Health Related Quality of Life of Patients Undergoing In-Centre Hemodialysis in Rwanda: a Cross Sectional Study

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Abstract

Background

There are few studies assessing the quality of life of patients with chronic and end stage kidney disease in sub-Saharan Africa. We aimed to describe the health-related quality of life (HRQOL) of patients undergoing in-centre maintenance hemodialysis in Rwanda using the KDQOL™-36 and determine sociodemographic and clinical factors associated with their quality of life.

Methods

We conducted a multicenter, cross-sectional study between September 2020 and March 2021. Patients over the age of 18 receiving maintenance in-centre hemodialysis for at least 3 months at the Rwandan tertiary hospitals were administered the KDQOL™-36 questionnaire to assess physical and mental health functioning, the effect, burden and symptoms and problem of kidney disease. Sociodemographic and clinical information were also collected for all eligible patients. Using mixed effects linear regression models, we explored factors associated with overall KDQOL and its domains, while accounting for clustering of patients within hemodialysis centres.

Results

Eighty-nine eligible patients were included in the study. The majority of participants were younger than 60 years old (69.7%), male (66.3%), had comorbidities (91%), and 71.6% were categorized as level 3 on a 4 tier in-country poverty scale. All participants had health insurance coverage, with 67.4% bearing no out of pocket payments for hemodialysis. The mean (SD) quality of life score was 48.92 (18.84) for overall HRQOL, 37.33 (10.66) for PCS and 44.74 (9.98) for MCS. Symptoms and problem of kidney disease, effect of kidney disease, and burden of kidney disease scored 58.22 (27.44), 53.48 (17.14) and 20.01 (18.27), respectively. A notable difference of KDQOL scores between hemodialysis centres was observed. Overall KDQOL was associated with male sex ($\alpha\beta$ [adjusted β coefficient]: 8.54, 95% confidence interval [CI]: 2.77, 14.26); being employed ($\alpha\beta$: 8.16, 95% CI: 2.18, 14.29); dialysis vintage of 13–24 months ($\alpha\beta$: 10.47, 95% CI: 3.57, 17.58), hemoglobin of 10–11g/dl ($\alpha\beta$: 7.27, 95% CI: 0.70, 13.72) and comorbidities (e.g., 4 comorbidities vs none ($\alpha\beta$: -29.76, 95% CI: -41.47, -18.32).

Conclusions

Patients on in-centre hemodialysis in Rwanda have reduced KDQOL scores, particularly in the burden of kidney disease and physical composite summary domains. Higher overall KDQOL mean score was associated with male sex, being employed, and dialysis vintage of 13–24 months, hemoglobin of 10–11g/dl and absence of comorbidities. Majority of patients have higher socioeconomic status reflecting the social and financial constraints to access and maintain dialysis in resource limited settings.

1. Background

The burden of kidney disease worldwide is substantial, growing and poses significant challenges for governments responding to the health of their populations, particularly in low and middle income countries (LMIC).(1) In middle and eastern Africa, access to renal replacement therapy (RRT) is estimated at 1–3% (7), and the outcome of dialysis patients is poor, and marked by premature mortality in the first year after dialysis initiation.(8)(9) A high mortality rate following initiation of dialysis may be related to late presentation to a nephrologist or kidney care center, affordability, lack of access to treatment for metabolic complications and poor education.(9)

Rwanda is one of the smallest central African countries with an approximately 13 million population and only about 17.6% living in urban areas.(10) The gross domestic product per capita is approximately 820 US dollars.(11) Over 92% of Rwandans access health care using community based health insurance (CBHI) linked to four socioeconomic life standing of Rwandan households, also named “Ubudehe categories”.(12)(13) Patients in category 1, are exempt from premiums; category 2,3 and 4 pay a fixed co-

pay for health center and hospital visits.(14) Approximately 6% of the total population have civil servant health insurance and military medical insurance (MMI).(12)(13)(14) In addition, there are private health insurance schemes available for purchase, and funds that cover medical care for vulnerable groups, such as genocide victim funds (GVF).

Based on estimates from World Health Organization, noncommunicable diseases (NCDs) including renal diseases were predominant cause of mortality in Rwanda, accounting for 58% of the mortality burden since 2016.(15) There are insufficient data on the prevalence of kidney diseases in Rwanda but kidney failure was among the top 10 leading cause of death from non-communicable diseases and injuries in Rwanda in 2016.(15)(16) Hemodialysis is the predominant renal replacement therapy available in Rwanda, very few patients are currently on peritoneal dialysis and renal transplantation is not performed in the country. Patients access transplantation through the Ministry of Health funded transplantation performed out of country or through out-of-pocket payments abroad.(16)

Access to dialysis is limited by its cost, a shortage of specialized medical staff with training in nephrology and renal replacement therapy and geographic distribution of in-centre hemodialysis units.(16)(17) The annual cost of hemodialysis per patient in Rwanda ranges between Int\$13,260 and Int\$20,592. CBHI covers hemodialysis for only six weeks for patients with acute kidney injury (AKI) and does not cover costs associated with chronic RRT for CKD.(18) Maintenance dialysis is covered by employer and private health insurances or special funds (eg GVF) at 85 to 100% of HD cost, thus, for the majority of Rwandans, there are substantial out of pocket costs and financial hardship associated with hemodialysis.(16)

Same as other specialized care centered in urban areas, dialysis centers are located in cities, particularly Kigali City; however, the majority of Rwandans live in rural areas.(10). Currently, in-centre maintenance hemodialysis is available at three public, university affiliated tertiary referral centers, Kigali University Teaching Hospital (CHUK), Rwanda Military hospital (RMH) located in the capital city, Kigali and Butare University Teaching Hospital (CHUB) built in the south province, and at King Faisal Hospital (KFH), which is a public-private quaternary hospital also located in Kigali. Community based hemodialysis is provided by African Health Network, a private company with three unities located at Kimihurura (Kigali), Rubavu and Rusizi (Western province) with relatively similar cost, insurance coverage and out of pocket expenses as in-centre hemodialysis.(16)

Between 2014 and 2017, approximately 47% of hemodialysis patients died within four months of initiation of dialysis at CHUK.(18)(19) There are dialysis dependent and non-dialysis dependent factors that impact patient experience and outcomes beyond dialysis adequacy including socioeconomic status, age, comorbidities, vascular access, dialysis session duration and adequacy, dialysis session frequency, and symptoms associated with dialysis.(20)(21)(22)(23)(24)(25)(26)

To promote high-quality services in renal dialysis facilities, routine measurement of patient reported outcomes measures such health related quality of life (HRQOL) in dialysis patients using the KDQOL-36™ is now mandatory in high income countries. For example, In the United States, these measurements are typically done four months after initiation of dialysis and at least every year.(27)(28) The Kidney Disease Quality of Life (KDQOL) instrument designed by RAND Health Care and validated by the National Kidney Foundation for patients with kidney diseases may provide a reasonable metric of quality of life of adult patients living with ESKD in resource limited settings.(29)(30)(31) In Africa, there are few studies that assessed the QOL of patients with CKD, less again of dialysis patients. Masina et al. (32) in Malawi and Kamau et al. (33) in Kenya reported reduced HRQOL of dialysis patients.

In this study, we aim to determine the health related quality of life of patients with ESKD undergoing in-centre maintenance hemodialysis in Rwanda, describe demographic and clinical features of those patients and the factors associated with their quality of life. This is the first study in Rwanda and will provide baseline data that can help inform improvement strategies for ESKD patients on hemodialysis in Rwanda and other settings with similar contexts.

2. Methods

We conducted a multicenter prospective cross-sectional study on all patients with end-stage kidney disease on in-centre hemodialysis in Rwanda between September 2020 and March 2021. In-centre hemodialysis units are located at Kigali University Teaching Hospital (CHUK), Rwanda Military hospital (RMH), Butare University Teaching Hospital (CHUB) and at King Faisal

Hospital (KFH). We enrolled 89 adults patients (18 years and above) with ESKD on in-centre maintenance hemodialysis for at least three months (Fig. 1). We excluded patients with AKI, hospitalized within the last four weeks and/or with neurological disability making them unable to respond to the questions.

Data collection and measures

HRQOL data were collected using the KDQOL36-Item Short Form questionnaire. Instructions and documentations on scoring were obtained from RAND Health Care.(29) Because of relatively small number of participants at CHUK and CHUB, results from these two in-centre hemodialysis units were aggregated for analysis. To determine factors associated with HRQOL of hemodialysis patients, sociodemographic and clinical data were collected and all cutoffs were based on distribution of the data. We collected data regarding hemodialysis. We did not collect data about small solutes clearance using Kt/V as it was not measured in most dialysis centers. A questionnaire was administered to each participant during their regularly scheduled dialysis in person by one study investigator to ensure clarifying questions that can be asked by the participant. For patients not fluent in English, questions were translated by the study team into local language before administration. After obtaining informed consent, participants anonymously and privately completed the questionnaire in person or with help of an investigator. Approximately 10 minutes were required for each patient to fill the survey.

Responses on quality of life questionnaire were exported to excel scoring tool of KDQOL-36™ which provided patients' score in five domains (Physical composite summary PCS, Mental composite summary MCS, Burden of kidney disease BKD, Effect of kidney disease EKD and Symptoms and problem of kidney disease SPKD). The overall KDQOL score was obtained from a programed KDQOL-36™ survey.(34) All demographic and clinical information were collected on paper, entered into excel with independent double entry by two study investigators to minimize data entry errors.

Analysis

Descriptive statistics were used to describe the study sample including demographic and clinical characteristics overall and by KDQOL. Mean and standard deviation (or median with inter-quartile range) were used, as appropriate, for continuous variables and frequency (and percentage) for categorical variables. Mixed effects linear regression models were fitted to explore factors associated with overall KDQOL and its five domains, while accounting for clustering of patients within hemodialysis centers. Parameter estimates are reported as β coefficients along with their 95% confidence interval (CI) and p values. All analyses were conducted using R version 4.0.2.

3. Results

Demographic and clinical characteristics of study participants

Majority of participants were young with male to female ratio of nearly 2:1. Almost all participants (91%) had comorbidities and 79.8% were taking > 3 medications per day. More than half (59.5%) have been on hemodialysis for more than 12 months with 80.9% on thrice weekly hemodialysis (**Table 1**).

Health related quality of life

The overall mean $\pm$ SD quality of life score was 48.92 ± 18.84 . The mean physical composite summary (PCS) score was 37.33 ± 10.66 and mental composite summary (MCS) mean score was 44.74 ± 9.98 . Symptoms and problems of kidney disease (SPKD), effect of kidney disease (EKD), and burden of kidney disease (BKD) had respectively a mean (SD) scores of 58.22 (27.44), 53.48 (17.14) and 20.01 (18.27) (**Figure 2**). Comparison between hemodialysis centers showed significant difference of HRQOL scores between hemodialysis centers and the overall KDQOL score and SPKD, BKD, PCS and MCS (P value <0.001) and King Faisal Hospital hemodialysis unit had the highest HRQOL mean scores in all domains.

KDQOL varied by independent variables. Significantly higher mean quality of life scores were observed in patients 45-60 years (53.39 ± 17.67), with a serum albumin level above 40g/dl (52.39 ± 16.96), on hemodialysis for 13-24 months (56.63 ± 15.31), with

a fistula for hemodialysis access (58.40 ± 19.77) and without comorbidities (68.80 ± 13.32).

Table 1. Demographic and clinical characteristics of study participants

Variable	Category	Sample n= 89	%
Sex	Female	30	33.7
	Male	59	66.3
Age	< 45 years	29	32.6
	45-60 years	33	37.1
	> 60 years	27	30.3
Education	Post-secondary	36	40.4
	Secondary school	26	29.2
	Primary or less	27	30.3
Marital status	Married/ living together	48	53.9
	Never married	23	25.8
	Separated or widowed	18	20.2
Ubudehe category	1	7	8.0
	2	18	20.5
	3	63	71.6
	4	0	0
Insurance coverage	<100% coverage	29	32.6
	100% coverage	60	67.4
Hemodialysis centers	CHUK-CHUB	14	15.7
	King Faisal Hospital	43	48.3
	Rwanda Military Hospital	32	36.0
Employment status	Employed	27	30.3
	Retired	12	13.5
Number of comorbidities	0	8	9.0
	1	44	49.4
	2	28	31.5
	3	9	10.1
Number of medications	<3 drugs	18	20.2
	3-4 drugs	38	42.7
	>4 drugs	33	37.1
Hospitalized in the last 6 months (n=87)	No	40	46.0
	Yes	47	54.0
Albumin g/l	<35	21	23.6
	35-40	40	44.9
	>40	28	31.5
Hemoglobin g/dl	<10	38	42.7
	10-11	24	27.0
	>11	27	30.3
Number of HD per week	2	17	19.1
	3	72	80.9
Number of HD in past 30 days	≤10 sessions	28	31.5
	>10 sessions	61	68.5
Hemodialysis access	Fistula/ graft	30	33.7
	Semi-permanent dialysis catheter	34	38.2
	Temporary dialysis catheter	25	28.1
Dialysis vintage	<12 months	36	40.4
	13-24 months	22	24.7
	>24 months	31	34.8
	Unemployed	50	56.2

#Ubudehe category: economic life standing of households of Rwandan population

Factors associated with health related quality of life

In adjusted model; sex, employment status, dialysis vintage, number of comorbidities, and hemoglobin level correlated significantly with overall kidney disease quality of life. Sex, employment status, type of hemodialysis access and comorbidities were statistically significantly associated with physical composite summary domain. Employment status, dialysis vintage and number of comorbidities were significantly associated with mental composite summary domain (**Table 2**). The burden of kidney disease subscale correlated significantly with employment status, type of hemodialysis access and number of comorbidities. Number of hemodialysis in the past 30 days and number of comorbidities were significantly associated with the effect of kidney disease. Age, sex, dialysis vintage and number of comorbidities were significantly associated with symptoms and problems of kidney disease subscale (**Table 3**).

Discussion

In the current study, we found reduced quality of life mean scores. Our results were relatively lower or similar to studies from middle and higher income countries that have used the same KDQOL-36™ tool and others from SSA, though they used the KDQOL-SF 1.3 version. For example, Masina et al in Malawi (32) and Bagasha et al in Uganda (35) found an overall HRQOL score of 59.9 (±8.8) and 41.71 (±4.42) respectively (**Table 4**). The BKD had a lower score (20.01±18.27) and Symptoms and problem of kidney disease domain had relatively higher mean score (58.22±27.44) more marked in elder patients above 60 (β: 13.611; 95% CI: 1.42, 26.29). Similar findings of low scores in the burden of kidney disease sub-scale and relatively higher score in the symptoms and problem of kidney disease sub-scale have been noted in studies conducted Africa.(32)(33)(35) Similar to other studies from LMICs, 69.7% of participants were young than 60 reflecting the pattern of causes and risk factors of kidney disease in LMICs, the lack of strategies of prevention and management of communicable and non-communicable diseases and the poor socioeconomic status and the low access to transplantation.(36)(16)(33)(35)(32)(37)(38)(25) In our study, the majority of patients were living in Kigali where three of four in-centre hemodialysis units are located. Therefore patients and their family have to travel long distances or move to near dialysis centers affecting their daily activities, and relationship with others. Our findings showed that the majority of patients on hemodialysis in Rwanda were largely from a relatively higher socioeconomic status, echoing other African studies.(32)(33)(35)(38)(39)(16) Among our study participants, 53.9% were married living together with their partner, 68.5% were living in urban area and 70.7% had secondary school level or post-secondary. Despite that a small proportion of Rwandan population is categorized in “ubudehe” category three and four (13), 71.6% of our study participants were classified in third category. This echoes findings from other African studies that have highlighted that the majority of patients on hemodialysis are largely from a relatively higher socioeconomic status.(32)(33)(35)(38)(39)(16). Similarly, all participants had health insurance coverage, with 67.4% covered at 100%. These findings reflect the financial constraints and the social impact to access and maintain RRT in resource limited settings.

Table 2. Factors associated with overall KDQOL, PCS and MCS

Independent variables (reference group)	Overall KDQOL				Physical Composite Summary				Mental Composite Summary			
	Crude β coefficient (95% CI)	P value	Adjusted β coefficient (95% CI)	P value	Crude β coefficient (95% CI)	P value	Adjusted β coefficient (95% CI)	P value	Crude β coefficient (95% CI)	P value	Adjusted β coefficient (95% CI)	P value
Sex (Female)												
Male	6.57 (0.02, 13.04)	0.04	8.54 (2.77, 14.26)	0.008	6.84 (3.24, 10.41)	<0.001	4.62 (1.02, 8.21)	0.01	-0.45 (-4.39, 3.42)	0.81	0.61 (-2.86, 4.12)	0.74
Age (<45 years)												
15-60 years	3.35 (-4.32, 11.49)	0.40	6.23 (-0.37, 13.14)	0.09	-2.76 (-7.19, 1.91)	0.23	-1.32 (-5.40, 2.96)	0.55	4.04 (-0.37, 8.85)	0.08	3.83 (-0.17, 8.39)	0.08
>60 years	5.37 (-2.43, 13.47)	0.18	6.68 (-1.67, 15.17)	0.15	-3.92 (-8.42, 0.74)	0.09	-4.19 (-9.50, 1.20)	0.14	4.56 (0.05, 9.31)	0.05	1.09 (-3.86, 6.36)	0.68
Education (Primary school and less)												
Secondary school	2.38 (-6.06, 10.56)	0.56			0.75 (-4.16, 5.52)	0.75			2.58 (-2.24, 7.45)	0.24		
Post-secondary	2.17 (-5.33, 9.57)	0.57			0.62 (-3.76, 4.93)	0.77			2.70 (-1.81, 6.89)	0.27		
Marital status (Never married)												
Married/living together	3.59 (-3.63, 10.89)	0.33			-1.09 (-5.17, 3.01)	0.60			1.37 (-2.94, 5.75)	0.53		
Separated/widowed	-4.77 (-13.75, 4.31)	0.30			-7.61 (-12.67, -2.49)	0.004			-1.48 (-6.84, 3.96)	0.59		
Employment (Unemployed)												
Employed	5.99 (-0.85, 12.89)	0.09	8.16 (2.18, 14.29)	0.01	4.85 (0.92, 8.80)	0.01	3.88 (0.39, 7.39)	0.04	2.32 (-1.66, 6.34)	0.25	5.76 (2.09, 9.53)	0.005
Retired	6.93 (-2.32, 16.37)	0.14	4.23 (-5.01, 13.70)	0.41	4.18 (-1.12, 9.58)	0.12	5.68 (0.05, 11.40)	0.06	6.45 (1.07, 11.96)	0.02	8.18 (2.66, 13.86)	0.007
Obudehe category (1)												
2	1.78 (-10.99, 14.66)	0.78			-0.75 (-7.75, 6.30)	0.83			-2.87 (-10.46, 4.80)	0.46		
3	6.84 (-4.62, 18.56)	0.25			4.41 (-1.87, 10.83)	0.17			-1.04 (-7.84, 5.96)	0.76		
Health insurance coverage (<100% coverage)												
100% coverage	4.77 (-1.84, 11.28)	0.15			0.34 (-3.55, 4.17)	0.86			1.08 (-2.86, 4.93)	0.58		
Number of HD per week (Twice)												
Thrice	-1.47 (-9.67, 6.46)	0.71			-0.48 (-5.26, 4.13)	0.83			-0.30 (-5.15, 4.35)	0.89		
Number of HD in the past 30 days ($\leq$ 10)												
>10	-2.53 (-9.19, 4.09)	0.45			-0.39 (-4.27, 3.47)	0.84			-0.15 (-4.08, 3.74)	0.93		
Hospitalized in the last 6 months (No)												
Yes	-3.61 (-9.88, 2.63)	0.25			-4.68 (-8.22, -1.15)	0.01			-1.97 (-5.66, 1.68)	0.29		
Number of medications taking (<3 drugs)												

Independent variables (reference group)	Overall KDQOL				Physical Composite Summary				Mental Composite Summary			
	Crude β coefficient (95% CI)	P value	Adjusted β coefficient (95% CI)	P value	Crude β coefficient (95% CI)	P value	Adjusted β coefficient (95% CI)	P value	Crude β coefficient (95% CI)	P value	Adjusted β coefficient (95% CI)	P value
3-4 drugs	-2.32 (-10.76, 6.01)	0.58			-4.22 (-9.06, 0.54)	0.08			-2.75 (-7.67, 2.08)	0.27		
>4 drugs	-2.74 (-11.48, 5.80)	0.53			-3.72 (-8.74, 1.16)	0.14			-0.12 (-5.23, 4.83)	0.96		
Albumin (<35 g/l)												
35-40 g/l	8.36 (0.65, 16.27)	0.03	6.29 (-0.39, 13.17)	0.09	3.07 (-1.47, 7.76)	0.19			1.97 (-2.65, 6.77)	0.41		
>40 g/l	8.86 (0.66, 17.27)	0.03	2.47 (-4.92, 10.01)	0.54	3.76 (-1.07, 8.75)	0.13			2.36 (-2.55, 7.46)	0.35		
Hemoglobin (<10 g/dl)												
10-11 g/dl	9.44 (2.03, 16.82)	0.01	7.27 (0.70, 13.72)	0.04	1.84 (-2.59, 6.26)	0.41			5.05 (0.66, 9.40)	0.02		
>11 g/dl	2.39 (-4.75, 9.59)	0.51	2.09 (-3.94, 8.13)	0.53	-0.59 (-4.89, 3.71)	0.78			2.65 (-1.58, 6.91)	0.22		
Dialysis vintage (≤ 12 months)												
13-24 months	8.65 (0.83, 16.80)	0.03	10.47 (3.57, 17.58)	0.008	-0.44 (-5.09, 4.40)	0.85			7.48 (3.04, 12.19)	0.001	9.10 (5.03, 13.46)	<0.001
>24 months	5.70 (-1.36, 13.03)	0.12	9.71 (3.33, 16.30)	0.007	1.52 (-2.68, 5.87)	0.48			3.40 (-0.6, 7.63)	0.107	6.30 (2.54, 10.30)	0.003
Dialysis access (Fistula/graft)												
Semi-permanent hemodialysis catheter	-8.44 (-16.35, -0.89)	0.03			-6.20 (-10.69, -1.90)	0.006	-6.11 (-10.38, -1.94)	0.008	-3.88 (-8.62, 0.57)	0.09		
Temporary dialysis catheter	-6.75 (-14.71, 1.01)	0.09			-5.59 (-10.12, -1.17)	0.01	-5.30 (-9.51, -1.16)	0.02	-3.00 (-7.75, 1.59)	0.21		
Number of comorbidities (0) ^{\$}												
1	-11.40 (-22.62, -0.52)	0.04	-15.31 (-25.17, -5.76)	0.005	-0.12 (-6.52, 6.08)	0.96	-3.28 (-9.11, 2.40)	0.29	-10.04 (-16.60, -3.74)	0.003	-9.55 (15.58, -3.82)	0.003
2	-11.14 (-22.79, 0.13)	0.06	-13.20 (-23.30, -3.46)	0.01	-4.55 (-11.20, 1.88)	0.17	-3.36 (-9.64, 2.72)	0.31	-6.51 (-13.33, 0.021)	0.059	-6.51 (-12.96, -0.57)	0.04
3	-21.49 (35.22, -8.03)	0.002	-29.97 (-41.47, -18.32)	<0.001	-9.49 (-17.33, -1.81)	0.01	-9.06 (-16.42, -1.84)	0.02	-10.81 (-18.84, -3.012)	0.009	-12.55 (-19.97, -5.60)	0.001

*Adjusted for clustering of patients within hemodialysis centers.

^{\$} Comorbidities include hypertension, heart failure, hepatitis B or C, cerebrovascular disease, HIV/AIDS and gout

Table 3. Factors associated with BKD, EKD and SPKD domains

Independent les (reference) group)	Burden of kidney disease				Effects of kidney disease				Symptom problem of kidney disease			
	Crude β coefficient (95% CI)	P value	Adjusted β coefficient (95% CI)	P value	Crude β coefficient (95% CI)	P value	Adjusted β coefficient (95% CI)	P value	Crude β coefficient (95% CI)	P value	Adjusted β coefficient (95% CI)	P value
Sex (Female)												
Male	7.17 (-0.11, 14.32)	0.05	2.95 (-4.49, 10.29)	0.46	6.51 (-1.27, 13.78)	0.09	6.84 (-0.35, 14.03)	0.07	5.51 (-4.75, 15.66)	0.29	11.98 (2.82, 21.18)	0.01
Age (<45 years)												
45-60 years	-0.71 (-9.23, 8.55)	0.87	1.16 (-7.12, 10.49)	0.80	2.25 (-6.31, 10.82)	0.61	7.24 (-0.98, 15.47)	0.10	7.30 (-4.46, 19.91)	0.23	11.49 (0.50, 23.35)	0.05
>60 years	0.99 (-7.68, 10.15)	0.82	-1.70 (-12.81, 9.70)	0.78	3.02 (-5.98, 12.02)	0.51	9.09 (-0.42, 18.61)	0.07	9.87 (-2.10, 22.39)	0.11	13.611 (1.42, 26.29)	0.04
Education (Primary school and less)												
Secondary school	0.11 (-9.22, 9.02)	0.98			0.51 (-8.69, 9.44)	0.91			3.75 (-9.30, 16.34)	0.87		
Post-secondary	5.68 (-2.58, 13.77)	0.17			7.51 (-0.93, 15.87)	0.08			-0.94 (-12.55, 10.45)	0.56		
Marital status (Never married)												
Married/living together	0.17 (-7.86, 8.32)	0.96			0.04 (-8.49, 8.62)	0.99			5.81 (-5.53, 17.27)	0.32		
Separated/widowed	-8.12 (-18.10, 2.02)	0.11			1.52 (-9.05, 12.18)	0.78			-0.87 (-14.96, 13.41)	0.90		
Employment (Unemployed)												
Employed	9.78 (2.34, 17.31)	0.01	10.29 (3.20, 17.49)	0.009	12.35 (4.72, 19.98)	0.002			-0.12 (10.91, 10.76)	0.98		
Retired 8.12 (-1.92, 18.43)		0.12	10.57 (-0.96, 22.57)	0.10	6.33 (-3.93, 16.60)	0.23			4.01 (-10.56, 18.91)	0.59		
Ubudehe category (1)												
2	8.34 (-5.78, 22.63)	0.25			3.51 (-11.22, 18.52)	0.64			8.71 (-11.00, 28.62)	0.39		
3	7.09 (-5.54, 20.15)	0.28			3.06 (-9.93, 16.67)	0.65			6.89 (-10.77, 25.05)	0.45		
Health insurance coverage (<100% coverage)												
100% coverage	1.60 (-5.85, 8.88)	0.66			-2.18 (-9.81, 5.42)	0.57			13.03 (3.06, 22.81)	0.01	9.57 (0.01, 18.74)	0.05
Number of HD per week (Twice)												
Thrice	-0.56 (-9.74, 8.20)	0.90			-11.83 (-20.59, -3.07)	0.009			2.21 (-10.46, 14.46)	0.72		
Number of HD in the past 30 days (≤ 10)												
>10	-1.34 (-8.75, 6.02)	0.72			-9.08 (-16.56, -1.62)	0.01	-7.70 (-14.81, -0.59)	0.04	-1.91 (-12.22, 8.34)	0.71		
Hospitalized in the last 6 months (No)												
Yes	-3.73 (-10.62, 3.11)	0.28			-8.30 (-15.42, -1.15)	0.025			0.75 (-9.08, 10.53)	0.87		
Number of medications taking (<3 drugs)												

Independent variables (reference) group	Burden of kidney disease				Effects of kidney disease				Symptom problem of kidney disease			
	Crude β coefficient (95% CI)	P value	Adjusted β coefficient (95% CI)	P value	Crude β coefficient (95% CI)	P value	Adjusted β coefficient (95% CI)	P value	Crude β coefficient (95% CI)	P value	Adjusted β coefficient (95% CI)	P value
3-4 drugs	-5.10 (-14.33, 3.96)	0.27			-5.69 (-15.26, 3.87)	0.25			-7.48 (-20.31, 5.16)	0.25		
>4 drugs	1.64 (-7.95, 10.92)	0.73			-6.07 (-15.87, 3.72)	0.23			-12.43 (-25.73, 0.52)	0.06		
Albumin (<35 g/l)												
35-40 g/l	7.24 (-1.29, 16.14)	0.10			2.19 (-6.89, 11.27)	0.64			-1.02 (-13.24, 11.61)	0.87		
>40 g/l	9.62 (0.51, 19.08)	0.04			2.71 (-7.01, 12.44)	0.58			0.36 (-12.65, 13.77)	0.95		
Hemoglobin (<10 g/dl)												
10-11 g/dl	9.03 (0.74, 17.25)	0.03			4.80 (-3.93, 13.54)	0.28			11.12 (-0.50, 22.68)	0.06		
>11 g/dl	1.17 (-6.81, 9.21)	0.77			2.84 (-5.58, 11.29)	0.51			6.05 (-5.16, 17.34)	0.29		
Vintage (≤12 months)												
13-24 months	5.10 (-3.66, 14.44)	0.26			4.82 (-4.16, 13.88)	0.30			18.70 (6.97, 31.03)	0.002	16.28 (5.20, 27.82)	0.008
>24 months	-0.01 (-7.95, 8.35)	0.99			-2.76 (-10.89, 5.44)	0.51			11.61 (1.001, 22.68)	0.03	9.74 (-0.35, 20.31)	0.07
HD access (Fistula/graft)												
Semipermanent dialysis catheter	-8.59 (-17.38, -0.37)	0.04	-8.01 (-16.95, 0.51)	0.09	-2.87 (-11.30, 5.64)	0.50			-8.89 (-21.34, 2.92)	0.15		
Temporary dialysis catheter	-10.78 (-19.59, -2.28)	0.01	-10.71 (-19.48, -2.32)	0.02	-1.14 (-10.26, 7.97)	0.80			-4.32 (-16.83, 7.84)	0.49		
Number of comorbidities (0)\$												
1	-9.66 (-22.58, 2.62)	0.13	-17.32 (-29.95, -5.63)	0.009	-6.32 (-18.76, 6.12)	0.32	-5.89 (-18.13, 6.34)	0.36	-22.96 (-40.51, -6.03)	0.01	-19.93 (-36.47, -4.05)	0.02
2	-13.45 (-26.87, -0.69)	0.04	-14.96 (-28.29, -2.676)	0.03	-13.17 (-26.14, -0.18)	0.05	-15.53 (-27.99, -3.06)	0.02	-19.00 (-37.23, -1.43)	0.04	-19.16 (-36.56, -2.71)	0.03
3	-14.78 (-30.54, 0.46)	0.06	-17.62 (-33.01, -2.97)	0.03	-17.36 (-33.09, -1.62)	0.03	-19.66 (-34.92, -4.41)	0.01	-26.47 (-47.96, -5.51)	0.01	-33.27 (-53.11, -14.20)	0.001

*Adjusted for clustering of patients within hemodialysis centers.

\$ Comorbidities include hypertension, heart failure, hepatitis B or C, cerebrovascular disease, HIV/AIDS and gout

Our results showed higher overall KDQOL score and all five domains scores in patients on in-centre maintenance hemodialysis at King Faisal Hospital and lower scores at CHUK-CHUB in-centre hemodialysis unit. This discrepancy might be related to patient's choice due to the fact that KFH is the most accredited hospital of the country, was the first to have HD unit in Kigali with more HD beds than other centers, specialized medical staff, sufficient human resources and materials. In addition, the national referral board office that transfers patients for kidney transplantation is located at KFH and there is a possibility to access HD using

health insurance coverage as in other in-centre dialysis units. The majority of patients managed at CHUK and CHUB are referred from rural areas with lesser socioeconomic status making their dialysis units less frequently used for chronic maintenance HD.

Our findings showed positive correlation between dialysis vintage and higher QoL scores, likely reflecting the cognitive adaptation of patients dialyzed for a long period. (40)(25)(21)(38)(32) In this study, the number of comorbidities was in direct proportion with worse quality of life score, affecting all HRQOL domains. Jieun Cha et al (23) in Korea demonstrated a significant poor HRQOL associated with the high number of comorbidities ($p < 0.001$).

Study limitations: There are a number of limitations that need to be acknowledged. First, while KDQOL-36™ instrument has been validated in other contexts, it is yet to be validated in Rwandan context and there is no validated translation form of KDQOL-36™ survey into the local language (Kinyarwanda) before data collection. Therefore, there might have been some instance of misinterpretations when translating the questionnaire during data collection. Second, being a cross-sectional study makes it difficult to infer causality including the determination of causes of low HRQOL found. Third, while the sample size appears relatively small, we included nearly all eligible patients across the in-centre hemodialysis centres. Fourth, we did not include community dialysis units – there were three community dialysis unities in the country during the study period. Lastly, our analysis did not thoroughly explore some metrics that clinicians/patients frequently report as barriers to care and to QOL such as financial constraints (out of pocket costs or yearly income) and travel to HD units.

Conclusion

Patients on in-centre hemodialysis in Rwanda have a significantly low HRQOL scores. The lowest score was found on burden of kidney disease and physical composite summary domains. There is a notable difference of HRQOL scores between hemodialysis units. Factors associated with overall HRQOL found were sex, employment status, number of comorbidities, dialysis vintage, and hemoglobin level. Optimizing medical and biomedical management of dialysis patients and finding ways to make dialysis less obstructive to maintain employment should improve their HRQOL. The majority of patients on hemodialysis have higher socioeconomic status reflecting the financial constraints and the social impact to access and maintain renal replacement therapy in resource limited settings. As such, improving equitable access to RRT should remain a priority.

We recommend local validation of the KDQOL survey instrument, use of different validated poverty index to further evaluate the impact of poverty on quality of life in Rwandan context to ensure outcomes of the survey and help clinical decision making routinely. Further studies on HD adequacy to both in-centre as well as community based HD units, and comparison between using internationally accepted measures of dialysis adequacy (Kt/V) and QOL measures which are cheap and easy to administer in low income countries are also recommended.

Table 4. Health related quality of life of patients treated with hemodialysis from different studies using the KDQOL-36™

	Country				
	Rwanda #	Kenya(24)	Saudi Arabia(65)	USA(64)	USA(46)
PCS	37.33	39.09	37.4	38	36.6
MCS	44.74	41.87	43.5	51.8	49.0
BKD	20.01	16.15	31.5	53.2	51.3
EKD	53.48	67.63	56.5	76.6	78.1
SPKD	58.22	73.46	74	80.7	73.0

PCS physical component summary, **MCS** mental component summary, **BKD** burden of kidney disease component summary, **EKD** effect of kidney disease component summary, **SPKD** symptoms and problem of kidney disease component summary **USA** United States of America #present study

Declarations

- **Ethics approval and consent to participate:** All methods were carried out in accordance with relevant guidelines and regulations. The approval to carry out this study was given by the University of Rwanda Institutional Review Board (IRB) N° 053/CMHS IRB/2020 as well as the ethics committee of University Teaching Hospital of Kigali, referenced as Ref: EC/CHUK/102/2020, Rwanda military hospital, referenced as Ref: 046/RMH/COMDT/2021, University Teaching Hospital of Butare, referenced as Ref: CHUB/DG/SA/12/2734/2020 and King Faisal Hospital.

All study participants signed written informed consent prior to study enrollment.

- **Consent for publication:** Not applicable. No individual personal data were included in the study. All patients provided the necessary consent to participate in the present study.
- **Availability of data and materials:** The datasets generated and analyzed during the current study are not publicly available because we are not allowed to share individual level data. However additional information about the data is available from the corresponding author on reasonable request.
- **Competing interests:** All the authors have declared no conflicts of interest
- **Funding:** The study was not funded
- **Authors' contributions:**

A. Gloria SHUMBUSHO conceived, designed and coordinated the study, collected data and wrote the manuscript.

B. Jules KABAHIZI participated in the design of the study and critically reviewed the manuscript.

C. Marla MCKNIGHT participated in the design of the study and critically reviewed the manuscript.

D. Celestin HATEGEKA contributed to the study design, performed statistical analysis and critically reviewed the manuscript.

E. Marianne Vidler reviewed the manuscript.

All authors read and approved the final manuscript.

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Figures

ESKD: End stage kidney disease

Figure 1. Patients selection flow

Figure 1

Patients' selection flow

Figure 2

Distribution of HRQOL patients scores by KDQOL-36™ domains