (42.2)
DKD increases the risk of heart disease.	170 (53.1)	156 (48.8)
DKD can lead to high blood pressure.	147 (45.94)	142 (44.4)
DKD can cause ESRD requiring dialysis.	168 (52.5)	151 (47.2)
Proper blood glucose control can DKD.	161 (50.3)	158 (49.4)
Controlling blood pressure helps manage DKD.	160 (50)	156 (48.8)
Exercise and diet help manage DKD.	245 (76.6)	243 (75.9)
Maintaining normal weight helps prevent DKD.	242 (75.6)	237 (74.1)

The analysis of the knowledge state of 14 known DKD patients revealed that 85.7% were aware of their disease stage and expressed satisfaction with the healthcare information provided. Of them, 64.3% had received education on DKD management, including diabetes control (91.7%) and blood pressure management (83.3%). Gaps were noted in areas such as cholesterol control (58.3%) and protein intake (50%). Awareness of key DKD risk factors, such as uncontrolled diabetes (85.7%) and high blood pressure (71.4%), was relatively high. However, fewer patients were knowledgeable about glucose control targets (30%) and lipid goals (20%). Despite this reasonable level of awareness, only 40% adhered to management guidelines, with 57.1% citing financial barriers as a significant obstacle. Overall, 85.7% of the DKD patients expressed satisfaction with the healthcare services offered by the centers.

DKD prevention targets: In this study, a strikingly low percentage of participants achieved the recommended targets for the prevention of DKD (Table-8). Among the entire study population, only 0.3% met all six prevention targets, which included glycemic control, blood pressure control, weight management, tobacco avoidance, and the use of renoprotective medications (ACE inhibitors/ARBs) and statins. This gap was even more pronounced among the individuals with DKD, where none of the participants achieved all prevention targets, underscoring significant shortcomings in managing DKD risk factors.

Table-8: *Gap in the DKD prevention targets in total and DKD populations*

Variable	Study Population (N=320)	TotalDKD Population (N=109)	Known DKD Population (N=14)
HbA1c High	262 (81.9)	97 (89)	11 (78.6)
Uncontrolled BP	221 (69.1)	79 (72.5)	10 (71.4)
High BMI	221 (69.1)	74 (67.9)	10 (71.4)
Any Form of Tobacco	67 (20.9)	27 (24.8)	8 (57.1)
Not Taking ACE Inhibitors/ARBs	257 (80.3)	86 (78.9)	5 (35.7)
Not Taking Statins	246 (76.9)	79 (72.5)	6 (42.9)
Target Achievement			
All targets achieved	1 (0.3)	None	None
5 targets achieved	2 (0.6)	None	None
4 targets achieved	26 (8.1)	10 (9.2)	2 (14.3)
3 targets achieved	67 (20.9)	17 (15.6)	5 (35.7)
2 targets achieved	113 (35.3)	43 (39.4)	4 (28.6)
1 target achieved	99 (30.9)	35 (32.1)	3 (21.4)
No target achieved	12 (3.8)	4 (3.7)	None

Discussion

This study highlights the high prevalence of DKD in patients attending BADAS-affiliated diabetes healthcare centers in Bangladesh and underscores critical gaps in its management. The prevalence of DKD in this population, approximately 34.1%, is notably higher than previously reported estimates from similar studies in Bangladesh, which ranged around 21.3% [7]. This difference may reflect the growing burden of diabetes in Bangladesh, which is projected to rise sharply in the coming decades, with an estimated 22.3 million cases by 2045 [6]. Also, in the present study, DKD was diagnosed based on a single estimation of uACR and eGFR, which might have led to an overestimation of the prevalence of DKD. Future studies should incorporate repeated measures of uACR and eGFR to confirm the diagnoses of DKD.

One of the key findings of this study is the suboptimal screening for DKD, with more than half of the participants never have undergone proper testing, such as uACR or eGFR assessments. This highlights a significant barrier to early diagnosis of DKD and timely intervention. Previous research has shown that early detection of DKD can substantially slow the disease progression and improve patient outcomes [6]. Current international guidelines recommend routine screening for albuminuria and eGFR in diabetic patients, but these practices remain inconsistent in many low-resource settings, including Bangladesh [9,10].

The present study also found that management practices of diabetes, hypertension and DKD were inadequate, with poor glycemic and blood pressure control among the majority of thepatients. These findings highlight significant gaps in hypertension management and glycemic control, further exacerbated by the high prevalence of obesity. Addressing these issues with aggressive interventions is essential to improving patient outcomes and preventing DKD.Only 19.7% of participants were using renoprotective medications such as ACE inhibitors or ARBs, despite their proven efficacy in slowing DKD progression. Recent advances in pharmacotherapy, such as use of SGLT2 inhibitors and non-steroidal mineralocorticoid receptor antagonists (NS-MRAs), have shown additional benefits in preserving renal function, yet their use remains limited due to cost and accessibility [11,12]. This underutilization of evidence-based therapies is a significant concern, as proper medication can substantially reduce the risk of progression to ESRD [1].

Lifestyle factors, including tobacco use and obesity, were also prevalent in the study population, further contributing to the risk of DKD progression. The findings suggest that greater emphasis on lifestyle interventions, such as smoking cessation and weight management, is needed to complement pharmacological treatments [13-16]. The relatively low levels of patient education on DKD symptoms and management also indicate the need for enhanced educational programs to improve disease awareness and self-care practices [17].

In conclusion, this study underscores the urgent need for systematic improvements in the screening, management, and education of DKD patients in Bangladesh. Enhancing access to renoprotective medications, implementing routine screening protocols, and providing comprehensive patient education are critical steps toward addressing the growing burden of DKD in the country. Future efforts should focus on overcoming the barriers to care, such as availability of diabetes care centers and cost, to ensure that all diabetic patients receive the necessary interventions to slow the progression of DKD and improve their quality of life.

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Conflict of Interest

The authors have no conflicts of interest to declare. The funding bodies had no role in the design of the study, data collection, analysis, interpretation, or in the decision to publish the results

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