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ORIGINAL ARTICLE

Chronic kidney disease and risk factors among Type 2 Diabetic patients in selected hospitals in Dhaka, Bangladesh

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Abstract

Chronic kidney disease (CKD) may be defined as abnormalities of kidney function or structure present for more than 3 months. Around 10% of people worldwide have CKD. The data about chronic kidney disease among diabetics in Bangladesh is inadequate, and very few studies have been done on specific populations, i.e., male or female. Thus, the study aims to determine the prevalence of CKD and its risk factors among diabetic patients in selected hospitals in Dhaka city. The specific objectives of the study were to assess the participants through physical and laboratory evaluations, categorize them into the different stages of CKD, analyze their socio-demographic characteristics, and determine the association between CKD and various risk factors. This is a cross-sectional study. The study population consisted of different outpatient diagnostic centers and outpatient and indoor patients of Shaheed Suhrawardy Medical College and Hospital. The sample size of the study is 369. The Modification of Diet in Renal Disease equation was used to calculate eGFR. This study revealed that in Dhaka, 18.2% of Type 2 Diabetic patients had CKD. Most of the participants were between 46 and 65years old. Most of the CKD patients had a low education level and a lower family income. Having diabetes for more than 3 years and hypertension for more than 5 years were associated with a higher risk of developing CKD, especially among individuals who consumed added salt in their diet.

Keywords: Chronic kidney disease, type 2 diabetes, hypertension, dyslipidemia, salt intake, body mass index

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Introduction

The term "chronic kidney disease" (CKD) refers to abnormalities of the kidney's structure or function that persist for longer than three months and impact health. This includes individuals with kidney damage markers as well as those who, with or without kidney damage signs, have a glomerular filtration rate (GFR) of less than 60 ml/min/1.73 m^2 on at least two occasions separated by at least 90 days [1]. Chances of having CKD increase with age; it increases after age 50 years and is most common among adults older than 70 years [2]. Around 10% of people globally suffer from CKD, and millions of people lose their lives to the condition every year due to a lack of access to affordable treatment [3]. Data from hospital, urban and underprivileged population-based studies suggest that there is a CKD prevalence of 16-18% in Bangladesh; of them, 11% belong to stage-III and above [4]. The cause of chronic kidney disease is in some cases not known; it is referred to as chronic kidney disease of unknown etiology (CKDu). As of 2020 a rapidly progressive chronic kidney disease, unexplained by diabetes and hypertension, had increased dramatically in prevalence over a few decades in several regions in Central America and Mexico, a CKD referred to as the Mesoamerican nephropathy (MeN) [5].

About 10% of the global population is affected by CKD, and millions die each year because they do not have access to affordable treatment. According to the 2010 Global Burden of Disease study, chronic kidney disease was ranked 27th in the list of causes of total number of deaths worldwide in 1990 but rose to 18th in 2010 [6]. Chronic kidney disease resulted in 956,000 deaths in 2013 up from 409,000 deaths in 1990. From 409,000 deaths in 1990 to 956,000 deaths in 2013, chronic kidney disease was the cause of mortality. The only conditions on the list with a greater degree of movement up were HIV and AIDS. Currently, over 2 million people worldwide receive treatment for chronic kidney disease, yet this may only account for 10% of those who require medical attention [7]. According to analysis of another study, 4.1% of the individuals had diabetes, 11.6% had hypertension, and 7.7% had proteinuria. Among them, about 13.1% of participants were found to have chronic kidney disease (CKD) based on the MDRD equation, whereas 16% were found to have CKD based on the Cockcroft-Gault equation [8]. Another study done in Bangladesh among healthcare provider found that the prevalence of chronic kidney disease was 9.9% according to Cockcroft-Gault (C-G) equation and 7.2% according to modification of diet in renal disease (MDRD) study equation [9]. Most of them were in stage 1-3 (7.9% in CG; 7.2% in MDRD). Among CKD patients, physicians were found to be at lower risk (39.3%) of developing CKD than other occupants working in the same hospital. Participants with lower income, <30,000 taka/month (68.8%) were also observed to be significantly associated with CKD. Approximately 17.3% were hypertensive; 4.5% were diabetic and 2.9% were proteinuria. Individuals older than 40 years (76.9%) and females (51.9%) were significantly prone to develop CKD. The risk factors like Type 2 Diabetes, hypertension (HTN) and combined diabetes and hypertension were demonstrated to be significantly associated with CKD. Another study was done to evaluate the management of End Stage Renal Disease-Bangladesh Perspective [4]. It is evident that although 415 million people globally have diabetes, including 78 million in the SEA Region, and there were 7.1 million cases of diabetes in Bangladesh in 2015 [10], very few studies among CKD patients suffering from diabetes have been conducted in Bangladesh. However, some isolated studies on CKD have been done. For example, between July 2003 and June 2005, a cross-sectional survey was conducted in selected slum neighborhoods of Mirpur, Dhaka, Bangladesh. The participants' age range was 15 to 65. [8].

Overall, the data about CKD among diabetics in Bangladesh is inadequate, and very few studies have been conducted on specific population groups, such as males or females. Therefore, the study was carried out to determine the prevalence of chronic kidney disease among Type 2 Diabetic patients in Bangladesh.

Materials and Methods

The study was a cross-sectional study done among 369 diabetic patients under 30 years old from different outpatient diagnostic centers (e.g. LABAID diagnostic, ALOK diagnostic, POPULAR diagnostics diagnostic etc.) and outpatient and indoor patients of Shaheed Suhrawardy Medical College and Hospital. Primary data were collected by a semi-structured pre-tested questionnaire, face to face interview. Secondary data were collected by documented past medical record analysis. In situations where the patient was unable to communicate with the interviewer, the interview of the patient's attendance was considered instead. All possible measures were taken to maintain good quality of the data for the study. Statistical analysis was performed using SPSS version 16 (IBM Corp., Armonk, NY, USA). The analyzed data were presented in tables, graphs and charts. All data were expressed as the frequency, percentage, median and mean ± SD. Chi-square test was conducted to assess the relationship between selected variables. A significant level of 0.05 was considered as proper and thus *p*-values of less than 0.05 was considered statistically significant. Data analysis was also conducted using Numbers (Apple Inc., Cupertino, CA, USA) on the macOS X operating system. eGFR and stages of the CKD were done using MDRD formula: eGFR is estimated GFR calculated by the abbreviated MDRD equation: 186 x (Creatinine/88.4)-1.154 x (Age)-0.203 x (0.742 if female) x (1.210 if black). BMI (body mass index) = weight in kilograms / (height in meter)^2 , BUN Creatinine ratio=BUN/ serum creatinine ("eGFR Calculator," 2000).

The ethical clearance was obtained from the Ethical review committee of BUHS on 20.08.2020 and memo no: BUHS/ERC/EA/20/253. All participants who voluntarily consented were included in the study, and all personal information was kept confidential, with privacy respected.

Results

Table 1 shows that 40% of the total population was male, and 59.1% was female. Most of the study subjects were married (79.1%), while 20.6% were widowed, and 0.3% was unmarried. Among different educational levels, JSC was 38.8%, no-education was 32.2%, SSC was 11.9%, HSC was 11.1%, and degree was 6.0%. In the case of profession of the participants, it was observed that 39.8% of patients' professions were in the others or prefers not to say category, 37.9% were in private service, 8.9% were in business, 7.9% were in government service, and day labor was 5.4%. Among the participants, patients earning less than 15,000 Taka (approximately 125 USD) comprised 45.0% (n=166), those earning between 15,000–30,000 Taka (approximately 125–251 USD) made up 34.1% (n=126), participants earning between 30,001–45,000 Taka (approximately 251–376 USD) accounted for 19.5% (n=72), those earning between 45,001–60,000 Taka (approximately 376–502 USD) were 1.1% (n=4), and only 1 participant (0.3%) reported an income above 60,000 Taka (approximately 502 USD). The income brackets were chosen to represent a wide range of economic conditions, reflecting the diversity of the population. The 30,000- and 60,000-Taka thresholds were not based on official poverty or wealth limits but were selected to categorize participants into relevant socioeconomic groups for analysis.

Table 2 shows that participants' urinary ACR levels were found to be normal (10-29) in 53.4%, microalbuminuria (30-299) in 40.4%, and gross proteinuria (≥300) in 6.2%. The mean ± SD was 115 ± 156.28. 18.2% of patients had serum creatinine levels above 1.4, while 81.2% had levels less than or equal to 1.4. The mean ± SD was 1.5 ± 1. Among study participants, eGFR Stage 1 was found in 8.1%, Stage 2 in 37.4%, Stage 3A in 30.6%, Stage 3B in 8.7%, Stage 4 in 6.8%, and Stage 5 in 8.4% of patients. The mean ± SD was 57.59 ± 25.82. Normal serum albumin (3.4-4.5) was observed in 73.7% of patients, while low serum albumin (<3.4) was seen in 26.3%, with a mean ± SD of 4.13 ± 0.9. Normal serum potassium (3.5-5.5) was found in 65.9%, low serum potassium (<3.5) in 21.4%, and high serum potassium (>5.5) in 12.7% of patients, with a mean ± SD of 4.2 ± 0.8. Normal

BUN (7-20) was found in 18.2% of patients, while high BUN (>20) was observed in 81.8%, with a mean ± SD of 24.87 ± 27.73.

Table 3 shows that 81.8% of patients had no history of CKD, while 18.2% had a family history of CKD. Additionally, 46.6% of patients had hypertension for less than 5 years or were within normal limits, whereas 53.4% had hypertension for 5 years or more. Among the study participants, 1.4% were underweight (BMI <18.5), 19.5% had a normal BMI (18.5–24.9), and 79.1% were overweight (BMI >25). It was found that 99.2% of patients had no history of alcohol intake, while 0.8% did. Furthermore, 82.1% of patients had Type 2 Diabetes for 3 years or more, while 17.9% had the condition for less than 3 years. Regarding smoking, 65.3% had no history of smoking, while 34.7% did. Additionally, 48.2% of patients had abnormal bladder and bowel habits, while 51.8% had normal habits. Lastly, 68.6% of patients had no history of healthy food intake, while 31.4% reported a history of healthy food intake.

Table 4 shows that 16.6% (25 out of 176) of male and 19.3% (42 out of 126) of female participants had CKD. However, gender did not have a statistically significant effect on the prevalence of CKD ($\chi^2=0.44$, $p=0.507$). Additionally, 16.4% (48 out of 292) of married participants and 25% (19 out of 76) of widowed participants had CKD, while none of the unmarried participants had CKD. Marital status also did not show any significant association with CKD presence ($\chi^2=3.2$, $p=0.202$). Regarding education, it was found that 38.8% (143) had JSC, 32.2% (119) had no education, 11.9% (44) had SSC, 11.1% (41) had HSC, and 6.0% (22) had a degree. Education level showed a significant association with CKD presence ($\chi^2=17.93$, $p=0.001$), with the HSC group at higher risk, as 22% of this group had CKD,

Table 1. Distribution of respondents according to the socio-demographic status (n=369).

Variable	Frequency	Percentage
Sex		
Male	151	40.9
Female	218	59.1
Total	**369**	**100**
Marital status		
Married	292	79.1
Unmarried	1	0.3
widowed	76	20.6
Total	**369**	**100**
Educational level of the respondents		
Degree	22	6
HSC	41	11.1
SSC	44	11.9
JSC	143	38.8
No education	119	32.2
Total	**369**	**100**
Profession		
Business	33	8.9
Day labor	20	5.4
Govt. service	29	7.9
Others or prefers not to say	147	39.8
Private service	140	37.9
Total	**369**	**100**
Family income	**Mean±SD: 21111±12661**	
Residence		
Rural	94	25.5
Slum	67	18.1
Urban	208	56.4
Total	**369**	**100**
Living Area		
Building	200	54.2
Tin shed	169	45.8
Total	**369**	**100**

Table 2. Distribution of respondents according to the laboratory assessment (n=369).

Variables	Frequency	Percentage
Urinary ACR (mg/gm)		
Normal (10-29)	197	53.4
Microalbuminuria (30-299)	149	40.4
Gross proteinuria (>=300)	23	6.2
Mean±SD: 115±156.28		
Total	**369**	**100**
Serum creatinine(mg/dl)		
Normal (<=1.4)	302	81.8
>1.4	67	18.2
Mean±SD: 1.5±1		
Total	**369**	**100**
eGFR(ml/min)		
Stage 1	30	8.1
Stage 2	138	37.4
Stage 3A	113	30.6
Stage 3B	32	8.7
Stage 4	25	6.8
Stage 5	31	8.4
Mean±SD: 57.59±25.82		
Total	**369**	**100**
Serum Albumin(gm/dl)		
Normal (3.4-4.5)	272	73.7
Low (<3.4)	97	26.3
Mean±SD: 4.13±0.9		
Total	**369**	**100**
Serum potassium (mEq/l)		
Normal (3.5-5.5)	243	65.9
Low (<3.5)	79	21.4
High (>5.5)	47	12.7
Mean±SD: 4.2±0.8		
Total	**369**	**100**
BUN (mg/dl)		
Normal (7-20)	67	18.2
High (>20)	302	81.8
Mean±SD: 24.87±27.73		
Total	**369**	**100**
Bicarbonate (HCO3) (mEq/l)		
10-20	67	18.2
21-25	90	24.4
26-30	212	57.5
Mean±SD: 25.11±3.31		
Calcium (mg/dl)		
Normal (8.5-10.5)	306	82.9
Low (<8.5)	63	17.1
High (>10)	33	8.9
Mean±SD: 9.3±0.7		
Total	**369**	**100**
HbAIC		
6-9	70	19
9.1-12	272	73.7
>12.1	27	7.3
Mean± SD: 10.01±1.87		

Table 2. (continued) Distribution of respondents according to the laboratory assessment (n=369).

Total	**369**	**100**
iPTH (pg/ml)		
Normal (10-65)	308	83.5
High (>65)	61	16.5
Mean± SD: 58±26.5		
Total	**369**	**100**
LDL (mg/dl)		
Norma l(<130)	110	29.8
High (>=130)	259	70.2
Mean± SD: 145±25		
Total	**369**	**100**
HDL (mg/dl)		
Normal	77	20.9
Low	292	79.1
Mean± SD: 40.85±3.45		
Total	**369**	**100**
TG (mg/dl)		
Normal (<150)	19	5.1
High (>=150)	350	94.9
Mean± SD: 288.66±90.65		
Total	**369**	**100**

Table 3. Distribution of respondents according to the risk factor (n=369).

Variables	Frequency	Percentage (%)
Family History of CKD		
No	302	81.8
Yes	67	18.2
Total	**369**	**100**
Duration of HTN (Years)		
< 5 years or normal	172	46.6
5 or more years	197	53.4
Total	**369**	**100**
BMI		
Underweight (<18.5)	5	1.4
Normal (18.5-24.9)	72	19.5
Overweight (>25)	292	79.1
Total	**369**	**100**
Alcohol Intake		
No	366	99.2
Yes	3	.8
Total	**369**	**100**
Duration of Diabetes (Years)		
>3 years	303	82.1
< 3 years	66	17.9
Total	**369**	**100**
Smoking		
No	241	65.3
Yes	128	34.7
Total	**369**	**100**
Bladder bowel habit		
Abnormal	178	48.2
Normal	191	51.8
Total	**369**	**100**

compared to 20.5% in the SSC group, 14.7% in the JSC group, and 14.3% in the no-education group. Profession did not have any significant association with CKD status (χ^2=2.27, p=0.687), with 39.8% of patients falling under 'others or prefers not to say,' 37.9% in private service, 8.9% in business, 7.9% in government service, and 5.4% in day labor. It was also observed that 17% of rural respondents and 24.5% of urban respondents had CKD. From Table 4, it was noted that 30.5% of CKD patients were from buildings, while only 3.6% were from tin sheds.

Table 5 shows the following association between CKD status and variables regarding risk factors: Family history of CKD was negative in 15.9% of participants and positive in 18.4%. Family history of CKD was associated with CKD (χ^2=5.73, p=0.022). In terms of hypertension, 7% of patients had hypertension for less than 5 years or no history of hypertension, while 27.9% had hypertension for more than 5 years. There was a very strong association between the duration of hypertension and CKD (χ^2=27.0, p=0.000). A strong association was also found between BMI and CKD (χ^2=14.44, p=0.001). Alcohol intake was rare, with 99.2% of patients having no history of alcohol consumption, but there was no significant association between alcohol intake and CKD (χ^2=0.47, p=0.453). Regarding diabetes, 82.1% of patients had Type 2 Diabetes for more than 3 years, and 17.9% had it for less than 3 years. There was a strong association between the duration of diabetes and CKD (χ^2=6.01, p=0.013). Smoking was reported by 34.7% of participants, but no association was found between smoking and CKD (χ^2=0.005, p=0.95). The study also found that 9.6% of CKD patients did not take added salt, compared to 23.2% who did. Bladder and bowel habits showed a very strong association with CKD (χ^2=15.74,

Table 4. Association between socio-demographic variables and CKD status (n=369).

Variables	**CKD status %**		**χ2**	***p* value**
	CKD present	**CKD absent**		
Gender				
Male	16.6	83.4	0.44	0.507
Female	19.3	80.7		
Marital Statius				
Married	16.4	83.6	3.2	0.202
Unmarried	0	1		
Widowed	25	75		
Educational Status				
Degree	50	50	17.93	**0.001**
HSC	22	78		
SSC	20.5	79.5		
JSC	14.7	85.3		
No education	14.3	85.7		
Profession				
Business	24.2	75.8	2.27	0.687
Day labor	15	85		
Govt	20.7	79.3		
Others or prefers not to say	19.7	80.3		
Private	15	85		
Residence				
Rural	17	83	20.61	**0.000**
Slum	0	67		
Urban	24.5	75.5		
Living Area				
Building	30.5	69.5	44.77	**0.000**
Tin shed	3.6	96.4		

p=0.000), while healthy food intake did not show any significant association with CKD status (χ^2=0.095, *p*=0.757).

Figure 1 shows that 18.16% (67 out of 369) of study participants had CKD (chronic kidney disease). Figure 2 shows that among the study participants, eGFR Stage 1 was found in 30 (8.1%), Stage 2 in 138 (37.4%), Stage 3A in 113 (30.6%), Stage 3B in 32 (8.7%), Stage 4 in 25 (6.8%), and Stage 5 in 31 (8.4%) patients.

Discussion

According to the study, 18.2% of patients with Type 2 Diabetes were found to have CKD, which is consistent with a similar study conducted in Ethiopia [11]. The research was carried out in urban, rural, and slum areas, with 369 participants, approximately 59.1% of whom were female and 40% male. Statistical analysis (χ^2=0.44, *p*=0.507) indicated that gender did not have a statistically significant impact on the prevalence of CKD. This finding aligns with a study conducted in northern Thailand, where the gender distribution was similar, with the majority of patients being female (57.1%), and no significant association between gender and CKD prevalence among Type 2 Diabetes mellitus (T2DM) patients. The unadjusted CKD prevalence was 24.5% for males and 24.3% for females, with a *p*-value of 0.943, indicating no significant difference [12].

Elderly individuals were found to be more susceptible to CKD, as over half of the participants were aged 46–65. This is consistent with a related

Table 5. Association between CKD status & Risk factors (n=369).

Variables	CKD status %		χ2	*p* value
	CKD present	CKD absent		
Family History of CKD				
No	15.9	84.1	5.73	**0.022**
Yes	18.4	81.6		
Duration of HTN in Years				
< 5 years or normal	7	93	27.0	**0.000**
5 or more years	27.9	72.1		
BMI				
Underweight (<18.5)	80	20	14.44	**0.001**
Normal (18.5-24.9)	12.5	87.5		
Overweight (>=25)	18.5	81.5		
Alcohol Intake				
No	18	82	0.47	0.453
Yes	33.3	66.7		
Duration of Diabetes in Years				
>3years	20.5	79.5	6.01	**0.013**
< 3years	7.6	82.4		
Smoking				
No	18.3	81.7	0.005	0.95
Yes	18	82		
Salt Intake				
No	9.6	90.4	10.72	**0.001**
Yes	23.2	76.8		
Bladder bowel habit				
Abnormal	26.4	73.6	15.74	**0.000**
Normal	10.5	89.5		
Healthy food intake				
No	18.6	81.4	0.095	0.757
Yes	17.2	82.8		

Ethiopian study, where participants had a mean age of 45 ± 14.5 years [11]. Elderly patients (>65 years) with T2DM showed a similar trend, with CKD prevalence rates of 40.5% in one study and 56.1% at the national level in Thailand [13].

The study provides important insights into participants' blood pressure, with mean diastolic blood pressure (DBP) readings of 91.98 ± 14.77 mmHg and systolic blood pressure (SBP) readings of 145.01 ± 26.27 mmHg. In contrast, a study conducted in Thailand reported different average blood pressure readings, with a mean DBP of 77.6 ± 11.1 mmHg and mean SBP of 132.4 ± 18.2 mmHg. These variations underscore the potential influence of demographic, cultural, or regional factors on cardiovascular health markers [12].

An important new finding is the relationship between albumin-to-creatinine ratio (ACR) levels and CKD, as evidenced by participants' urine ACR levels. Among the individuals, 40.4% had microalbuminuria (30–299), 6.2% had large

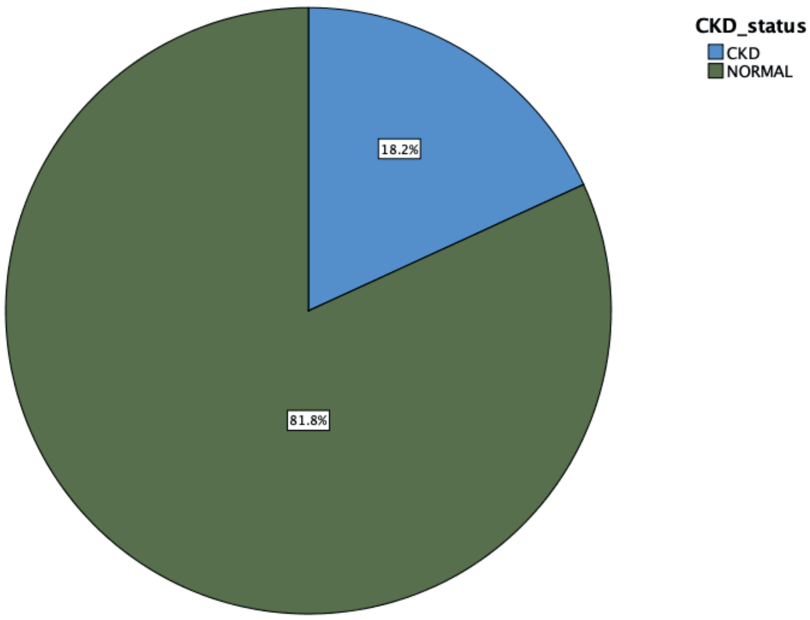

Figure 1. Distribution of respondents according to the prevalence of CKD.

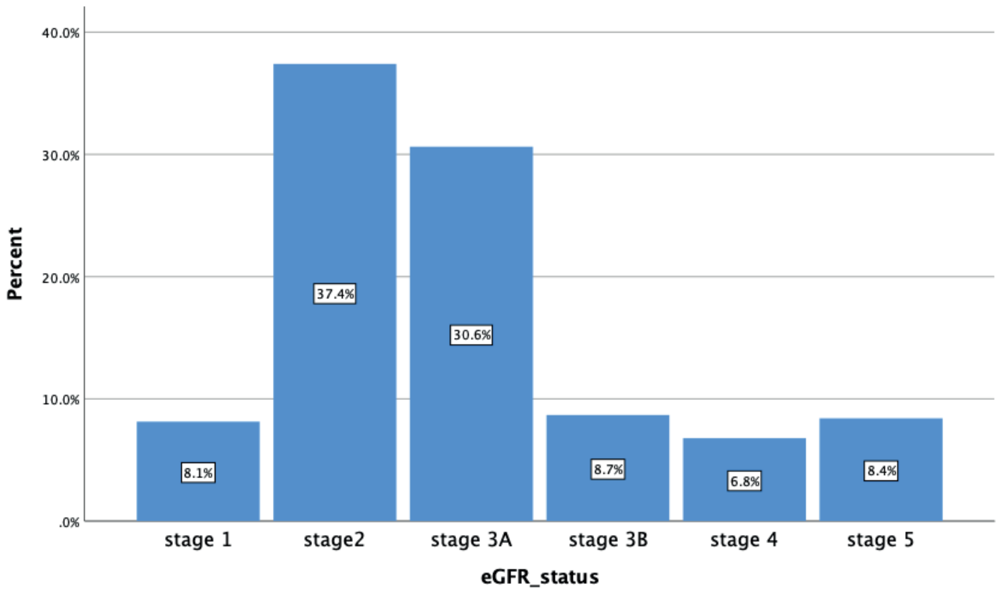

Figure 2. Different stages of CKD among the participants.

proteinuria (≥300), and 53.4% had normal ACR (10–29). The mean ACR was 115 ± 156.28. A substantial correlation was observed between CKD and varying ACR levels (χ^2=160.35, p=0.000). Given that proteinuria is present in 100% of individuals with CKD, this study emphasizes the importance of proteinuria as a reliable indicator of the disease. Monitoring urine ACR is thus critical in assessing and managing CKD risk in individuals with Type 2 Diabetes. These findings are consistent with a Chinese study, which showed varying rates of renal insufficiency and lower estimated glomerular filtration rates (eGFR) across normo-, micro-, and macroalbuminuria categories. This highlights the global significance of ACR as a key marker for assessing renal function and predicting CKD progression. When developing individualized treatment regimens and focused interventions for patients with Type 2 Diabetes, healthcare providers can make more informed decisions by understanding the relationship between urine ACR levels and renal outcomes [14].

The distribution of CKD stages among patients showed that 45.5% were in stages 1 and 2, 39.3% in stages 3A and 3B, and 15.2% in stages 4 and 5, indicating a greater proportion of patients in the early to moderate stages of CKD, with a smaller group experiencing advanced stages of the disease. This pattern is consistent with research from Ethiopia, underscoring the necessity of targeted therapies at various stages of CKD [11]. The study also found a strong correlation between the duration of diabetes and CKD (χ^2=6.01, p=0.013). For instance, 82.1% of patients had diabetes for more than three years, and the risk of CKD increased with the duration of the condition. This is consistent with an Ethiopian study, which showed a greater prevalence of CKD (32.4% and 39.7%) in patients who had diabetes for more than ten years compared to those who had it for shorter periods (11.6% and 16.4%) [11]. These findings highlight the global importance of early detection and management of CKD, particularly among long-term diabetes patients.

The study also revealed a notable correlation between hypertension (HTN) and CKD in individuals with diabetes. Approximately 27.9% of patients had hypertension for more than five years, while 7% had never experienced hypertension. These figures reflect the importance of regular blood pressure monitoring to manage CKD in diabetic patients, as demonstrated by another study in China, where 66.5% of CKD stage 1–2 patients and 81.8% of CKD stage 3–4 patients reported hypertension [14].

Overall, the study underscores the critical role of ACR monitoring, blood pressure management, and diabetes duration in the management of CKD among Type 2 Diabetes patients. Early intervention and tailored treatment strategies are essential for preventing or delaying CKD progression in this at-risk population.

Conclusion

The research highlights the significance of consistent, individualized glucose management in achieving optimal control to minimize complications, particularly for individuals with Type 2 Diabetes Mellitus who also have chronic kidney disease (CKD). It emphasizes the need for further research, as early detection and targeted intervention have the potential to reduce CKD incidence and improve patient outcomes. Multidisciplinary care, which involves collaboration between doctors, nurses, pharmacists, dietitians, and social workers, plays a crucial role in providing optimal care for patients with complex chronic conditions like CKD and may be achieved through coordinated efforts among these healthcare professionals.

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Conflict of interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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