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RESEARCH ARTICLE

Assessment of Kidney Failure Risk Equation among Chronic Kidney Disease Patients: A cross-sectional study

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Abstract

Background: Patients with chronic kidney disease (CKD) are at increased risk for kidney failure, cardiovascular events, and both cause mortality. Accurate models are needed to predict and identify patients at risk of progression to kidney failure which may facilitate more optimal nephrology care.

Objective: This study assessed the kidney failure risk equation among CKD patients to predict when they need to start renal replacement therapy.

Materials and methods: Total of 38 CKD patients were recruited from the renal unit of the Cape Coast Teaching Hospital. Estimated glomerular filtration rate (eGFR) and albumin creatinine ratio were measured from each patient. Information on age, gender, body mass index, blood pressure, cause of CKD and type of medication on were obtained from the patient's medical records. The 4-variable Kidney Failure Risk Equation (KFRE) was used to assess the risk of progression to kidney failure among the participants. The KFRE uses 4-variables (age, sex, estimated GFR, albumin).

Results: For both 2-year and 5-year risk of progression, serum creatinine and ACR increases as the risk increases from participants with low risk of progression through to high risk. Mean eGFR decreased from participants with low risk of progression through to those with high risk. Serum creatinine and ACR positively correlated with both 2-year and 5-year risk progression. eGFR, on the other hand, negatively correlated with both 2-year and 5-year risk progression. Participants with high 2- year and 5-year risk were on Linopril/Calcitonin/Atorvostatin drug combination, while participants with low and intermediate risks for both 2-year and 5-year were on lisinopril only.

Conclusion: KFRE was able to discriminate which participants have low, intermediate and high 2-year and 5-year risk of progression to end stage kidney failure and which participants need to start renal replacement therapy.

Keywords: Chronic kidney disease, End stage kidney disease, Kidney failure risk equation, Renal replacement therapy, Risk of progression.

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Introduction

Chronic kidney disease (CKD) is a global health concern and adequate preparation is required to provide education, consider renal replacement therapy, mortality option and plan for the initiation of renal therapy. CKD describes the persistent urine and structural abnormalities or impaired excretory renal function which is suggestive of a loss of functional nephrons. CKD is an adverse clinical condition because renal impairment may prelude to the development of end-stage renal disease (ESRD) requiring the need for dialysis and transplantation (Zoccali, Kramer, & Jager, 2009). Also, CKD amplifies the risk for cardiovascular complication (Chobanian et al., 2003). It is reported that patients with stage 4–5 CKD, independent of other risk factors have a death risk for cardiovascular complications which is 2–4 times higher than that of the coeval general population, whilst patients with ESRD have absolute higher risk (Baigent, Burbury, & Wheeler, 2000). Worldwide, people have predicted when CKD patients would start

dialysis or transplantation in order to put in measures to reduce the rate of progression of CKD to kidney failure (Tangri, 2017).

Cases of CKD across sub Saharan Africa keeps increasing due to the ever-increasing number of predisposing factors (Nahas, 2005). Instigated by CKD and ESRD in both adults (Kimmel & Patel, 2006) and children (McKenna et al., 2006) are increased mortality, morbidity and poor quality of life which further imposes high direct and indirect costs to society. The situation is further compounded by the low number of primary health care facilities and the lack of specialist personnel to manage cases of CKD. The kidney function risk equation developed by Tangri and colleagues (Tangri, 2017) is useful in predicting when one will need to start renal replacement therapy. This will enable nephrologists to put in measures to reduce the rate of progression of CKD which will help reduce some of the financial stress associated with renal replacement therapy. However, data on the use of such a tool especially across Sub-Saharan Africa is scanty. Thus, we assessed the kidney function risk equation among CKD patients to predict when they need to start dialysis or transplantation.

Materials and Methods

Study design: A cross-sectional study design was used to recruit CKD patients from the renal unit of Cape Coast Teaching Hospital. Currently, the hospital is a 400-bed capacity referral hospital in the region. The hospital also serves as the teaching and practical biomedical site for several nursing and allied health programmes. Presently, the hospital has accreditation for the training of resident physicians in Internal Medicine and Surgery.

Study Population: Thirty-eight (38) CKD patients were recruited from the renal unit of the Cape Coast Teaching Hospital. Both gender (male and female) with stages 1, 2, 3 CKD patients and are undergoing treatment were recruited as participants for the study.

Eligibility criteria/Ethical clearance: Participants with CKD stage 1, 2 and 3 with written informed consent were enrolled in the study. Patients with CKD stage 4, end stage kidney failure, on dialysis and those who have been transplanted were excluded from this study. Ethical clearance was sought from the Ethical Review Committee of Cape Coast Teaching Hospital, Cape Coast and written consent was also obtained from all the participants.

Experimental Protocols

Blood Sample Collection: After 8 – 12 hours overnight fast, two (2) ml of venous blood was drawn from each participant and a drop was used for fasting blood glucose (FBG) was estimated with ACCU-CHEK glucometer (manufactured by Roche Diabetes Care GmbH, Germany). The blood was put in a gel tube and allowed to clot and serum separated and stored. Serum creatinine was measured using the automated Selectra Pro S Clinical Chemistry analyzer (manufactured by ELITechGroup, Puteaux France). eGFR was calculated from the creatinine values for each participant using Chronic Kidney Disease Epidemiological Collaboration Equation, CKD-EPI.

Measurement of Albumin– Creatinine ratio (ACR): About 10 ml of a clean-catch urine sample was collected from each participant into a dry, sterile wide-mouth container. Semi quantitative CLINITEK albumin and creatinine strips (SIEMENS Healthineers, Germany) was used to detect the amount of albumin and creatinine in the urine sample to get the albumin creatinine ratio.

Using the Kidney Failure Risk Equation: The Kidney Failure Risk equation (KFRE) models are based on laboratory data and demographic variables that predicts the risk of developing kidney failure. (Tangri et al., 2011). The sex, age, eGFR and albumin creatinine ratio of each participant was input into the KFRE to calculate for Kidney failure in over 2 years and over 5 years (renal). The formulas are:

$P = 1\text{-}S_{ave}$ (t=1,826)

$a = -0.55418x[(eGFR/5)\text{-}7.22] + 0.26940 \times (male\text{-}0.56) + 0.45608 \times [in\ (ACR) - 5.2774]\text{-}0.21670 \times [(age/10) - 7.04]$

Where:

- p = Five-year risk of kidney failure
- S_{ave} (t=1826) = Five-year survival rate for an individual with the average value of covariates in the risk equation and was 0.929 in the development dataset
- eGFR = Estimated Glomerular Filtration Rate (eGFR) (ml/min/1.73m2)
- ln (ACR) = Natural logarithm of Albumin-Creatinine Ratio (ACR) (mg/g)
- male = Indicator for sex (male = 1, female = 0)
- age = Age (years) at test date

Data Analysis: Independent t-test was used to compare mean scores between two groups. One-way ANOVA was also employed to compare the mean scores of more than two groups. Correlation (Pearson correlation) and linear regression analyses were also performed. P<0.05 was considered statistically significant. Data was analyzed with SPSS version 16 (SPSS Inc. Chicago).

Results

Table 1 shows the general characteristics of study participants stratified by gender. Most (77.8%) of the males had normal weight, while most of the females (45%) were obese. All the males and most (60.0%) of the females had significantly high creatinine concentration (P<0.005).

Table 1: General characteristics of the study participants.

Parameter	Total (N=38)	Male (N=18)	Female (N=20)	P-value
Age (years)	58.50±13.60	60.72±12.55	56.50±14.50	0.346
Age group (years)				
21-35	3 (7.9)	1 (5.6)	2 (10.0)	0.644
36-50	7 (18.4)	3 (16.7)	4 (20.0)	
51-65	15 (39.5)	6 (33.3)	9 (45.0)	
>65	13 (34.2)	8 (44.4)	5 (25.0)	
Diagnosis				
Diabetes	6 (15.8)	3 (16.7)	3 (15.0)	0.888
Hypertension	32 (84.2)	15 (83.3)	17 (85.0)	
BP (mmHg)				
Optimal	3 (7.9)	1 (5.6)	2 (10.0)	0.688
Normal	2 (5.3)	1 (5.6)	1 (5.0)	

Prehypertension	2 (5.3)	1 (5.6)	1 (5.0)	
Hypertension	21 (55.3)	12 (66.7)	9 (45.0)	
ISH	10 (26.3)	3 (16.7)	7 (35.0)	
BMI (Kg/m2)				
Normal	17 (44.7)	14 (77.8)	3 (15.0)	<0.001
Overweight	12 (31.6)	4 (22.2)	8 (40.0)	
Obese	9 (23.7)	0 (0.0)	9 (45.0)	
FBG (mmol/l)				
Normal	31 (81.6)	15 (83.3)	16 (80.0)	0.791
High	7 (18.4)	3 (16.7)	4 (20.0)	
Creatinine (µmol/l)				
Normal	8 (21.1)	0 (0.0)	8 (40.0)	0.003
High	30 (78.9)	18 (100.0)	12 (60.0)	
eGFR (ml/min/1.72m2)				
≥90	1 (2.6)	0 (0.0)	1 (5.0)	0.352
60-89	2 (5.3)	0 (0.0)	2 (10.0)	
45-59	13 (34.2)	7 (38.9)	6 (30.0)	
30-44	14 (36.8)	8 (44.4)	6 (30.0)	
15-29	7 (18.4)	2 (11.1)	5 (25.0)	
<15	1 (2.6)	1 (5.6)	0 (0.0)	
ACR (mg/g)				
<30	8 (21.1)	5 (27.8)	3 (15.0)	0.335
30-300	30 (78.9)	13 (72.2)	17 (85.0)	
FBG = Fasting Blood Glucose ACR = Albumin Creatinine ratio ISH = Isolated Systolic Hypertension BMI = Body Mass Index				

Figure 1 illustrates the distribution of 2-year and 5-year progression to kidney failure risk among participants. For the 2-year risk of progression, 94.7%, 2.6%, 2.6% of the participants had low risk, intermediate risk and high risk of progression respectively whereas for the 5-year risk of progression, 68.4%, 18.4%, 13.2% of the participants had low risk, intermediate risk and high risk of progression respectively and were statistically significant (P=0.012).

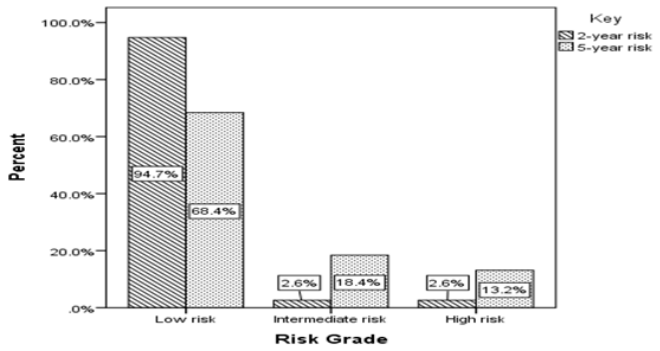

Figure 1: Distribution of 2-year and 5-year progression to kidney failure among participants (P=0.012).

Figure 2 presents the 2-year risk progression of participants in relation to gender. For the males, 94.4%, 0%, 5.6% of the participants had low, intermediate, and high risk of progression respectively whereas for females, 95.0%, 5.0%, 0.0% of the participants had low, intermediate, and high risk of progression respectively and were statistically insignificant (P=0.366).

Figure 3 presents 5-year risk progression of participants in relation to gender. For the males, 66.7%, 16.7%, 16.7% of the participants had low, intermediate, and high risk of progression respectively whereas for females, 70.7%, 20.0%, 10.0% of the participants had low, intermediate, and high risk of progression respectively and were statistically insignificant (P=0.822).

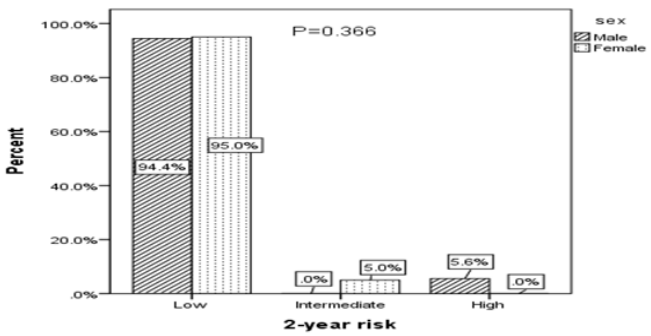

Figure 2: Two-year risk progression of participants in relation to gender.

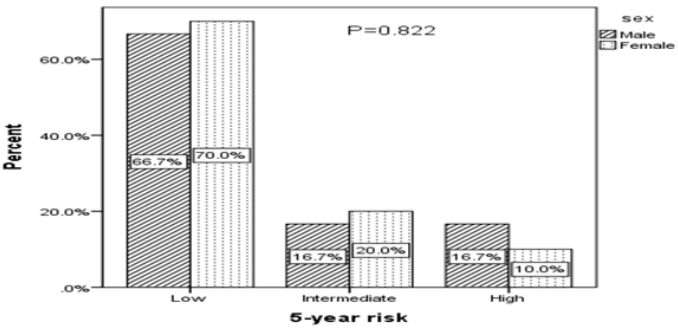

Figure 3 Five-year risk progression of participants in relation to gender.

Table 2 presents the socio-demographic, and distribution of clinical and biochemical characteristics of participants stratified by 2-year kidney failure risk. Most (41.7%) of the participants with low 2-year risk progression were within 51-65 years. The participants with intermediate risk and high risk were within 21-35 years and 36-50 years respectively.

Table 2 Socio-demographic, and distribution of clinical and biochemical characteristics of participants stratified by 2-year kidney failure risk.

Parameter	Low (N=36)	Inter mediate (N=1)	High (N=1)	P-value
Age (years)	59.47±13.20	34.00±0.00	48.00±0.00	0.133
Age group (years)				
21-35	2 (5.6)	1 (100.0)	0 (0.0)	0.011
36-50	6 (16.7)	0 (0.0)	1 (100.0)	
51-65	15 (41.7)	0 (0.0)	0 (0.0)	
>65	13 (36.1)	0 (0.0)	0 (0.0)	
Diagnosis				
Diabetes	6 (16.7)	0 (0.0)	0 (0.0)	0.820
Hypertension	30 (83.3)	1 (100.0)	1 (100.0)	
BP (mmHg)				
Optimal	3 (8.3)	0 (0.0)	0 (0.0)	0.989
Normal	2 (5.6)	0 (0.0)	0 (0.0)	
Prehypertension	2 (5.6)	0 (0.0)	0 (0.0)	
Hypertension	19 (52.8)	1 (100.0)	1 (100.0)	
ISH	10 (27.8)	0 (0.0)	0 (0.0)	
BMI (Kg/m2)				
Normal	16 (44.4)	0 (0.0)	1 (100.0)	0.487
Overweight	11 (30.6)	1 (100.0)	0 (0.0)	
Obese	9 (25.0)	0 (0.0)	0 (0.0)	
FBS (mmol/l)				
Normal	29 (80.6)	1 (100.0)	1 (100.0)	0.788

High	7 (19.4)	0 (0.0)	0 (0.0)	
Creatinine (µmol/l)				
Normal	8 (22.2)	0 (0.0)	0 (0.0)	0.755
High	28 (77.8)	1 (100.0)	1 (100.0)	
eGFR (ml/min/1.72m2)				
≥90	1 (2.8)	0 (0.0)	0 (0.0)	0.001
60-89	2 (5.6)	0 (0.0)	0 (0.0)	
45-59	13 (36.1)	0 (0.0)	0 (0.0)	
30-44	14 (38.9)	0 (0.0)	0 (0.0)	
15-29	6 (16.7)	1 (100.0)	0 (0.0)	
<15	0 (0.0)	0 (0.0)	1 (100.0)	
ACR (mg/g)				
<30	8 (22.2)	0 (0.0)	0 (0.0)	0.755
30-300	28 (77.8)	1 (100.0)	1 (100.0)	
Drug used				
Lisinopril	26 (72.2)	0 (0.0)	0 (0.0)	0.006
Lisinopril+Metformin	6 (16.7)	0 (0.0)	0 (0.0)	
Lisinopril+Atorvostatin	2 (5.6)	0 (0.0)	0 (0.0)	
Linopril+Calciton+Atorvostatin	2 (5.6)	1 (100.0)	1 (100.0)	

Majority (91.7%) with low risk had eGFR ranging from 30 to 60. Participants with intermediate risk and high risk had eGFR of 15-29 and less than 15 respectively. Both participants with intermediate and high 2-year risk were on Lisinopril/Calciton/Atorvostatin drug combination while majority (72.2%) of low risk participants were on lisinopril.

Mean clinical and biochemical characteristics of participants in relation to 2-year risk of kidney failure is shown in **Table 3**. Mean serum creatinine [140.48±37.72; 242.50±0.00; 838.00±0.00, P<0.05] and ACR [35.56±15.53; 60.00±0.00; 150.00±0.00, P<0.0001] significantly increased as the risk increased from participants with low risk through to high risk. Mean eGFR significantly decreased from participants with low risk through to high risk [44.36±15.77; 21.70±0.00; 5.80±0.00, P=0.031].

Table 3: Mean clinical and biochemical characteristics of participants in relation to 2-year risk of kidney failure.

Parameter	Low (N=36)	Inter mediate (N=1)	High (N=1)	P-value
SBP (mmHg)	158.08±24.49	140.00±0.00	180.00±0.00	0.517
DBP (mmHg)	89.97±11.76	90.00±0.00	110.00±0.00	0.257
Weight (Kg)	68.19±9.29	72.00±0.00	69.00±0.00	0.919
BMI (Kg/m2)	26.87±5.58	28.48±0.00	23.20±0.00	0.786
FBG (mmol/l)	6.19±1.46	5.90±0.00	6.00±0.00	0.973
Creatinine (µmol/l)	140.48±37.72	242.50±0.00	838.00±0.00	<0.001
eGFR (ml/min/1.72m2)	44.36±15.77	21.70±0.00	5.80±0.00	0.031
ACR (mg/g)	35.56±15.53	60.00±0.00	150.00±0.00	<0.001

Table 4 presents the socio-demographic, and distribution of clinical and biochemical characteristics of participants stratified by 5-year kidney failure risk. Majority (88.4%) with low risk had eGFR less than 60. All participants with intermediate risk and high risk had eGFR ranging from 30 to 60. Majority (80%) with high 5-year risk were on Linopril/Calciton/Atorvostatin drug combination. Most of the participants with low (84.6%) and intermediate (57.1%) risks were on lisinopril.

Mean clinical and biochemical characteristics of participants in relation to the 5-year risk of kidney failure is presented in **Table 5**. Mean serum creatinine [125.09±28.10; 166.14±18.53; 344.60±276.83, P<0.001] and ACR [29.80±10.44; 41.43±9.00; 85.00±37.42, P<0.001] significantly increased from participants with low 5-year risk progression through to high risk. Mean eGFR significantly decreased in participants with intermediate and high 5-year risk progression compared to those with low risk [49.62±15.41; 32.67±3.69; 21.16±8.84, P<0.001].

Table 6 shows the correlation of age, clinical and biochemical characteristics of participants with 2- and 5-year kidney failure risk. Serum creatinine and ACR positively correlated with both 2-year and 5-year risk progression (P<0.05). eGFR on the other hand, negatively correlated with both 2-year and 5-year risk progression (P<0.05).

Table 4: Socio-demographic, and distribution of clinical and biochemical characteristics of participants stratified by 5-year kidney failure risk.

Parameter	Low (N=26)	Inter mediate (N=7)	High (N=5)	P-value
Age (years)	61.23±12.43	54.00±16.94	50.60±12.36	0.176
Age group (years)				
21-35	1 (3.8)	1 (14.3)	1 (20.0)	0.327
36-50	3 (11.5)	2 (28.6)	2 (40.0)	
51-65	13 (50.0)	1 (14.3)	1 (20.0)	
>65	9 (34.6)	3 (42.9)	1 (20.0)	
Diagnosis				
Diabetes	5 (19.2)	1 (14.3)	0 (0.0)	0.554
Hypertension	21 (80.8)	6 (85.7)	5 (100.0)	
BP (mmHg)				
Optimal	2 (7.7)	1 (14.3)	0 (0.0)	0.859
Normal	1 (3.8)	1 (14.3)	0 (0.0)	
Prehypertension	2 (7.7)	0 (0.0)	0 (0.0)	
Hypertension	14 (53.8)	3 (42.9)	4 (80.0)	
ISH	7 (26.9)	2 (28.6)	1 (20.0)	
BMI (Kg/m2)				
Normal	11 (42.3)	3 (42.9)	3 (60.0)	0.771
Overweight	8 (30.8)	2 (28.6)	2 (40.0)	
Obese	7 (26.9)	2 (28.6)	0 (0.0)	
FBS (mmol/l)				
Normal	19 (73.1)	7 (100.0)	5 (100.0)	0.138
High	7 (26.9)	0 (0.0)	0 (0.0)	
Creatinine (µmol/l)				
Normal	8 (30.8)	0 (0.0)	0 (0.0)	0.096
High	18 (69.2)	7 (100.0)	5 (100.0)	
eGFR (ml/min/1.72m2)				
≥90	1 (3.8)	0 (0.0)	0 (0.0)	<0.001
60-89	2 (7.7)	0 (0.0)	0 (0.0)	
45-59	13 (50.0)	0 (0.0)	0 (0.0)	
30-44	9 (34.6)	5 (71.4)	0 (0.0)	
15-29	1 (3.8)	2 (28.6)	4 (80.0)	
<15	0 (0.0)	0 (0.0)	1 (20.0)	
ACR (mg/g)				
<30	8 (30.8)	0 (0.0)	0 (0.0)	0.096
30-300	18 (69.2)	7 (100.0)	5 (100.0)	
Drug used				
Lisinopril	22 (84.6)	4 (57.1)	0 (0.0)	<0.001
Lisinopril+Metformin	4 (15.4)	1 (14.3)	1 (20.0)	
Lisinopril+Atorvostatin	0 (0.0)	2 (28.6)	0 (0.0)	
Linopril+Calciton+Atorvostatin	0 (0.0)	0 (0.0)	4 (80.0)	

Table 6: Correlation of age, clinical and biochemical characteristics of participants with 2- and 5-year kidney failure risk

Parameters		Age	SBP	DBP	BMI	FBS	CR	GFR	ACR
2-year risk	R	-0.191	0.144	0.281	-0.093	-0.054	0.977	-0.47	0.845
	P	0.252	0.389	0.087	0.579	0.746	<0.001	0.003	<0.001
5-year risk	R	-0.238	0.135	0.278	-0.076	-0.086	0.971	-0.556	0.890
	P	0.149	0.421	0.091	0.652	0.608	<0.001	<0.001	<0.001

Table 5 Mean clinical and biochemical characteristics of participants in relation to 5-year risk of kidney failure.

Parameter	Low (N=36)	Inter mediate (N=1)	High (N=1)	P-value
SBP (mmHg)	157.73±23.13	151.57±31.42	169.80±19.45	0.445
DBP (mmHg)	90.00±11.26	87.29±15.33	97.60±8.99	0.319
Weight (Kg)	69.15±9.14	67.57±9.98	65.00±8.22	0.637
BMI (Kg/m2)	26.76±5.23	28.01±7.89	25.42±2.54	0.727
FBG (mmol/l)	6.44±1.64	5.53±0.52	5.72±0.36	0.242
Creatinine (µmol/l)	125.09±28.10	166.14±18.53	344.60±276.83#	<0.001
eGFR (ml/ min/1.72m2)	49.62±15.41	32.67±3.69*	21.16±8.84*	<0.001
ACR (mg/g)	29.80±10.44	41.43±9.00	85.00±37.42*#	<0.001

*: statistically significant from low risk group; #: statistically significant from intermediate risk group

Discussion

This study seeks to assess the kidney failure risk equation among CKD patients and to predict when they need to start dialysis or transplantation. The study showed that the KFRE was able determine which proportion of patients are likely to progress to low, intermediate and high kidney failure over the next 2 to 5 years. For both 2-year and 5-year risk of progression, serum creatinine and ACR increased as the risk increased from participants with low risk of progression through to high risk. Mean eGFR on the other hand decreases from participants with low risk of progression through to high risk. Serum creatinine and ACR positively correlated with both 2-year and 5-year risk progression. eGFR, on the other hand, negatively correlated with both 2-year and 5-year risk progression. Participants with high 2-year and 5-year risk were on Linopril/Calciton/Atorvostatin drug combination, while participants with low and intermediate risks for both 2-year and 5-year were on lisinopril only. For 2-year risk of progression, 94.7%, 2.6%, 2.6% of the participants had low risk, intermediate risk and high risk of progression respectively. For 5-year risk of progression, 68.4%, 18.4%, 13.2% of the participants had low risk, intermediate risk and high risk of progression respectively.

The abbreviated 4-variable KFRE was able to discriminate which patients need to start dialysis or transplantation. For the 5-year risk of progression, the KFRE showed that 5 of the participants need to start dialysis and for the 2-year risk of progression, it showed 1 of the participants need to start dialysis.

With respect to the 2-year risk progression in relation to gender, 94.4%, 0%, 5.6% of the male participants had low, intermediate, and high risk of progression respectively. For the females, 95.0%, 5.0%, 0.0% of the participants had low, intermediate, and high risk of progression respectively and were statistically insignificant (P=0.366). With regards to the 5-year risk progression, 66.7%, 16.7%, 16.7% of the male participants had low, intermediate, and high risk of progression respectively whereas for females, 70.7%, 20.0%, 10.0% of the participants had low, intermediate, and high risk of progression respectively and were statistically insignificant (P=0.822). In this study, the risk of progression of CKD to end stage kidney failure is higher in males than in females which is similar to findings by Kaiser Permanente and the RENAAL study group (Nephrology A clinical trial–Reduction in Endpoints in patients with Non-insulin-dependent diabetes mellitus with the Angiotensin II Antagonist Losartan), who reported that a lower estimated eGFR, higher albuminuria, younger age, and male sex predict faster progression to kidney failure (Acedillo, Tangri, & Garg, 2013).

Most (41.7%) of the participants with low 2-year risk progression were within 51-65 years. The participants with intermediate risk and high risk were within 21-35 years and 36-50 years respectively. Majority (91.7%) with low risk had eGFR between 30 to 60. Participants with intermediate risk and high risk had eGFR of 15-29 and less than 15 respectively. CKD in younger age in the midst of Lower estimated eGFR, higher albuminuria and male sex has a faster progression rate to kidney failure than old age (Acedillo et al., 2013).

Both participants with intermediate and high 2-year and 5-year risk were on Lisinopril/Calciton/Atorvostatin drug combination while participants with low risk were on only lisinopril. Most CKD patients with high risk progression to kidney failure have symptoms like high blood pressure, hypocalcemia, and high cholesterol level (Crook, 2012) whereas low risk patients are mostly hypertensives and asymptomatic (Sanguankeo, Upala, Cheungpasitporn, Ungprasert, & Knight, 2015) as such, medications and symptoms are to be carefully monitored in these state.

Mean serum creatinine and ACR significantly increased as the risk increased from participants with low 2-year risk progression through to high risk whereas mean eGFR significantly decreased from participants with low 2-year risk progression through to high risk. Mean serum creatinine and ACR significantly increased from participants with low 5-year risk progression through to high risk whereas mean eGFR significantly decreased in participants with intermediate and high 5-year risk progression compared to those with low risk. In a study by (Tangri, 2017), the mean serum creatinine level and eGFR were 2.30 mg/dl (203.32 umol/l) and 31 ml/min/1.72m2 respectively. The serum creatinine was very high in the CKD patients and the eGFR was very low in the same population. This was consistent with our study as majority (78.94%) of the participants had high mean serum creatinine (161.53 umol/l) and most (92.10%) had low mean eGFR (42.75 ml/min/1.72m2). The difference in the mean eGFR and serum creatinine may be due to the low sample size used in this study. A eGFR level less than 60 mL/min per 1.73 m2 represents loss of half or more of the adult level of normal kidney function. Below this level, the prevalence of complications of chronic

kidney disease increases (Levey, 2000).

Serum creatinine and ACR positively correlated significantly with both 2-year and 5-year risk progression. eGFR, on the other hand, significantly correlated negatively with both 2-year and 5-year risk progression.

This study, though the first in the sub-Saharan region had a few limitations. First, the small sample size used which was due to the small number of CKD patients at the renal unit of Cape Coast Teaching Hospital. Second, ACR was estimated using semi quantitative albumin dipstick instead of High Performance Liquid Chromatography which is relatively more sensitive. Third, though the KFRE should be used in patients with CKD stage 1 to stage 3, this study had participants with stages 4 and 5 which could be due to some participants who could not afford renal replacement therapy.

Conclusion

The KFRE was able to identify participants with both two- and five-year risk of progression to end stage renal failure. The KFRE showed an association with gender, serum creatinine, ACR eGFR, and medication used. Prospective studies are needed to verify whether its implementation can result in better resource allocation of nephrology team CKD care.

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