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Original Article

Correlates of Risk Factors for Hemodialysis in Kano, Nigeria

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Abstract

Background: Kidney diseases are on the increase, with renal replacement therapy (RRT) in the form of dialysis or kidney transplant becoming increasingly inaccessible to underserved individuals. This study aimed to identify the correlates of risk factors for hemodialysis in Kano, Nigeria.

Methodology: A retrospective cross-sectional study design was used to review the records of patients from Kano State enrolled for hemodialysis from January, 2019 to December, 2022.

Results: A total of 443 patients were provided with hemodialysis. More cases were identified from urban areas of the State. The minimum age of the patients was 6, and the maximum was 100, with a median of 50 (interquartile range=34, 60) years. The majority of the patients (72.0%) had chronic kidney disease (CKD), while acute kidney injury (AKI) and acute on chronic kidney disease (AOCCKD) were found in (15.6%), and (12.4%) respectively. Similarly, a significantly higher proportion of mortality and post-partum hemorrhage (PPH) was recorded among patients with AKI. While higher proportions of hypertensive and diabetic patients had CKD. However, a significantly higher proportion of patients with AOCCKD had chronic glomerulonephritis (CGN)

Conclusions: Hemodialysis is an important RRT. The majority of patients studied had CKD, with hypertension and DM as the major correlates for hemodialysis, followed by AKI, with PPH and sepsis as the major correlates, while AOCCKD had CGN as the major correlate. The government and all relevant stakeholders should target the preventive strategies of all the correlates and improve the quality of RRT.

Keywords: Renal replacement therapy, hemodialysis, acute kidney injury, chronic kidney injury, acute on chronic kidney failure, Nigeria

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Introduction

End-stage renal disease (ESRD) is associated with suboptimal kidney function, and life can only be supported by either a kidney transplant or dialysis [1, 2]. It occurs when the estimated glomerular filtration rate (GFR) is below 15 mL per minute per 1.73 m^2 [3]. About one-third of patients with the disease receive little or no kidney care prior to the diagnosis [1]. Early referral of patients at risk of ESRD is essential in improving patients' outcomes, and decreasing the risk of complications like platelet dysfunction-related bleeding, erythropoietin deficiency-linked anemia, and excretory dysfunction-related uremic encephalopathy, among other complications, and mortality [1]. A dysfunctional kidney can be supported by renal replacement therapy (RRT) in the form of either a kidney transplant, peritoneal dialysis, intermittent hemodialysis, or continuous renal replacement therapy [4].

The indications for hemodialysis consist of uremic complications, GFR <10 ml/min, and dialyzable intoxications (lithium, toxic alcohols, and salicylates) [4]. Effective hemodialysis requires access to the bloodstream of the patient [1]. However, vascular access thrombosis and infection are common and associated with dialysis-related morbidity among patients on prolonged hemodialysis [5]. Globally, over 1.5 million individuals are managed with hemodialysis annually, with an average of two hospitalizations, out of which 10%–25% die of complications [5].

There has been a remarkable improvement in the principles and practice of RRT, resulting in better outcomes among patients diagnosed early [6, 7]. The choice of RRT is dependent on the available procedure, financial accessibility, expertise of the healthcare workers, haemodynamic stability of the patients, and the primary indication [4, 7]. Acute kidney injury (AKI) is a serious health concern globally [8, 9]. The epidemiology, management, and prognosis of AKI differ in different parts of the world, with an estimated 1.7 million people dying each year [8, 9].

In the United States (USA), AKI is associated with high hospitalization costs ranging from $5.4 to $24.0 billion [9]. The hospitalized patients have a prevalence of AKI ranging from 10% to 20%, with up to 10% requiring hemodialysis [9]. AKI is linked to longer hospital stay and long-term disability, including chronic kidney disease (CKD) and ESRD [9]. For critically ill patients, the incidence of AKI was reported to be between 45%–50% [9], with overall mortality at 30 days after AKI as high as 24% [9].

The prevalence of CKD were 13.9%, and 10.1% amongst men and women in sub-Saharan Africa, resulting in a higher risk of ESRD, RRT, hospital admission, and cardiovascular-related mortality [10, 11]. A study conducted in Nigeria reported the prevalence of CKD of 12% [12]. However, the global prevalence was reported at 9.1%, which accounted for about 700 million cases [13]. More so, a significant number of people are currently receiving hemodialysis as a result of preventable causes worldwide [13-16]. Hypertension is the commonly identified risk factor (87–90%), with ventricular hypertrophy (40%), and coronary heart disease (70%), among patients on RRT [17]. Similarly, more than 50% of patients had CVD, with 20 folds increased relative risk of mortality compared with the general population [17].

More than 70% of patients hospitalized for acute decompensated heart failure (ADHF) experience worsening of kidney function acutely [18]. Thus, acute worsening of kidney function in ADHF is a result of new-onset kidney injury (AKI) or acute deterioration of pre-existing CKD, otherwise known as acute-on-chronic kidney disease (AOCCKD) [18]. In developed countries, increasing indications for RRT among patients have resulted in the establishment of more RRT centres, training of qualified health personnel for renal care, and improved quality of care [7].

There is a progressive increase in the burden of non-communicable diseases (NCDs), especially hypertension (HTN), and diabetes (DM) [7]. Despite this emerging trend, patients in Nigeria are characterized by advanced disease at presentation, late referral to the RRT centers, younger age, and higher

risk of other comorbidities [7]. Similarly, there is a paucity of local data on correlates of risk factors for hemodialysis, which could limit the use of an appropriate targeted framework by the government for preventive interventions.

It is in line with the above background that Ibrahim et al [7], conducted a multicenter review of patient's records across the largest RRT centers in northwest Nigeria, and reported the burden and risk factors, [19] which resulted in a policy on the establishment of RRT centers, and provision of free treatment for hypertensive and diabetic patients [21], the leading risk factors of kidney disease in the district [19]. This study, therefore, aimed to identify the correlates of risk factors for hemodialysis by assessing the centers providing hemodialysis services from 2019 to 2022 in Kano and Jigawa, Northwest Nigeria. The findings could provide guidance for positive policy on prevention and improving approaches in managing patients by relevant stakeholders.

Methods

Study design and population

A retrospective descriptive cross-sectional study design was used to study the records of 443 patients from all the LGAs of Kano State enrolled for hemodialysis from January 2019 to December 2022. The hemodialysis centers in Kano and Jigawa State were studied. All the patients enrolled within the study period were included. A total of 1329 patients who were enrolled for hemodialysis over the study period were documented, out of which only 443 were from Kano state, with the remaining coming from various States. Registered patients waiting for a dialysis session, patients with no written indication for hemodialysis, sex, age, and risk factors in the registers were excluded.

Study Area

Kano is the most populous state in Nigeria with 44 local government areas (LGAs), and an estimated population of 15,462,200 in 2022. Aminu Kano Teaching Hospital (AKTH) is the biggest tertiary facility in northwest Nigeria, providing RRT (kidney transplant and hemodialysis services), while Muhammad Abdullahi Wase Teaching Hospital (MAWTH) is a secondary facility owned by Kano State Government that was converted to a state Teaching Hospital in 2022 [19]. Similarly, Hadejia General Hospital (HGH) was upgraded to serve as a dialysis center in 2018 by the Jigawa State Government. Rasheed Shekoni Specialist Hospital (RSSH) was a secondary facility established in 2009 by the Jigawa state government, which was handed over to the federal government in 2022 as a teaching hospital [19].

Sampling procedure and sample size

All the functional government-owned hemodialysis centers in Kano (AKTH, MAWTH) and Jigawa State (RSTH and HGH) from 2019 to 2022 were studied. A total of 443 patients from Kano State who met the inclusion criteria were extracted from 1329 patients enrolled during the study period.

Procedure of data collection and the instrument of data collection

A Pro forma was designed to abstract data from the registers of the study areas. Information obtained includes: name of the hospital, sex, age, indication/ diagnosis/for dialysis, underlying risk factor, serology status for HIV, hepatitis B, and hepatitis C, LGA, patient's status, and year of commencing dialysis were obtained. The Pro forma was pre-tested in a hemodialysis center in another state outside Kano and Jigawa. Three qualified nephrology nurses from the dialysis centers were trained on the principles of research ethics, study objectives, methods of data abstraction, and quality data entry into an Excel Spreadsheet among others. The research assistants conducted the data entry differently and serially, with only concordant information for each patient considered for analysis.

Data analysis

Data collected were entered into a Microsoft Excel Spreadsheet, cleaned, and analyzed using IBM SPSS Statistics for Windows version 22.0. Armonk, NY, USA: IBM Corp. Quantitative data were presented using median and interquartile range, whereas qualitative variables were presented using frequencies and percentages. The variables included the hospitals (AKTH, RSSH, MAWTH, and HGH), diagnosis/indications (AKI, CKD, and AOCCKD), risk factors (HTN, HIV, DM, postpartum hemorrhage, sepsis, and bladder outlet obstruction), serology (hepatitis B and hepatitis C status, HIV status), year of treatment (2019, 2020, 2021, and 2022), and patient status (alive or dead).

The outcome/dependent variables: AKI (present/absent), CKD (present/absent), AOCCKD (present/absent), while the independent variables were: age, hospital, serology status, patient's status, sex, risk factors, among others. The Chi-squared test was used to test for the association between the outcome and independent variables. Binary logistic regression was used to find the independent predictors of AKI, CKD, and AOCCKD, and control for confounders with statistical significance set at $P \leq 5\%$. Total cases for each LGA of the state were expressed as the ratio of the total number of cases from that LGA over the study period to the total number of cases across the state per 100,000 population.

Ethics

The approval for the study was given by the Health Research Ethics Committees of Kano State Ministry of Health (NHREC/17/03/2018) dated 11 March 2022, and Jigawa State Ministry of Health (JGHREC/2022/086) dated 4 April 2022. Appropriate institutional entry was done for permission from the facilities leadership and the hemodialysis units. The principles of the Helsinki Declaration were ensured in the conduct of this research, which is necessary in dealing with human subjects.

Results

Socio-demographic and clinical characteristics

A total of 443 patients were provided with hemodialysis from 2019 to 2022. The minimum age of the patients was 6, and the maximum was 100, with a median of 50 (interquartile range=34, 60) years. More than one-third (46.3%) were greater than 50 years of age, while more than half (59.6%) had hemodialysis at AKTH. While more than half (54.4%) were commenced on hemodialysis in 2021, up to (5.2%) were dead as a result of kidney disease-related complications. The majority of the patients (72.0%) had CKD, while AKI and AOCCKD were found in (15.6%), and (12.4%) respectively. Some patients (44.9%) had HTN, about a quarter (24.8%) of the patients had DM, while less than a quarter (19.0%) had CGN. The serological status for HIV, hepatitis B, and hepatitis C were (3.8%), (5.4%), and (1.6%), respectively (Table 1).

Table 1: Socio-demographic and Clinical Characteristics					
Socio-demographic characteristics			Clinical characteristics		
Variable (s)	Frequency (n=443)	Percentage (%)	Variable (s)	Frequency (n=443)	Percentage (%)
Sex			**Diagnosis**		
Male	277	62.5	Chronic kidney disease	319	72.0
Female	166	37.5	Acute kidney injury	69	15.6
Age groups			Acute on chronic kidney failure	55	12.4
1-10	2	0.5	**Hypertensive**		
11-20	27	6.1	Yes	199	44.9
21-30	62	14.0	No	244	55.1
31-40	72	16.3	**Diabetic**		
41-50	75	16.9	Yes	110	24.8
>50	205	46.3	No	333	75.2
Hospital			**HIV**		
RSTH	27	6.1	Positive	17	3.8
AKTH	264	59.6	Negative	426	96.2
HGH	1	0.2	**Bladder outlet obstruction (BOO)**		
MAWTH	151	34.1	Yes	6	1.4
Current status			No	347	98.6
Alive	420	94.8	**Chronic glomerulonephritis (CGN)**		
Dead	23	5.2	Yes	84	19.0
Year of commencing hemodialysis			No	359	81.0
2019	27	6.1	**Sepsis**		
2020	133	30.0	Yes	43	9.7
2021	241	54.4	No	400	90.3
2022	42	9.5	**Post-partum hemorrhage (PPH)**		
			Yes	26	5.9
			No	417	94.1

			Serological status		
			Negative	395	89.2
			HIV-positive	17	3.8
			Hepatitis-B positive	24	5.4
			Hepatitis-C positive	7	1.6
			Acute kidney injury (AKI)		
			Yes	69	15.6
			No	374	84.4
			Chronic kidney disease (CKD)		
			Yes	319	72.0
			No	124	28.0
			Acute on chronic kidney disease		
			Yes	55	12.4
			No	388	87.6

RSTH: Rasheed Shekoni Teaching Hospital, AKTH: Aminu Kano Teaching Hospital, HGH: Hadejia General Hospital, MAWTH: Muhammad Abdullahi Wase Teaching Hospital

Predictors of Acute Kidney Injury

A significantly higher proportion of patients with AKI were females (19.1%, P=0.05). The odds of having AKI were higher among female patients; the male patients were 50% less likely to have AKI compared with the female patients (Adjusted odds ratio [aOR] =0.5, 95% confidence interval [CI] = [0.3–0.9]). Similarly, a significantly higher proportion of mortality (30.4%, p=0.04†) was recorded among patients with AKI. Patients who had no AKI were 50% less likely to die compared with those who had AKI (Adjusted odds ratio [aOR] =0.5, 95% confidence interval [CI] = [0.1–0.9]). More so, a significantly higher proportion of AKI was found among patients who had no HTN (27.5%, p=0.04). Patients who had no HTN were 3% less likely to have AKI compared with hypertensive patients (Adjusted odds ratio [aOR] =0.03, 95% confidence interval [CI] = [0.01–0.1]).

A significantly higher proportion (20.4%, p<0.001) of non-diabetic patients had AKI. The odds of having AKI were lower among diabetic patients, who were 90% less likely to have AKI compared with non-diabetic patients (Adjusted odds ratio [aOR] =0.9, 95% confidence interval [CI] = [0.1–11.1]). However, a significantly higher proportion (50.0%, p<0.05†) of patients with AKI had BOO, and the odds of having AKI were higher among patients with BOO. Patients with BOO were 95 times more likely to have AKI compared with patients who had no BOO (Adjusted odds ratio [aOR] =95.4, 95% confidence interval [CI] = [11.4–800.5]).

For CGN, a significantly higher proportion (47.6%, p<0.001) of patients with AKI had the disease. Patients with CGN were 10 times more likely to have AKI compared with patients who had no CGN (Adjusted odds ratio [aOR] =10.3, 95% confidence interval [CI] = [5.8–180.3]). More so, a significantly higher proportion (93.0%, p<0.001†) of patients with AKI had sepsis. The odds of having AKI were higher among patients with sepsis. Patients with sepsis were 170 times more likely to have AKI compared with patients who had no sepsis (Adjusted odds ratio [aOR] =170.6, 95% confidence interval [CI] = [50.0–585.0]). Similarly, a significantly higher proportion (85.5%, p<0.001) of patients with AKI had PPH. The odds of having AKI were higher among patients who had PPH. Patients who had PPH had a much higher likelihood of having AKI compared with patients who had no PPH (Adjusted odds ratio [aOR] =1567, 95% confidence interval [CI] = [162–15150]) (Table 2).

Table 2: Predictors of Acute Kidney Injury

	Acute Kidney Injury (AKI)					
Variable	Present	Absent	χ^2	P	aOR (95% CI)	P
Sex						
Male	36 (13.0)	241 (87.0)	3.7	0.05*	0.5(0.3-0.9)	0.04*
Female (Reference)	33 (19.1)	133 (80.1)			1	
Age group						
1-10	0 (0)	2 (100.0)		<0.001* †	0.7 (0.4-1.2)	0.7
11-20	11 (40.7)	16 (59.3)				
21-30	21 (33.9)	41 (66.6)				
31-40	10 (13.9)	62 (86.1)				
41-50	6 (8.0)	69 (92.0)				
>50 (Reference)	21 (10.2)	184 (89.8)			1	
Status						
Alive	62 (14.8)	358 (85.2)		0.04*†	0.3 (0.1-0.9)	0.05*
Dead (Reference)	7 (30.4)	16 (69.6)			1	
Hospital						
RSSH	0 (0)	27 (100.0)		0.04*†	0.9 (0.5-1.6)	0.8
AKTH	50 (18.9)	214 (81.1)				
MAWTH	19 (12.6)	132 (87.4)				
HGH (Reference)	0 (0)	1 (100)			1	

Hypertensive						
Yes	2 (1.0)	197 (99.0)	58.3	<0.001*	0.03 (0.01-0.1)	<0.001*
No (Reference)	67 (27.5)	177 (72.5)			1	
Diabetic						
Yes	1 (0.9)	109 (99.1)	23.9	<0.001*	0.9 (0.1-11.1)	<0.001*
No (Reference)	68 (20.4)	265 (79.6)			1	
HIV						
Positive	0 (0)	17 (100)		0.1†		
Negative (Reference)	69 (16.2)	357 (83.8)			1	
BOO						
Yes	3 (50.0)	3 (50.0)		0.05*†	95.4 (11.4-800.5)	<0.001*
No (Reference)	66 (15.1)	371 (84.9)			1	
CGN						
Yes	40 (47.6)	44 (52.4)	81.0	<0.001*	10.3 (5.8-18.3)	<0.001*
No (Reference)	29 (8.1)	330 (91.9)			1	
Sepsis						
Yes	40 (93.0)	3 (7.0)	217.2	<0.001*†	170.6 (50.0-585.0)	<0.001*
No (Reference)	29 (7.1)	371 (92.8)			1	
PPH						
Yes	23 (85.5)	3 (11.5)		<0.001*	1567 (162-15150)	<0.001*
No (Reference)	46 (11.0)	371 (89.0)			1	
Year						
2019	10 (37.0)	17 (63.0)	21.2	<0.001*	0.9(0.7-1.4)	0.9
2020	20 (15.0)	113 (85.0)				
2021	26 (10.8)	215 (89.2)				
2022 (Reference)	13 (31.0)	29 (69.0)			1	

RSTH: Rasheed Shekoni Teaching Hospital, AKTH: Aminu Kano Teaching Hospital, HGH: Hadejia General Hospital, MAWTH: Muhammad Abdullahi Wase Teaching Hospital, BOO: Bladder outlet obstruction, CGN: Chronic glomerulonephritis, HIV: Human immunodeficiency virus, aOR: Adjusted odds ratio, CI: Confidence interval, AKI: Acute kidney injury, PPH: Post-partum haemorrhage. *,†Statistical significance, Fishers, $P \leq 0.05$

Predictors of Chronic Kidney Disease

A significantly higher proportion (85.9%, p<0.001) of hypertensive patients had CKD. The odds of having CKD were higher among hypertensive patients. The hypertensive patients were 4 times more likely to have CKD compared with those who had no HTN = (Adjusted odds ratio [aOR] =4.1, 95% confidence interval [CI] = [2.5–6.7]). Similarly, a significantly higher proportion (85.9%, p<0.005) of diabetic patients had CKD. The DM patients were 18 times more likely to have CKD compared with those who had no DM (Adjusted odds ratio [aOR] =17.7, 95% confidence interval [CI] = [2.4–132.3]). More so, the odds of having CKD were lower among patients who had BOO. Patients who had BOO were 20% less likely to have CKD compared with those who had no BOO (Adjusted odds ratio [aOR] =0.2, 95% confidence interval [CI] = [0.03–0.8]). However, a significantly higher proportion (83.8%, p<0.001) of patients with CKD had no CGN. Patients with CGN were 10% less likely to have CKD compared with those who had no CGN= (Adjusted odds ratio [aOR] =4.1, 95% confidence interval [CI] = [2.5–6.7]). Similarly, a significantly higher proportion (79.0%, p<0.001) of patients with CKD had no sepsis. Patients with sepsis were 10% less likely to have CKD compared with those who had no sepsis= (Adjusted odds ratio [aOR] =0.1, 95% confidence interval [CI] = [0.003–0.1]) (Table 3).

Table 3: Predictors of Chronic Kidney Disease

	Chronic Kidney Disease					
Variable	Present	Absent	χ^2	P	aOR (95% CI)	P
Sex						
Male	205 (74.0)	72 (26.0	1.5	0.2	1.3 (0.8-2.1)	0.2
Female (Reference)	114 (68.7)	52 (31.3)			1	
Age group						
1-10	2 (100)	0 (0)		<0.001*†	1.2 (0.9-1.5)	0.2
11-20	15 (55.6)	12 (44.4)				
21-30	30 (48.4)	32 (51.6)				
31-40	53 (73.6)	19 (26.4)				
41-50	59 (78.7)	16 (21.3)				
>50 (Reference)	160 (78.0)	44 (22.0)		1		
Status						
Alive	305 (72.6)	115 (27.4)	1.5	0.2	1.5 (0.5-4.0)	0.5
Dead (Reference)	14 (60.9)	9 (29.1)			1	
Hospital						
RSSH	17 (63.0)	10 (37.0)		<0.001*†	0.4 (0.3-0.6)	<0.001*
AKTH	170 (64.4)	94 (35.6)				
MAWTH	131 (86.8)	20 (13.2)				
HGH (Reference)	1 (100)	0 (0)			1	
Hypertensive						

Yes	171 (85.9)	28 (14.1)	34.7	<0.001*	4.1 (2.5-6.7)	<0.001*
No (Reference)	148 (60.7)	96 (39.3)			1	
Diabetic						
Yes	109 (85.9)	28 (14.1)	53.2	<0.001*	17.7 (2.4-132.3)	0.005*
No (Reference)	148 (60.7)	96 (39.3)			1	
HIV						
Positive	15 (88.2)	2 (11.8)		0.1†	1.2 ((0.3-5.6)	0.9
Negative (Reference)	304 (71.4)	122 (28.6)			1	
BOO						
Yes	3 (50.0)	3 (50.0)		0.2†	0.2 (0.03-0.8)	0.03*
No (Reference)	316 (72.3)	121 (27.2)			1	
CGN						
Yes	18 (21.4)	66 (78.6)	131.6	<0.001*	0.1 (0.04-0.2)	<0.001*
No (Reference)	301 (83.8)	58 (16.2)			1	
Sepsis						
Yes	3 (7.0)	40 (93.0)	100.0	<0.001*	0.1 (0.003-0.1)	<0.001*
No (Reference)	316 (79.0)	84 (21.0)			1	
PPH						
Yes	2 (7.7)	24 (92.3)	56.7	<0.001	0.01 (0.003-0.1)	<0.001*
No (Reference)	317 (76.0)	100 (24.1)			1	
Year						
2019	15 (55.6)	12 (44.4)	25.2	<0.001*	0.9 (0.7-1.2)	0.7
2020	81 (60.9)	52 (39.1)				
2021	197 (81.7)	44 (18.3)				
2022 (Reference)	26 (61.9)	16 (38.1)			1	

Predictors of Acute on Chronic Kidney Disease

For AOCCKD, a significantly higher proportion (37.0%, p<0.001†) of patients with AOCCKD were seen at RSSH. The odds of having AOCCKD were higher among patients who were seen at RSSH. Patients seen at RSSH were 6 times more AOCCKD compared with those seen at HGH (Adjusted odds ratio [aOR] =6.0, 95% confidence interval [CI] = [3.1–11.8]). Similarly, a significantly higher proportion (31.0%, p<0.001†) of patients with AOCCKD had CGN. The odds of having AOCCKD were higher among patients who had CGN. Patients with CGN were 13 times more likely to have AOCCKD compared with those who had no CGN (Adjusted odds ratio [aOR] =13.1, 95% confidence interval [CI] = [5.7–29.7]) (Table 4).

Table 4: Predictors of Acute on Chronic Kidney Disease						
	Acute on Chronic Kidney Disease					
Variable	Present	Absent	χ^2	P	aOR (95% CI)	P
Sex						
Male	36 (13.0)	241 (87.0)	0.2	0.6	1.0 (0.5-1.9)	1.0
Female (Reference)	19 (11.4)	147 (88.6)			1	
Age group						
1-10	0 (0)	2 (100.0)		0.6†	0.9 (0.7-1.2)	0.4
11-20	1 (3.7)	26 (96.3)				
21-30	11 (17.7)	51 (82.3)				
31-40	9 (12.5)	63 (87.5)				
41-50	10 (13.3)	65 (86.7)			1	
>50 (Reference)	24 (11.7)	181 (88.3)				
Status						
Alive	53 (12.6)	367 (87.4)		0.8†	3.2 (0.6-16.3)	0.2
Dead (Reference)	2 (8.7)	21 (91.3)			1	
Hospital						
RSSH	10 (37.0)	17 (63.0)		<0.001†	6.0 (3.1-11.8)	<0.001*
AKTH	44 (16.7)	220 (83.3)				
MAWTH	1 (0.7)	150 (99.3)				
HGH (Reference)	0 (0)	1 (100.0)			1	
Hypertensive						
Yes	26 (13.1)	173 (86.9)	0.1	0.7	1.1 (0.6-2.0)	0.8
No (Reference)	29 (11.9)	215 (88.1)			1	
Diabetic						
Yes	0 (0)	110 (100.0)	20.7	<0.001*		

No (Reference)	55 (16.5)	278 (83.5)			1	
HIV						
Positive	2 (11.8)	15 (88.2)		1.0†	1.0 (0.2-4.6)	1.0
Negative	53 (12.4)	373 (87.6)			1	
BOO (Reference)						
Yes	0 (0)	6 (100.0)	0.6†			
No (Reference)	55 (12.6)	382 (87.4)			1	
CGN						
Yes	26 (31.0)	58 (69.0)	32.7	<0.001*	13.1 (5.7-29.7)	<0.001*
No (Reference)	29 (8.1)	330 (91.9)			1	
Sepsis						
Yes	0 (0)	43 (100.0)		0.01*†		
No (Reference)	55 (13.8)	345 (86.3)			1	
PPH						
Yes	1 (3.8)	25 (96.2)		0.2†	0.3 (0.04-2.7)	0.3
No (Reference)	54 (12.9)	363 (87.1)			1	
Year						
2019	2 (7.4)	25 (92.6)	27.3	<0.001*	0.8 (0.6-1.2)	0.1
2020	32 (24.1)	101 (75.9)				
2021	18 (7.5)	223 (92.5)				
2022 (Reference)	3 (7.1)	39 (92.9)			1	

Distribution of cases across LGAs

Out of the 44 LGAs in the state, thirty-six (36) LGAs had at least a case enrolled for hemodialysis across the study area. The urban LGAs had more cases than rural LGAs notably: Kano Municipal LGA had a total of 15576 cases per 100,000 population, Nassarawa LGA had 13093 cases per 100,000 population, Tarauni LGA had 11287 cases per 100,000 population, Kumbotso LGA had 8352 cases per 100,000 population, Ungogo LGA had 6998 cases per 100,000 population, Gwale LGA had 5643 cases per 100,000 population, and Dala LGA had 4740 cases per 100,000 population, respectively (Table 5).

Table 5: Distribution of cases across LGAs of Kano State			
Local Government Areas (LGAs)	Frequency n=443	Percentage %	Cases/100,000 population
Ajingi	3	0.7	677
Albasu	7	1.6	1580
Bagwai	3	0.7	677
Bebeji	1	0.2	226
Bichi	4	0.9	903
Bunkure	4	0.9	903
Dawakin Kudu	10	2.3	2257
Dawakin Tofa	6	1.4	1354
Dala	21	4.7	4740
Danbatta	6	1.4	1354
Doguwa	4	0.9	903
Fagge	34	7.7	7675
Garko	2	0.5	452
Gaya	6	1.4	1354
Gezawa	4	0.9	903
Gwale	25	5.6	5643
Kabo	1	0.2	226
Kiru	2	0.4	452
Kano Municipal	69	15.6	15576
Kumbotso	37	8.4	8352
Kunchi	1	0.2	226
Kura	9	2	2032
Madobi	1	0.2	226
Minjibir	3	0.7	677
Nassarawa	58	13.1	13093

Rano	5	1.1	1129
Rimin Gado	3	0.7	677
Rogo	1	0.2	226
Shanono	1	0.2	226
Sumaila	1	0.2	226
Takai	18	4.1	4063
Tarauni	50	11.3	11287
Tsanyawa	4	0.9	903
Tudun Wada	1	0.2	226
Ungogo	31	7	6998
Wudil	7	1.6	1580

Discussion

Optimal kidney functions are necessary for human survival, and the inability of the kidney to perform the essential functions may require RRT. There is an increase in cases of kidney diseases requiring hemodialysis globally, including in Nigeria. The financial and geographical access to RRT is difficult, especially among the rural populace. This study identified a total of 443 enrolled patients for hemodialysis over the study period. Patients with AKI, CKD, or AOCCKD could have an indication for haemodialyisis [4]. However, timely presentation is an important factor that could determine survival. The majority of patients in this study were enrolled as a result of CKD due to failed conservative management with progressive deterioration of kidney function.

The significant risk factors for CKD were HTN and DM in keeping with studies conducted in southern Nigeria, which reported HTN and hyperglycaemia of (20.8%, and 4.3%) [22], and (30%, and 3.7%) [23], respectively as risk factors. Though this study utilized secondary data, with all the patients having one or more indications for RRT, the studies corroborated the finding of this study of the major risk factors. In a similar pattern, another study in southwest Nigeria reported a prevalence of 27.6%, resulting from HTN (28.9%) and DM (4.2%) [24]. A lower prevalence of 7.8% was reported by a study in south-east Nigeria, also predominantly resulting from HTN (36.9%) and DM (7.9%) [25]. A slightly higher than what was reported from southeast Nigeria, but lower than the burden reported from southwest Nigeria [22-24], a report from northern Nigeria had CKD (12%), with HTN (24%) and DM (4%) as the leading risk factors [12]. Similarly, a higher prevalence of CKD (46.9%) was reported among hypertensive patients in Ghana [26]. Contrary to many studies that reported HTN as a major risk factor of CKD [12, 22-26], a study conducted in western Ghana had a CKD prevalence of 30 % with DM (27 %), constituting more risk than HTN (22 %), but the majority (74 %) of patients had both DM and HTN [27].

These findings are consistent with the epidemiologic transition in developing countries, facilitated by urbanization and nutritional transition, with the picture of the risk factors gradually becoming comparable with developed countries. For example, the electronic databases from France, Japan, Germany, Italy, and the USA reported a similar pattern of CKD risk factors [28], while a UK-based cohort study revealed HTN as the prevalent (> 55%) comorbid condition in CKD [29]. This implies an ongoing trend of double burden

of diseases consisting of outbreaks of communicable diseases, and an ongoing trend of non-communicable diseases (NCDs) in middle and low-income countries. There is therefore an urgent need to develop or adopt an effective model for screening of these risk factors, early diagnosis, and prompt management of hypertensive and diabetic patients. This is evident by identifying the prevalence of systolic HTN of 32.1% and diastolic HTN of 36.8% [30], while the burden of dysglycemia and DM were 10.5% and 3.6%, respectively, following a community screening program of areas identified to have a high burden of kidney disease [31]. The findings positively impacted policy backed by improving RRT services, free screening, and treatment of all patients diagnosed with HTN or DM.

An important factor to consider in the study area is the quality of care provided to patients with risk factors for CKD, especially HTN and DM, including but not limited to early diagnosis and treatment, which is vested in the availability of qualified healthcare workers, especially at the primary healthcare level, where most of the patients can access care. Similarly, compliance with prescribed medications and dietary prescriptions requires collaborative effort in identification as a potential facilitator, especially due to deep-rooted cultural trust and belief in traditional medicine vendors. These traditional medications, in addition to questionable quality to normalize the blood pressure and the blood sugar level, have the potential to negatively affect the kidneys' function.

More cases of AKI were found among patients who do not have CGN, BOO, sepsis, and PPH, which is corroborated by the result of a significant link between these risk factors and AKI. In keeping with a report linking high burden and exposure to AKI risk factors to low-income countries like Nigeria. This is connected to social inequality with associated lack of safe and adequate water supply, where endemic diseases like malaria are common [32].

Similarly, antepartum (40.7%) and post-partum (22.2%) hemorrhage were reported to be important risk factors for AKI in line with our finding [33], and in Egypt, up to 1% of women who were at the obstetrics service point, accounting to 14% of total AKI patients who were managed at RRT centers [34]. This study also found more mortalities among patients with AKI, which could be linked to late diagnosis, delayed presentation to the facility presumably due to gender role in low and middle income countries or poor quality of care associated with delay in either making a diagnosis or lack of the required diagnostic equipment, technical capacity by the healthcare workers, lack of blood bank for emergency transfusion and purchasing power for the services which is supported by the finding of a significantly higher proportion of AKI patients patronizing the state owned hospitals that provides free RRT.

CGN was the significant risk factor for AOCCKD, however, it is a diagnosis of exclusion that will only be confirmed with a histology, and it is therefore not unlikely that most of the clinicians at RSSH which was the facility with significantly more cases of the condition, made the diagnosis on clinical ground based on clinical presentation, renal ultrasound and other laboratory results which is not definitive because of the lack of histology services at the facility. This potentially implies that some patients might be missed without being diagnosed; therefore, an improved high index of suspicion and histology services are essential in early diagnosis of cases.

This was able to review the available secondary data to identify the correlates of hemodialysis in the study area, despite the paucity of data on the study globally. This study is limited by the non-availability of some information in the hemodialysis centers registers that could facilitate an in-depth understanding of the topics.

Limitations of the study

This study is constrained by reliance on secondary data and the absence of histopathology records to confirm diagnoses. Nonetheless, it represents an important step in highlighting existing gaps and offers practical guidance to hospital administrators and clinicians on strengthening histology services for patients. In addition, the findings reflect only patients who were able to access diagnostic and management services,

which may have led to an underestimation of the true disease burden. Despite these limitations, the study provides valuable insights into the key factors associated with risk.

Conclusion

Hemodialysis is an important RRT. There is a high burden of kidney diseases requiring RRT in Kano. The majority of patients studied had CKD, with hypertension and DM as the major risk factors for hemodialysis, followed by AKI, with PPH and sepsis as the major correlates, while AOCCKD had CGN as the major correlate. The government and all relevant stakeholders should target the preventive strategies, such as community screening for hypertension and diabetes, and expanding dialysis access in rural LGAs for managing patients.

Conflicts of interest

There is no conflict of interest

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