Original paper

Mortality and Associated Factors in End-Stage Renal Disease Patients Admitted at the Kenyatta National Hospital from 2017 to 2021

Allan Were Omollo[1], Najma Jelle Adan[2], Mercy Anyango Ojunju[1], Faithjoy Wangechi Waweru[1], Caroline Lenkoseg[2], Maldrine Mmboga Munga[2], Mabwai C. Kelvin[2], Maithya Anne Mwende[2]

[1]Department of Clinical Medicine and Therapeutics, School of Medicine, Faculty of Health Sciences, University of Nairobi, P. O. Box 19676-00202, Nairobi, Kenya

[2]Department of Nursing Nurses, School of Medicine, Faculty of Health Sciences, University of Nairobi, P. O. Box 19676-00202, Nairobi, Kenya

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Address for correspondence: Mr. Allan Were Omollo, P.O. Box 30197-00100, Nairobi, Kenya. Email: allan.omollo7@gmail.com

Abstract

Background: End Stage Renal Disease (ESRD) presents a challenge to global healthcare systems. While there have been improvements in treatment modalities available, the mortality associated with ESRD is still high.

Objective: To determine the mortality and associated factors among ESRD patients admitted at the Kenyatta National Hospital (KNH) between 2017 and 2021.

Methodology: A retrospective study design using medical records of 252 patients obtained through simple random sampling. Data of in-patients with ESRD at KNH from 2017-2021 was extracted from records. Data on socio-demographic and disease-related factors was also extracted from the records. Stata 17 software was used for data analysis. The main study outcomes were death or survival at discharge.

Results: Sixty percent of the patients were males and the median age was 52 years. Over the 5 years, 33% of the patients died during admission. Older age (>50 years), male gender, rural residence, lack of medical insurance, hypertension as an aetiology and comorbidity, unknown cause of ESRD, using a catheter for dialysis access, eGFR at admission, and hyperkalemia were associated with higher mortality with p values ≤ 0.05.

Conclusion: Mortality among ESRD patients on haemodialysis admitted at KNH is high. The focus should be on prevention and improving access to kidney transplantation services. For patients on haemodialysis, modifiable risk factors associated with mortality such as catheter access as a route for dialysis and hyperkalemia at admission should be identified early.

Key words: End Stage Renal Disease, Mortality, Kenyatta National Hospital, Haemodialysis

Introduction

End-Stage Renal Disease (ESRD) presents a challenge to global healthcare systems (1). Worldwide prevalence of Chronic Kidney Disease (CKD) stands at 13.4% (1,2). The estimated prevalence in Africa is 10.1% (3). A study conducted at the Kenyatta National Hospital, which is the national referral hospital in Kenya revealed the prevalence of CKD at 38.6% (4). A steadily declining Glomerular Filtration Rate (GFR), which eventually results in ESRD and the need for renal replacement therapy is one of the dreaded consequences of CKD. While there have been major advances in care for patients with ESRD, in most African countries the major modality relied upon by patients is haemodialysis, as most patients cannot afford renal transplantation and peritoneal dialysis is not widely available (5–7). In Kenya, there have been major improvements in ESRD treatment since the National Health Insurance Fund started reimbursements for twice-weekly haemodialysis sessions in 2017 shielding patients from out-of-pocket payments and hence improving access to care for patients with ESRD (8).

While there has been a lot of improvement in the quality of care for ESRD patients in our region and Kenya, there is still a need for emphasis on education and increasing access to renal

transplantation for all patients (9). One significant area of improvement in the care for patients with ESRD is in improving data availability to understand the impact of current policies and serve as an audit for the quality of care and this is possible through extensive research in the field (10). Without a renal disease registry, much of the data on ESRD in Kenya is from research conducted on this population and currently, the factors associated with mortality among ESRD patients in Kenya have not been studied despite the growing mortality and morbidity associated with ESRD.

Materials and methods

Study setting: The study was conducted at Kenyatta National Hospital.

Study design: A retrospective study design focusing on ESRD patients admitted between January 2017 and December 2021.

Dependent variable: The event at discharge: either death during admission or survival and discharge from the facility.

Independent variables: Socio-demographic factors: age, gender, marital status, residence, and health insurance.

Clinical factors: eGFR, CRP, albumin, potassium, aetiology of ESRD, and comorbidities.

Data collection: All files of patients with ESRD (Code N18) admitted during the 5 years (2017-2021) were obtained from the hospital's medical records, totaling 2000 files. Stratified sampling was used to divide the files by the year of admission, followed by systematic sampling to select 531 files. Out of the 531 files selected, 252 files meeting the inclusion criteria were enrolled in the study. Data was collected using a data extraction tool adapted from various literature sources.

Inclusion criteria: Patients diagnosed with ESRD and admitted between January 2017 and December 2021.

Exclusion criteria: Incomplete records or patients not fitting the ESRD diagnosis criteria.

Ethical approval: The study was undertaken under the approval of the KNH-UoN Ethics and Research Committee, study number UP825/11/2022. Permission to access the records and collect data was sought from the health information and records department at KNH.

Data processing and analysis: We conducted descriptive statistics, reporting median, inter-quartile ranges, mean, and standard deviations for continuous variables. Frequencies and proportions were reported for categorical variables. A multivariate logistic regression model was fitted to determine factors associated with mortality in ESRD patients admitted to Kenyatta National Hospital. Variables included in the multivariable model were selected based on the literature review. The significance level was set at an alpha of 0.005. Data analysis was performed using STATA version 15.

Results

Among the 252 patients admitted, the median age was 52 years (IQR 36,63). The number of male patients was 151 (60%). One hundred and thirty four (53%) of the patients lived in the urban residences. More than half of the patients were married 172 (68%). Most of the patients had the National Health Insurance Fund (NHIF) insurance 186 (74%). Table 1 summarizes the sociodemographic characteristics of the patients with ESRD admitted at KNH between the years 2017 and 2021.

Table 1: Sociodemographic characteristics

Characteristics		Frequency (n=252)	(%)
Gender	Male	151	60
	Female	101	40
Marital status	Married	172	68
	Not married	79	31
	Missing	1	1
Employment status	Unemployed	52	21
	Self employed	28	11
	Informal employment	25	10
	Formal employment	25	10
	Missing	122	48

Residence	Urban	134	53
	Rural	117	46
	Missing	1	1
Insurance	National Health Insurance	186	74
	No insurance	60	24
	Private insurance	2	1
	Missing	4	1

Among the 252 ESRD patients enrolled in this study, the primary causes of End Stage Renal Disease (ESRD) were hypertension 152 (60%), diabetes 73 (29%), glomerulonephritis 24 (10%), HIV 20 (8 %), polycystic kidney disease 5 (2%) and 30 (12%) who had unknown causes as shown in Table 2. The majority of the patients 173 (69%) had two dialysis sessions per week. Arteriovenous Fistula (AVF) access accounted for 43 (17%) of patients while 201 (80%) relied on catheter (AVC) access for haemodialysis. Almost half of the patients 104 (41%) received a blood transfusion during their admission at KNH as seen in Table 2.

Table 2: Haemodialysis characteristics and aetiology of ESRD

Variable	Characteristic	Frequency (n)	(%)
Type of vascular access	Catheter	201	80
	Arteriovenous fistula	43	17
	Missing	8	3
Frequency of dialysis per week	Twice	173	69
	Thrice	35	14
	Missing	44	17
Cause of ESRD	Diabetes	73	29
	Hypertension	152	60
	Glomerulonephritis	24	10
	Polycystic kidney disease	5	2
	HIV	20	8
	Idiopathic	30	12
Blood transfusion	Yes	104	41
	No	148	59

Among the 252 patients with ESRD the leading comorbidities were anaemia 152 (60%), hypertension 148 (59%), and infections 72 (29%) as shown in Table 3.

Table 3: Associated comorbidities and complications in ESRD patients at KNH

Variable	Frequency (n)	(%)
Hypertension	148	59
Diabetes	65	26
Cerebrovascular accidents	18	7
Anaemia	152	60
Congestive heart failure	28	11
Infections	72	29

Table 4 highlights the biological parameters at admission. Median creatinine values were 668 µmol/L, albumin median value of 33g/L, Urea median value of 23 mg/dL, potassium median level of 5 mmol/L, haemoglobin median value of 8 g/dL and GFR median value of 7 mL/min.

Table 4: Biological parameters at admission of ESRD patients at KNH

Variable (at admission)	Median	IQR (Interquartile range)
Creatinine	668	(481, 1017)
Urea	23	(28, 37)
Albumin	33	(28, 37)
Potassium	5	(4.2, 5.8)
Haemoglobin	8	(7, 10)
GFR	7	(4, 11)

Outcome: Among the 252 patients admitted to Kenyatta National Hospital with ESRD between January 2017 to December 2021, 85 patients (33%) died during admission, and 166 patients (66%) were discharged while the record of one patient was not complete.

As seen in Table 5, factors that were associated with mortality include; Age >= 50 years (P -value= 0.003), Male gender (P-value= 0.042), rural residence (p value= 0.029), lack of medical insurance (P-value=0.049), hypertension as an aetiology (P-value= 0.002), idiopathic causes of ESRD (P-value < 0.001), hypertension as a comorbidity (P-value= 0.008), using a catheter as the vascular access for haemodialysis (p-value= 0.006), potassium levels of >5 at admission (P- value= 0.023), and GFR levels at admission (0.048).

Table 5: Factors associated with mortality in ESRD patients

Variable	Unadjusted odds rat ratios OR (95% CI)	P-value	Adjusted Odds Ratios aOR (95% CI)	P-value
Socio-demographics				
Age (years)				
< 50	Ref		Ref	
>= 50	2.31 (1.33-3.99) *	0.003*	1.94(0.97-3.87)	0.059
Gender				
Female	Ref		Ref	
Male	1.73 (0.99-2.99)	0.051	2.07 (1.02-4.20) *	0.042*
Marital status				
Not married	Ref			
Married	1.57 (0.87-2.83)	0.134	-	
Employment				
Unemployed	Ref			
Informal employment	1.69 (0.52-5.57)	0.383	-	
Self-employment	1.17 (0.34-3.98)	0.804		
Formal employment	2.52 (0.82-7.83)	0.107		
Residence				
Urban	Ref		Ref	
Rural	1.80 (1.06-3.06)	0.029*	1.30 (0.68- 2.49)	0.421

Insurance				
NHIF/ Private Insurance	Ref		Ref	
No insurance	1.82 (1.00- 3.30)	0.049*	1.92 (0.93-3.98)	0.08
Aetiology of chronic kidney **Disease**				
Hypertension				
No	Ref		Ref	
Yes	0.43 (0.25-0.73) *	0.002*	0.57 (0.25-1.28)	0.171
Diabetes				
No	Ref			
Yes	0.66 (0.36-1.19)	0.167	-	
Glomerulonephritis				
No	Ref			
Yes	0.79 (0.31-1.97)	0.610	-	
Polycystic kidney disease				
No	Ref			
Yes	8.14 (0.89-74.0)	0.063	-	
HIV				
No	Ref			
Yes	1.06 (0.41-2.75)	0.911	-	
Not known				
No	Ref			
Yes	5.72 (2.48-13.2) *	<0.001*	3.37 (1.05-10.6) *	0.040*
Comorbidities				
Hypertension				
No	Ref		Ref	
Yes	2.12 (1.22-3.71) *	0.008*	2.91 (1.33-6.35) *	0.007*
Diabetes				
No	Ref		Ref	
Yes	1.56 (0.88-2.80)	0.130	1.20 (0.57-2.54)	0.625
Cerebrovascular accidents				
No	Ref			
Yes	2.06 (0.79-5.41)	0.140	-	
Anaemia				
No	Ref			
Yes	1.26 (0.73-2.17)	0.402	-	
Congestive heart failure				
No	Ref			
Yes	1.54 (0.69-3.43)	0.289	-	
HIV				
No	Ref			
Yes	1.82 (0.71-4.68)	0.211	1.66 (0.47-5.84)	0.431

Infections				
No	Ref			
Yes	1.61 (0.91-2.84)	0.099	-	
Type of vascular access				
Fistula	Ref		Ref	
Catheter	3.54 (1.42-8.80) *	0.006*	2.94 (1.06-8.15) *	0.037*
Blood transfusion				
No	Ref			
Yes	0.73 (0.43-1.25)	0.254	-	
Biological parameters				
Creatinine levels	1.00 (0.99-1.00)	0.168	-	
Urea	1.01 (0.99-1.03)	0.071	-	
Albumin			-	
>=34	Ref			
<34	1.65 (0.87-3.16)	0.128		
Potassium			1.48 (0.77-2.87)	0.237
<=5	Ref			
>5	1.86 (1.08-3.19)	0.023*		
Haemoglobin			-	
>=10	Ref			
<10	1.17 (0.67-2.05)	0.573		
GFR at the initiation of dialysis (mL/min/1.73 m^2)	0.97 (0.95-0.99) *	0.048*	0.97 (0.94-1.01)	0.130
Frequency of dialysis per week	0.63 (0.26-1.51)		-	

**Significant variables at alpha=0.05*

Discussion

Our study identified a mortality of 33% among ESRD patients admitted to Kenyatta National Hospital. These results are almost similar to but lower compared to a study done in Ethiopia in 2021 which revealed a mortality of 35.1% among inpatients with ESRD on haemodialysis (11). In comparison, studies done in 2011 showed the mortality rate of ESRD to be 6% in Morocco, 10.4% in Tunisia, and 12% in Algeria (12). These rates could be higher currently given the gradual increase in ESRD-associated mortality worldwide (13–15).

Older age (>50 years) was found to be linked with higher mortality among ESRD patients admitted to the hospital. This observation aligns with previous research, including a study that indicated that mortality rates tend to increase with age, especially beyond 55 years (16,17). Therefore, careful management of older ESRD patients is essential to mitigate mortality risks. Additionally, we observed a gender disparity in mortality, with a higher mortality in males as compared to females. This finding is consistent with a study that relied on data from the Global Burden of Disease Study to evaluate the sex differences in mortality associated with CKD between 1990 and 2019. Particularly for Kenya, the study found the mortality rate to be 31 per 100, 000 for males and 21 per 100, 000 for females (18). However, this is contrary to some that studies revealed that there was no significant difference in the outcome of haemodialysis and mortality between male and female patients receiving haemodialysis (19,20). Women in general have a survival advantage over men but this is highly diminished for patients on haemodialysis with no significant difference in mortality between genders. This has sometimes been attributed to lead time bias with female patients starting dialysis later than male patients due to lower creatinine generation (21). The reasons behind this gender disparity in ESRD-related mortality in Kenya warrant further investigation to develop targeted interventions and reduce this discrepancy.

Hypertension was identified as a significant factor associated with mortality. Hypertension is a risk factor for adverse cardiovascular events, such as stroke, cardiac failure, and myocardial infarction, ultimately contributing to mortality among ESRD patients (22). Previous research has also highlighted the association between hypertension and intradialytic mortality (23,24). These results emphasized the importance of adequate blood pressure management in patients with ESRD.

This study revealed a noteworthy association between rural residence and mortality in ESRD patients, consistent with research conducted in the Amhara region of Ethiopia (11). This could be attributable to challenges accessing dialysis centers due to proximity, leading to missed sessions (25). Socioeconomic factors, including lower affordability and limited access to ESRD education in rural areas, could impact compliance and timely medical intervention (26).

The study findings also highlighted the risk associated with catheter access for haemodialysis, aligning with previous research. Catheters are more prone to infections and thrombosis compared to other vascular access methods such as grafts and fistulas (27). Catheter-related complications, including inadequate flow during dialysis, can significantly impact patient outcomes (28). Despite these, most patients with ESRD rely on catheters for haemodialysis access (80%) as shown in this study. Once patients are diagnosed with ESRD, physicians need to discuss the options available in terms of dialysis access together with the benefits and risks in each case.

Potassium levels of more than 5mmol/l are associated with higher mortality in ESRD patients on haemodialysis which can be attributable to an increased risk of cardiac arrhythmias These findings are in agreement with other studies such as a cohort study conducted in China among 1003 pairs of patients found the all-cause mortality to be 5.39 times higher in the cohort with hyperkalemia compared to the cohort without hyperkalemia ($P < 0.001$) (29). Potassium levels should therefore be closely monitored in ESRD patients and proper management instituted to minimize complications.

Conclusions

In conclusion, our study provides valuable insights into the socio-demographic factors, biological parameters, and comorbidities associated with mortality in patients with End-Stage Renal Disease (ESRD) at Kenyatta National Hospital. The findings shed light on the higher prevalence of ESRD among males, the substantial impact of marital and employment status on ESRD outcome, the disparities between urban and rural patients, and the pivotal role of insurance coverage in ESRD management. Moreover, our study underscores the significant burden of comorbidities in ESRD patients, notably anaemia, hypertension, and infections, highlighting the need for comprehensive and multidisciplinary care approaches to address the complex needs of ESRD patients and optimize outcomes. By implementing these recommendations, healthcare systems can make strides in reducing mortality improving patient outcomes, and enhancing the quality of life for individuals grappling with this challenging condition.

Recommendations

Efforts should be made to increase insurance coverage among the population at risk for ESRD. Additionally, exploring the impact of insurance coverage on ESRD outcomes and addressing barriers to obtaining insurance is crucial.

Prevention and treatment of comorbidities and the resulting complications would significantly lower the mortality rate among patients with ESRD while taking a complete and integrated approach to managing hypertension and diabetes.

Collaboration and coordination among healthcare professionals can improve patient outcomes by addressing the complex needs of ESRD patients. It is also important to focus on gender-specific interventions in developing targeted prevention and treatment strategies for both men and women.

Further research followed up on patients from the beginning of diagnosis of ESRD and initiation of haemodialysis is needed to determine the mean survival time for patients diagnosed with ESRD in Kenya.

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