

1                                    **Knowledge about the kidney, kidney disease,**  
2                                    **prevention and therapeutic options among non-**  
3                                    **clinical Healthcare Providers at a tertiary facility in**  
4                                    **Southern Nigeria**

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6 **ABSTRACT**  
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**Introduction:** In Nigeria, the occurrence of kidney disease is on the rise and prevention is key. Disease awareness is low, yet knowledge of kidney in disease and health is an essential preventive measure. Information on the knowledge of the kidney, disease prevention and therapeutic options among non-clinical healthcare providers (HCPs) in hospital settings is scarce. This study is aimed to address the knowledge gap.

**Study design:** Cross-sectional study.

**Place and Duration of study:** conducted at the Rivers State University Teaching Hospital, South-South Nigeria, as part of the 2022 World Kidney Day celebrations held on March 10<sup>th</sup> 2022.

**Methodology:** 165 consenting non-clinical HCPs were consecutively recruited. A self-administered questionnaire comprising sociodemographic characteristics and knowledge-based questions was deployed. Total knowledge scores were categorized as poor knowledge, if <50%, fair knowledge, if 50-69% and good knowledge if ≥ 70-100%. Data were analyzed and logistic regression was used to determine predictors of good knowledge using SPSS version 25. A p-value of <0.05 was considered statistically significant.

**Results:** Of 165 respondents recruited, 113(68.5%) were females with a mean age of 46.48 ± 14.01 years and 109(66.1%) had tertiary education. Overall, 74(44.8%) had poor, 43(26.1%) had fair and 48 (29.1%) had good knowledge about the kidney, disease prevention and therapeutic options. Tertiary education was the only significant independent predictor (aOR: 4.676; CI: 1.984; 11.023) of higher knowledge scores. No association was found between past medical/social history and knowledge of the kidney in health and disease.

**Conclusion:** Knowledge of the kidney, disease prevention and therapeutic options among non-clinical HCPs is poor. There is a need for a change in educational approaches to include non-clinical HCPs during kidney health promotion activities, particularly those with lower levels of education.

8 *Keywords: [Kidney disease; knowledge; non-clinical healthcare providers; prevention; therapeutic options]*  
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10 **1. INTRODUCTION**  
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12 Chronic Kidney disease (CKD) is a non-communicable disease that includes a range of different physiological disorders  
13 that are associated with abnormal renal function and progressive decline in glomerular filtration rate (GFR) [1]. CKD is  
14 defined by the Kidney Disease Improving Global Outcome (KDIGO) as kidney damage that has continued for more than  
15 three months as characterized by structural and functional abnormalities of the kidney with or without a decrease in  
16 glomerular filtration rate [2]. It is an emerging public health issue globally and it disproportionately impacts low and  
17 middle-income countries where both prevalence and deaths due to CKD are significantly higher [3].

18 The increasing burden across the globe has been attributed to the rise in the prevalence of its risk factors such as  
19 obesity, hypertension, diabetes, and other cardiovascular diseases [3]. The global estimated prevalence of CKD is

20 13.4% (11.7% -15.1%) and patients with end-stage kidney disease needing renal replacement therapy are estimated  
21 between 4.902 and 7.083 million [4]. A large number of deaths from poor access to renal replacement therapy in  
22 developing countries and also a large increase of patients with end-stage kidney disease in future will produce a  
23 substantial burden for even the wealthiest countries [4] In a study carried out by Innocent et al, the prevalence of CKD  
24 was estimated at 11.4% as at 2018 [5].

25 CKD increases the risk of cardiovascular disease mortality and is a risk factor for both people with diabetes and high  
26 blood pressure. These risk factors can be identified early and treated utilizing commonly accessible, low-cost methods.  
27 These therapies can enhance cardiovascular and renal outcomes and delay the onset of end-stage kidney disease  
28 (ESKD) [6]. Even in nations where data are accessible, disease awareness is low among the general public and health  
29 care authorities. As a result, many of these nations have underdeveloped nephrology workforces or primarily  
30 concentrate on treating patients with ESKD rather than those with early stages of CKD [7].

31 The financial burden involved in taking care of most CKD patients is borne by the patients and their relatives most time  
32 in developing countries and the cost of renal replacement therapy is beyond the reach of most CKD patients in Nigeria  
33 [8]. Despite the huge burden of CKD majority of Nigerians are not well informed about the disease [8–11]. There is a  
34 need to create more public awareness, especially among high-risk individuals as part of the efforts to reduce the disease  
35 burden [5].

36 Non-clinical healthcare providers defined as health coaches, patient navigators, and other personalities (ward maids,  
37 technical assistants, nurse assistants, admin staffers, etc) who interrelate with patients but do not dispense medical  
38 advice or carry out procedures [9]. Their importance for patient and community engagement and care coordination is  
39 increasingly being recognized, in the wave of human resource crisis, as they contribute a significant workforce in the  
40 healthcare system in Africa.[12] Nevertheless, they constitute a potentially high-risk group whose health risks are often  
41 given less attention. Often times, they can be easily assumed to have basic knowledge of health and disease states  
42 because of their routine work schedules in hospital care settings. Yet, they are often unintentionally missed when health  
43 promotion activities are being conducted. Since these non-clinical healthcare providers work within the hospital setting,  
44 they are more often sought out by family members, friends and individuals in the community for advice on health-related  
45 issues before presenting in the hospital [8]. Awareness of the kidneys in health and disease among these 'primary'  
46 healthcare providers is therefore necessary to enable them know their CKD risks and also be effective in enlightening  
47 other people in the community.

48 Most studies have focused on the assessing knowledge of CKD among non-nephrology specialists and non-specialist  
49 doctors and nurses [8,13–16] as a means to improve their clinical suspicion of renal disease and prompt referral to the  
50 nephrologist when indicated. However, there is a paucity of data on the assessment of knowledge of CKD, kidney  
51 disease prevention and therapeutic options among non-clinical healthcare providers, who are also a potential source of  
52 educators to the populace. This study, therefore, aimed to address the gap by assessing the knowledge of the kidney,  
53 disease prevention and therapeutic options among non-clinical healthcare providers in a tertiary hospital in southern  
54 Nigeria as the outcomes from this study will provide the platform to further create awareness of CKD in the hospital and  
55 the community.

## 57 **2. MATERIAL AND METHODS**

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59 This cross-sectional study was conducted in Rivers State, South-South Nigeria, at the Rivers State University of Port  
60 Harcourt Teaching Hospital. The RSUTH Renal Study Group (RRSG), which is made up of adult and pediatric  
61 nephrologists, nephrologists-in-training, and nephrology nurses, carried out the study. The members of the RRSG group  
62 supervised the completion of the questionnaires by consenting participants. As part of ongoing World Kidney Day  
63 celebrations, the study was carried out on March 10 of 2022. The focus was on bridging the knowledge gap for better  
64 kidney care.

65 A sample size calculation using the Cochran formula and a prevalence from a previous study [13] = 12%, e = 0.05%,  
66 alpha: 1.96, CI: 95% was 162. Using a Convenience sampling technique, all non-clinical healthcare providers who gave  
67 consent and made themselves available were enrolled. A total of 190 participants filled and returned the questionnaires,  
68 however, complete data were obtained from 165 of the non-clinical HCPs.

69 The survey tool was a standardized self-administered semi-structured questionnaire validated by the Nephrology  
70 Association of Nigeria (NAN) to be used to assess the basic knowledge of the populace. It had two parts. Section A was  
71 for the sociodemographic variables of participants and section B was a nine-item knowledge-based set of questions. It  
72 included questions on the kidney anatomy: number, physiology: functions, risk factors of kidney disease, symptoms of  
73 kidney disease, tests to detect kidney disease, the prognosis of kidney disease and treatment options. Participants were

74 to provide three answers to the questions that assessed kidney functions, risk factors of kidney disease, symptoms of  
75 kidney disease, tests and treatment options. One point was given to each question completely answered correctly. Total  
76 scores were converted to percentages and categorised as Poor knowledge if the score was <50%, Fair knowledge if the  
77 score was between 50-69% and good knowledge if the score was ≥ 70-100%.

78 **Data Analysis:** Completed questionnaires were entered into an Excel spreadsheet and then analysed using Statistical  
79 Product and Service Solutions for Windows® version 25, SPSS Inc.; Chicago, USA. Results were presented as simple  
80 frequencies and percentages for categorical variables, and the mean and standard deviation for continuous variables. A  
81 p-value of <0.05 was taken as statistically significant at a 95% confidence interval. Bivariate analysis was used to assess  
82 a relationship between participants' sociodemographic and medical and social variables and respondents' knowledge of  
83 the kidney, kidney disease prevention and treatment options. Logistic regression analysis was further conducted with  
84 the significant independent variables from the bivariate analysis to determine the predictors of good knowledge of the  
85 kidney, kidney disease prevention and treatment among the respondents. The dependent variable 'overall knowledge'  
86 was also dichotomized into good knowledge and poor knowledge – by combining fair and poor knowledge.

87 **Ethical approval:** The study was conducted following the Helsinki declaration and the details of the WKD activities and  
88 screening were approved by the Head of the Hospital before commencement.

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### 90 3. RESULTS

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#### 92 Socio-demographic characteristics of respondents

93 A total of 165 respondents were studied and 113 (68.5%) were females. Their ages ranged between 25 and 65 years,  
94 with a mean age of  $46.48 \pm 14.01$  years. Most, 121 (73.3%) of the respondents lived in urban communities, were  
95 married 102 (61.8%), earned monthly stipend of <N30,000, 69 (41.8%) and had tertiary level of education 109 (66.1%),  
96 as shown in Table I.

97 **Table I. Sociodemographic characteristics of respondents**

	Frequency (n=165)	Percent
<b>Sex</b>		
Male	52	31.5
Female	113	68.5
<b>Age (years)</b>		
< 44	87	52.7
45-65	78	47.3
<b>Type of community</b>		
Rural	9	5.5
Semi-urban	35	21.2
Urban	121	73.3
<b>Marital status</b>		
Single	42	25.5
Married	102	61.8
Divorced/Separated	4	2.4

Widowed 17 10.3

**Highest level of education**

None 2 1.2  
Primary 17 10.3  
Secondary 37 22.4  
Tertiary 109 66.1

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**Medical and Social variables of respondents**

A review of the medical and social variables of the respondents revealed that 56 (33.9%) had a history of hypertension, 44 (26.7%) take hypertension medication regularly, 29 (17.6%) had diabetes mellitus, 21 (12.7%) were regularly on diabetes medication, 7 (4.2%) smoke tobacco, 44 (26.7%) take alcohol, 20 (12.1%) use skin lightening cream or soap, 23 (13.9%) take herbal concoctions, 80 (48.5%) take pain killers (NSAIDs), 52 (31.5%) have been screened for kidney disease, 8 (4.8%) have been told they have kidney diseases before, 7 (4.2%) had a relative with kidney disease, while 43 (26.1%) had other medical conditions, as shown in Table II.

**Table II. Medical and social variables of respondents**

	Frequency (n=165)	Percent
<b>Have hypertension</b>		
No	109	66.1
Yes	56	33.9
<b>Take hypertension medication regularly</b>		
No	121	73.3
Yes	44	26.7
<b>Have diabetes mellitus</b>		
No	136	82.4
Yes	29	17.6
<b>Take diabetes mellitus medication regularly</b>		
No	144	87.3
Yes	21	12.7
<b>Smoke tobacco</b>		
No	158	95.8
Yes	7	4.2

**Take alcohol**

No	121	73.3
Yes	44	26.7

**Use skin-lightening cream or soap**

No	145	87.9
Yes	20	12.1

**Take herbal concoctions**

No	142	86.1
Yes	23	13.9

**Take painkillers (NSAIDs)**

No	85	51.5
Yes	80	48.5

**Have been screened for kidney disease**

No	113	68.5
Yes	52	31.5

**Ever been told you have kidney disease**

No	157	95.2
Yes	8	4.8

**Have any relative with kidney disease**

No	158	95.8
Yes	7	4.2

**Have any other medical condition**

No	122	73.9
Yes	43	26.1

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**Knowledge about kidneys, kidney disease prevention and treatments**

One hundred and forty-four (87.3%) of the respondents knew the number of kidneys a normal human has, 93 (56.4%) were aware that someone can live a normal life with one healthy kidney, 73 (44.2%) could state only one out of three functions of the kidney, 62 (37.6%) could state only one out of three required risk factors of kidney disease and 83 (50.3%) could state only one of three symptom/signs of kidney disease. About two-thirds of respondents 103 (62.4%) knew at least one of three required tests used to detect kidney disease, and 89 (53.9%) were aware of at least one way of preventing kidney disease. Nearly two-thirds, 97 (58.8%) were aware that kidney disease can be treated. However, only about one-third, 52 (31.5%) of respondents were aware that chronic kidney disease has no cure.

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123 Overall, 74 (44.8%) had poor, 43(26.1%) had fair knowledge, and 48 (29.1%) had good knowledge about kidneys and  
124 disease, as displayed in Table III.  
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**Table III. Knowledge of the kidney, kidney disease prevention and treatment**

	Frequency (n=165)	Percent
<b>How many kidneys does a normal person have?</b>		
Wrongly answered	21	12.7
Correctly answered	144	87.3
<b>Can someone live a normal life with one healthy kidney?</b>		
Wrongly answered	72	43.6
Correctly answered	93	56.4
<b>What are the functions of the kidney?</b>		
Wrongly answered	92	55.8
Correctly answered	73	44.2
<b>What are the risk factors of the kidney?</b>		
Wrongly answered	103	62.4
Correctly answered	62	37.6
<b>What are the symptoms/signs of kidney disease?</b>		
Wrongly answered	82	49.7
Correctly answered	83	50.3
<b>What test can be used to detect kidney disease?</b>		
Wrongly answered	62	37.6
Correctly answered	103	62.4
<b>How can kidney disease be prevented?</b>		
Wrongly answered	76	46.1
Correctly answered	89	53.9
<b>How is kidney disease treated?</b>		
Wrongly answered	68	41.2
Correctly answered	97	58.8
<b>Can Chronic kidney disease be cured?</b>		

Wrongly answered	113	68.5
Correctly answered	52	31.5
<b>Overall knowledge about Kidney and disease</b>		
Poor (0 – 49.9%)	74	44.8
Fair (50.0 – 69.9%)	43	26.1
Good (70.0 – 100.0%)	48	29.1

### Socio-demographics and knowledge of the kidney, kidney disease prevention and treatment

Table IV showed the distribution of knowledge about kidney disease across some socio-demographic variables. Of all the socio-demographic variables tested, only the level of education showed a statistically significant relationship with knowledge about kidneys and disease. This was particularly notable among respondents with a tertiary level of education (Fisher's Exact Test=26.707,  $p < 0.001$ ), when compared to participants with below tertiary education.

**Table IV. Socio-demographics and knowledge of kidney and disease**

	Knowledge of the kidney, kidney disease prevention and treatment (n=165)						X <sup>2</sup>	p-value
	Poor (n=74)		Fair (n=43)		Good (n=48)			
	Freq	%	Freq	%	Freq	%		
<b>Sex</b>								
Male	20	38.5%	16	30.8%	16	30.8%	1.410	0.494
Female	54	47.8%	27	23.9%	32	28.3%		
<b>Age group</b>								
<45 years	34	39.1%	24	27.6%	29	33.3%	2.668	0.263
45-65 years	40	51.2%	19	24.4%	19	24.4%		
<b>Type of community</b>								
Rural	6	66.7%	3	33.3%	0	0.0%	4.761	0.313
Semi-urban	16	45.7%	7	20.0%	12	34.3%		
Urban	52	43.0%	33	27.3%	36	29.8%		

**Marital status**

Single	13	31.0%	15	35.7%	14	33.3%	6.679	0.352
Married	50	49.0%	25	24.5%	27	26.5%		
Divorced/Separated	2	50.0%	0	0.0%	2	50.0%		
Widowed	9	52.9%	3	17.6%	5	29.4%		

**Monthly income**

Not applicable	0	0.0%	1	33.3%	2	66.7%	12.723	0.139 <sup>#</sup>
<N30,000 (USD 65)	36	52.2%	18	26.1%	15	21.7%		
N30,000-N74,999 (USD 66 – 165)	27	47.4%	12	21.1%	18	31.6%		
N75,000-N149,999 (USD 165 – 330)	10	34.5%	8	27.6%	11	37.9%		
N150,000-N200,000 (USD 330 – 440)	0	0.0%	3	75.0%	1	25.0%		
>N200,000 (> USD 440)	1	33.3%	1	33.3%	1	33.3%		

**Highest level of education**

None	2	100.0%	0	0.0%	0	0.0%	26.707 <sup>#</sup>	<0.001*
Primary	13	76.5%	3	17.6%	1	5.90%		
Secondary	25	67.6%	8	21.6%	4	10.8%		
Tertiary	34	31.2%	32	29.4%	43	39.4%		

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\*=Statistically significant at p<0.05; <sup>#</sup>=Fishers Exact Test used

**Medical and social variables of respondents and knowledge of the kidney, kidney disease prevention and treatment**

Table V shows a there was a significant (p=0.042) association between having a history of hypertension and respondents' knowledge of the kidney, kidney disease prevention and treatment. Good knowledge of kidney disease was higher among those that did not have hypertension compared to those that were hypertensive. Among the former, 35.1% had good knowledge compared to 16.7% of those who were hypertensive. Also, there was a statistically significant (p=0.007) association between taking pain medications and respondents' knowledge of the kidney, kidney disease prevention and treatment. Good knowledge of the kidney, kidney disease prevention and treatment were higher among those who did not take pain medications compared to those that took painkillers. Among the former, 33.7% had good knowledge compared to 23.7% of those who reported having taken painkillers.

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**Table V: Medical and social variables and knowledge of kidney, kidney disease prevention and treatment**

	Knowledge about kidney, kidney disease, prevention and treatment (n=165)						X <sup>2</sup>	p-value
	Poor (n=74)		Fair (n=43)		Good (n=48)			
	Freq	%	Freq	%	Freq	%		
<b>Have hypertension</b>								
No	47	42.3%	25	22.5%	39	35.1%	6.363	<b>0.042*</b>
Yes	27	50.0%	18	33.3%	9	16.7%		
<b>Take hypertension medication regularly</b>								
No	54	45.0%	31	25.8%	35	29.2%	0.012	0.994
Yes	20	44.4%	12	26.7%	13	28.9%		
<b>Have diabetes mellitus</b>								
No	61	45.2%	33	24.4%	41	30.4%	1.181	0.554
Yes	13	43.3%	10	33.3%	7	23.3%		
<b>Take diabetes mellitus medication regularly</b>								
No	66	47.1%	33	23.6%	41	29.3%	3.294	0.193
Yes	8	32.0%	10	40.0%	7	28.0%		
<b>Smoke tobacco</b>								
No	70	44.0%	41	25.8%	48	30.1%	0.991 <sup>#</sup>	0.667
Yes	4	66.7%	2	33.3%	0	0.0%		
<b>Take alcohol</b>								
No	52	41.2%	37	29.4%	37	29.4%	3.770	0.152
Yes	22	56.4%	6	15.4%	11	28.2%		
<b>Use skin-lightening cream or soap</b>								
No	66	46.1%	33	23.1%	44	30.8%	0.739	0.691

<b>Yes</b>	8	36.3%	10	45.5%	4	18.2%		
<b>Take herbal concoctions</b>								
<b>No</b>	63	43.8%	37	25.7%	44	30.6%	1.197	0.549
<b>Yes</b>	11	53.4%	6	28.6%	4	19.0%		
<b>Take painkillers routinely</b>								
<b>No</b>	36	40.4%	23	25.8%	30	33.7%	9.788	<b>0.007*</b>
<b>Yes</b>	38	50.0%	20	26.3%	18	23.7%		
<b>Have been screened for kidney disease</b>								
<b>No</b>	50	43.9%	27	23.7%	37	32.5%	2.315	0.314
<b>Yes</b>	24	47.1%	16	31.4%	11	21.6%		
<b>Ever been told you have kidney disease</b>								
<b>No</b>	71	45.5%	41	26.3%	44	28.2%	1.107	0.575
<b>Yes</b>	3	33.3%	2	22.2%	4	44.4%		
<b>Have any relative with kidney disease</b>								
<b>No</b>	71	44.9%	43	27.2%	44	27.8%	1.459 <sup>#</sup>	0.545
<b>Yes</b>	3	42.9%	0	0.0%	4	57.1%		
<b>Have any other medical condition</b>								
<b>No</b>	55	45.4%	25	20.7%	41	33.9%	4.066	0.131
<b>Yes</b>	19	45.2%	16	38.1%	7	16.7%		

\*=Statistically significant at  $p < 0.05$ ; <sup>#</sup>=Fishers Exact Test used

On logistic regression analysis, as shown in Table VI, it was revealed that participants' highest level of education was significantly ( $p = 0.001$ ) associated with having a good knowledge of kidney, and kidney disease prevention and treatment. Participants with a tertiary level of education were 4.676 times more likely (aOR: 4.676; CI:1.984; 11.023) to have good knowledge when compared to participants below a tertiary level of education. Although bivariate analysis suggested otherwise, regression analysis showed that there was no significant association between taking pain medications aOR: 0.589 (CI: 0.286; 1.217) or being hypertensive aOR: 1.151 (CI: 0.520; 2.548) and having good knowledge of kidney, kidney disease prevention and treatment, after adjusting for all other confounding variables.

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**Table VI: Logistic regression showing the strength of association of significant demographic, medical and social variables and knowledge of kidney, kidney disease prevention and treatment**

	B	aOR	95% CI for OR		p-value
			Lower Limit	Upper Limit	
<b>Take pain killers</b>					
Good knowledge	-.529	0.286	1.217	0.589	<b>0.153</b>
Poor knowledge	0 <sup>b</sup>				
<b>Have Hypertension</b>					
Good knowledge	0.141	1.151	0.520	2.548	<b>0.729</b>
Poor knowledge	0 <sup>b</sup>				
<b>Highest level of education</b>					
Good knowledge	1.543	4.676	1.984	11.023	<b>&lt;0.001*</b>
Poor knowledge	0 <sup>b</sup>				

aOR=Odds Ratio; Reference category (b)= Poor knowledge; b=Parameter set at 0 because it is redundant

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## DISCUSSION

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Chronic kidney disease is a common and increasing problem globally[8,14,15]. There is evidence that a huge aspect of the populace has insufficient awareness of the disease[3,16–18]. This study assessed the knowledge of the kidney, kidney disease prevention and therapeutic options among non-clinical healthcare providers at a tertiary hospital in Southern Nigeria. There is a paucity of data concerning kidney disease, among non-clinical healthcare providers [7,19–21].

The study participants had an overall poor knowledge about kidneys, disease prevention and therapeutic options. The fact that these non-clinical healthcare providers had inadequate knowledge despite rendering some form of care in the hospital community including the medical and nephrology outpatients' clinics suggests that physicians' existing education strategies do not necessarily meet the needs of these cohorts of healthcare staffers. Our finding, has invariably, identified and highlighted a gap through the World Kidney Day activities in 2022, which focused on - 'bridging the knowledge gap for better kidney care' among non-clinical HCPs in our setting. It is plausible that these non-clinical healthcare providers are not receiving adequate education from their clinical counterparts and are more often than not, missing out despite being within the hospital. This research highlights the need for a change in educational approaches, such that even non-medical staffers are included during the health promotions and education about the kidney in health and disease. Similar to our findings were reported from other studies within Nigeria[22–24] and outside Nigeria[20,25] which found low levels of knowledge of the kidneys, kidney disease prevention and therapeutic options among the general populace of adults. In contrast, studies by Ibitoba et al[21] conducted among motorcyclists in Ado-Ekiti State, and Adejumo et al[26] among nurses in Akure, Ondo State, both in South West Nigeria found that only 35.5% and 37% had poor knowledge of kidney disease respectively. Our rather higher prevalence of poor knowledge found can be possibly explained by the fact that the general awareness of kidney disease and health promotions often occur outside of the hospitals and are often within clinical healthcare providers, somehow overlooking the non-clinical HCPs.

228 Despite a majority of respondents having poor knowledge, there were some items on the survey tool on which they  
229 scored fairly well. Particularly, 87.3% of the participants knew the anatomical location and the number of kidneys, 56.4%  
230 knew that a person could live a normal life with only one kidney, 50,3% could mention at least one symptom of kidney  
231 disease, 58.8% knew at least one modality of treatment for kidney disease. This was in contrast to findings from a study  
232 in Akwa-Ibom state, South-South Nigeria by Akpan and Ekrikpo,[22] where only 43.3% knew the correct location of the  
233 kidneys. However, less than half of the respondents in this study could mention only one of any three vital functions of  
234 the kidney. A greater majority could not answer beyond one of the required three items per question. Our study was  
235 similar to findings from other Nigerian studies where respondents had low knowledge of the functions and symptoms of  
236 kidney disease. Risk factors for kidney disease and the possibility of curing chronic kidney disease were also areas with  
237 low levels of knowledge, found in this study.

238 Also, it was found that of all the sociodemographic, medical and social variables tested, only the level of education  
239 showed a statistically significant relationship with knowledge about the kidney, kidney disease prevention and treatment.  
240 This was similar to the findings done in Maiduguri, North East Nigeria, Ado Ekiti and Lagos, South West Nigeria, Saudi  
241 Arabia and Brazil [2,17,21,27,29]. This underscores the well-established fact that improvement in social determinants of  
242 health such as educational status improves health outcomes [30]. The educated are more likely to understand and follow  
243 up on their health statuses as has been demonstrated in the already existing literature [27].

244 As regards the medical history of the respondents, it was found that about one-third either had a history of hypertension  
245 (33.9%) or diabetes mellitus (29%) and about one-tenth (9%) either knew a relative with kidney disease or had kidney  
246 disease themselves. It was also rather an unexpected finding that there was no significant relationship between  
247 respondents with a past medical history of hypertension, diabetes and other risk factors and their knowledge of kidney  
248 disease. It would rather have been expected that those with existing risk factors would know more, this albeit, was not  
249 the case among the non-clinical healthcare providers. These further stresses the importance of health education,  
250 promotion and physician-patient communication.

251 Worthy of note are other risk factors known to be linked with kidney disease identified among non-clinical healthcare  
252 providers in this study. Almost half (48.5%) reported using painkillers like nonsteroidal anti-inflammatory drugs (NSAIDs)  
253 regularly, almost one-quarter (26.7%) take alcohol and just over a tenth (13.9%) of non-clinical HCPs use herbal  
254 concoctions. Our findings differed from studies in Nigeria conducted among non-clinical healthcare provider populations,  
255 where herbal concoctions were the most commonly identified risk factor for kidney disease followed by alcoholic  
256 beverages and NSAIDs [31,32]. This could be because painkillers are more readily available over the counter and would  
257 naturally be the go-to drug for non-clinical HCPs in clinical settings.

#### 258 **Limitations:**

259 Despite being able to achieve our main aim to determine the knowledge of the kidney, kidney disease prevention and  
260 therapeutic options among non-clinical healthcare providers in our setting, our study was limited due to the study design,  
261 a considerably small sample size, and being single-centred.  
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263  
264

## 265 **4. CONCLUSION**

266 Knowledge of the kidney, disease prevention and therapeutic options among non-clinical HCPs is unsatisfactory. There  
267 is a need for change in educational approaches to ensure kidney and CKD-targeted health education and promotional  
268 activities are also towards non-clinical HCPs, particularly those with lower levels of education. This is essential as they  
269 are a potential, yet a crucial source of educators for kidney health promotion in the community.  
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272

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283 **COMPETING INTERESTS**

284  
285 The authors have declared that no competing interests exist.  
286

287 **AUTHORS' CONTRIBUTIONS**

288  
289 Author DCB, EBJ designed the study. DCB performed the statistical analysis and managed the analysis, wrote the  
290 protocol and wrote the first draft of the manuscript. Authors 'MI, NTI, OE, and DCB' managed the literature searches.  
291 'Author EBJ wrote the abstract, EBJ and PMD proofread for intellectual content' All authors were involved in data  
292 collation, read and approved the final manuscript.  
293

294 **CONSENT**

295  
296 All authors declare that informed consent was obtained from the participants before the commencement of the study.  
297

298 **ETHICAL APPROVAL**

299  
300 All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee  
301 and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of  
302 Helsinki."  
303

304 **REFERENCES**

- 305  
306 1. Ghelichi-Ghojogh M, Fararouei M, Seif M, Pakfetrat M. Chronic kidney disease and its health-related factors: a  
307 case-control study. *BMC Nephrol.* 2022;23(1):24.
- 308 2. Chukwuonye II, Ohagwu KA, Adelowo OO, Chuku A, Obi EC, Onwuchekwa U, et al. Prevalence and Predictors  
309 of Chronic Kidney Disease in a Semiurban Community in Lagos. *International Journal of Nephrology.*  
310 2019;2019:e1625837.
- 311 3. Shrestha N, Gautam S, Mishra SR, Virani SS, Dhungana RR. Burden of chronic kidney disease in the general  
312 population and high-risk groups in South Asia: A systematic review and meta-analysis. *PLoS ONE.*  
313 2021;16(10):e0258494.
- 314 4. Liu B-C, Lan H-Y, Lv L-L, Lv J-C, Zhang L-X (eds.). Prevalence and Disease Burden of Chronic Kidney Disease.  
315 In: *Renal Fibrosis: Mechanisms and Therapies.* 2019. Singapore. Springer Singapore: 3–15.
- 316 5. Chukwuonye II, Ogah OS, Anyabolu EN, Ohagwu KA, Nwabuko OC, Onwuchekwa U, et al. Prevalence of  
317 chronic kidney disease in Nigeria: systematic review of population-based studies. *IJNRD.* 2018;11:165–172.
- 318 6. Couser WG, Remuzzi G, Mendis S, Tonelli M. The contribution of chronic kidney disease to the global burden of  
319 major noncommunicable diseases. *Kidney International.* 2011;80(12):1258–1270.
- 320 7. Bikbov B, Purcell CA, Levey AS, Smith M, Abdoli A, Abebe M, et al. Global, regional, and national burden of  
321 chronic kidney disease, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *The Lancet.*  
322 2020;395(10225):709–733.
- 323 8. Adejumo O, Akinbodewa A, Iyawe I, Emmanuel A, Ogungbemi O. Assessment of knowledge of chronic kidney  
324 disease among non-nephrology nurses in Akure, South-West Nigeria. *Saudi J Kidney Dis Transpl.* 2018;29(6):1417.
- 325 9. Nahlah Fahad A, Ahmed Alkhateeb A, Rabah Alsharari A, Naif Alharbi A, Abdullaziz Hamed A. Measuring the  
326 Awareness of Chronic Kidney Disease (CKD) with Environmental Evaluation among Adult Diabetic Patients in Hail  
327 Region, Saudi Arabia. *Journal of Environmental and Public Health.* 2022;2022:1–6.
- 328 10. Akpan EE, Ekrikpo UE. Chronic Kidney Failure: Knowledge of Kidney Disease, Perception of Causes and  
329 Symptomatology in Uyo, Nigeria. *OJNeph.* 2015;05(03):91–97.
- 330 11. Okoro RN, Ummate I, Ohieku JD, Yakubu SI, Adibe MO, Okonta MJ. Kidney Disease Knowledge and Its  
331 Determinants Among Patients With Chronic Kidney Disease. *Journal of Patient Experience.* 2020;7(6):1303–1309.

- 332 12. Eyal N, Cancedda C, Kyamanywa P, Hurst SA. Non-physician Clinicians in Sub-Saharan Africa and the  
333 Evolving Role of Physicians. *Int J Health Policy Manag.* 2015;5(3):149–153.
- 334 13. Choukem S-P, Nchifor PK, Halle M-P, Nebongo DN, Mboue-Djieka Y, Kaze FF, et al. Knowledge of physicians  
335 on chronic kidney disease and their attitudes towards referral, in two cities of Cameroon: a cross-sectional study. *BMC*  
336 *Research Notes.* 2016;9(1):29.
- 337 14. Jazienicka-Kielb A, Babicki M, Krajewska M, Oko A, Kloda K, Mastalerz-Migas A. Assessment of primary care  
338 physicians' knowledge of chronic kidney disease in Poland. *Frontiers in Public Health.* 2022;10.  
339 <https://www.frontiersin.org/articles/10.3389/fpubh.2022.1032240>. Accessed 21 January 2023.
- 340 15. Agaba EI, Agaba PA, Dankyau M, Akanbi MO, Daniyam CA, Okeke EN, et al. Specialist physician knowledge of  
341 chronic kidney disease: A comparison of internists and family physicians in West Africa. *Afr j prim health care fam med.*  
342 2012;4(1). doi:10.4102/phcfm.v4i1.319.
- 343 16. Mahmud M, Hussain N, Kamal A, Samoo ZI, Khan WA. Doctors Knowledge and Practices Regarding Chronic  
344 Kidney Disease at a Tertiary Care Hospital. *International Archives of Medicine.* 2016;9. doi:10.3823/1959.
- 345 17. Olanrewaju TO, Aderibigbe A, Popoola AA, Braimoh KT, Buhari MO, Adedoyin OT, et al. Prevalence of chronic  
346 kidney disease and risk factors in North-Central Nigeria: a population-based survey. *BMC Nephrology.* 2020;21(1):467.
- 347 18. Fauziyati A. Global challenge of early detection and management of chronic kidney disease. *JKKI.* 2017;8(1):1–  
348 2.
- 349 19. Younes S, Mourad N, Safwan J, Dabbous M, Rahal M, Al Nabulsi M, et al. Chronic kidney disease awareness  
350 among the general population: tool validation and knowledge assessment in a developing country. *BMC Nephrol.*  
351 2022;23(1):266.
- 352 20. Stanifer JW, Turner EL, Egger JR, Thielman N, Karia F, Maro V, et al. Knowledge, Attitudes, and Practices  
353 Associated with Chronic Kidney Disease in Northern Tanzania: A Community-Based Study. *PLoS One.*  
354 2016;11(6):e0156336.
- 355 21. Alobaidi S. Knowledge of Chronic Kidney Disease Among the Population of Saudi Arabia Evaluated Using a  
356 Validated Questionnaire: A Cross-Sectional Study. *PPA.* 2021;15:1281–1288.
- 357 22. Wolide AD, Kumela K, Kerga F, Debalke S, Seboka M, Edilu B, et al. Knowledge, attitude, and practices toward  
358 chronic kidney disease among care providers in Jimma town: cross-sectional study. *BMC Public Health.*  
359 2020;20(1):1079.
- 360 23. Ngendahayo F, Mukamana D, Ndateba I, Nkurunziza A, Adejumo O, Chironde G. Chronic Kidney Disease  
361 (CKD): knowledge of risk factors and preventive practices of CKD among students at a University in Rwanda. *Rwanda*  
362 *Journal of Medicine and Health Sciences.* 2019;2(2):185.
- 363 24. Yabeyu AB, Haile KT, Belay YB, Tegegn HG. Limited Public Knowledge of Chronic Kidney Disease in a  
364 Resource-Limited Setting: A Cross-Sectional Study. *Int J Gen Med.* 2022;15:4997–5003.
- 365 25. Ibitoba FA, Akpor OA, Akpor OB. Prevalence and risk factors of chronic kidney disease among commercial  
366 motorcyclists in Ado-Ekiti, Ekiti State, Nigeria. *Scientific African.* 2022;16:e01136.
- 367 26. Okwuonu C, Chukwuonye I, Ogah S, Abali C, Adejumo O, Oviasu E. Awareness level of kidney functions and  
368 diseases among adults in a Nigerian population. *Indian J Nephrol.* 2015;25(3):158.
- 369 27. Oluyombo R, Ayodele O, Akinwusi P, Okunola O, Gbadegesin B, Soje M, et al. Awareness, knowledge and  
370 perception of chronic kidney disease in a rural community of South-West Nigeria. *Niger J Clin Pract.* 2016;19(2):161.
- 371 28. Assiry A, Alshahrani S, Banji D, Banji OJF, Syed NK, Alqahtani SS. Public Awareness of Chronic Kidney  
372 Disease in Jazan Province, Saudi Arabia—A Cross-Sectional Survey. *Healthcare.* 2022;10(8):1377.

- 373 29. Adejumo O, Akinbodewa A, Iyawe I, Emmanuel A, Ogungbemi O. Assessment of knowledge of chronic kidney  
374 disease among non-nephrology nurses in Akure, South-West Nigeria. *Saudi J Kidney Dis Transpl.* 2018;29(6):1417.
- 375 30. Omeonu PE, Olayemi AT, Asekun-Olarinmoye I. Awareness of the Risk Factors for Chronic Kidney Disease  
376 among Secondary School Students in Nigeria: Evidence from Ogun State. *African Journal of Health, Nursing and*  
377 *Midwifery.* 2022;5(1):55–63.
- 378 31. Albuquerque ACRM de M, Pinto GN, Pereira GA, Silva LF, Fontenele TAS, Oliveira JGR de, et al. Population  
379 knowledge on chronic kidney disease, its risk factors and means of prevention: a population-based study in Fortaleza,  
380 Ceará, Brazil. *Braz J Nephrol.* 2022;44(4). doi:10.1590/2175-8239-jbn-2022-0017pt.
- 381 32. Levin A. Improving Global Kidney Health: International Society of Nephrology Initiatives and the Global Kidney  
382 Health Atlas. *Ann Nutr Metab.* 2018;72(Suppl. 2):28–32.
- 383 33. Akokuwebe ME, Odimegwu C. Socioeconomic Determinants of Knowledge of Kidney Disease Among Residents  
384 in Nigerian Communities in Lagos State, Nigeria. *Oman Med J.* 2019;34(5):444–455.
- 385 34. Yusuf AA, Oche MO, Isha AB, Onankpa B. Awareness and prevalence of risk factors of chronic kidney disease  
386 among civil servants in Sokoto, Nigeria. *International Archives of Medical and Health Research.* 2019;1(1):1–7.
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