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PATIENT SURVIVAL STATUS AND ASSOCIATED FACTORS AMONG END-STAGE KIDNEY DISEASE PATIENTS UNDERGOING HEMODIALYSIS AT A TERTIARY HEALTHCARE FACILITY IN WESTERN KENYA

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ABSTRACT

Background: **End-stage kidney disease (ESKD) is a critical health condition requiring ongoing management, often through hemodialysis. Despite advances in treatment, survival rates remain a concern. Identifying factors influencing survival can improve patient outcomes.**

Aim: **To assess the survival status and associated factors among ESKD patients undergoing hemodialysis at a tertiary healthcare facility in Western Kenya.**

Setting: The study was conducted at a tertiary healthcare facility in Western Kenya.

Method: **This was a cross-sectional study involving 174 ESKD patients who received hemodialysis between 2015 and 2021. Data on patient demographics, clinical characteristics, laboratory results, and survival status were collected retrospectively. Unadjusted and adjusted Cox regression analyses were used to determine the relationship between various factors and survival status.**

Results: **Of the 174 patients, 35 (20.1%) were alive, and 139 (79.9%) had died by the end of 2021. Key factors associated with survival included treatment status, type of comorbidity, and elevated levels of calcium, sodium, and potassium. However, after adjusting for confounders, only elevated calcium levels remained statistically significant (Adjusted Hazard Ratio = 3.85, 95% CI: 1.77, 8.36; P = 0.001). The majority of deceased patients 89 (64%) died within one month of initiating hemodialysis, while 38 (27.34%) died within one to six months.**

Conclusion: **ESKD patients undergoing hemodialysis in this setting experience high mortality, with treatment status and comorbidities significantly influencing survival outcomes.**
Contribution: **This study provides valuable insights into the survival status and factors influencing outcomes in ESKD patients undergoing hemodialysis in Kenya.**
Keywords: **End-stage kidney disease, hemodialysis, survival status, mortality, comorbidities, Western Kenya, Cox regression**

INTRODUCTION

A national cohort study conducted in Taiwan compared the clinical outcomes of elderly patients with end-stage kidney disease (ESKD) receiving peritoneal dialysis and hemodialysis. The study found that the risks of all-cause mortality and infection-related mortality were comparable between the two groups[1]. Additionally, a study examining the survival, healthcare utilization, quality of life, and end-of- life care for patients with advanced kidney disease who opted not to undergo dialysis revealed that many patients lived for several years, maintaining a good quality of life despite disease progression. However, these patients frequently required emergency care, and the level of end-of-life care varied significantly among different groups [2]. End-stage kidney disease remains a major global health issue, with high mortality rates, particularly in the early years of treatment [3]. Certain laboratory test results, including elevated ferritin, serum calcium, phosphorus, albumin, leukocytes, serum protein, and serum iron levels, can be important indicators for predicting patient survival [3]. A global study examining factors influencing outcomes for ESKD patients found that many individuals receiving in-centre hemodialysis experience low survival rates, especially in the early stages of ESKD, highlighting the need for better treatment preparation and alignment with patient and family preferences [4]. Research conducted at Adama Hospital in Ethiopia on ESKD patient survival revealed that complications, a family history of ESKD, and being female were associated with increased mortality risk, underscoring the need for age-specific and gender-focused follow-up care to improve outcomes [5]. Despite advancements in dialysis treatment, the growing demand is unsustainable, with many patients lacking access to care and millions of deaths annually. This has led to calls for patient-centered innovations and international collaboration to improve the quality of care and expand treatment options for those with kidney failure [6]. Unpublished data from the birth and death registry in Western Kenya indicates a significant burden of morbidity and mortality associated with ESKD in the region. This highlights the importance of the current study, which aims to assess patient outcomes for those with ESKD receiving hemodialysis at a tertiary healthcare center in Western Kenya.

Research methods and design

This study utilized a cross-sectional design to assess the outcomes of patients with end-stage kidney disease (ESKD) undergoing hemodialysis at Kakamega County General Teaching and Referral Hospital. The data collected were from secondary sources, specifically medical records of ESKD patients receiving hemodialysis from January 2015 to December 2021. Given the nature of the study, the design allowed for a snapshot of the patient characteristics, treatment

outcomes, and survival rates over the specified period.

Participants and materials

The study involved 174 ESKD patients who were aged 18 years and older and were actively receiving hemodialysis treatment. This was a cross-sectional study involving patients who received hemodialysis between 2015 and 2021. Data on patient demographics, clinical characteristics, laboratory results, and survival status were collected retrospectively in 2021. For this study, laboratory data on creatinine, urea, phosphate, calcium, sodium, potassium, chloride, and hemoglobin levels were obtained from the results of the final session prior to dialysis at the time of data collection. The focus was on adult patients with ESKD who were receiving treatment for the condition, ensuring that the data was pertinent to the specific patient group under study.

Data collection process

Data collection was carried out using a consecutive sampling method, where medical records of patients diagnosed with ESKD who were undergoing hemodialysis during the study period were reviewed. A detailed abstraction of data from patient files was made, which included demographic information, clinical diagnoses, and laboratory test results. The study excluded patients who had died from COVID-19-related complications during the period of the study, due to the potential confounding effects of the virus on the outcomes.

Laboratory test results such as creatinine, urea, phosphate, calcium, sodium, potassium, chloride, and hemoglobin were retrieved from the healthcare facility's database. The Medonic Hematology Analyzer M32 (Boule Diagnostics AB, Sweden) was used for the analysis of hemoglobin, while COBAS INTEGRA 400 plus (Roche Diagnostics, United States) was used for other biochemical parameters.

Statistical analysis

Data analysis was performed using the Statistical Package for Social Sciences (SPSS) version 25 (IBM SPSS, Chicago, Illinois, USA). Descriptive statistics, including means and frequencies, were used to summarize the patient demographics, treatment characteristics, and laboratory test results. Binary logistic regression analysis was employed to assess the relationship between various factors and patient survival outcomes, specifically focusing on the odds of favorable versus unfavorable outcomes (alive vs. deceased).

Additionally, Cox proportional hazard regression analysis was utilized to evaluate the influence of hematological and kidney biochemical parameters on survival. This model helped identify independent predictors of mortality and time to death. A hazard ratio greater than 1 indicated an increased risk, while a hazard ratio less than 1 suggested a reduced risk. A p-value of less than 0.05 was considered statistically significant for all analyses.

Ethical considerations

Approval for the study was granted by the Secretary of Eastern Africa, Baraton (UEAB) Research Ethics Committee (approval number UEAB/ISERC/22/6/2022). A permit to conduct the study was also obtained from the National Commission for Science, Technology, and Innovation (NACOSTI) (reference number: 237672, License No: NACOSTI/P/22/18844). As this study utilized secondary data, patient identifiers were redacted to ensure confidentiality. Consent from individual patients was not required

due to the anonymized nature of the data collected. All data were handled in strict accordance with ethical guidelines to maintain patient confidentiality and privacy. This study primarily relied on secondary laboratory data and thus did not involve direct interaction with patients. Only patients aged 18 years and above were included in the study, ensuring that the analysis focused on an adult population receiving dialysis treatment.

Results

Demographics, Prognostic Factors, and Survival Status of ESKD Patients Undergoing Hemodialysis.

This study aimed to assess the survival status and explore factors associated with survival among patients with end-stage kidney disease (ESKD) undergoing hemodialysis at a tertiary healthcare center in Western Kenya. A total of 174 patients who received hemodialysis from 2015 to 2021 were included in the study.

The data demonstrated that survival outcomes varied by year. As of 2021, out of the 174 ESKD patients, 35 (20.1%) were alive, and 139 (79.9%) had passed away. Notably, patients who began hemodialysis in the earlier years (2015-2017) had poor survival outcomes, with 100% mortality within the first year of dialysis initiation for those who started in 2015 and 2016 (Table 1).

Table 1: Patient Survival Status by Year for Hemodialysis Patients (2015-2021)

Year	Patients on dialysis	Alive by 2021 (n, %)	Deceased by 2021 (n, %)
2015	22	0 (0%)	22 (100%)
2016	24	0 (0%)	24 (100%)
2017	27	1 (3.7%)	26 (96.3%)
2018	31	9 (29%)	22 (71%)
2019	34	12 (35.3%)	22 (64.7%)
2021	36	13 (36.1%)	23 (79.9%)
Total	**174**	**35 (20.1%)**	**139 (79.9%)**

Survival status was analyzed with regard to various demographic and clinical factors (table 2). Among male and female patients, there was no statistically significant association between gender and survival (Odds Ratio = 1.01, 95% CI: 0.48, 2.14; P = 0.97). Similarly, age was not found to be a significant predictor of survival (Odds Ratio = 1.0, 95% CI: 0.98, 1.02; P = 0.67), although a majority of patients (81%) were aged 33 years or older, and a high percentage of them (78%) had died by the end of the study period.

In this cross-sectional study, certain clinical and laboratory findings, such as elevated creatinine, low hemoglobin, and high levels of sodium, potassium, calcium, phosphate, and chloride, were statistically significant in univariate analysis. However, after adjusting for confounders, only a few of these

variables, such as elevated calcium levels, remained significant in predicting survival. The relationship between comorbidity status and survival was also explored, with type of comorbidity being found to significantly influence outcomes. Hypertension was particularly associated with worse survival outcomes among ESKD patients.

The treatment status, which included medications for managing comorbidities and supplementation for anemia and calcium regulation, was found to have significant implications for survival. In particular, ESKD patients who were not receiving any treatment had higher mortality rates compared to those on specific treatments.

Comorbidity and Mortality Trends

The study also highlighted that a majority of ESKD patients 97.7% (n= (170/174) had one or more comorbid conditions, with hypertension being the most common 46% (n= 80), followed by hypertension and diabetes mellitus 27% (n= 47), and HIV 25.9% (n= 44). Despite this, comorbidity status alone was not found to significantly predict survival outcomes, though the specific type of comorbidity was found to influence mortality, particularly among patients with hypertension.

At the end of the study period, 35 patients were alive, and 139 had died. Among the deceased, the majority 64% (n= 89) passed away within one month of initiating hemodialysis, while 27.34% (n= 38) died within one to six months, and 8.63% (n= 12) died after six months.

Table 2: Cox Regression Analysis on Demographic, Kidney Profile, and Clinical Characteristics of ESKD Patients Enrolled at a Tertiary Healthcare Facility in Kenya from January 2015 to December 2021

Patient characteristics	Survival Status (n)		Unadjusted Crude OR (95% CI)	P Value	Adjusted aOR (95% CI)	P Value
	Alive	Deceased				
Gender			1.01 (0.48, 2.14)	0.97	-	-
Male (n = 99)	20	79				
Female (n = 75)	15	60				
Age Groups			1.0 (0.98, 1.02)	0.67	-	-
18–33 years (n = 33)	4	29				
> 33 years (n = 141)	31	110				
Laboratory Results						
Elevated creatinine * (> 106 μmol/L in males & > 97 μmol/L in females) [n = 167]	33	134	1.62 (0.30, 8.75)	0.57	-	-
Elevated urea * (> 7.1 mmol/L in adults) [n = 166]	33	133	1.34 (0.26, 6.96)	0.73	-	-
Elevated phosphate ** (>1.45 mmol/L in adults) [n = 148]	25	123	3.08 (1.25, 7.56)	0.014	1.14 (0.58, 2.24)	0.7
Elevated calcium ** (>2.5 mmol/L in adults) [n = 126]	17	109	3.85 (1.77, 8.36)	0.001	1.23 (0.73, 2.10)	0.44
Low Hb ** (< 13.5 g/dL in males	30	135	5.63 (1.43, 22.20)	0.014	1.30 (0.41, 4.13)	0.66

& < 12.5 g/dL in females) [n = 165]						
Elevated sodium * (>145 mmol/L in adults) [n = 148]	23	125	4.66 (1.91, 11.35)	0.001	1.47 (0.75, 2.88)	0.26
Elevated potassium * (>5.5 mmol/L in adults) [n = 115]	12	103	5.48 (2.48, 12.14)	<0.0001	1.21 (0.71, 2.07)	0.48
Elevated chloride * (>106 mmol/L in adults) [n = 135]	20	115	3.59 (1.61, 8.01)	0.002	1.18 (0.71, 1.98)	0.53
Comorbid Status	35	137	0.8 (0.41, 1.56)	0.48		
Type of Comorbidity	35	137	1.13 (0.96 – 1.32)	<0.0001	1.10 (0.92, 1.29)	0.15
Hypertension	26	54		0.017		
Hypertension & Diabetes Mellitus	6	41		0.33		
Treatment Status						
Not on any treatment (n = 101)	1 2	89	3.41 (1.57, 7.44)	0.002	1.34 (0.86, 2.08)	1.98

Note. OR = Odds Ratio; Hb = Hemoglobin; * = Test conducted every two weeks; ** = Test conducted monthly; P-value < 0.05 was considered statistically significant.

To monitor kidney function over time and determine whether the condition is improving or worsening, a series of laboratory tests were conducted on ESKD patients before they started dialysis. The unadjusted (crude) regression analysis revealed that factors such as treatment status, type of comorbidity, hypertension, elevated levels of calcium, phosphate, sodium, potassium, chloride, and low hemoglobin levels were statistically significant indicators affecting the survival of ESKD patients (see Table 2).

Among the 170 enrolled ESKD patients, 170 had comorbidities for which they were receiving clinical care. The chronic conditions recorded included hypertension in 80 patients (46%), hypertension combined with diabetes mellitus in 47 patients (27%), other comorbidities such as Human Immunodeficiency Virus (HIV) in 44 patients (25.9%), and two patients who had no comorbidities (see Table 2). Although comorbidity status itself did not significantly predict poor survival outcomes, the type of comorbidity was found to be statistically significant, particularly among ESKD patients with hypertension (see Table 2).

ESKD patients who were undergoing treatment—whether for comorbidities or receiving iron or calcium supplements—showed statistically significant survival outcomes. By the end of the study period, 35 ESKD patients were still alive and undergoing dialysis, while 139 patients had passed away. Among the deceased, 64% (89) died within one month of starting dialysis, 27.34% (38) died between one and six months, and 8.63% (12) died after six months.

Discussion

Our study identified several factors associated with survival outcomes in patients with end-stage kidney disease (ESKD), including age, gender, kidney biochemical parameters, hemoglobin levels, treatment status, and comorbidity status. The

crude odds ratio of 1.01 for gender suggests no significant survival difference between male and female ESKD patients. This indicates that factors such as comorbidities and treatment regimens may have a more substantial influence on survival outcomes than gender alone. Similarly, the odds ratio of 1.0 for age implies that survival rates between patients aged 18 to 33 years and those older than 33 years do not differ significantly. This suggests that age might not be as critical a determinant of survival as factors like treatment adherence, comorbid conditions, and overall health.

The study also revealed important concerns about the adequacy of dialysis treatment in sub-Saharan Africa, particularly in Kenya, where the standard recommended three dialysis sessions per week is often not met. Many countries in this region only provide dialysis twice a week, raising concerns about the potential for higher mortality rates and reduced quality of life due to insufficient dialysis frequency [7].

Regarding biochemical parameters, elevated creatinine, urea, calcium, phosphate, sodium, potassium, chloride, and low hemoglobin levels were found to correlate with an increased mortality risk, with odds ratios greater than one. However, after adjusting for other variables, these parameters were not statistically significant in predicting survival outcomes. This suggests that other unmeasured health factors, such as access to care or early detection, may play a more crucial role in determining survival. The findings underscore the need for a more comprehensive approach to identifying survival determinants, taking into account broader health and social factors.

The overall mortality rate of 79.9% in our study, with 139 deaths among 174 ESKD patients over the six- year period, highlights the severe burden of ESKD. This high mortality rate may reflect factors such as multiple comorbidities, limited healthcare resources, and challenges in providing adequate dialysis care. These findings stress the need for improved healthcare infrastructure, better management of comorbidities, and enhanced treatment protocols to improve survival rates for ESKD patients. This is particularly urgent given the study's alignment with the 72.7% mortality rate observed in a study in China over a similar period [8].

Our study found that 78.7% of deceased patients had comorbidities, with hypertension and diabetes being the most prevalent conditions. The observation made on the current study where majority (63.2%) of study population were over 33 years of age resonates the Kenya Kidney Registry that recorded hypertensive renal disease and diabetic nephropathy as the most frequent kidney diseases requiring kidney replacement therapy (KRT) [9]. According to a population-based study, age and HIV infection are significant risk factors for Chronic Kidney Disease (CKD) in rural East Africa [10].

Conclusion

Our findings highlight the alarmingly high mortality rate among ESKD patients, suggesting that many individuals face significant risks shortly after their diagnosis, particularly following the initiation of dialysis. The unadjusted risk ratios demonstrate that survival is challenging even in the early stages of dialysis treatment. Despite analyzing factors like age, gender, and comorbidities, these were not found to be significant predictors of survival, suggesting that other unmeasured variables or systemic challenges might be affecting patient outcomes. This underscores the need for better diagnostic protocols, more frequent

dialysis, and targeted interventions aimed at improving the survival and quality of life for ESKD patients. Addressing these gaps in care could help reduce mortality and enhance health outcomes for this vulnerable population.

Limitation of the study

This study had several limitations, including its data abstraction design. The cause of death for ESKD patients could not be determined, as the registry only recorded survival status (alive or deceased) without specifying causes of death. Additionally, crucial data on potential confounders, such as family history of kidney disease, inherited kidney disorders, or cardiovascular diseases, were missing from patient records. Furthermore, details about specific treatments provided to the patients were not captured during data collection, limiting our ability to analyze the effects of various treatment protocols on survival outcomes.

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Competing interests

The authors declare no competing interests.

Author's contributions

RND and SMA developed the study concept and design. RND, SMA, and SMK supervised the data collection process. RND and SMK carried out the statistical analysis and interpretation. RND, SMK, and SMA contributed to drafting the manuscript. RND and SMK took primary responsibility for the final version of the manuscript. All authors have reviewed and approved the final manuscript.

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Data availability statement

The data included in this manuscript will be available upon request from the corresponding author. Those interested can contact the corresponding author directly to obtain the necessary materials for further review or analysis.

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