

## Research Article

# Gender Differences in Disease Severity and Healthcare Access Among Patients with Chronic Kidney Disease Attending Aminu Kano Teaching Hospital, Kano, Nigeria

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### ABSTRACT

Chronic kidney disease (CKD) is a major cause of morbidity and mortality globally, including in Nigeria. Although gender-related disparities in CKD have been described, limited quantitative evidence exists from tertiary nephrology settings in Northern Nigeria evaluating sex differences in disease severity. This hospital-based cross-sectional analytical study included 190 adults with confirmed CKD attending Aminu Kano Teaching Hospital. CKD staging was determined using the CKD-EPI 2021 equation and classified according to KDIGO 2023 guidelines. Advanced CKD was defined as Stage 4–5 (eGFR <30 mL/min/1.73m<sup>2</sup>) or dialysis dependence. Sociodemographic, clinical, and healthcare access data were collected using a structured questionnaire and medical record review. Chi-square tests assessed bivariate associations. Multivariable logistic regression was performed to identify independent predictors of advanced CKD. The mean age was 48.7 ± 14.2 years, and 56.8% were male. Advanced CKD was present in 44.2% of participants. Although a higher proportion of males had advanced CKD compared with females (48.1% vs. 39.0%), the difference was not statistically significant (p = 0.214). In multivariable analysis, hypertension (AOR = 3.27; 95% CI: 1.59–6.71; p = 0.001) and diabetes mellitus (AOR = 3.84; 95% CI: 1.92–7.67; p < 0.001) were independently associated with advanced CKD. Male sex was not independently associated with disease severity (AOR = 1.29; 95% CI: 0.63–2.63; p = 0.476). Significant sex differences were observed in reported healthcare access barriers (p = 0.033), with women more frequently reporting financial constraints. In this tertiary nephrology population, advanced CKD was common and primarily associated with hypertension and diabetes rather than sex alone. While gender differences in reported healthcare access were observed, sex was not independently associated with CKD severity. Strengthening early cardiometabolic disease control may reduce advanced CKD presentation in similar settings.

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## INTRODUCTION

Chronic kidney disease (CKD) is a progressive disorder characterized by abnormalities of kidney structure or function persisting for more than three months, with implications for health, including reduced estimated glomerular filtration rate (eGFR) or markers of kidney damage such as albuminuria (Kidney Disease: Improving Global Outcomes [KDIGO], 2023). CKD is associated with substantial morbidity and premature mortality, largely due to its strong relationship with cardiovascular disease and progression to end-stage kidney disease (ESKD) requiring renal replacement therapy (Bikbov et al., 2020; GBD 2019 Chronic Kidney Disease Collaborators, 2020). Globally, CKD has emerged as one of the fastest-growing causes of mortality, driven by population ageing and the increasing prevalence of hypertension and diabetes mellitus (Mills et al., 2020). The burden is disproportionately higher in low- and middle-income countries, where late presentation, limited screening programs, and restricted access to dialysis and transplantation services worsen outcomes (Stanifer et al., 2020). In Nigeria, CKD represents a significant and growing clinical challenge. Recent studies indicate a high burden of CKD risk factors and late-stage presentation in tertiary hospitals (Oluyombo et al., 2021; Ezenwankwo et al., 2021). However, most hospital-based studies have primarily described clinical characteristics and risk factors without systematically evaluating gender differences in disease severity using multivariable analytical approaches. Furthermore, although gender-related barriers to healthcare access are widely acknowledged in sub-Saharan Africa, empirical assessments of how these barriers relate to CKD severity within tertiary nephrology settings remain limited. Gender may influence CKD outcomes through both biological and social pathways. Biological differences in renal physiology and hormonal modulation may affect progression patterns (Carrero et al., 2018; Hecking et al., 2022). Simultaneously, socioeconomic factors such as income, education, healthcare autonomy, and financial capacity may shape access to timely diagnosis and sustained treatment. In Northern Nigeria, sociocultural norms and economic disparities may further affect healthcare-seeking

behavior, yet there is limited quantitative evidence examining these dynamics among patients receiving nephrology care. At Aminu Kano Teaching Hospital (AKTH), a major referral center for renal services in North-West Nigeria, no prior study has rigorously evaluated sex differences in CKD severity while simultaneously examining gender-related access barriers using multivariable modelling. Clarifying whether observed gender disparities reflect biological differences, socioeconomic inequalities, or differential exposure to cardiometabolic risk factors is essential for designing equitable renal health interventions. This study, therefore, aimed to examine gender differences in CKD severity and healthcare access among patients receiving care at AKTH, with explicit assessment of clinical and socioeconomic predictors of advanced disease.

## MATERIALS AND METHODS

### Study design and Setting

This hospital-based cross-sectional analytical study was conducted at Aminu Kano Teaching Hospital (AKTH), Kano, Nigeria, a federal tertiary referral center providing outpatient nephrology services, inpatient renal care, and maintenance hemodialysis. AKTH serves as a major referral facility for Kano State and neighboring states in North-West Nigeria. The study aimed to examine sex differences in chronic kidney disease (CKD) severity and healthcare access among adult patients receiving nephrology care.

### Population

The study population comprised adults aged 18 years and above with a confirmed diagnosis of CKD for at least three months, attending the nephrology outpatient clinic, renal medical wards, or dialysis unit during the study period. Patients with acute kidney injury, incomplete laboratory data preventing CKD staging, or those unable to provide informed consent or refused consent were excluded.

### Sampling Technique and Sample

Sample size was calculated using Yamane's formula for finite populations, based on an estimated sampling frame of 322 eligible patients and a margin of error of 5%. This yielded a minimum sample size of 178 participants. After adjusting for a 10% non-response rate, 196 participants were targeted. Of

these, 190 had complete clinical and questionnaire data and were included in the final analysis. Participants were recruited using consecutive sampling, whereby all eligible patients presenting during clinic days, ward rounds, and dialysis sessions were approached sequentially until the required sample size was attained. Because recruitment occurred within a tertiary nephrology setting, the findings reflect the distribution of CKD severity among clinic attendees and are not generalizable to the community population.

### **Operational definitions**

CKD was defined in accordance with the Kidney Disease Improving Global Outcomes (KDIGO) 2023 clinical practice guidelines as abnormalities of kidney structure or function persisting for more than three months with health implications. CKD staging was determined using estimated glomerular filtration rate (eGFR) calculated from serum creatinine values using the CKD-EPI 2021 race-neutral equation, as documented in patients' medical records. CKD stages were categorized as follows: Stage 1 (eGFR  $\geq 90$  mL/min/1.73 m<sup>2</sup>), Stage 2 (60–89), Stage 3a (45–59), Stage 3b (30–44), Stage 4 (15–29), and Stage 5 (<15). For the purpose of regression analysis, the primary outcome variable, advanced CKD, was operationally defined as Stage 4 or Stage 5 disease (eGFR <30 mL/min/1.73 m<sup>2</sup>) or dialysis dependence. The dependent variable was therefore dichotomized as non-advanced CKD (Stages 1–3) versus advanced CKD (Stages 4–5 or dialysis).

### **Instrument**

Data were collected using a structured interviewer-administered questionnaire developed from CKD epidemiological surveys and adapted to the local context. The instrument comprised sections on socio-demographic characteristics, clinical history, lifestyle factors, and gender-related barriers to healthcare access. The questionnaire was reviewed by nephrology and public health experts to ensure content validity and was pretested among 20 CKD patients not included in the final sample. Minor revisions were made for clarity. Internal consistency of the healthcare access section demonstrated acceptable reliability (Cronbach's alpha = 0.78). Clinical variables, including CKD

stage and comorbid conditions, were verified from medical records.

### **Study Variable**

Independent variables included sex, age category, marital status, educational level, monthly income, residence (urban/rural), hypertension, diabetes mellitus, family history of CKD, smoking, alcohol use, and herbal medication use. Healthcare access variables were categorized as financial barrier, sociocultural restriction, no major barrier, or easy access.

### **Data Analysis**

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 26. Continuous variables were summarized using mean and standard deviation, while categorical variables were presented as frequencies and percentages with corresponding 95% confidence intervals where appropriate. Associations between sex and categorical variables, including advanced CKD and healthcare access barriers, were assessed using chi-square tests, with chi-square statistics and p-values reported. Multivariable logistic regression analysis was performed to determine whether sex was independently associated with advanced CKD after controlling for potential confounders. Variables with  $p < 0.20$  in bivariate analysis were entered into the multivariable model. Sex was included a priori based on the study objective. Socioeconomic variables, including education, income, and residence, were included in the model to assess their contribution to disease severity and to account for potential confounding. Reference categories were specified as follows: female for sex; age <30 years; tertiary education; and monthly income  $> \text{N}60,000$ . Adjusted odds ratios (AORs) with 95% confidence intervals were reported. Model adequacy was assessed using the Hosmer–Lemeshow goodness-of-fit test, and multicollinearity was evaluated using variance inflation factors. Statistical significance was set at  $p < 0.05$ .

### **Ethical Considerations**

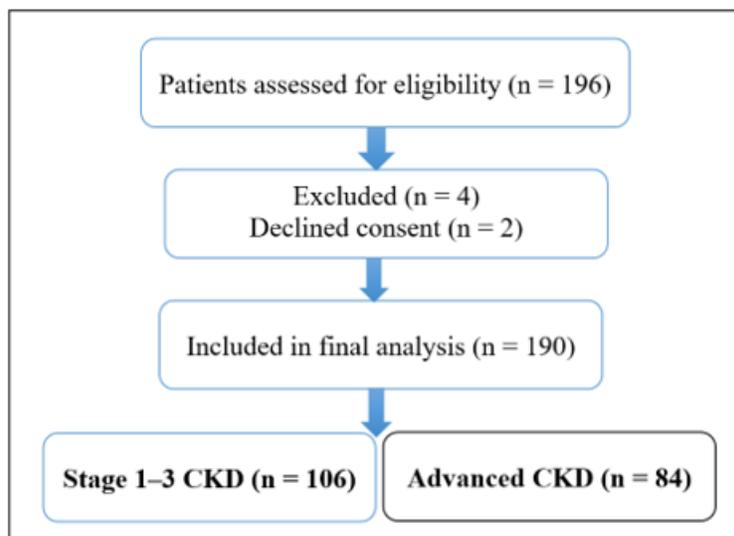
Ethical approval was obtained from the Bayero University Health Research Ethics Committee (NHREC/BUK-HREC/708/10/2311). Written informed consent was obtained from all

participants. Confidentiality was maintained, and participation was voluntary.

## RESULTS

A total of 196 eligible patients were approached during the study period. Six declined

participation or had incomplete clinical data, resulting in 190 participants included in the final analysis (response rate: 96.9%) as shown in Figure 1.



**Figure 1:** Flow Diagram of Participants Recruitment

### Participant Characteristics

The average age of participants was  $48.7 \pm 14.2$  years (range: 19–78 years). More than half (54.2%) were between 40 and 59 years old. Males made up 108 participants (56.8%; 95%

CI: 49.7–63.7), while females accounted for 82 (43.2%). Most participants lived in urban areas (70.5%), and 68.4% reported a monthly income below ₦30,000. Detailed demographic details are shown in Table 1.

**Table 1:** Socio-Demographic Characteristics of Participants (N = 190)

Variable	n	%
<b>Sex</b>		
Male	108	56.8
Female	82	43.2
<b>Age group (years)</b>		
<30	20	10.5
30–39	32	16.8
40–49	48	25.3
50–59	55	28.9
≥60	35	18.4
<b>Residence</b>		
Urban	134	70.5
Rural	56	29.5
<b>Monthly Income (₦)</b>		
<10,000	62	32.6
10,000–30,000	68	35.8

Variable	n	%
31,000–60,000	38	20.0
>60,000	22	11.6

*Mean age ± SD: 48.7 ± 14.2 years*

#### Distribution of CKD Severity by Sex

CKD stage was determined according to KDIGO 2023 criteria using the CKD-EPI 2021 equation. Advanced CKD was defined as Stage 4–5 (eGFR <30 mL/min/1.73m<sup>2</sup>) or dialysis-dependent status. Overall, 84 participants

(44.2%) had advanced CKD, while 106 (55.8%) had Stage 1–3 disease. Among males, 52 of 108 (48.1%) had advanced CKD compared with 32 of 82 females (39.0%). The difference was not statistically significant ( $\chi^2 = 1.54$ ,  $df = 1$ ,  $p = 0.214$ ). These findings are shown in Table 2.

**Table 2. Distribution of Advanced CKD by Sex**

Sex	Advanced CKD n (%)	Non-Advanced CKD n (%)	Total	$\chi^2$	p-value
Male	52 (48.1)	56 (51.9)	108		
Female	32 (39.0)	50 (61.0)	82	1.54	0.214
<b>Total</b>	84 (44.2)	106 (55.8)	190		

**Advanced CKD = Stage 4-5 or dialysis-dependent.**

#### Gender Differences in Healthcare Access

Reported healthcare access barriers differed significantly by sex. Financial barriers were reported by 23 of 82 females (28.0%) compared with 13 of 108 males (12.0%). Easy access to

hospital services was reported by 72.2% of males and 54.9% of females. Chi-square analysis demonstrated a statistically significant association between sex and reported access barriers ( $\chi^2 = 8.72$ ,  $df = 3$ ,  $p = 0.033$ ). Results are presented in Table 3.

**Table 3: Gender Differences in Healthcare Access Barriers**

Access Barrier	Male n (%)	Female n (%)	$\chi^2$ (df=3)	p-value
Financial barrier	13 (12.0)	23 (28.0)		
Sociocultural restriction	6 (5.6)	8 (9.8)	8.72	0.033
Easy access	78 (72.2)	45 (54.9)		
No major barrier	11 (10.2)	6 (7.3)		

#### Bivariate Associations with Advanced CKD

Hypertension was present in 122 participants (64.2%) and was significantly associated with advanced CKD ( $\chi^2 = 14.81$ ,  $p < 0.001$ ). Diabetes mellitus was present in 74 participants (38.9%) and was also significantly associated with

advanced CKD ( $\chi^2 = 16.42$ ,  $p < 0.001$ ). Socioeconomic variables, including education and income, were entered into the multivariable analysis using a  $p < 0.20$  threshold from bivariate screening, as presented in Table 4.

**Table 4:** Bivariate Associations between Independent Variables and Advanced CKD (N = 190)

Variable	Advanced CKD n (%)	Non-Advanced CKD n (%)	$\chi^2$	p-value
<b>Sex</b>			1.54	0.214
Male (n=108)	52 (48.1)	56 (51.9)		
Female (n=82)	32 (39.0)	50 (61.0)		
<b>Hypertension</b>			14.81	<0.001
Yes (n=122)	68 (55.7)	54 (44.3)		
No (n=68)	16 (23.5)	52 (76.5)		
<b>Diabetes Mellitus</b>			16.42	<0.001
Yes (n=74)	46 (62.2)	28 (37.8)		
No (n=116)	38 (32.8)	78 (67.2)		
<b>Monthly Income</b>			4.11	0.250
<30,000	63 (48.1)	68 (51.9)		
≥30,000	21 (35.0)	39 (65.0)		
<b>Education Level</b>			5.02	0.170
≤Secondary	56 (47.5)	62 (52.5)		
Tertiary	28 (38.9)	44 (61.1)		

*Advanced CKD = Stage 4–5 or dialysis-dependent*

#### Multivariable Logistic Regression Analysis

Multivariable logistic regression was performed with advanced CKD (Stage 4–5 or dialysis) as the dependent variable. Female sex, age <30 years, tertiary education, and monthly income >₦60,000 served as reference categories. After adjustment for demographic, clinical, and socioeconomic variables:

- Hypertension remained independently associated with advanced CKD (AOR = 3.27; 95% CI: 1.59–6.71; p = 0.001).
- Diabetes mellitus remained independently associated with advanced

CKD (AOR = 3.84; 95% CI: 1.92–7.67; p < 0.001).

- Male sex was not independently associated with advanced CKD (AOR = 1.29; 95% CI: 0.63–2.63; p = 0.476).
- Education and income were not statistically significant predictors after adjustment.

Model diagnostics indicated adequate fit (Hosmer–Lemeshow  $\chi^2 = 6.41$ , p = 0.602). No multicollinearity was detected (all VIF < 2.0). The model demonstrated moderate explanatory power (Nagelkerke  $R^2 = 0.32$ ). Detailed regression results are presented in Table 5

**Table 5:** Multivariable Logistic Regression Predicting Advanced CKD

Variable	Adjusted OR	95% CI	p-value
<b>Sex</b>			
Male	1.29	0.63–2.63	0.476
Female	Reference		
<b>Hypertension</b>	3.27	1.59–6.71	0.001
<b>Diabetes Mellitus</b>	3.84	1.92–7.67	<0.001
<b>Age</b>			
30–44	1.16	0.42–3.24	0.775
45–59	1.84	0.64–5.33	0.259

Variable	Adjusted OR	95% CI	p-value
≥60	2.13	0.72–6.34	0.174
<30	Reference		
<b>Income &amp; Education</b> Included in the model		NS	—

*Advanced CKD = Stage 4–5 or dialysis-dependent; NS = Not statistically significant*

## DISCUSSION

This hospital-based cross-sectional study examined sex differences in CKD severity and healthcare access among adults receiving nephrology care at Aminu Kano Teaching Hospital, Northern Nigeria. Using KDIGO 2023 staging criteria and multivariable logistic regression modelling, the study found that although males constituted a higher proportion of clinic attendees and had a higher crude proportion of advanced CKD, sex was not independently associated with advanced disease after adjustment. Instead, hypertension and diabetes mellitus emerged as the principal independent predictors of advanced CKD. Additionally, significant sex differences were observed in reported healthcare access barriers at the bivariate level.

In this cohort, males accounted for 56.8% of patients receiving nephrology care. This male predominance is consistent with patterns reported in several hospital-based studies in sub-Saharan Africa, where men frequently represent a larger proportion of CKD clinic attendees (Oluyombo *et al.*, 2021; George *et al.*, 2019). Possible explanations proposed in prior literature include higher exposure to cardiometabolic risk factors among men and differences in healthcare-seeking behavior.

However, while 48.1% of males had advanced CKD compared with 39.0% of females, this difference was not statistically significant at the bivariate level and did not persist after adjustment for clinical and socioeconomic variables (AOR = 1.29; 95% CI: 0.63–2.63). This attenuation suggests that the apparent sex disparity in crude distribution may be mediated by differential exposure to hypertension and diabetes rather than sex alone.

Recent large-scale analyses have similarly shown that sex differences in CKD progression diminish after controlling for comorbidities and socioeconomic factors (Carrero *et al.*, 2018; Hecking *et al.*, 2022). Although biological

differences in renal physiology and hormonal modulation have been proposed as contributing factors, contemporary evidence increasingly emphasizes the complex interplay between biological and social determinants. The present findings align with this perspective, indicating that in this tertiary setting, sex was not an independent predictor of advanced CKD severity.

Hypertension and diabetes mellitus were strongly associated with advanced CKD in both bivariate and multivariable analyses. Hypertension was associated with more than threefold increased odds of advanced disease (AOR = 3.27), while diabetes was associated with nearly fourfold increased odds (AOR = 3.84).

These effect sizes are comparable to those reported in global and regional studies. The Global Burden of Disease analysis identified hypertension and diabetes as leading drivers of CKD-related mortality and progression worldwide (Bikbov *et al.*, 2020). Similarly, systematic analyses have reported two- to fourfold increased risk of advanced CKD among individuals with poorly controlled hypertension or diabetes (Mills *et al.*, 2020). Studies from sub-Saharan Africa have also demonstrated strong associations between these cardiometabolic conditions and late-stage CKD presentation in tertiary centers (George *et al.*, 2019).

The magnitude of association observed in this study therefore reinforces the central role of cardiometabolic disease control in reducing severe CKD burden. Given that the majority of patients in this cohort presented with Stage 4–5 disease, delayed detection and suboptimal management of hypertension and diabetes at earlier stages may contribute to progression before referral.

Socioeconomic indicators, including income and education, were included in multivariable modelling but were not independently associated

with advanced CKD after adjustment. This finding suggests that within this tertiary referral population, clinical risk factors exerted a stronger influence on CKD stage than measured socioeconomic characteristics.

However, the absence of statistical significance does not imply the absence of socioeconomic influence. Rather, it may reflect limited variability within the sample or residual confounding. Other studies have demonstrated socioeconomic gradients in CKD outcomes, particularly in community-based populations (Stanifer et al., 2020). The current findings indicate that within this clinical setting, cardiometabolic comorbidities appear to be the dominant determinants of advanced disease.

A statistically significant association was observed between sex and reported healthcare access barriers, with women more frequently reporting financial constraints. This pattern is consistent with broader evidence indicating that women in many sub-Saharan African contexts experience greater financial vulnerability and reduced healthcare autonomy (George et al., 2019).

However, it is important to interpret this finding cautiously. The present study did not model predictors of healthcare access barriers nor assess their longitudinal relationship with CKD progression. Therefore, while sex differences in reported access experiences were observed, the analysis does not establish that such barriers directly contributed to advanced CKD severity in this population.

Future studies employing longitudinal designs and multivariable modelling of access determinants would be necessary to clarify these relationships.

Compared with other Nigerian tertiary hospital studies, the proportion of advanced CKD (44.2%) in this cohort is comparable to reports indicating high rates of Stage 4–5 disease at presentation (Oluyombo et al., 2021). This supports the broader observation that late-stage referral remains common in Nigeria.

The adjusted odds ratios for hypertension and diabetes in this study fall within ranges reported in African cohorts, where odds ratios between 2.0 and 5.0 have been documented for progression to advanced CKD (George et al., 2019). Thus, the present findings are

quantitatively consistent with existing regional data.

#### **LIMITATIONS**

This study benefits from the verification of key variables through clinical records and the use of multivariable analysis, which enhances the robustness of the findings. However, several limitations should be noted. The cross-sectional design prevents assessment of temporal relationships or causality. Recruitment from a tertiary nephrology service may disproportionately represent individuals with more advanced disease, thereby limiting generalizability to broader community populations. Reliance on self-reported access barriers introduces the possibility of reporting bias. Finally, residual confounding cannot be entirely ruled out.

#### **IMPLICATIONS**

The findings highlight the continued dominance of hypertension and diabetes as drivers of advanced CKD severity in tertiary settings. Strengthening early detection and control of these conditions at the primary care level may reduce late-stage presentation. While sex was not independently associated with advanced CKD, observed differences in access experiences suggest that equitable financial protection mechanisms remain important considerations in chronic disease management.

#### **Conclusion**

In this hospital-based study of adults receiving nephrology care in Northern Nigeria, advanced CKD was present in nearly half of clinic attendees. Although males constituted a higher proportion of patients and demonstrated a higher crude proportion of advanced disease, sex was not independently associated with advanced CKD after adjustment for clinical and socioeconomic factors. Hypertension and diabetes mellitus emerged as the primary independent predictors of advanced CKD severity. While significant sex differences were observed in reported healthcare access barriers, these did not translate into independent differences in disease stage. Overall, the findings suggest that cardiometabolic comorbidities remain the dominant determinants of CKD severity in this tertiary population.

## RECOMMENDATIONS

Efforts to reduce advanced CKD presentations in tertiary centers should prioritize early detection and effective management of hypertension and diabetes at the primary healthcare level. Strengthening routine CKD screening among high-risk individuals may facilitate earlier referral and intervention. Although sex was not independently associated with disease severity, the observed differences in reported financial barriers highlight the need for continued attention to equitable access to renal services, particularly in low-resource settings. Future research employing longitudinal designs is recommended to clarify the temporal relationships between gender, healthcare access, and CKD progression.

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## CONFLICT OF INTEREST

The authors declare no conflict of interest.

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