PREDICTORS AND PROGNOSTIC SURVIVAL FACTORS OF PATIENTS UNDERGOING HEMODIALYSIS AT KAKAMEGA COUNTY GENERAL TEACHING AND REFERRAL HOSPITAL, KENYA

BY

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DECLARATION

This thesis is my original work and has not been presented for the award of any other degree or to any other University.

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DEDICATION

I dedicate this thesis to my dearest wife Dr. Sylviah Mweyeli Aradi whose words of encouragement and push for tenacity ring in my ears. My beloved sons Klyle Emmanuel Demba and Milan Llyoid Demba whom I can't force myself to stop loving.

Finally, I would like to dedicate this thesis to all my former, current, and future students, may you find this work a beacon of hope and feel encouraged when you read it. Lifelong learning is an asset that you can gift yourself, be it at any age. In the words of Jim Rohn, I leave this to you, "Formal education will make you a living. Self-education will make you a fortune.”

ABSTRACT

The global, regional, and national burden of kidney diseases (acute kidney injury and chronic kidney disease) are attributed to impaired kidney function. The birth and death registry office in Kakamega County has recorded increased morbidity and mortality attributed to acute kidney injury (AKI) and chronic kidney disease (CKD). Most of the studies done in Kenya were on the prevalence of AKI and CKD among the population that are in Nairobi and Nyeri. The findings of this study were the first of its kind in Kenya on the survival analysis of AKI and CKD patients undergoing haemodialysis. The broad objective of this study was to determine the factors influencing survival in hemodialysis patients in Kakamega County general teaching and referral hospital (KCGT&RH). The specific objectives were to determine the demographic characteristic influencing the survival of patients undergoing hemodialysis, to establish the renal biochemical parameters as a survival predictor of patients undergoing hemodialysis, and to evaluate the prognostic factors as a survival indicator of patients undergoing hemodialysis in the renal unit, at KCGT&RH. This was hospital-based retrospective cohort study where records from the renal unit were reviewed from December 2021 to January 2015. Approval to conduct the study was obtained from the Secretary of Eastern Africa, Baraton (UEAB) Research Ethics Committee. Permit to conduct the study was also be obtained from National Commission for Science, Technology, and Innovation (NACOSTI). The clinical chemistry autoanalyzer Olympus 640 (Olympus Diagnostica GmbH, Hamburg, Germany) was used for measuring renal biochemical parameters and Huma Count 5D was used for estimating the Hb levels. The statistical package for social sciences (SPSS) version 23 was used for cleaning of data and analysis. The total number of 174 cases that had CKD and 69 cases diagnosed to have AKI were recruited and studied. Descriptive statistics were used to present frequency and proportion for the categorical variables. Inferential statistics involved the binary logistic regression analysis to establish the relationship between demographic characteristics (age and gender) and survival of both AKI and CKD patients. Whereas multinomial logistic regression was used to determine relationship between the types of comorbidities, number of comorbidities and survivals status of AKI and CKD patients. To estimate the survival functions, Kaplan Meier analysis was used, and Cox-proportional hazard regression analysis was also used to identify independent predictors and prognostic of time to death. The study was able to perform a crude and adjusted hazard ratios with a confidence interval of 95%, and p-values of less than 0.05 were used to declare the presence of statistically significant. The demographic characteristic of AKI patients showed that 33 (47.8%) were males and 36 (52.2%) Females, 36 (52.2%) were 18 – 33 years and 33 (47.8%) above 33 years whereas CKD patients showed that 99 (56.9%) were males, 75 (43.1%) Females and 33 (19%) were 18 – 33 years and 14 1(81%) above 33 years. Majority 64.03% (89) of the patients with CKD died in less than one month, 27.34% (38) died between one to six months and 8.63% (12) died > six months after the clinical diagnosis despite being on hemodialysis. The results showed statistically significant relationship between survival status and time-to-event at a p value of < 0.0001 at 1 df with a 95% CI of 0.055 – 0.218. Majority 55.56% (10) of the AKI patients died in less than one month and 44.44% (8) died $\geq$ one month after clinical diagnosis despite being on hemodialysis. The results showed no statistically significant relationship between survival status and time of event at a p value of 0.923 at 1 df with a 95% CI of 0.357 – 3.112. Potassium levels were a significant (p value 0.038) parameter that acted as a survival predictor of AKI patients. Prognostic factors did not significantly influence the survival of AKI patients whereas in CKD patients it was observed that the predictors and prognostic factors significantly (p value <0.05) influenced their survival.

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LIST OF ABBREVIATIONS

ACR	Albumin-to-creatinine Ratio
AER	Albumin Excretion Rate
AKI	Acute Kidney Injury
ANA	Antinuclear antibody
ARF	Acute Renal Failure
ATN	Acute Tubular Necrosis
BUN	Blood Urea Nitrogen
CKD	Chronic Kidney Disease
eGFR	estimated Glomerular Filtration Rate
ESRD	End-Stage Renal Disease
ESRF	End-Stage Renal Failure
GFR	Glomerular Filtration Rate
KDIGO	Kidney Disease Improving Global Outcome
KDOQI	Kidney Disease Outcome Quality Initiative
LMICs	Low-Income too Middle-Income Countries
MOH	Ministry of Health
RRT	Renal Replacement Therapy
SCORED	Screening for Occult Renal Disease
SPSS	Statistical Package for Social Science

OPERATIONAL DEFINATION OF TERMS

Acute kidney injury: Rise in serum creatinine of ≥50% from baseline or a rise of serum creatinine by ≥26.5 μmol/L (≥0.3 mg/dL) in <48 h

Acute-on-chronic kidney disease: Rise in serum creatinine of ≥50% from baseline or a rise of serum creatinine by ≥26.5 μmol/L (≥0.3 mg/dL) in <48 h in a patient with cirrhosis whose glomerular filtration rate is <60 ml/min for >3 months

Chronic kidney disease: Glomerular filtration rate of <60 ml/min for >3 months

Hemodialysis: Is a substitute for normal function of the kidney in patients whose kidney can longer perform its function naturally.

Patients: These are acute kidney injury and chronic kidney disease cases.

Predictors: These are biochemical parameter and urine out providing information about the functional status of the kidney.

Prognostics: These are independent variables that determines the survival of patients undergoing hemodialysis.

Renal Unit: This is a Centre in the hospital providing full range of treatment including hemodialysis for patients with kidney disease.

Survival: Is a state of being alive or dead in spite of impaired renal function.

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CHAPTER ONE

INTRODUCTION

1.1 Introduction

In Chapter one, the thesis opens with describing acute kidney injury (AKI), chronic kidney disease (CKD), historical background, theory, indicators, global, developing countries and Kenya's perspective on AKI and CKD. The study intends to review predictors and prognostics factors to establish the survival of AKI and CKD patients undergoing hemodialysis in the renal unit. The chapter further highlight on what hemodialysis is, the statement of research problem, study objectives and hypotheses. In-addition, this chapter pinpoints the justification and conceptual framework of the proposed study.

1.1.1 Acute Kidney Injury and Chronic Kidney Disease

Kidney or renal disease is a damage to or disease of the kidney and there are two main types' namely acute kidney injury and chronic kidney disease. Acute kidney injury (AKI) is a sudden damage and decline in kidney function which occurs within days characterized by decreased urine output, increased serum creatinine or both (Ronco *et al.*, 2019). Acute kidney injury is often preventable or reversible (Muroya *et al.*, 2018; Zuber and Davis, 2018; Palevsky, 2018; O'connor *et al.*, 2016). Acute Kidney Injury is a spontaneous failure in kidney function that can result to a long-term kidney damage and/or death (Makris & Spanou, 2016). On contrary to AKI which might occur quickly over a matter of days, CKD takes months or years to develop. However, AKI increases the risk of developing CKD (Makris & Spanou, 2016). According to WHO fact sheet, chronic kidney disease (CKD) also referred as Chronic Kidney Failure (CKF) is the continuing deterioration of kidney function over time. Mills, (2016), describes CKD as a condition where the function of kidney, which is to filter blood, is impaired for a period of more than three months, characterized by loss of their ability to drains waste products and retains blood proteins. The Centers for Disease Control and Prevention report of 2021 indicated that kidneys of patients with CKD become damaged over time and later may not clean blood resulting to extra fluid and toxic accumulation later progressing to cause heart disease, high blood pressure, resulting to early death. Chronic Kidney Disease is a slow, gradual disease that is characteristically presents with no symptoms that are obvious until the condition advances to a late stage, however, early diagnosis and treatment has been shown to significantly delay its progression (Shang *et al.*, 2021).

Historical perspective following a disease surveillance appreciates that, while communicable diseases (CDs) have contributed significantly impacting on population health, non-communicable diseases (NCDs) have gained prominence and are now reported as the main causes of mortality and morbidity for now over 50 years (Divyaveer & Jha, 2021). Acute kidney injury and CKD disease is among the non-communicable diseases (NCDs) contributing to worldwide morbidity and mortality with the risk factors linked to diabetes, hypertension, infections, and environmental factors (Brachman, 2003). Acute kidney injury previously described as acute renal failure (ARF) (Longo *et al.*, 2011), at the starting of twentieth century it was named Acute Bright's disease and in the course of the First World War it was called war nephritis (Davies and Weldon, 1917). Acute kidney injury linked to acute tubular necrosis (ATN) was first identified in 1940s in the United Kingdom where it observed that the affected patients developed necrosis of kidney tubules (Bywaters and Beall, 1941). The incidence of AKI decreased during the Korean and Vietnam wars due to better acute management and administration of intravenous fluids (Schrier *et al.*, 2004). The 16^{th} most important cause of years of life lost globally is attributed to CKD despite available screening, diagnosis, and management measure to prevent adverse outcome associated with the disease (Chen, Knicely, & Grams, 2019).

The theory that can be used to study AKI and CKD as shown in figure 1.1 is based on the concept of planetary health in the context of human diseases (Oldekop *et al.*, 2020; Arora & Mishra, 2020). In this concept as shown in figure 1.1 below, communicable diseases (CDs) for example Coronavirus and non-communicable diseases (NCDs) for example AKI and CKD are interlinked either by one predisposing or contributing to another and or by one influencing the severity of another (Oldekop *et al.*, 2020; Arora & Mishra, 2020). The environment modifies or causes afflictions with both CDs and NCDs with all these determinants affecting human health under the purview of planetary health. A change in any or both the ecosystems and environment is likely to impact on both CDs and NCDs (Oldekop *et al.*, 2020; Arora & Mishra, 2020). Air pollution has been linked with increased transmission of infectious diseases (for example Coronavirus and or Mycobacterium tuberculosis) that are airborne (Coccia, 2020), and is also emerging as a causative or a significant contributor in AKI and CKD progression (Bowe *et al.*, 2018; Afsar, *et al.*, 2019). Planetary health recognizes that human health and the health of our planet are interconnected. Lack of safe water and sufficient sanitation brought about by global warming and climate change have shown to affect humans and compromising kidney health thereby increasing the risk of acute kidney diseases & chronic kidney diseases and death worldwide (Miranda *et al.*, 2019; Stenvinkel *et al.*, 2020).

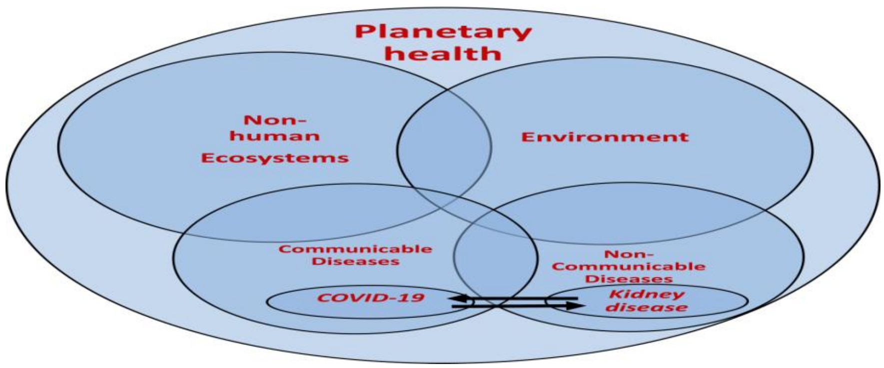

Figure 1.1: The concept of planetary health in the context of human diseases (Oldekop et al., 2020; Arora & Mishra, 2020).

Centers for Disease Control and Prevention fact sheet reports that predictors and prognostics factors are used as indicators linked to AKI and CKD. Among the predicting indicators includes routine screening of serum biochemistry profile, urine output and studies if the condition is advanced, peripheral edema, dyspnea, weight loss, metallic taste, nausea, vomiting and poor appetite (Fogarty & Taal, 2016). Furthermore, Chen, Knicely, & Grams, (2019) observed that the etiology of AKI and CKD is directed by clinical history of the patient, standard physical examination for possibility of signs and symptoms, and urinalysis. The prognostic indicators involve examining kidney structure, function and upon making the diagnosis of AKI and CKD, the subsequent step is staging which is based on glomerular filtration rate (GFR), checking for albuminuria and the cause (Eknoyan *et al.*, 2013).

Globally, more than 1 in every 10 adults have CKD hence considered a global health problem (Mills *et al.*, 2015). Worldwide burden of CKD is fast increasing at an alarming rate to anextend that its being postulated to be the 5th general cause of years of life lost by 2040 (Li *et al.*, 2020). Boukenze *et al.*, (2016) stated that 10% of the population globally are affected by CKD and millions die yearly because they lack sufficient funds required for treatment. Globally, over 2 million people undergo dialysis or go for kidney transplant to survive and out of the 2 million only 20% can access treatment in a proximately one hundred developing countries which contributes to 50% of the world's population (Couser *et al.,* 2011). Chronic kidney disease has been documented as one of the leading public health problems globally (Hill *et al.,* 2016), with worldwide estimate of 13.4% prevalence and persons with end-stage kidney disease (ESKD) estimated between 4.902 and 7.083 million (Lv & Zhang, 2019). In 2010, Global burden of diseases ranked CKD number 18 in the list of diseases that causes death world-wide from number 27 in 1990 (Jha *et al.,* 2013). According to the CDC report, (2021), about 15% of adults (thirty-seven million people) are projected to have CKD, more in 65 years or older at 38% and at 12% in 45-64 years with CKD slightly in women than men, more (16%) among blacks than white adults (13%). Globally, the epidemiology of CKD tends to vary with age, sex, and geography. The distribution of CKD in terms of gender is similar among the younger age groups, however, women surpass men in middle age and at older age specifically at stages 3-5 (Mills *et al.,* 2015). Except Iran, the prevalence of CKD is utmost in high-income regions of Europe, United States of America, Australia, and Canada, contrasted with low-and middle-income regions found in India and sub- Saharan Africa (Hill *et al.,* 2016). The highest prevalence of end-stage renal disease has been reported in Japan, USA, and Taiwan (Hu & Coresh, 2017). In United States, AKI contributes to one percent of hospital admission with an incidence rate of 2% to 5% and up to 67% in intensive care unit patients (Winther-Jensen et al., 2018; Park *et al.,* 2018).

In sub-Saharan Africa, individuals of ages 20 to 50 years are commonly affected by CKD (Matsha *et al.,* 2013). The beginning of end-stage renal disease (ESRD) is reported to be seen 20 years earlier (approximately at 45 years of age) among African descent compared to western countries (approximately at 63 years of age) (El Nahas, & Bello, (2005); Arogundade & Barsoum, 2008). Due to risk factors and genetic predisposition linked to chronic kidney disease, this illness might be widespread in sub-Saharan Africa (Muiru, *et al.,* 2020). Chronic kidney disease is a global public health concern and the prevalence in Sub-Saharan Africa has been on the rise (Muyodi *et al.,* 2020). In Kenya, among inpatients, a study done by Mwenda *et al.,* (2019) at Kenyatta National Hospital, Kenya found the prevalence of chronic kidney disease to be 38.6% (118/306). A study conducted at Nyeri County hospital determine the burden of CKD in patients with type 2 diabetes and it was observed that 30% (116/385) had unrecognized chronic kidney disease (Otieno *et al.,* 2020). In Western Kenya, the prevalence of chronic kidney disease is 3.7% (Muiru *et al.,* 2020). Muiru *et al.,* (2020) further estimated that majority of the patients with chronic kidney disease were in stage1 or 2, while 24.2% in stage 3 to 5. The Proportion of the Acute Kidney Injury was reported to be 17.5% and this captured all cases of acute renal failure including those due to medical causes (Otieno *et al.*, 1991). In 2017, data from Ministry of Health (MOH) indicated that an estimate of 4 million Kenyans have chronic kidney disease out of these about 10,000 require dialysis yet only 10% can access the services. According to the MOH, as of 2017, there are 74 dialysis facilities in Kenya, found in both government and private sector.

1.2 Statement of the problem

Acute kidney injury is worldwide problem associated with in-patient mortality (Hansrivijit *et al.*, 2021). In Africa, the disease burden of acute kidney injury remains high (Yousif *et al.*, 2018), and this has been marked with challenges in diagnosis and treatment due to scarce medical resources (Feehally, 2016). In the year 2019, Chen, Knicely, & Grams observed that CKD was the 16th disease causing mortality globally. Kovesdy, (2022) further observed that CKD had emerged as one of the leading causes of mortality globally in low- and middle-income countries and was prevalent in older women who presented with other comorbidities like diabetes mellitus and hypertension.

The renal unit was founded in Kakamega general County teaching and referral hospital the year of 2015. Hemodialysis performed at the renal unit is an essential modality of treatment for patients with AKI and CKD. To-date, Kakamega County general teaching and referral hospital have six dialysis machines in the renal unit. Reports from the Ministry of Health in Kakamega County indicates an influx in the number of patients requiring hemodialysis, yet the dialysis machine is not sufficient to carter for all the registered patients. For instance, one patient requires a minimum of two sessions of hemodialysis in a week, yet the renal unit has a registered number of approximately 300 patients. Availability of screening assay, diagnosis and management by laboratorians, clinicians and the nurses play a pivot role reducing the AKI and CKD burden in Kakamega. In addition, birth, and death registry reports from the Ministry of Health in Kakamega County, has recorded death cases attributed to AKI and CKD. Studies (Kirkley *et al.*, 2019; Winther-Jensen *et al.*, 2018; Park *et al.*, 2018) have shown that AKI have a significant morbidity and mortality if left untreated and thus an important cause of extended hospital stay. Chronic kidney disease is a progressive illness with no cure, associated with high morbidity and mortality in adult population (Kalantar-Zadeh *et al.,* 2021), Kakamega County not an exception. Due to high cost associated with renal replacement treatments and increased prevalence, CKD has been considered as one of the most expensive health problems (Bikbov *et al.,* 2020). Study conducted by Eckardt *et al*., (2012), observed that the underlying pathogenic mechanism leading to CKD, prognosis and the outcome of the illness differ significantly between the affected patients**.** Based on the observation made by Eckardt *et al*., (2012), this present study seeks to determine the predictors and prognostic factors influencing the survival of chronic kidney disease patients undergoing hemodialysis in the renal unit, Kakamega County.

1.3 Justification

There is need to understand the predictors and prognostic factors influencing the survival of patients undergoing hemodialysis in the renal unit, Kakamega County. The findings of this current study will enlighten the clinicians, laboratorians, and nurses on the need for a multidisciplinary approach in management of patients undergoing hemodialysis in Kakamega County. A comprehensive healthcare of hemodialysis patients should not solely rely on clinical presentation and laboratory investigation but the need to consider patient factors when panning the delivery of healthcare is quite important. This study aims at understanding the predictors and prognostic factors influencing the survival of patients undergoing hemodialysis with a view of managing the AKI and CKD by employing interprofessional team approach. There is need for all healthcare workers to be aware of AKI and CKD condition, its causes, potential complications, management, and preventions. This study employed a retrospective cohort study design which is a type of longitudinal study with an aim of establishing the duration of time from diagnosis (kidney disease) until an event (death) occurs.

1.4 Objectives

1.4.1 Broad Objective

To determine the predictors and prognostic survival factors of patients undergoing hemodialysis at Kakamega County general teaching and referral hospital, Kenya.

1.4.2 Specific Objective

i. To determine the demographic characteristic influencing the survival of patients undergoing hemodialysis at Kakamega County general teaching and referral hospital, Kenya.

ii. To establish the renal biochemical parameters as a survival predictor of patients undergoing hemodialysis at Kakamega County general teaching and referral hospital, Kenya.

iii. To examine the prognostic factors as a survival indicator of patients undergoing hemodialysis at Kakamega County general teaching and referral hospital, Kenya.

1.5 Hypotheses

i. **Ho_1:** The demographic characteristic does not significantly influence the survival of patients undergoing hemodialysis at Kakamega County general teaching and referral hospital, Kenya.

ii. **Ho_2:** The renal biochemical parameters do not significantly influence the survival of patients undergoing hemodialysis at Kakamega County general teaching and referral hospital, Kenya.

iii. **Ho_3:** The prognostic factors do not significantly influence the survival of patients undergoing hemodialysis at Kakamega County general teaching and referral hospital, Kenya.

1.6 Limitation and delimitation of the study

1.6.1 Limitation of the study

The study was conducted during COVID-19 pandemic which caused death across population and had adverse outcome in patience with comorbid and chronic diseases.

This being a retrospective cohort, the findings cannot be used to determine cause and effect of AKI and CKD.

1.6.2 Delimitation of the study

Even though the study was conducted during the covid-19 era, the pandemic virus was considered a confounder of survival and all deaths attributed to coronavirus were excluded in this study. This was a survival analysis study that established the expected duration of time from diagnosis to occurrence of death or survival.

CHAPTER TWO

LITERATURE REVIEW

2.1 Demographic characteristics of acute kidney injury and chronic kidney disease patients

The cause of AKI can be categorized into prerenal intrarenal vasoconstriction that is hemodynamically mediated, intrinsic renal involving glomerulus, interstitial, tubular, vascular and postrenal where intra and extrarenal obstruction occurs (Rahman *et al.*, 2012). Acute kidney injury has two major causes prerenal and acute tubular necrosis (ATN), and they account for 65 to 75% of the cases (Khwaja, 2012). Non-communicable diseases like diabetes and hypertension are risk factors of CKD worldwide. In sub-Saharan Africa and Asia, CKD is attributed to glomerulonephritis and infectious diseases attributed to poor sanitation, vector borne diseases and contaminated water (Jha *et al.,* 2013). The etiologies of CKD in some developing countries have been reported to be shifting, China for instance, diabetes surpassed glomerulonephritis in 2011 as the leading causative agent (Zhang *et al.*, 2016). The rise of diabetes and hypertension prevalence world-wide is being attributed to the increased of CKD globally in the decades to come with countries like China and Belgium reporting aristolochic acid nephropathy and progressive renal interstitial fibrosis as a potential risk (Debelle *et al.*, 2008). In Asia and Africa, the population are exposed to harm of nephrotoxicity arising from the usage of herbal medications, whereas Sri Lanka and India are at danger of developing CKD due to unknown cause, heavy metal contamination being the possible etiologic agent (Wanigasuriya *et al.,* 2011).

Centre for Disease Control fact sheet of 2021 reports that females and older age > 65 years are at risk of both AKI and CKD. Age, gender, and family history are a risk factor for CKD (Takamatsu *et al.,* 2009). However, the physiopathology of AKI is complex, dependent on a several factors and the most frequent cause is attributed to ischemia which is observed in several reasons (Kosaka *et al.*, 2016). In the setting of sepsis, AKI has been documented as the commonest due to hyperdynamic circulation and altered blood flow characterized by a drop in the glomerulus filtrate rate (Zarjou and Agarwal, 2011). In chronic kidney disease is, there is a gradual deterioration of renal function over time due to decline in GFR and creatinine clearance (Go *et al.,* 2004). Patients with CKD are classified in five stages because management and prognosis varies depending on progression of damage (Levey & Coresh, 2012; Eknoyan *et al.*, 2013). The five stages are; stage one; the kidney is damaged with normal or increased GRF (>90 mL/min/1.73m^2), stage two; there is mild reduction in GFR (60 - 89 mL/min/1.73m^2), stage three; there is moderate reduction in GFR (30 - 59 mL/min/1.73m^2), stage four; severe reduction in GRF (15 -29 mL/min/1.73m^2), stage five; kidney failure (GFR <15 mL/min/1.73m^2 or dialysis) (Levey & Coresh, 2012; Eknoyan *et al.*, 2013).

Chronic kidney disease patients with stages one to three (GFR) >30 mL/min) are generally asymptomatic with water/electrolyte imbalances or endocrine/metabolic derangements are not evident clinically, whereas patients in stages 4 -5 (GFR <30 mL/min) have the deranged and clinically manifested (Seifter & Samuels, 2011; Levey & Coresh, 2012). Urea and other toxins accumulate in blood resulting to uremia complication in CKD patients as shown in figure 2.1 is characterized by ecchymosis, gastrointestinal bleeding and pericardial friction rub which is life threatening as it might progress from chest pain, malaise, headache, confusion, and coma (Seifter & Samuels, 2011; Levey & Coresh, 2012).

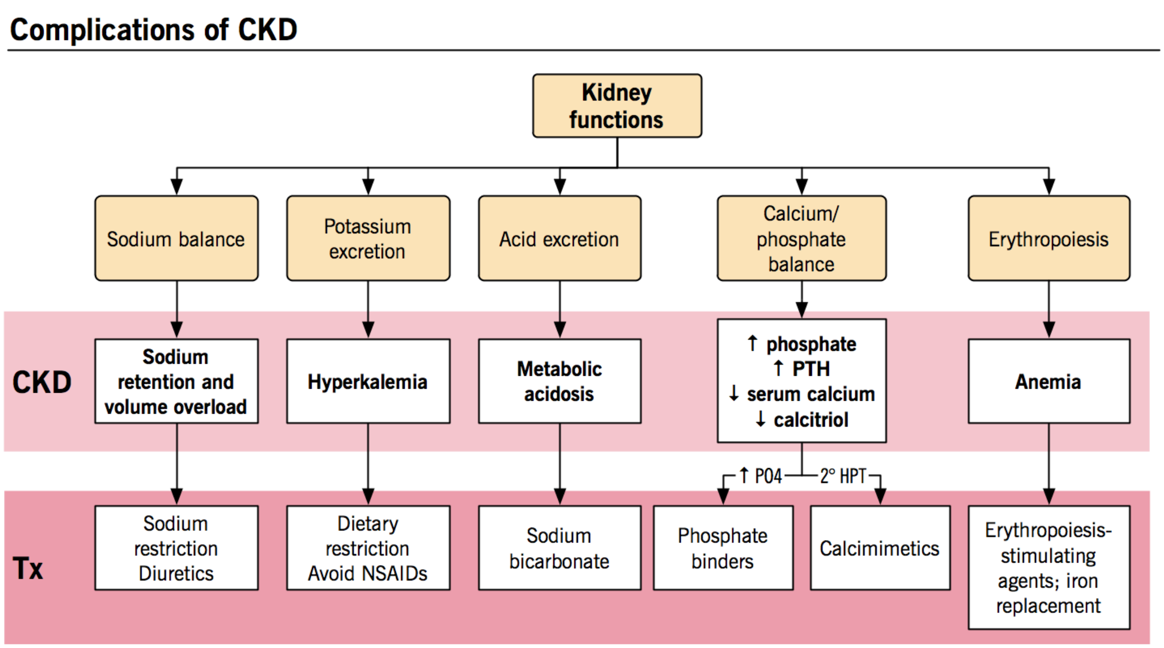

Figure 2.1: Compications of chronic kidney disease (Seifter & Samuels, 2011; Levey & Coresh, 2012).

2.2 Biochemical parameters as predictor of acute kidney injury and chronic kidney disease patients

Serum creatinine and urine output is the current clinical practice used to identify patients with AKI (Fliser *et al.*, 2012). Studies (Gaut *et al.*, 2014; Waikar *et al.*, 2012) have shown that serum creatinine may not be elevated until three to seven days arising from injury, and this may be altered in cases where there is no structural kidney damage, might not be altered notwithstanding injury to patients with significant renal reserve. In low- and middle-income countries, the first line screening tool is recommended because it consist of risk scores and questionnaires that are used to establish the risk of CKD, after which biochemical tests which comprises eGFR and albuminuria tests are done. The renal biochemical tests can be used in combination or alone for identifying specific stages of CKD (Qaseem *et al.,* 2013).

2.2.1 Risk scores and questionnaires

The revised classification of AKI proposed by Kidney Disease Improving Global Outcomes (KDIGO) suggested that AKI be identified by an increase in serum creatinine to at least 0.3 mg/dl (26.5 μmol/L) within a time frame of forty-eight hours or by a 50% increase in serum creatinine from the baseline within a period of seven days or a urine volume of less than 0.5 mL/kg/h for at least six hours (Fliser *et al.,* 2012). Several projection models have since been developed to aid in screening for the prevalence and progression of CKD (Echouffo-Tcheugui & Kengne 2012). The CKD prediction models are often of European origin, a systematic review found these models to be discriminative and their performance were acceptable-to-being satisfactory in the population in which they developed (Echouffo-Tcheugui & Kengne 2012; Moons *et al.,* 2012; Mogueo *et al.,* 2015). A few algorithms for CKD have been validated in different populations and rarely in low- and middle-income countries. Of all the predictor models, Screening for Occult Renal Disease (SCORED) was found to be reliable for CKD as it was validated several times in mixed ethnic groups giving reasonable discriminations (Bang *et al.,* 2007; Blech *et al.,* 2011; De Almeida *et al.,* 2012; Sugiura *et al.,* 2018).

Laboratory investigations are critical in the diagnosis and management of AKI and CKD (Table 2.2). The AKI staging has stages 1, 2 and 3 which is based on absolute increase in serum creatinine and urine output over a time. The progress of a patient with AKI are staged based on the time frame where an elevated serum creatinine up-to three times from the baseline or more than 4.0 mg/dl (354 μmol/L) is classified as stage 3 (Makris and Spanou, 2016). The staging of CKD is founded on estimates of glomerular filtration rate and the assessment of albuminuria (protein in urine) (Radišić Biljak *et al.,* 20217). In the year 2002, United States of America Kidney Disease Outcomes Quality Initiative (KDOQI) group developed and published Clinical

Practice Guidelines for Chronic Kidney Disease to be used for evaluating, classifying, and stratifying AKI and CKD. The Kidney Disease Improving Global Outcomes was later released in 2012 as a Clinical Practice Guideline for Evaluating and Management of CKD (Eknoyan *et al.*, 2013).

The biochemical tests that act as markers for assessing renal function exist in both urine and blood (plasma or serum) (Treacy *et al.*, 2019). The simultaneous assessment and monitoring of kidney damage (albuminuria and or proteinuria) and renal function (by estimating eGFR serum creatinine) is the rational approach to the diagnosis and evaluating of CKD (Radišić Biljak *et al.*, 20217). The criteria for the diagnosis of CKD as shown in figure 2.2 are based on evaluation of the markers of kidney damage and decreased GFR which should be present for > 3 months. The markers of kidney damage involve assessing the Albuminuria (Albumin Excretion Rate (AER) ≥ 30 mg/24 hours; Albumin-to-creatinine Ratio (ACR) ≥ 3 mg/mmol, urine sediment abnormalities, electrolytes, and other abnormalities due to tubular disorders, abnormalities detected by histology, abnormalities in the structure detected by imaging and history of kidney transplant. Whereas decreased GFR involve assessing the GFR value (< 60 mL/min/1.73m^2) which is categorized as G3a- G5) (Eknoyan *et al.*, 2013). For staging of CKD, creatinine is used along with albumin content if there are persistent abnormalities for longer than 3 months (Eknoyan *et al.*, 2013).

Table 2.1 shows the general test that should be done to gauge kidney function, screen for, monitor and diagnose kidney disease include a renal penal in which in most cases include electrolytes (sodium, potassium, chloride and bicarbonate), urea (urea nitrogen or blood urea nitrogen), creatinine, phosphorus, calcium, albumin, glucose and the calculated values may include eGFR, urea (BUN)/ creatinine ratio and anion gap (Rizvi & Kashani, 2017; Clarke & Marzinke, 2020). However, some selected test may be ordered based on a patient's medical history, physical examination and laboratory investigation which includes but not limited to urinalysis, blood culture, Hepatitis B or Hepatitis C test, Antinuclear antibody (ANA) and anti-dsDNA, Kidney stone analysis, complement tests mostly C3 and C4, urine protein electrophoresis (Rizvi & Kashani, 2017; Clarke & Marzinke, 2020).

To detect CKD, urinalysis and urine microscopy plays a significant role to detect existence of hematuria, chronic pyuria, and cellular casts which is a suggestive of renal impairment

(Ninomiya *et al.,* 2009). Complete blood count and hemoglobin estimation is also essential test to be performed on CKD patients because they are at risk of bone, anemia, and mineral disease. In patients with stage three CKD, hemoglobin levels should be tested annually (Eknoyan *et al.*, 2013; Tonelli *et al.*, 2013; Willis *et al.*, 2013).

Table 2.1: Some of the biochemical parameters for monitoring renal disease

Biochemical test	Effect of kidney disease	Rationale for the test
▪ Calcium x Phosphate products	increased	associated with increased risk of soft tissue calcification (aim Ca^{2+} & $PO_4 < 4.4\ mmol^2/L^2$) (Mannstadt *et al.*, 2017).
▪ Ferritin	increased	level <100 µg/L in CKD suggest iron deficiency, While levels >800 µg/L suggests iron overload (Treacy *et al.*, 2019).
▪ Parathyroid hormone	increased	ESRF patients on dialysis should aim for levels 2-9 times the upper limit of normal to reduce risk osteomalaciaor adynamic bone disease (↓) or tertiary erparathyroidism (↑) (Yuen *et al.*, 2016)

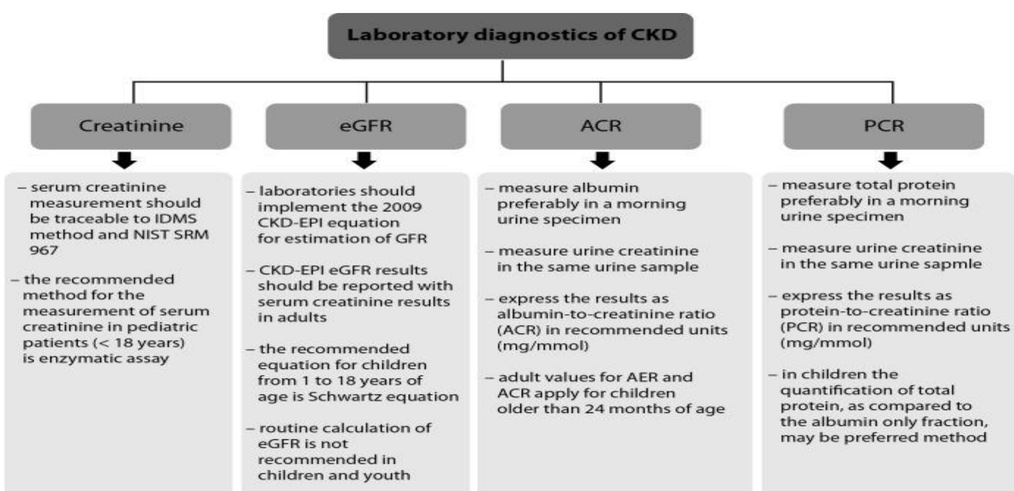

Figure 2.2: Recommended laboratory diagnostics for CKD (Eknoyan et al., 2013).

Laboratory test surveillance shown in table 2.2 are critical for patients with acute kidney injury and chronic kidney disease because of the risk for accelerated loss of kidney function, morbidity and mortality (Matheny *et al.*, 2014).

Table 2.2: Normal ranges of laboratory investigations done on dialysis patients

Creatinine	Female: 44 – 97 µmol/L	Male: 53 – 106 µmol/L	Every two weeks
Urea	Adult: 3.6 -7.1 mmol/L		Every two weeks
Phosphates	Adult: 0.97 – 1.45 mmol/L		Monthly
Calcium	Adult: 2 – 2.5 mmol/L		Monthly
Sodium	Adult: 135-145 mmol/L		Every two week
Hb	Female: 12.5 – 14.5 g/dL	Male: 13.5 – 16 g/dL	Monthly
Potassium	Adult: 3.5 – 5.5 mmol/L		Every two weeks
Chloride	Adult: 98 – 106 mmol/L		Every two weeks

Abbreviation: Hb=Haemoglobin

2.3 Prognostic factors of acute kidney injury and chronic kidney disease patients

Studies by Nazzal *et al.,* (2022), showed that AKI is significantly linked with congestive heart failure, sepsis, elevated calcium levels in cancer patients, CKD and these have contributed to the high mortality rates among the affected patients. Besides the traditional risk factors for AKI, uric acid levels are independent predictors of all the cause mortality after AKI (Nie *et al.,* 2017). Older patients with AKI especially those previously diagnosed to have CKD have a significant Afsprogression (Ishani *et al.,* 2009). Among the African Americans decent, family history, low birth weight and old age are a risk factor for CKD (Takamatsu *et al.,* 2009). To-add on, smoking of cigarette, hypertension, diabetes mellitus and obesity have been shown to lead to kidney disease whereas, uncontrolled hypertension and diabetes can quickly lead to poor prognosis with patients ending up dead ((Tuttle *et al.,* 2019; Alicic *et al.,* 2017; Thomas *et al.,* 2016; Takamatsu *et al.,* 2009). Patients with AKI tend to develop serious complications of COVID-19, nevertheless, males, age, obesity, hypertension, obesity, diabetes, cardiovascular diseases, CKD are independent risk factors for AKI in adults' patients with COVID-19 (Cai *et al.,* 2021). Primary, secondary, or tertiary are preventive interventions against kidney disease that were highlighted in the year 2020 during the world kidney day campaign. The primary prevention focuses on addressing abnormalities of urinary tracts and kidney, modification of risk factors, contact with environmental risk factors and nephrooxins, whereas, secondary prevention key objective is education and clinical treatment including glycemic control and blood pressure optimization and tertiary prevention focuses on persons having advanced CKD, the treatment of co-morbidities such as cardiovascular diseases, diabetes, hypertension is highly recommended to avoid or delay dialysis or kidney transplantation (Li *et al.*, 2020). Prevention of AKI follows a risk assessment of the patient to rule out risk factors such as age above 65 years, diabetes, cardiac/liver failure, hypotension, use of nephrotoxic drugs and diagnosis of life-threatening complication associated with the disease (Harty, 2014). Optimization of blood pressure, optimization of fluid balance, medical reviews and reducing the risk of contracting AKI through nephrotoxic medications are some of the approached that have been shown to work as preventive measures against AKI (Harty, 2014). Through treatment, progression from CKD to ESRD may be delayed (Turner *et al.*, 2012). Prompt diagnosis of kidney disorder increases treatability chances and sometimes in acute kidney injury it is possible to reverse the condition. Patients with comorbidities diabetes and hypertension, monitoring and controlling these conditions helps protect their kidneys from damage. Other treatments relieve symptoms of kidney disease like edema and anemia or lower cholesterol levels to reduce the risk associated with heart disease and in some instances dietary changes may be recommended (Gaitonde *et al.*, 2017; Murphy *et al.*, 2016; Qaseem *et al.*, 2013).

2.4 Research gap

Most of the studies (Mohamed, 2012; Munyendo, 2017; Mwenda *et al.*, 2019; Neto, Ndemo and Karimi, 2021; Bagha *et al.*, 2021) done in Kenya on AKI and CKD were among the population that are in Nairobi and one (Otieno *et al.*, 2020) in Nyeri. In all these studies (Mohamed, 2012; Munyendo, 2017; Mwenda *et al.*, 2019; Otieno *et al.*, 2020; Neto, Ndemo and Karimi, 2021; Bagha *et al.*, 2021) a cross-sectional study design was used which is an inferior epidemiological study design compared to retrospective cohort that was used in this current study. In addition, none of these studies were on survival analysis but merely on prevalence. The findings of this study were the first of its kind in Kenya that reported on the survival status of AKI and CKD patients undergoing haemodialysis. To determine the survival status of patients undergoing haemodiaysis, this current study targeted two groups (AKI and CKD patients), reviewed independent variables (Age and gender) and confounder variables (predictor and prognostic factors) as shown in the conceptual framework in figure 2.3.

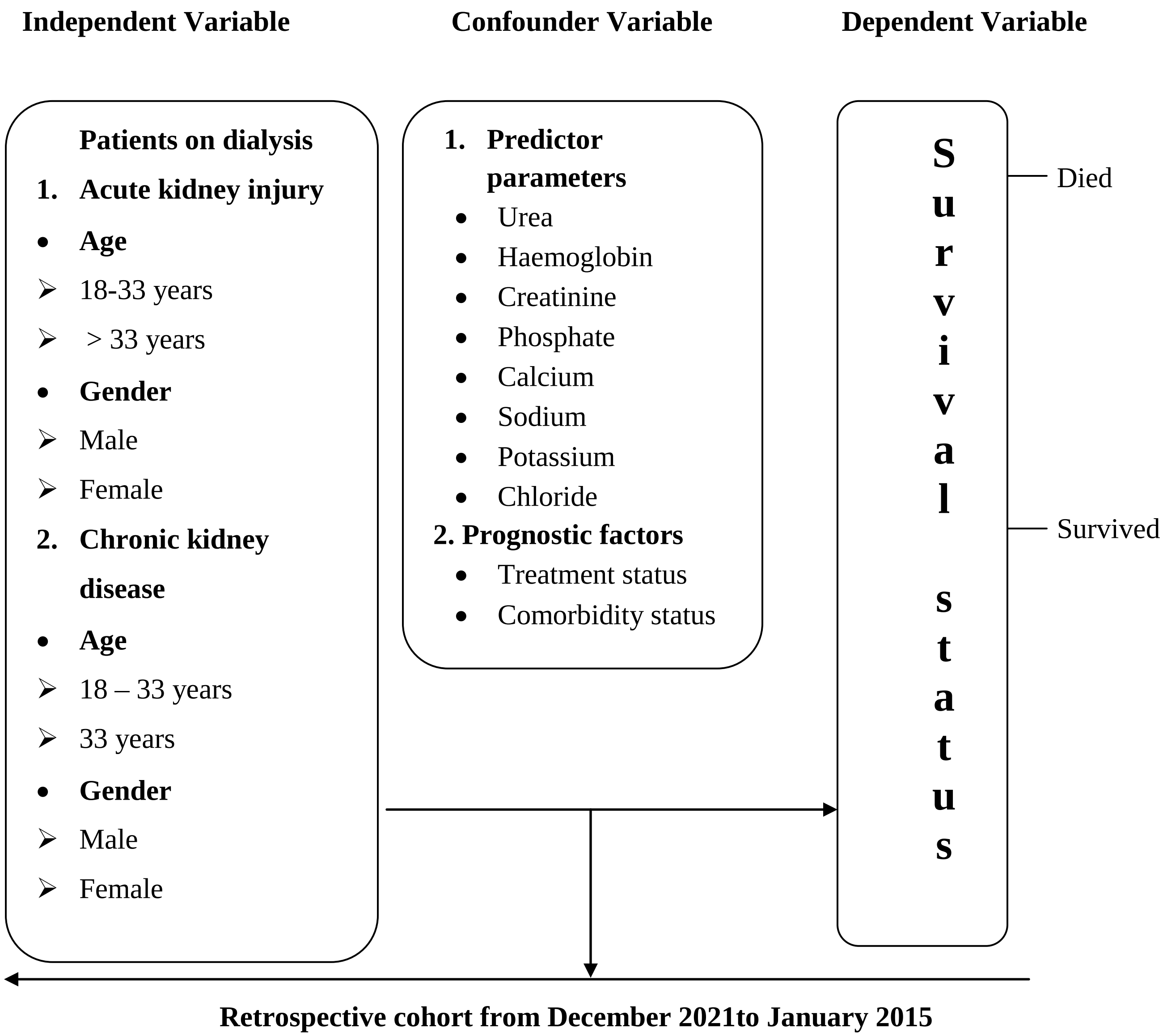

Figure 2.3: Conceptual framework

CHAPTER THREE

MATERIALS AND METHODS

3.1 Methodology

This chapter describes the study design, study area, study population, study variables, inclusion criteria, sample size, data analysis and ethical consideration that were sought.

3.2 Study design

This was hospital-based retrospective cohort study, targeting adult patients (AKI and CKD) undergoing hemodialysis in the renal unit in Kakamega County. Records from Kakamega County General Teaching and Referral hospital was reviewed over a period of five (5) years (December 2021 to January 2015).

3.3 Study area

A goggle map Kakamega shown in appendix I shows that it is lying 30 Km north of the Equator and has a population of 1,867,579. Kakamega is 52 Km north of Kisumu and is considered the heart of Luhya land. Kakamega County is bordering Vihiga County to the South, Bungoma and Trans Nzoia Counties to the North, Siaya County to the west and Nandi and Uasin Gishu Counties to the East with a population of 1,8967,579 as per 2019 census and area of 3,033.8 km^2. The County has an average of 433,207 households with an average size of 4.3 persons per household with population density of 618 people per square kilometer. The climatic conditions are characterized by rainfall throughout the year with an annual rainfall ranging from 1280.1 mm to 2214.1 mm per year. The temperature ranges from 18^oC to 29^oC with hottest month being January to March and coldest July and August. Kakamega County has 1631 ECD centre, 1136 primary schools, 408 secondary schools, 4 teachers training college, 51 youth polytechnics, 3 technical training institute and 6 university campuses and 1 university as of 2014. Kakamega County General Teaching and Referral hospital is the sole County referral hospital with 12 sub-County hospital, 47 health centres, 123 dispensaries and 44 clinics. Agriculture is the backbone of Kakamega County producing over 65% of the total earnings. Saint Marys Mumias hospital and Oasis hospital both in Kakamega County also offer dialysis services. However, AKI and CKD patients enrolled in these two hospital were not included in our study.

3.4 Study target population

This study targeted two groups (AKI and CKD patients) of patients with impaired kidney functions. The population under study was drawn from 290 patients undergoing hemodialysis at Kakamega County General Teaching and Referral hospital. The hospital data from the renal unit of the hospital for the patients who have since died from either AKI and or CKD were also reviewed. A total of 243 adults' patients were studied by reviewing a retrospective analysis of their dialytic data between January 2015 and December 2021.

3.5 Study variables

The variables that were studied to determine the predictors and prognostic survival factors of patients undergoing hemodialysis at Kakamega County general teaching and referral hospital, Kenya, County were independent variables, confounder variables and dependent variable.

The dependent variable (survival status) was to measure the fraction of patients that were still alive and the duration of time they have lived after they were diagnosed to have AKI or CKD. In this study to measure the dependent variable, the patients undergoing hemodialysis were categorized as either dead or alive at the study period.

The independent variable were the age and gender of AKI & CKD patients undergoing hemodialysis at the renal unit in the hospital. Data from the registry at the renal unit was reviewed targeting both acute kidney injury and chronic kidney disease patients. Gender being male or female, whereas the age was categorized into two groups, patients 18 to 33 years of age and those above 33 years of age. Since the dependent variable was to measure the survival, the categorization of age into two group was informed by World Bank Data (https://data.worldbank.org › indicator › SP.DYN.LE00.IN) on Kenya life expectancy report of 2021 that indicated that the life expectancy at birth, total years in Kenya was at 66.95%.

The confounder variables were the predictors and prognostic factors that were to be evaluated to establish their impact on the survival of patients undergoing hemodialysis. The predictor indicators that were studied include the renal biochemical parameters, creatinine, urea, phosphate, calcium, sodium, haemoglobin, potassium, and chloride. The prognostic indicators were treatment status and existence of any comorbidities in patients undergoing hemodialysis.

3.6 Inclusion and exclusion criteria

3.6.1 Inclusion criteria

- Data on patients who were still undergoing dialysis
- Data on AKI and CKD patients of $\geq$18 years of age
- Data on AKI and CKD patient who might have died

3.6.2 Exclusion criteria

- Data indicating AKI and CKD patient died due to Coronavirus (considered a confounder)
- Incomplete data that will not answer the objective of the current study

3.7 Sample size determination

Krejcie and Morgan (1970) formula was used to calculate the required sample size because this will be a finite population from the hospital records where a total of 290 acute kidney injury and chronic kidney disease patients are registered in the renal unit from January 2015 to December 2021.

$$n = \frac{x^2 NP(1-P)}{e^2\,(N-1) + x^2 P(1-P)}$$

Where n = the sample size for the current study

N = the population size registered with AKI & CKD at the renal unit

e = the acceptable sampling error

p = proportion of the population (P) =0.5 (unknown assumed 50% was used)

x^2 = the chi-square of degree of freedom 1 & confidence of 95% = 3.841

$$n = \frac{3.841 \times 290 \times 0.5\,(1-0.5)}{0.05^2\,(290-1) + 3.841 \times 0.5(1-0.5)}$$

n = 1069.61 ÷ 4.41 = 242.5

n = 243

From the data records, this present study adopted probability proportional to size approach where for CKD = Probability 1 (a X d) d ‘a’ = Cluster population and ‘b’ = Total population and ‘d’ = The number of clusters

Probability 1 = (208 X 2)/ 290 = 1.44

AKI = Probability 1 (a X d) d

‘a’ = Cluster population and ‘b’ = Total population and ‘d’ = The number of clusters

Probability 1 = (82 X 2)/ 290 = 0.566

(1.44 + 0.566) = 2.01

n sample size for CKD = (1.44 X 243)/2.01 = 174 cases

n sample size for AKI = (0.566 X 243)/2.01 = 69 cases

Total number of n to be studied was (174 cases of CKD + 69 cases of AKI) = 243 cases

3.8 Sampling method

Records from the renal unit were reviewed by obtaining the relevant information on the target population (CKD and AKI patients). A consecutive sampling method was used to recruit CKD and AKI patients. In consecutive sampling, every subject (AKI or CKD) that met the inclusion criteria was recruited until the required sample size was met. A written informed consent (appendix II) was obtained from the head of renal unit and medical superintendent on behalf of the patients and deceased. Only information that were answering the study objectives were extracted from the registry records.

3.9 Data collection tool

Data was collected from medical records using a paper-based data collection form found as appendix III. The paper-based data collection form was subjected to a pre-test for validity & reliability. All the cases and comparative group that had met the inclusion criteria were reviewed comprehensively from demographic characteristics (Age, Gender), Predictors of AKI and CKD (eGFR, Serum creatinine, Serum urea, Anemia/ Hb estimation, Serum calcium level, Serum phosphate level, Serum potassium level, Serum sodium level and Urine output) and Prognostic factors of KD (Age, Gender, Duration of disease, Cigarette smoking, Obesity status, Hypertension status, Cardiovascular disease and Diabetes were reviewed.

3.10 Validity and Reliability

3.10.1 Validity

In the paper-based data collection tool found in appendix II, validity was checked to ensure that the tool measured only what it was supposed to measure as conceptualized in Figure 1.2. The principal investigator implemented the supervisor's remarks on the study instruments and determine the validity index. The supervisor studied the paper-based data collection tool, recommended improvement with respect precision. Content validity of an instrument being the degree to which a test appears to measure a concept by logical analysis of the items, the emphasis becomes the adequacy of coverage by the instrument on the scope implied by the topic of study.

With respect to sensibility and precision required on each question in the paper-based data collection form, Content Validity Index (CVI) was calculated using the formula:

$$CVI = K/N$$

Where K = Total number of items in the paper-based data collection tool declared valid by both the supervisors and principal investigator

N = Total number of items in the paper-based data collection tool

A study conducted by Amin (2005) postulate that an instrument is considered valid if the CVI is at least 0.7. A total of 12 out of 16 questions in the data collection form were found to be relevant.

CVI will therefore calculated as:

$$CVI = (12/16) \times 100\%: \quad CVI = \geq 0.75$$

The validity test results evidenced by CVI score of 0.9 is above the recommended 0.7 which is considered acceptable. Hence, the results showed that the data collection form was able to correctly capture the predictors and prognostic survival factors of patients undergoing hemodialysis in the renal unit Kakamega, County.

3.10.2 Reliability

All the questions in the paper-based data collection tool were computed using the Cronbach's Alpha coefficient to determine the reliability of the current study findings. According to Richard and Clark, (2005), the Cronbach's alpha coefficient ought to range between 1 and 0 with higher coefficient value being more reliable than the others.

The Cronbach's alpha denoted low level of internal consistency within the cases studied and this will be attributed to the average covariance among items. Cronbach's alpha does present overall reliability coefficient for a set of variables. The findings for each of the study variables was presented in the Tables 3.1 (Cronbach's Alpha Findings by variable) and 3.2 (Cronbach's Alpha scale statistics). The results in table 3.1 showed the indicators that were reliable as evidenced by 0.736 being the least Cronbach's Apha value of the variable on the table. The indicators that were considered reliable included gender of the patients, survival status, number of comorbidities, treatment status, creatinine level, urea level, phosphate level, calcium level, sodium level, haemoglobin level, potassium level and chloride level. All the items appear good with R- value above 0. The rule of thumb is that these evaluates should be at least 0.70. In this case, if r will be equal to 0.01, therefore this will not be closer to the acceptable correlation coefficient where (r) = 0.70

Table 3.1: Reliability Statistics: Cronbach's Alpha Findings

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	No. of Items
0.736	0.739	12

Source: Author (field data, 2022)

The Cronbach's Alpha scale statistics finding from table 3.2 was used to indicate that all the variables tested for reliability has a mean, variance, and standard deviation values.

Table 3.2: Cronbach's Alpha scale statistics

Mean	Variance	Std. Deviation	No. of Items
19.6471	7.097	2.66410	12

Source: Author (field data, 2022)

3.11 Data analysis and presentation

In this study, data was retrieved from the registry records in the renal unit. Records of patients enrolled in the renal department were screened and only those that met the study inclusion criteria were included in this study. The statistical package for social sciences (SPSS) version 23 was used for cleaning of data and analysis.

To answer specific objective one which was to determine the demographic characteristic influencing the survival of AKI and CKD patients undergoing hemodialysis in the renal unit, Kakamega County, a binary logistic regression analysis was used. Descriptive statistics were also used in this study to present frequency and proportion for the categorical variables.

To establish the renal biochemical parameters as a survival predictor of patients undergoing hemodialysis in the renal unit, Kakamega County, the survival functions, Kaplan Meier analysis & Cox-proportional hazard regression analysis was also used to identify independent predictors of time to death. Presence of multi-collinearity was checked using variance inflation factor. The proportionality of hazard assumption was checked using the Log (-Log) S (t) plots.

To evaluate the prognostic parameters as a survival indicator of patients undergoing hemodialysis in the renal unit, Kakamega County, Multinomial logistic regression was used to determine relationship between the type of comorbidities, number of comorbidities and survivals status of AKI and CKD patients. To estimate the survival functions, Kaplan Meier analysis & Cox-proportional hazard regression analysis was also used to identify independent prognostic of time to death. Presence of multi-collinearity was checked using variance inflation factor. The proportionality of hazard assumption was checked using the Log (-Log) S (t) plots.

3.12 Ethical Consideration and Confidentiality

Approval to conduct the study was obtained from the Secretary of Eastern Africa, Baraton (UEAB) Research Ethics Committee approval number UEAB/ISERC/22/6/2022. Permit to conduct the study was also be obtained from National Commission for Science, Technology, and Innovation (NACOSTI) reference number: 237672 and License No: NACOSTI/P/22/18844. Only data required to answer the objective of this study was retrieved in-line with data privacy and protection laws information. Collected data was treated as confidential.

CHAPTER FOUR

RESULTS

4.1 Demographic characteristic influencing the survival of patients undergoing hemodialysis at Kakamega County general teaching and referral hospital, Kenya

4.1.1 Demographic characteristics of acute kidney injury patients undergoing hemodialysis

The data retrieved from the registry record at the renal unit in Kakamega County general teaching and referral hospital was sufficient to capture the age groups, gender, survival status, comorbidity status, type of comorbidity, the number of comorbidities the patients had, treatment status, creatinine levels, urea levels, phosphate level, calcium level, sodium level, haemoglobin level, potassium level and chloride level. In this study a total of 69 patients with acute kidney injury were studied.

In table 4.1, majority 52.2% (36) of the patients with acute kidney injury were of age group 18 to 33 years. The mean age was 38.35 with a standard deviation of 20.25. The gender distribution of the patients with acute kidney injury showed that more females 52.2% (36) were dialyzed in the period 2015 to 2021. Binary logistic regression was done to establish the relationship between age and survival of AKI patients and gender and survival of AKI patients and in both there was no statistically significant relationship. The relationship between age and survival of AKI patients had a p value of 0.830 at 1 df with 95% CI of 0.303 – 2.605, whereas the relative risk was 0.889. The relationship between gender and survival of AKI patients had a p value of 0.157 at 1 df with 95% CI of 0.731 – 6.921, whereas the relative risk was 2.250.

Table 4.1: Demographic characteristics of AKI patients undergoing hemodialysis (n = 69 patients)

Characteristics		frequency	percentage (%)
Age groups			
	18 – 33 years	36	52.2
	➢ 33 years	33	47.8
Gender			
	Male	33	47.8
	Female	36	52.2

Patient’s data on age, gender and survival status were retrieved from the registry records. In the survival status, this study was able to pick AKI who have since died and those still alive and were undergoing haemodialysis at the renal unit. The binary logistic regression analysis was used to establish relationship between gender and survival, age, and survival.

4.1.1.1 Relationship between gender and survival of AKI patients undergoing hemodialysis

The results of this study showed that 27 males were alive and 6 died. For females, 24 were alive and 12 died. The binary logistic regression analysis indicated a p value of 0.157 at 1 df with 95% confidence interval (CI) of 0.731 – 6.921, therefore accepting the null hypothesis that there was no statistically significant relationship between gender and survival status of a patient with AKI. These two variables gender and survival were independent to each other. An relative risk (OR) of 2.250 was observed meaning being male, one is 2.250 times more likely to be alive compared to female.

4.1.1.2 Relationship between age and survival of AKI patients undergoing hemodialysis

The finding of this study showed that for patients who were 18 – 33 years of age, 27 alive and 9 died. For patients who were over 33 years of age, 24 were alive and 9 died. The binary logistic regression analysis indicated a p value of 0.830 at 1 df with 95% confidence interval (CI) of 0.384 – 3.297, therefore accepting the null hypothesis that there was no statistically significant relationship between the two age groups and survival status of a patient with AKI. These two variables age and survival were independent to each other. An relative risk (OR) of 1.125 was observed meaning being 18- 33 years of age, one is 1.125 times more likely to be alive compared to over 33 years of age.

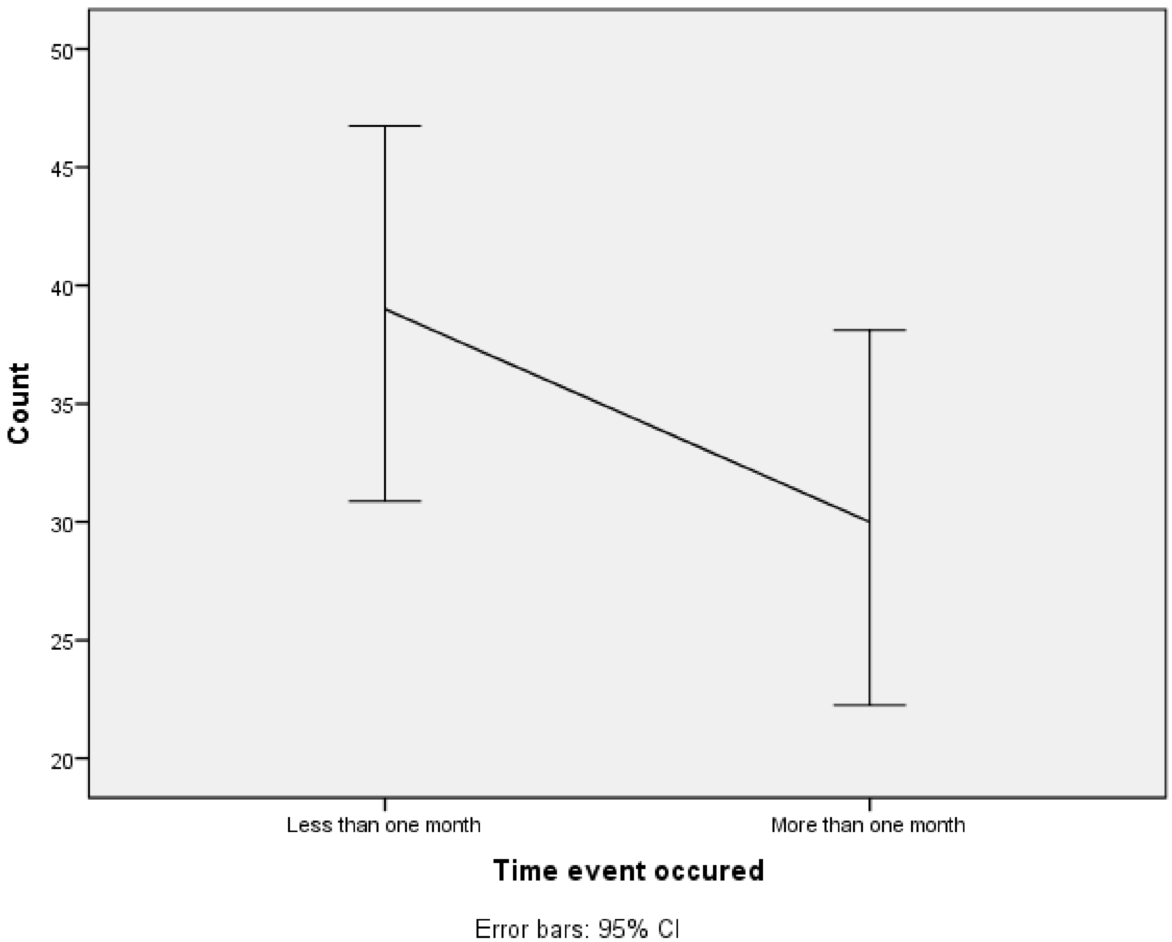

Figure 4.1: Survival outcome over-time in AKI patients on hemodialysis

In figure 4.1, majority 55.56% (10) of the AKI patients died in less than one month and 44.44% (8) died $\geq$ one month after clinical diagnosis despite being on hemodialysis. The results showed no statistically significant relationship between survival status and time of event at a p value of 0.923 at 1 df with a 95% CI of 0.357 – 3.112. The observation made was that AKI patients had the worse overall survival outcomes.

4.1.2 Demographic characteristics of chronic kidney disease patients undergoing hemodialysis

The data retrieved from the registry record at the renal unit in Kakamega County general teaching and referral hospital was sufficient to capture the age groups, gender, survival status, comorbidity status, type of comorbidity, the number of comorbidities the patients had, treatment status, creatinine levels, urea levels, phosphate level, calcium level, sodium level, haemoglobin level, potassium level and chloride level. In this study a total of 69 patients with chronic kidney disease were studied.

In table 4.2, majority 81% (141) of the patients with chronic kidney disease were of age group more than 33 years. The mean age was 51.49 with a standard deviation of 18.41. The gender distribution of the patients with chronic kidney disease showed that more males 56.9% (99) were dialyzed in the period 2015 to 2021. Binary logistic regression was done to establish the relationship between age and survival of CKD patients and gender and survival of AKI patients and in both there was no statistically significant relationship. The relationship between age and survival of CKD patients had a p value of 0.211 at 1 df with 95% CI of 0.160 – 1.498, whereas the relative risk was 0.489. The relationship between gender and survival of CKD patients had a p value of 0.974 at 1 df with 95% CI of 0.479 – 2.141, whereas the relative risk was 1.013.

Table 4.2: Demographic characteristics of CKD patients undergoing hemodialysis (n = 174 patients)

Characteristics		frequency	percentage (%)
Age groups			
	18 – 33 years	33	19
	> 33 years	141	81
Gender			
	Male	99	56.9
	Female	75	43.1

Patient's data on age, gender and survival status were retrieved from the registry records. In the survival status, this study was able to pick CKD who have since died and those still alive and were undergoing haemodialysis at the renal unit. The binary logistic regression analysis was used to establish relationship between gender and survival, age, and survival.

4.1.2.1 Relationship between gender and survival of CKD patients undergoing hemodialysis

The results of this study showed that 20 males were alive and 79 died. For females, 15 were alive and 60 died. The binary logistic regression analysis indicated a p value of 0.973 at 1 df with 95% confidence interval (CI) of 0.465 – 2.096, therefore accepting the null hypothesis that there was no statistically significant relationship between gender and survival status of a patient with CKD. These two variables gender and survival were independent to each other. An relative risk (OR) of 0.989 was observed meaning being male, one is 0.989 times more likely to be alive compared to female.

4.1.2.2 Relationship between age and survival of CKD patients undergoing hemodialysis

The finding of this study showed that for patients who were 18 – 33 years of age, 4 alive and 29 died. For patients who were over 33 years of age, 31 were alive and 110 died. The binary logistic regression analysis indicated a p value of 0.211 at 1 df with 95% confidence interval (CI) of 0.160 – 1.499, therefore accepting the null hypothesis that there was no statistically significant relationship between the two age groups and survival status of a patient with CKD. These two variables age and survival were independent to each other. An relative risk (OR) of 0.489 was observed meaning being 18- 33 years of age, one is 0.489 times more likely to be alive compared to over 33 years of age.

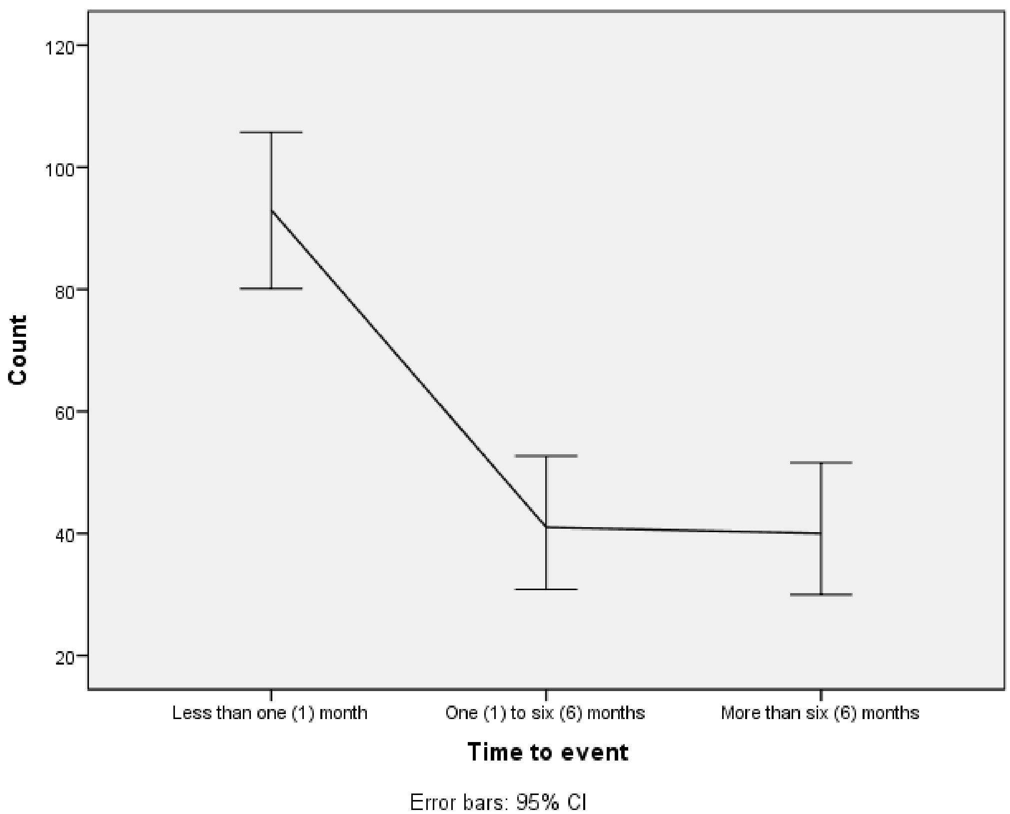

Figure 4.2: Survival outcome over-time in CKD patients on hemodialysis

In figure 4.2, majority 64.03% (89) of the patients with CKD died in less than one month, 27.34% (38) died between one to six months and 8.63% (12) died > six months after the clinical diagnosis despite being on hemodialysis. The results showed statistically significant relationship between survival status and time-to-event at a p value of < 0.0001 at 1 df with a 95% CI of 0.055 – 0.218. On further analysis to determine the relationship between survival outcome over-time among CKD patients, it was observed that there was a statistically significant relationship between survival outcome and patients who survived from one to six months at a p value of < 0.0001 at 1 df with a 95% CI of 0.006 – 0.065. There was no statistical significance relationship between survival outcome and patients who survived for less than one months at a p value of 0.475 at 1 df with a 95% CI of 0.122 – 2.667. The observation made was that CKD patients had poor survival outcomes.

4.2 Renal biochemical parameters as a survival predictor of patients undergoing hemodialysis at Kakamega County general teaching and referral hospital, Kenya

4.2.1 Renal biochemical parameters as a survival predictor of acute kidney injury patients undergoing hemodialysis

In table 2.2, the cut-off points for the renal biochemical parameter and haemtological test are defined in terciles and or according to recommendations patients who are undergoing haemodialysis (Daugirdas *et al.*, 2015). These renal biochemical and heamatological test are usually done before a patient is dialyzed. These tests are essential in monitoring the progress and function of the kidney in clearing blood.

All the AKI patients that were undergoing hemodialysis at the renal unit in Kakamega County general teaching and referral hospital had renal biochemical test done on them prior to dialysis and it was observed that deranged levels among the patients were more than the normal ranges in all the parameters as shown in table 4.3. These deranged levels of renal biochemical parameters are indications that these patients had difficulties in eliminating wastes and unwanted water from the blood.

Table 4.3: Predictive indicators of AKI patients undergoing hemodialysis (n = 69 patients)

Characteristics		frequency	percentage (%)
Creatinine level			
	Normal range	16	23.2
	Deranged levels	53	76.8
Urea level			
	Normal range	11	15.9
	Deranged levels	58	84.1
Phosphate level			
	Normal range	16	23.2
	Deranged levels	53	76.8
Calcium level			
	Normal range	15	21.7
	Deranged levels	54	78.3
Haemoglobin level			
	Normal range	05	7.2
	Deranged levels	64	92.8
Potassium level			
	Normal range	29	42.0
	Deranged levels	40	58.0
Sodium level			
	Normal range	15	21.7
	Deranged levels	54	78.3
Chloride level			
	Normal range	20	29.0
	Deranged levels	49	71.0

These renal tests are essential in monitoring the progress and function of the kidney in clearing blood. Binary logistic regression analysis was used to determine the relationship between predictive indicators and survival of AKI patients.

4.2.1.1 Relationship between creatinine level and survival of AKI patients undergoing hemodialysis

The results of this study showed that creatinine level was within the normal ranges in 16 patients who were alive. Deranged creatinine level was seen in 35 patients who were alive and 18 who died. Binary logistic regression analysis was further done to establish relationship between creatinine levels and survival status showed a p value of 0.998 at 1 df with a 95% CI of 0.00 – 1.00, therefore we accept the null hypothesis that there was no statistically significant relationship between the creatinine level and survival of a patient with AKI patients. These two variables creatinine level and survival status were independent to each other.

4.2.1.2 Relationship between urea level and survival of AKI patients undergoing hemodialysis

Laboratory findings on ureal levels showed that patients within the normal ranges in 10 patients who were alive and 1 died. Deranged phosphate level was seen in 41 patients who were alive and 17 who died. Binary logistic regression analysis was further done to establish relationship between ureal levels and survival status and the results showed a p value of 0.191 at 1 df with 95% CI of 0.492 – 34.959, therefore we accept the null hypothesis that there was no statistically significant relationship between the urea level and survival status of a patient with AKI. These two variables urea levels and survival status were independent to each other. It was observed that the risks (Relative risk) of being alive when AKI patient have urea levels within the normal range was 4.146 compared to when the patients have deranged levels.

4.2.1.3 Relationship between phosphate level and survival of AKI patients undergoing hemodialysis

The findings of this study showed that phosphate level was within the normal ranges in 15 patients who were alive and 1 died. Deranged phosphate level was seen in 36 patients who were alive and 17 who died. Binary logistic regression analysis was further done to establish relationship between phosphate levels and survival status and the results showed a p value of 0.068 at 1 df with 95% CI of 0.863 – 58.123, therefore we accept the null hypothesis that there was no statistically significant relationship between the phosphate level and survival status of a patient with AKI. These two variables phosphate levels and survival status were independent to each other. It was observed that the risk (Relative risk) of being alive when AKI patient have phosphate levels within the normal range was 7.083 compared to when the patients have deranged levels.

4.2.1.4 Relationship between calcium level and survival of AKI patients undergoing hemodialysis

The results of this study showed that calcium level was within the normal ranges in 15 patients who were alive and 3 died. Deranged calcium level was seen in 36 patients who were alive and 15 who died. Binary logistic regression analysis was further done to establish relationship between calcium levels and survival status, and the results showed a p value of 0.297 at 1 df with 95% CI of 0.525 – 8.266, therefore we accept the null hypothesis that there was no statistically significant relationship between the calcium level and survival status of a patient with AKI. These two variables calcium levels and survival status were independent to each other. It was observed that the risk (Relative risk) of being alive when AKI patient have calcium levels within the normal range was 2.083 compared to when the patients have deranged levels.

4.2.1.5 Relationship between haemoglobin level and survival of AKI patients undergoing hemodialysis

The laboratory findings of this study showed that haemoglobin level was within the normal ranges in 5 patients who were alive. Deranged haemoglobin level was seen in 46 patients who were alive and 18 who died. Binary logistic regression analysis was further done to establish relationship between haemoglobin levels and survival status and the results showed a p value of 0.99 at 1 df with 95% CI of 0.00 – 1.000, therefore we accept the null hypothesis that there was no statistically significant relationship between the haemoglobin level and survival status of a patient with AKI. These two variables haemoglobin levels and survival status were independent to each other.

4.2.1.6 Relationship between sodium level and survival of AKI patients undergoing hemodialysis

The results of this study showed that sodium level was within the normal ranges in 14patients who were alive and 1 died. Deranged sodium level was seen in 37 patients who were alive and 17 who died. Binary logistic regression analysis was further done to establish relationship between haemoglobin levels and survival status and the results showed a p value of 0.084 at 1 df with 95% CI of 0.781 – 52.975, therefore we accept the null hypothesis that there was no statistically significant relationship between the sodium level and survival status of a patient with AKI. These two variables sodium levels and survival status were independent to each other. It was observed that the risk (Relative risk) of being alive when AKI patient have sodium levels within the normal range was 6.432 compared to when the patients have deranged levels.

4.2.1.7 Relationship between potassium level and survival of AKI patients undergoing

The laboratory findings on potassium levels showed that patients within the normal ranges in 26 patients who were alive and 3 died. Deranged potassium level was seen in 25 patients who were alive and 15 who died. Binary logistic regression analysis was further done to establish relationship between potassium levels and survival status and the results showed a p value of

0.017* at 1 df with 95% CI of 1.340 – 20.174, therefore we accept the alternative hypothesis that there was statistically significant relationship between the potassium level and survival status of a patient with AKI. These two variables potassium levels and survival status were dependent to each other. It was observed that the risk (Relative risk) of being alive when AKI patient have potassium levels within the normal range was 5.200 compared to when the patients have deranged levels.

4.2.1.8 Relationship between chloride level and survival of AKI patients undergoing hemodialysis

The results of this study showed that chloride level was within the normal ranges in 16 patients who were alive and 4 died. Deranged chloride level was seen in 35 patients who were alive and 14 who died. Binary logistic regression analysis was further done to establish relationship between chloride levels and survival status and the results showed a p value of 0.464 at 1 df with 95% CI of 0.454 – 5.634, therefore we accept the null hypothesis that there was no statistically significant relationship between the chloride level and survival status of a patient with AKI. These two variables chloride levels and survival status were independent to each other. It was observed that the risk (Relative risk) of being alive when AKI patient have chloride levels within the normal range was 1.60 compared to when the patients have deranged levels.

To evaluate if the confounder variable (predictor indicators) has an influence on survival of AKI patients. In this study, table 4.4 has listed the predictive indicators of AKI patients undergoing hemodialysis. The Kaplan Meier (KM) analysis was used in this study to establish which confounder variable (predictive indicator) had an influence on survival.

4.2.1.9 Influence of creatinine level on survival of AKI patients

This study was able to evaluate if the creatinine level has an influence on survival of AKI patients undergoing haemodialysis in the renal unit, Kakamega County.

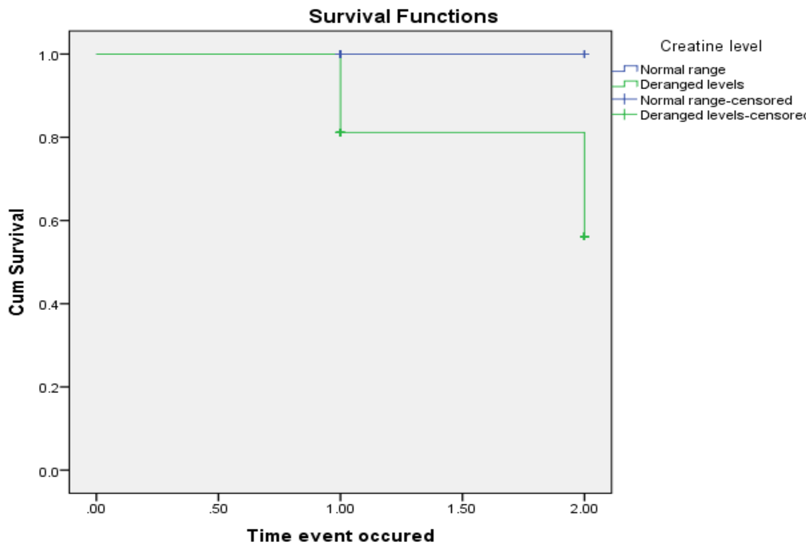

Figure 4.3: Test of equality of survival distribution for the creatinine levels in AKI patients undergoing haemodialysis

Since the log rank test statistics had a p value 0.024 at df of 1 with a Chi-Square $\chi 2$ of 5.102, therefore, the creatinine levels significantly influence survival of AKI patients undergoing haemodialysis (Figure 4.3).

4.2.1.10 Influence of urea level on survival of AKI patients

This study was able to evaluate if the urea levels have an influence on survival/mortality in AKI patients undergoing haemodialysis in the renal unit, Kakamega County.

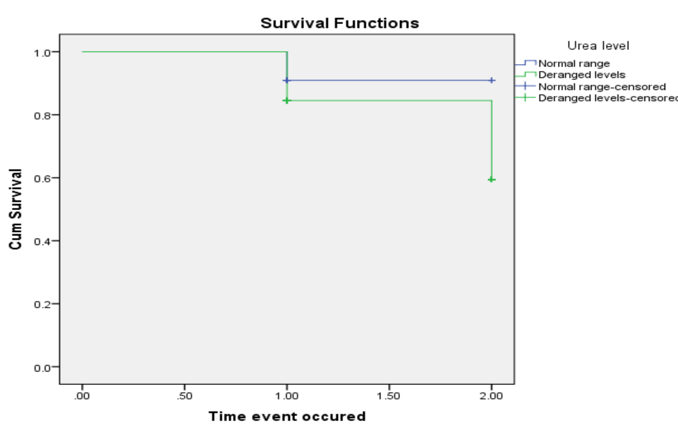

Figure 4.4: Test of equality of survival distribution for the urea levels in AKI patients undergoing haemodialysis

Since the log rank test statistics had a p value 0.286 at df of 1 with a Chi-Square $\chi2$ of 1.137, therefore, the urea levels do not significantly influence survival of AKI patients undergoing haemodialysis (Figure 4.4).

4.2.1.11 Influence of phosphate level on survival of AKI patients

This study was able to evaluate if the phosphate levels have an influence on survival of AKI patients undergoing haemodialysis in the renal unit, Kakamega County.

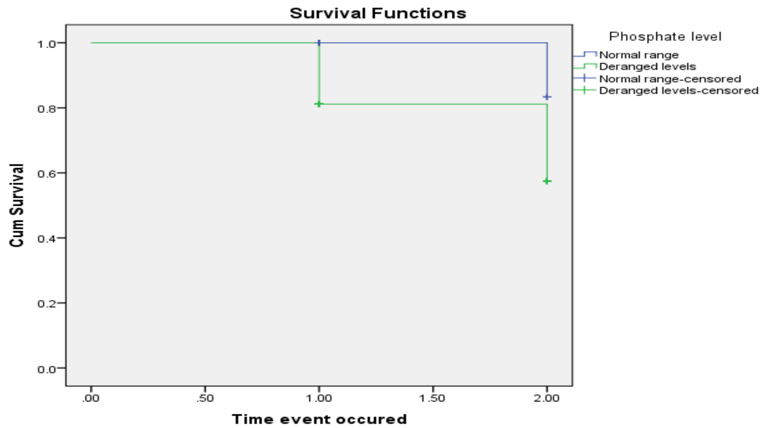

Figure 4.5: Test of equality of survival distribution for the phosphate levels in AKI patients undergoing haemodialysis

Since the log rank test statistics had a p value 0.066 at df of 1 with a Chi-Square $\chi2$ of 3.386, therefore, the phosphate levels do not significantly influence survival of AKI patients undergoing haemodialysis (Figure 4.5).

4.2.1.12 Influence of calcium level on survival of AKI patients

This study was able to evaluate if the calcium levels have an influence on survival/mortality in AKI patients undergoing haemodialysis in the renal unit, Kakamega County.

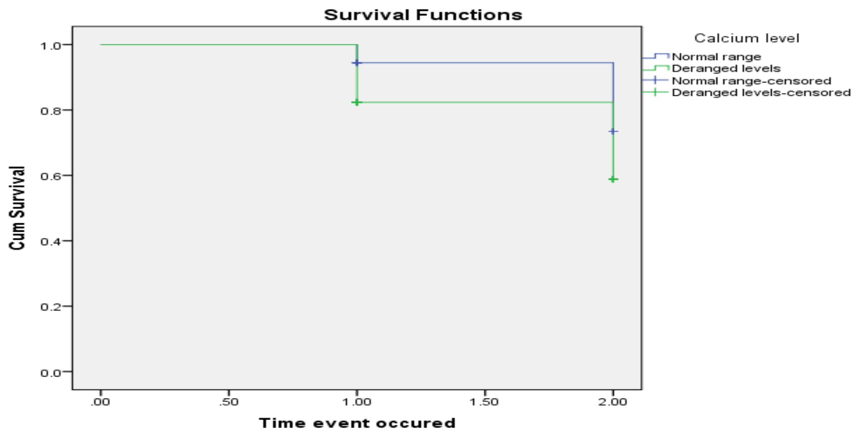

Figure 4.6: Test of equality of survival distribution for the calcium levels in AKI patients Undergoing haemodialysis

Since the log rank test statistics had a p value 0.242 at df of 1 with a Chi-Square $\chi 2$ of 1.369, therefore, the calcium levels do not significantly influence survival of AKI patients undergoing haemodialysis (Figure 4.6).

4.2.1.13 Influence of sodium level on survival of AKI patients

This study was able to evaluate if the sodium levels have an influence on survival/mortality in AKI patients undergoing haemodialysis in the renal unit, Kakamega County.

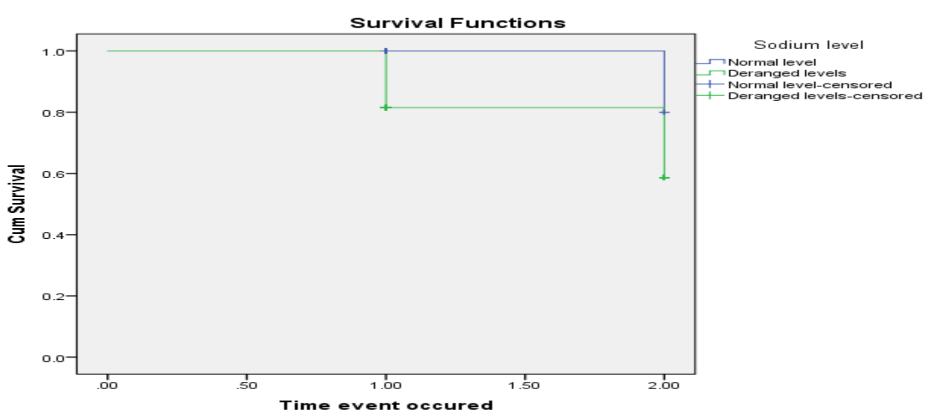

Figure 4.7: Test of equality of survival distribution for the sodium levels in AKI patients undergoing haemodialysis

Since the log rank test statistics had a p value 0.10 at df of 1 with a Chi-Square $\chi 2$ of 2.711, therefore, the sodium levels do not significantly influence survival of AKI patients undergoing haemodialysis (Figure 4.7).

4.2.1.14 Influence of haemoglobin level on survival of AKI patients

This study was able to evaluate if the haemoglobin levels have an influence on survival of AKI patients undergoing haemodialysis in the renal unit, Kakamega County.

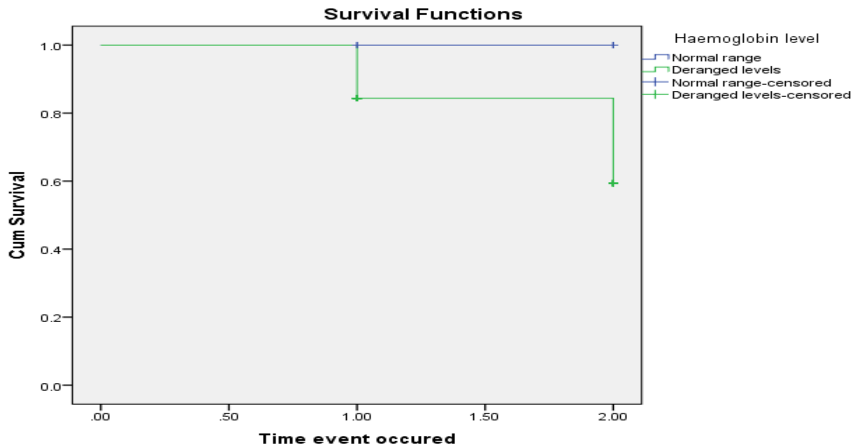

Figure 4.8: Test of equality of survival distribution for the haemoglobin levels in AKI patients undergoing haemodialysis

Since the log rank test statistics had a p value 0.151 at df of 1 with a Chi-Square $\chi 2$ of 2.058, therefore, the haemoglobin levels do not significantly influence survival of AKI patients undergoing haemodialysis (Figure 4.8).

4.2.1.15 Influence of potassium level on survival of AKI patients

This study was able to evaluate if the potassium levels have an influence on survival/mortality in AKI patients undergoing haemodialysis in the renal unit, Kakamega County.

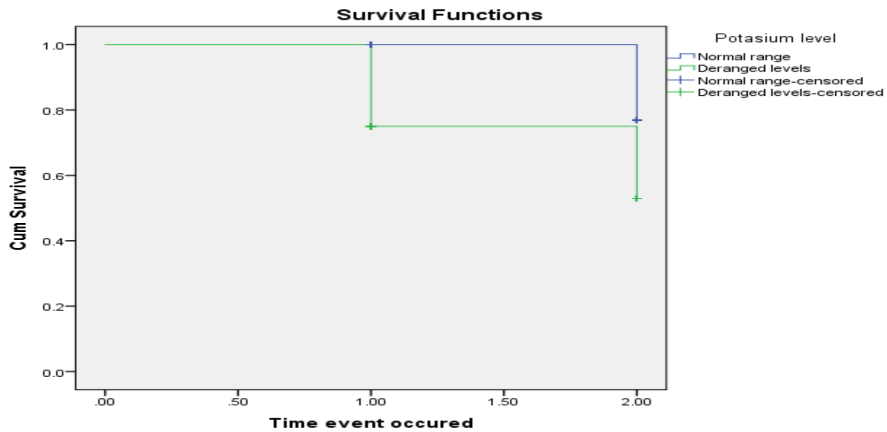

Figure 4.9: Test of equality of survival distribution for the potassium levels in AKI patients undergoing haemodialysis

Since the log rank test statistics had a p value 0.014 atdf of 1 with a Chi-Square χ2 of 6.050, therefore, the potassium levels significantly influence survival of AKI patients undergoing haemodialysis (Figure 4.9).

4.2.1.16 Influence of chloride level on survival of AKI patients

This study was able to evaluate if the chloride levels have an influence on survival/mortality in AKI patients undergoing haemodialysis in the renal unit, Kakamega County.

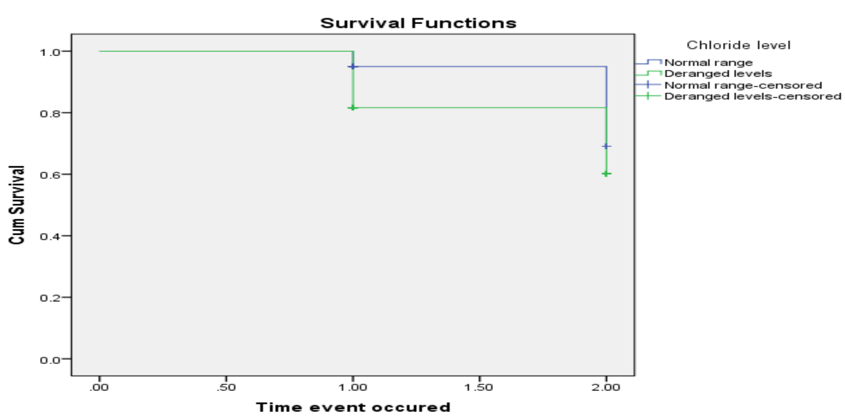

Figure 4.10: Test of equality of survival distribution for the chloride levels in AKI patients undergoing haemodialysis

Since the log rank test statistics had a p value 0.305 at df of 1 with a Chi-Square $\chi 2$ of 1.050, therefore, the chloride levels do not significantly influence survival/mortality in AKI patients undergoing haemodialysis (Figure 4.10).

4.2.1.17 Effect of gender on creatinine level and survival of AKI patients

This current study was able to evaluate if the creatinine level was predictive for survival in the gender of AKI patients undergoing haemodialysis in the renal unit, Kakamega County.

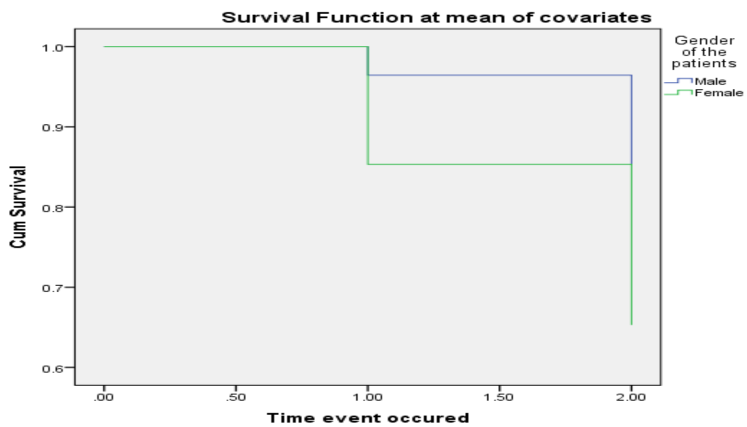

Figure 4.11: Cox-regression to test investigate if the creatinine level is predictive for survival in the gender of AKI patients undergoing haemodialysis

The hazard ratio of 0.034 is < 1 and this is associated with good survival, however, a p value of 0.196, was observed at 95% confidence interval (CI) of 0.00 – 5.711 therefore, the creatinine level did not significantly predict for survival in the gender of AKI patients undergoing haemodialysis (Figure 4.11).

4.2.1.18 Effect of gender on urea level and survival of AKI patients

This study was able to evaluate if the urea level was predictive for survival in the gender of AKI patients undergoing haemodialysis in the renal unit, Kakamega County.

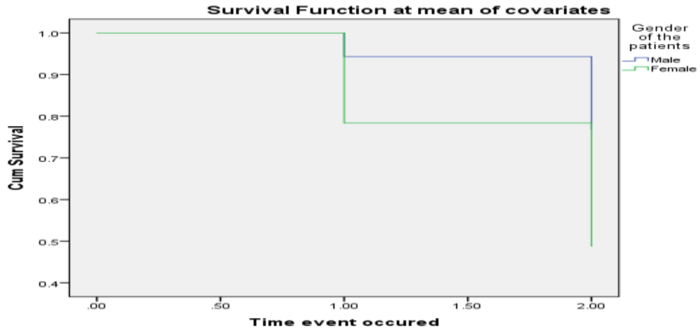

Figure 4.12: Cox-regression to test investigate if the urea level is predictive for survival in the gender of AKI patients undergoing haemodialysis

The hazard ratio of 0.374 is < 1 and this is associated with good survival, however, a p value of 0.34, was observed at 95% confidence interval (CI) of 0.050 – 2.82 therefore, the urea level did not significantly predict for survival in the gender of AKI patients undergoing haemodialysis (Figure 4.12).

4.2.1.19 Effect of gender on phosphate level and survival of AKI patients

This current study was able to evaluate if the phosphate level was predictive for survival in the gender of AKI patients undergoing haemodialysis in the renal unit, Kakamega County.

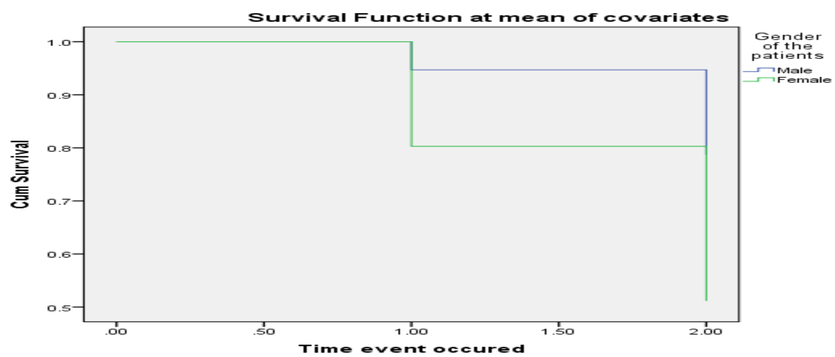

Figure 4.13: Cox-regression to test investigate if the phosphate level is predictive for survival in the gender of AKI patients undergoing haemodialysis

The hazard ratio of 0.22 is < 1 and this is associated with good survival, however, a p value of 0.14, was observed at 95% confidence interval (CI) of 0.029 – 1.617 therefore, the phosphate level did not significantly predict for survival in the gender of AKI patients undergoing haemodialysis (Figure 4.13).

4.2.1.20 Effect of gender on calcium level and survival of AKI patients

This current study was able to evaluate if the calcium level was predictive for survival in the gender of AKI patients undergoing haemodialysis in the renal unit, Kakamega County.

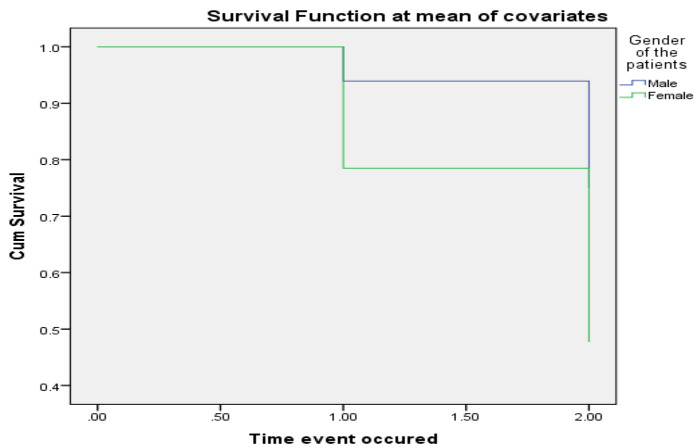

Figure 4.14: Cox-regression to test investigate if the calcium level is predictive for survival in the gender of AKI patients undergoing haemodialysis

The hazard ratio of 1.72 is > 1 and this is associated with poor survival, however, a p value of 0.393, was observed at 95% confidence interval (CI) of 0.495 – 6.00 therefore, the calcium level did not significantly predict for survival in the gender of AKI patients undergoing haemodialysis (Figure 4.14).

4.2.1.21 Effect of gender on sodium level and survival of AKI patients

This study was able to evaluate if the sodium level was predictive for survival in the gender of AKI patients undergoing haemodialysis in the renal unit, Kakamega County.

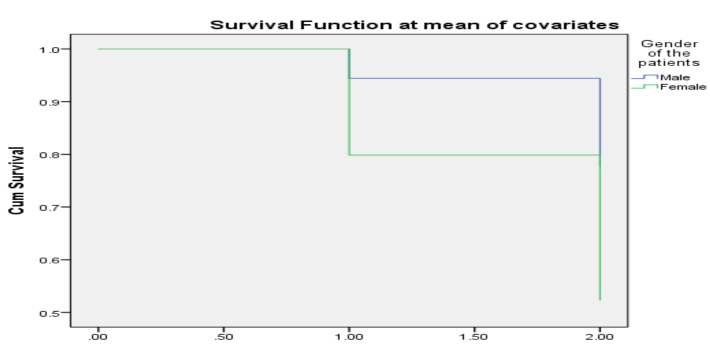

Figure 4.15: Cox-regression to test investigate if the sodium level is predictive for survival in the gender of AKI patients undergoing haemodialysis

The hazard ratio of 3.78 is > 1 and this is associated with poor survival, however, a p value of 0.198, was observed at 95% confidence interval (CI) of 0.500 – 28.49 therefore, the sodium level did not significantly predict for survival in the gender of AKI patients undergoing haemodialysis (Figure 4.15).

4.2.1.22 Effect of gender on haemoglobin level and survival of AKI patients

This current study was able to evaluate if the haemoglobin level was predictive for survival in the gender of AKI patients undergoing haemodialysis in the renal unit, Kakamega County.

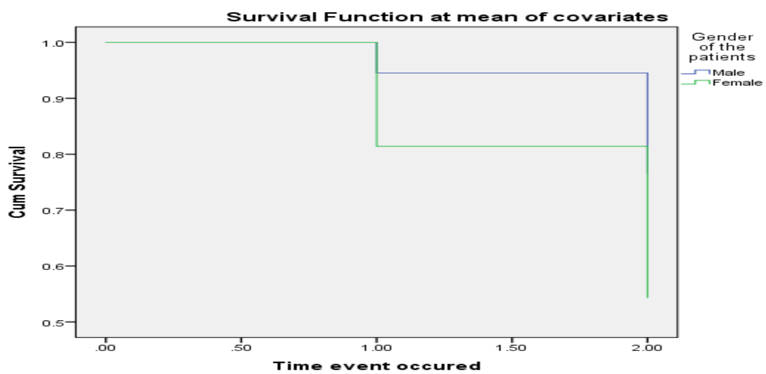

Figure 4.16: Cox-regression to test investigate if the haemoglobin level is predictive for survival in the gender of AKI patients undergoing haemodialysis

The hazard ratio of 24.38 is > 1 and this is associated with poor survival, however, a p value of 0.48, was observed at 95% confidence interval (CI) of 0.004 – 169545.04 therefore, the haemoglobin level did not significantly predict for survival in the gender of AKI patients undergoing haemodialysis (Figure 4.16).

4.2.1.23 Effect of gender on potassium level and survival of AKI patients

This current study was able to evaluate if the comorbidity status was predictive for survival in the gender of AKI patients undergoing haemodialysis in the renal unit, Kakamega County.

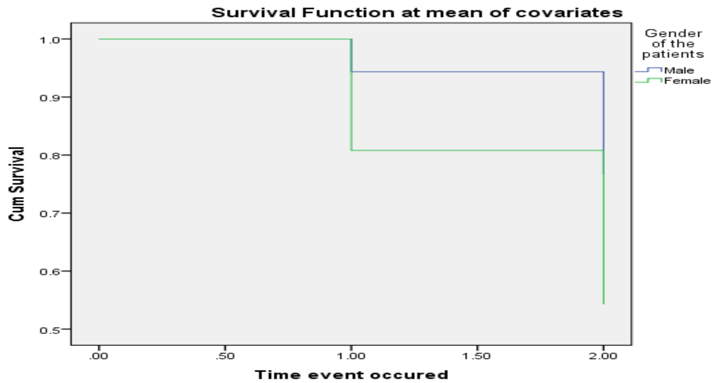

Figure 4.17: Cox-regression to test investigate if the potassium level is predictive for survival in the gender of AKI patients undergoing haemodialysis.

The hazard ratio of 3.31 is > 1 and this is associated with poor survival, however, a p value of 0.061, was observed at 95% confidence interval (CI) of 0.948 – 11.524 therefore, the potassium level did not significantly predict for survival in the gender of AKI patients undergoing haemodialysis (Figure 4.17).

4.2.1.24 Effect of gender on chloride level and survival of AKI patients

This present study was able to evaluate if the chloride level was predictive for survival in the gender of AKI ppatients undergoing haemodialysis in the renal unit, Kakamega County.

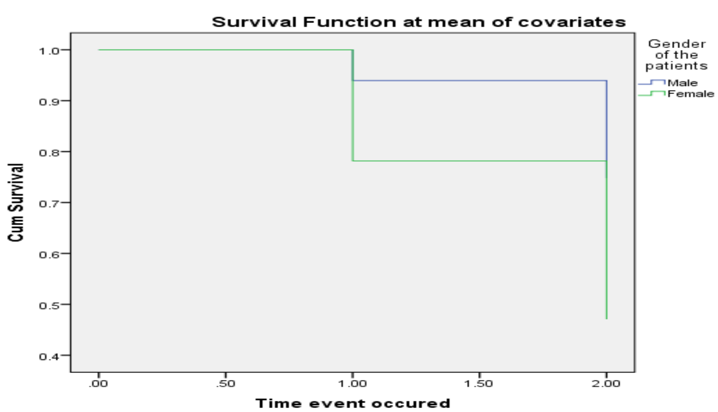

Figure 4.18: Cox-regression to test investigate if the chloride level is predictive for survival in the gender of AKI patients undergoing haemodialysis

The hazard ratio of 1.54 is > 1 and this is associated with poor survival, however, a p value of 0.452, was observed at 95% confidence interval (CI) of 0.502 – 4.704 therefore, the chloride level did not significantly predict for survival in the gender of AKI patients undergoing haemodialysis (Figure 4.18).

4.2.1.25 Effect of age on creatinine level and survival of AKI patients

This current study was able to evaluate if the creatinine was predictive for survival in the age of AKI patients undergoing haemodialysis in the renal unit, Kakamega County.

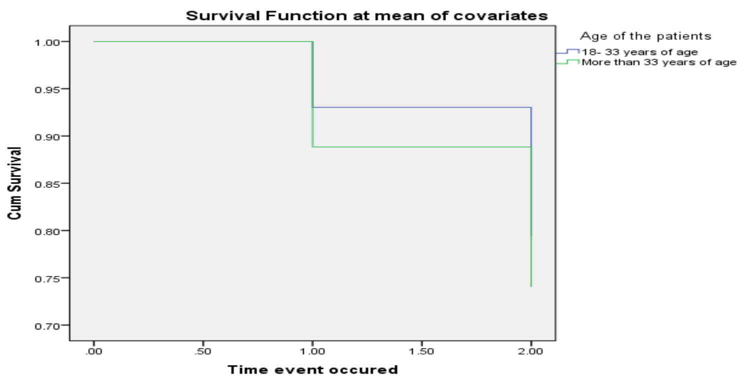

Figure 4.19: Cox-regression to test investigate if the creatinine level is predictive for survival in the age of AKI patients undergoing haemodialysis

The hazard ratio of 29.6 is > 1 and this is associated with poor survival, however, a p value of 0.204, was observed at 95% confidence interval (CI) of 0.16 – 55510.9 therefore, the creatinine level did not significantly predict for survival in the age of AKI patients undergoing haemodialysis (Figure 4.19).

4.2.1.26 Effect of age on urea level and survival of AKI patients

This current study was able to evaluate if the urea level was predictive for survival in the age of AKI patients undergoing haemodialysis in the renal unit, Kakamega County.

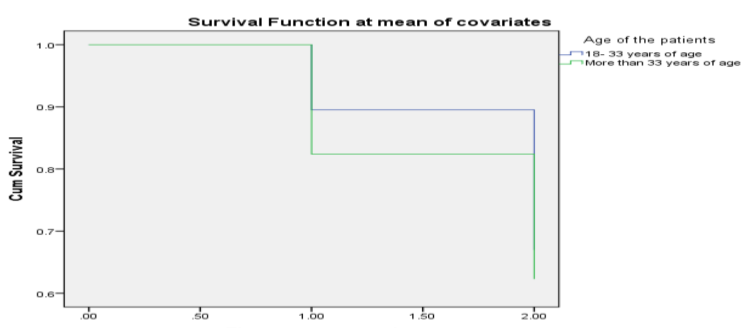

Figure 4.20: Cox-regression to test investigate if the urea level is predictive fo survival in the age of AKI patients undergoing haemodialysis

The hazard ratio of 0.34 is < 1 and this is associated with good survival, however, a p value of 0.34, was observed at 95% confidence interval (CI) of 0.05 – 2.82 therefore, the urea level did not significantly predict for survival in the age of AKI patients undergoing haemodialysis (Figure 4.20).

4.2.1.27 Effect of age on phosphate level and survival of AKI patients

This study was able to evaluate if the phosphate level was predictive for survival in the age of AKI patients undergoing haemodialysis in the renal unit, Kakamega County.

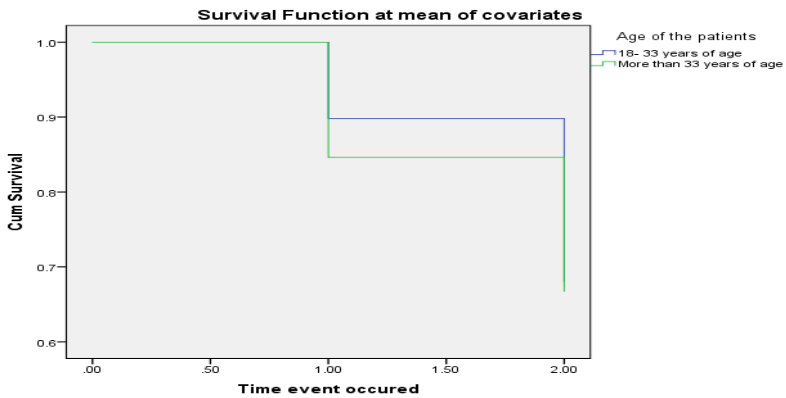

Figure 4.21: Cox-regression to test investigate if the phosphate level is predictive for survival in the age of AKI patients undergoing haemodialysis

The hazard ratio of 4.6 is > 1 and this is associated with poor survival, however, a p value of 0.14, was observed at 95% confidence interval (CI) of 0.612 – 34.77 therefore, the phosphate level did not significantly predict for survival in the age of AKI patients undergoing haemodialysis (Figure 4.21).

4.2.1.28 Effect of age on calcium level and survival of AKI patients

This present study was able to evaluate if the calcium level was predictive for survival in the age of AKI patients undergoing haemodialysis in the renal unit, Kakamega County.

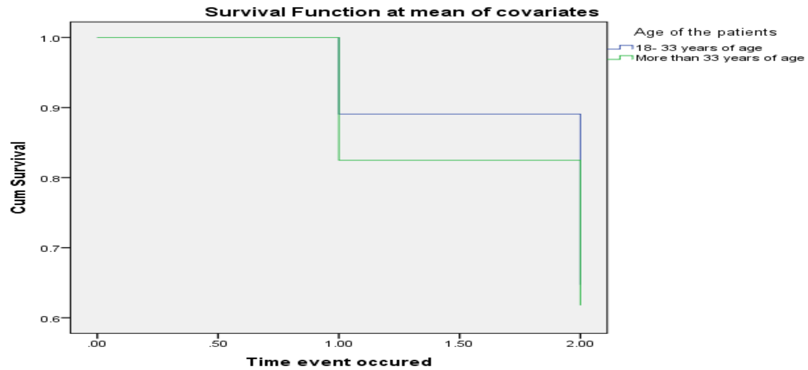

Figure 4.22: Cox-regression to test investigate if the calcium level is predictive for survival in the age of AKI patients undergoing haemodialysis

The hazard ratio of 1.9 is > 1 and this is associated with poor survival, however, a p value of 0.31, was observed at 95% confidence interval (CI) of 0.55 – 6.59 therefore, the calcium level did not significantly predict for survival/mortality in the age of AKI patients undergoing haemodialysis (Figure 4.22).

4.2.1.29 Effect of age on sodium level and survival of AKI patients

This current study was able to evaluate if the sodium level was predictive for survival in the age of AKI patients undergoing haemodialysis in the renal unit, Kakamega County.

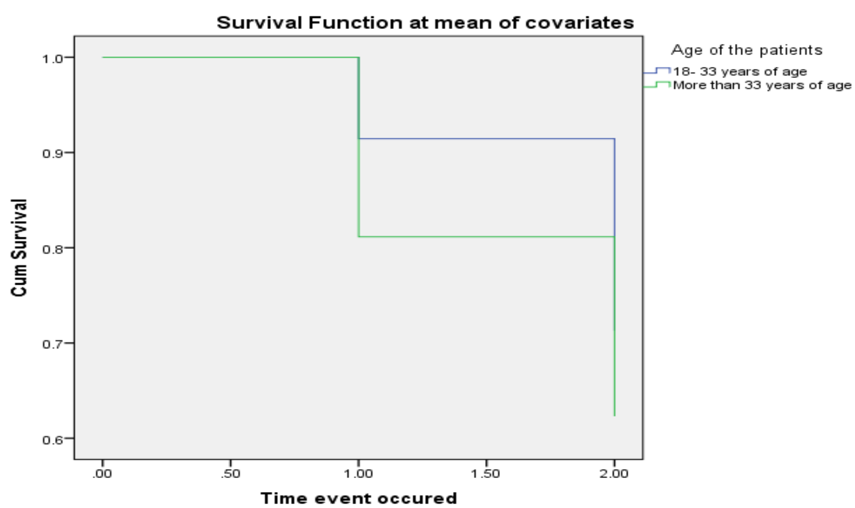

Figure 4.23: Cox-regression to test investigate if the sodium level is predictive for survival in the age of AKI patients undergoing haemodialysis

The hazard ratio of 4.98 is > 1 and this is associated with poor survival, however, a p value of 0.124, was observed at 95% confidence interval (CI) of 0.646 – 38.41 therefore, the sodium level did not significantly predict for survival in the age of AKI patients undergoing haemodialysis (Figure 4.23).

4.2.1.30 Effect of age on haemoglobin level and survival of AKI patients

This current study was able to evaluate if the haemoglobin level was predictive for survival in the age of AKI patients undergoing haemodialysis in the renal unit, Kakamega County.

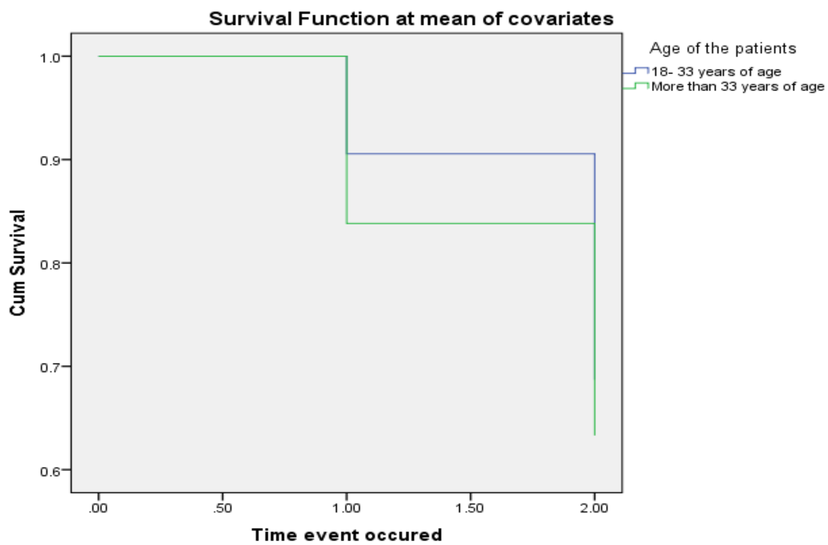

Figure 4.24: Cox-regression to test investigate if the haemoglobin level is predictive for survival in the age of AKI patients undergoing haemodialysis

The hazard ratio of 23.79 is > 1 and this is associated with poor survival, however, a p value of 0.395, was observed at 95% confidence interval (CI) of 0.016 – 35468.21 therefore, the haemoglobin level did not significantly predict for survival in the age of AKI patients undergoing haemodialysis (Figure 4.24).

4.2.1.31 Effect of age on potassium level and survival of AKI patients

This study was able to evaluate if the potassium level was predictive for survival in the age of AKI patients undergoing haemodialysis in the renal unit, Kakamega County.

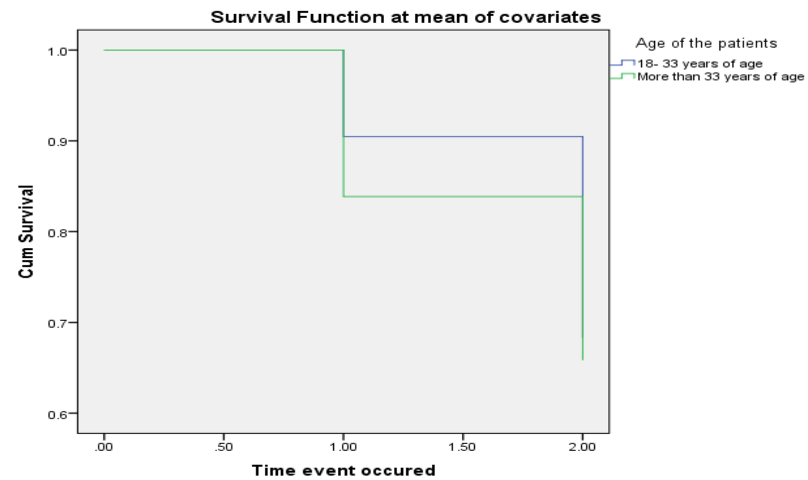

Figure 4.25: Cox-regression to test investigate if the potassium level is predictive for survival in the age of AKI patients undergoing haemodialysis

The hazard ratio of 3.73 is > 1 and this is associated with poor survival, however, a p value of 0.038 *, was observed at 95% confidence interval (CI) of 1.079 – 12.88 therefore, the potassium level significantly predicted for survival in the age group between 18-33 years of AKI patients undergoing haemodialysis (Figure 4.25).

4.2.1.32 Effect of age on chloride level and survival of AKI patients

This present study was able to evaluate if the chloride level was a predictor for survival in the age of AKI patients undergoing haemodialysis in the renal unit, Kakamega County.

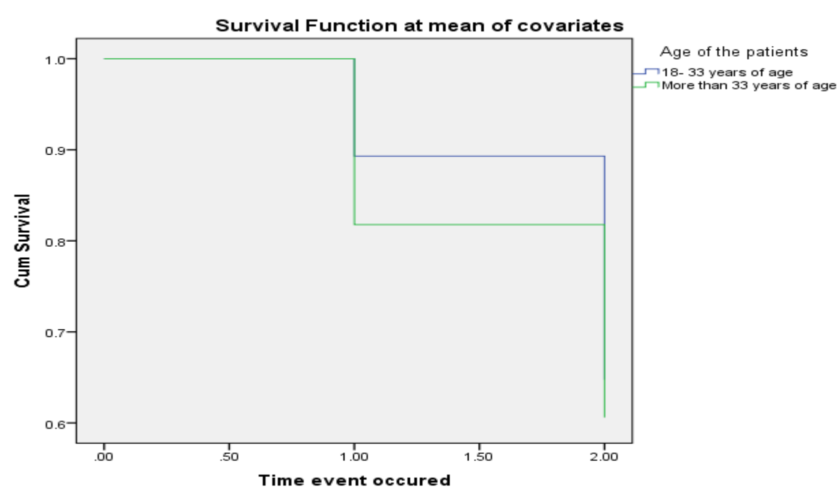

Figure 4.26: Cox-regression to test investigate if the chloride level is predictive for survival in the age of AKI patients undergoing haemodialysis

The hazard ratio of 1.724 is > 1 and this is associated with poor survival, however, a p value of 0.34, was observed at 95% confidence interval (CI) of 0.564 – 5.265 therefore, the chloride level did not significantly predict for survival/mortality in the age of AKI patients undergoing haemodialysis (Figure 4.26).

4.2.2 Renal biochemical parameters as a survival predictor of chronic kidney disease patients undergoing hemodialysis

All the CKD patients that were undergoing hemodialysis at the renal unit in Kakamega County general teaching and referral hospital had renal biochemical test done on them prior to dialysis and it was observed that deranged levels among the patients were more than the normal ranges in all the parameters as shown in table 4.4. These deranged levels of renal biochemical parameters are indications that these patients had difficulties in eliminating wastes and unwanted water from the blood.

Table 4.4: Predictive indicators of CKD patients undergoing hemodialysis (n = 174 patients)

Characteristics		frequency	percentage (%)
Creatinine level			
	Normal range	07	04
	Deranged levels	167	96
Urea level			
	Normal range	08	4.6
	Deranged levels	166	95.4
Phosphate level			
	Normal range	26	14.9
	Deranged levels	148	85.1
Calcium level			
	Normal range	48	27.6
	Deranged levels	126	72.4
Haemoglobin level			
	Normal range	09	5.2
	Deranged levels	165	94.8
Potassium level			
	Normal range	59	33.9
	Deranged levels	115	66.1
Sodium level			
	Normal range	26	14.9
	Deranged levels	148	85.1
Chloride level			
	Normal range	39	22.4
	Deranged levels	135	77.6

In table 4.4, the renal biochemical parameter and haemtological test were done before a CKD patient is dialyzed. These tests are essential in monitoring the progress and function of the kidney in clearing blood. Binary logistic regression analysis was used to determine the relationship between predictive indicators and survival of CKD patients.

4.2.2.1 Relationship between creatinine level and survival of CKD patients undergoing hemodialysis

The results of this study showed that creatinine level was within the normal ranges in 2 CKD patients who were alive and 5 who died. Deranged creatinine level was seen in 33 CKD patients who were alive and 134 who died. Binary logistic regression analysis was further done to establish relationship between creatinine levels and survival status showed a p value of 0.572 at 1 df with a 95% CI of 0.302 – 8.745, therefore we accept the null hypothesis that there was no statistically significant relationship between the creatinine level and survival of a patient with CKD patients. These two variables creatinine level and survival status were independent to each other. It was observed that the risk (Relative risk) of being alive when the CKD patients have creatinine levels that are within the normal ranges was 1.624.

4.2.2.2 Relationship between urea level and survival of CKD patients undergoing hemodialysis

Laboratory findings showed that CKD patients that had on urea levels within the normal ranges 2 were alive and 6 died. Deranged phosphate level was seen in 33 CKD patients who were alive and 133 who died. Binary logistic regression analysis was further done to establish relationship between ureal levels and survival status and the results showed a p value of 0.725 at 1 df with 95% CI of 0.259 – 6.961, therefore we accept the null hypothesis that there was no statistically significant relationship between the ureal level and survival status of a patient with CKD. These two variables urea levels and survival status were independent to each other. It was observed that the risk (Relative risk) of being alive when CKD patient have ureal levels within the normal range was 1.343 compared to when the patients have deranged levels.

4.2.2.3 Relationship between phosphate level and survival of CKD patients undergoing hemodialysis

The findings of this study showed that phosphate level was within the normal ranges in 10 CKD patients who were alive and 16 who died. Deranged phosphate level was seen in 25 patients who were alive and 133 who died. Binary logistic regression analysis was further done to establish relationship between phosphate levels and survival status and the results showed a p value of 0.014* at 1 df with 95% CI of 1.251 – 7.560, therefore we accept the alternative hypothesis that there was statistically significant relationship between the phosphate level and survival status of a patient with CKD. These two variables phosphate levels and survival status were dependent to each other. It was observed that the risk (Relative risk) of being alive when CKD patient have phosphate levels within the normal range was 3.075 compared to when the patients have deranged levels.

4.2.2.4 Relationship between calcium level and survival of CKD patients undergoing hemodialysis

The results of this study showed that calcium level was within the normal ranges in 18 patients who were alive and 30 died. Deranged calcium level was seen in 17 patients who were alive and 109 who died. Binary logistic regression analysis was further done to establish relationship between calcium levels and survival status, and the results showed a p value of 0.001* at 1 df with 95% CI of 1.770 – 8.361, therefore we accept the alternative hypothesis that there was statistically significant relationship between the calcium level and survival status of a patient with CKD. These two variables calcium levels and survival status were dependent to each other. It was observed that the risk (Relative risk) of being alive when CKD patient have calcium levels within the normal range was 3.847 compared to when the patients have deranged levels.

4.2.2.5 Relationship between haemoglobin level and survival of CKD patients undergoing hemodialysis

The laboratory findings of this study showed that haemoglobin level was within the normal ranges in 5 CKD patients who were alive and 4 who died. Deranged haemoglobin level was seen in 30 patients who were alive and 135 who died. Binary logistic regression analysis was further done to establish relationship between haemoglobin levels and survival status and the results showed a p value of 0.014* at 1 df with 95% CI of 1.425 – 22.203, therefore we accept the alternative hypothesis that there was statistically significant relationship between the haemoglobin level and survival status of a patient with CKD. These two variables haemoglobin levels and survival status were dependent to each other. It was observed that the risk (Relative risk) of being alive when CKD patient have haemoglobin levels within the normal range was 5.625 compared to when the patients have deranged levels.

4.2.2.6 Relationship between sodium level and survival of CKD patients undergoing hemodialysis

The results of this study showed that sodium level was within the normal ranges in 12 CKD patients who were alive and 14 who died. Deranged sodium level was seen in 23 CKD patients who were alive and 125 who died. Binary logistic regression analysis was further done to establish relationship between haemoglobin levels and survival status and the results showed a p value of 0.001* at 1 df with 95% CI of 1.913 – 11.345, therefore we accept the alternative hypothesis that there was statistically significant relationship between the sodium level and survival status of a patient with CKD. These two variables sodium levels and survival status were dependent to each other. It was observed that the risk (Relative risk) of being alive when CKD patient have sodium levels within the normal range was 4.658 compared to when the patients have deranged levels.

4.2.2.7 Relationship between potassium level and survival of CKD patients undergoing hemodialysis

The laboratory findings on potassium levels showed that patients within the normal ranges in 23 CKD patients who were alive and 36 who died. Deranged potassium level was seen in 12 CKD patients who were alive and 103 who died. Binary logistic regression analysis was further done to establish relationship between potassium levels and survival status and the results showed a p value of <0.0001* at 1 df with 95% CI of 2.478 – 12.137, therefore we accept the alternative hypothesis that there was statistically significant relationship between the potassium level and survival status of a patient with CKD. These two variables potassium levels and survival status were dependent to each other. It was observed that the risk (Relative risk) of being alive when CKD patient have potassium levels within the normal range was 5.484 compared to when the patients have deranged levels.

4.2.2.8 Relationship between chloride level and survival of CKD patients undergoing hemodialysis

The results of this study showed that chloride level was within the normal ranges in 15 CKD patients who were alive and 24 who died. Deranged chloride level was seen in 20 CKD patients who were alive and 115 who died. Binary logistic regression analysis was further done to establish relationship between chloride levels and survival status and the results showed a p value of <0.002* at 1 df with 95% CI of 1.613 – 8.006, therefore we accept the alternative hypothesis that there was statistically significant relationship between the chloride level and survival status of a patient with CKD. These two variables chloride levels and survival status were dependent to each other. It was observed that the risk (Relative risk) of being alive when CKD patient have chloride levels within the normal range was 3.594 compared to when the patients have deranged levels.

The Kaplan Meier (KM) analysis is a non-parametric statistic used to calculate survival by estimating the survival function from time to event or lifetime data. It is used to measure the fraction of patients living for a certain amount of time after treatment or intervention has been administered. In this study, we had binary (two) events to measure the KM analysis which were alive and died. The log-rank test was used in the KM to calculate the p value. The Kaplan Meier (KM) analysis was used in this study to establish which renal parameter had an influence on survival.

4.2.2.9 Influence of creatinine level on survival of CKD patients

This study was able to evaluate if the creatinine level has an influence on survival of CKD patients undergoing haemodialysis in the renal unit, Kakamega County.

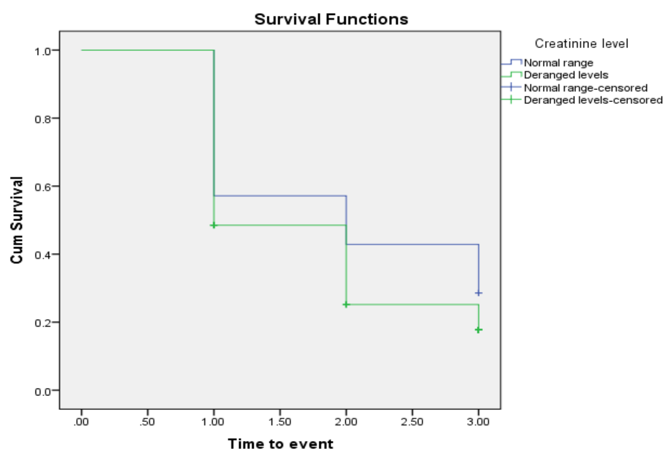

Figure 4.27: Test of equality of survival distribution for the creatinine levels in CKD patients undergoing haemodialysis

Since the log rank test statistics had a p value 0.451 at df of 1 with a Chi-Square $\chi 2$ of 0.567, therefore, the difference in creatinine levels was not statistically significant to influence survival in CKD patients undergoing haemodialysis (Figure 4.27).

4.2.2.10 Influence of urea level on survival of CKD patients

This study was able to evaluate if the urea levels have an influence on survival/mortality in CKD patients undergoing haemodialysis in the renal unit, Kakamega County.

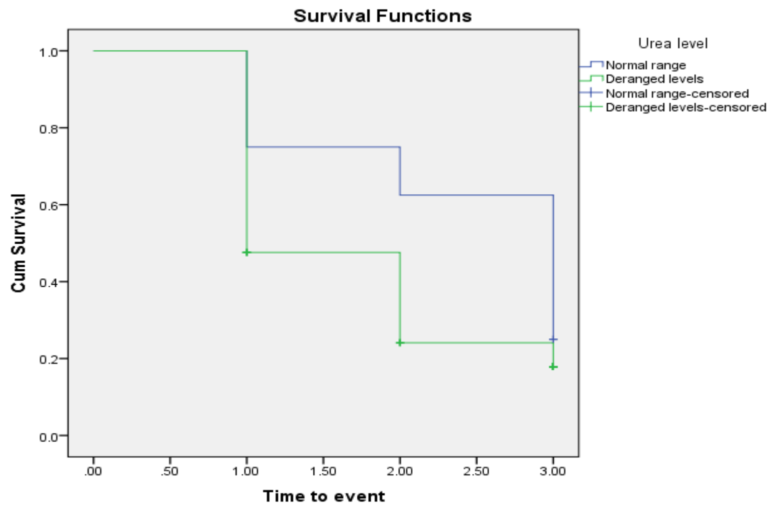

Figure 4.28: Test of equality of survival distribution for the urea levels in CKD patients undergoing haemodialysis

Since the log rank test statistics had a p value 0.244 at df of 1 with a Chi-Square $\chi 2$ of 1.359, therefore, the difference in urea levels was not statistically significant to influence survival in CKD patients undergoing haemodialysis (Figure 4.28).

4.2.2.11 Influence of phosphate level on survival of CKD patients

This study was able to evaluate if the phosphate levels have an influence on survival of CKD patients undergoing haemodialysis in the renal unit, Kakamega County.

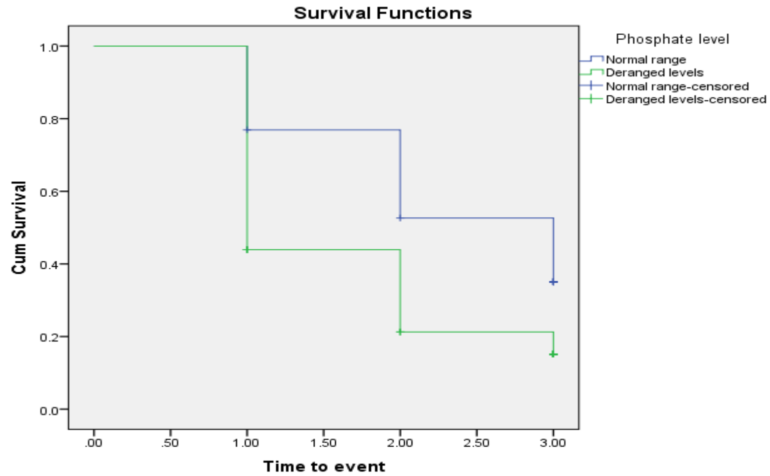

Figure 4.29: Test of equality of survival distribution for the phosphate levels in CKD patients undergoing haemodialysis

Sin Since the log rank test statistics had a p value <0.003* at df of 1 with a Chi-Square $\chi 2$ of 8.726, therefore, the difference in phosphate levels was statistically significant to influence survival in CKD patients undergoing haemodialysis (Figure 4.29).

4.2.2.12 Influence of calcium level on survival of CKD patients

This study was able to evaluate if the calcium levels have an influence on survival/mortality in CKD patients undergoing haemodialysis in the renal unit, Kakamega County.

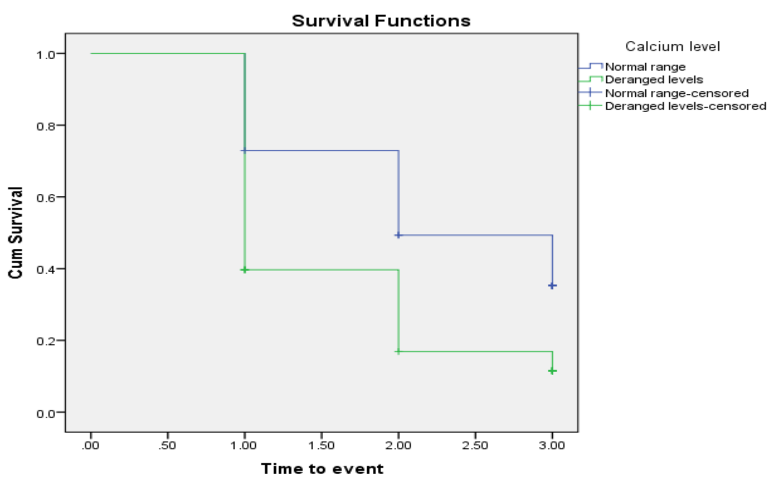

Figure 4.30: Test of equality of survival distribution for the calcium levels in CKD patients undergoing haemodialysis

Since the log rank test statistics had a p value <0.0001* at df of 1 with a Chi-Square $\chi 2$ of 17.802, therefore, the difference in calcium levels was statistically significant to influence survival in CKD patients undergoing haemodialysis (Figure 4.30).

4.2.2.13 Influence of sodium level on survival of CKD patients

This study was able to evaluate if the sodium levels have an influence on survival/mortality in AKI patients undergoing haemodialysis in the renal unit, Kakamega County.

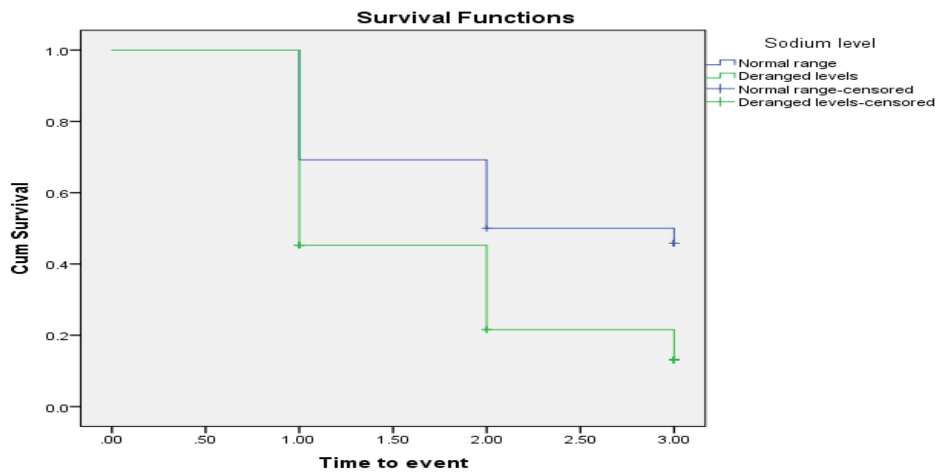

Figure 4.31: Test of equality of survival distribution for the sodium levels in CKD patients undergoing haemodialysis

Since the log rank test statistics had a p value <0.001* at df of 1 with a Chi-Square $\chi 2$ of 11.808, therefore, the difference in sodium levels was statistically significant to influence survival in CKD patients undergoing haemodialysis (Figure 4.31).

4.2.2.14 Influence of haemoglobin level on survival of CKD patients

This study was able to evaluate if the haemoglobin levels have an influence on survival of CKD patients undergoing haemodialysis in the renal unit, Kakamega County.

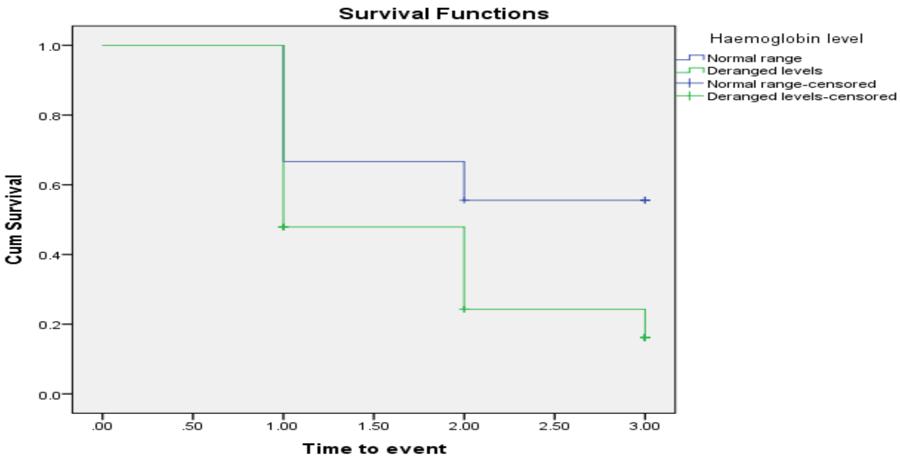

Figure 4.32: Test of equality of survival distribution for the haemoglobin levels in CKD Patients undergoing haemodialysis

Since the log rank test statistics had a p value <0.026* at df of 1 with a Chi-Square $\chi 2$ of 4.936, therefore, the difference in haemoglobin levels was statistically significant to influence survival in CKD patients undergoing haemodialysis (Figure 4.32).

4.2.2.15 Influence of potassium level on survival of CKD patients

This study was able to evaluate if the potassium levels have an influence on survival/mortality in CKD patients undergoing haemodialysis in the renal unit, Kakamega County.

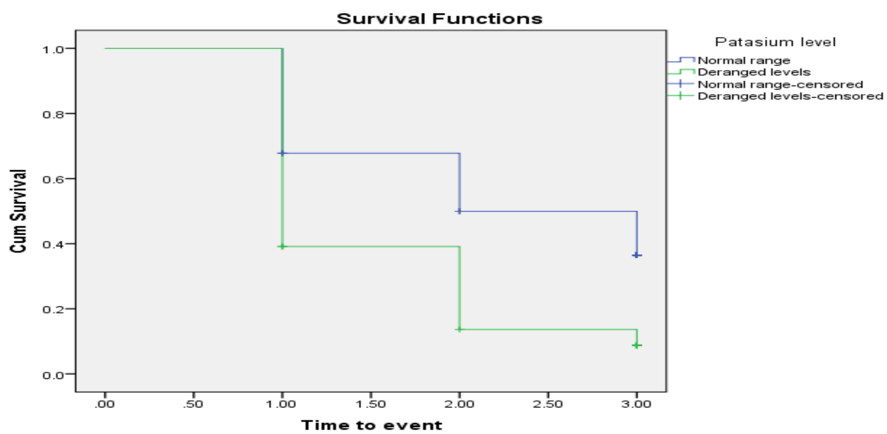

Figure 4.33: Test of equality of survival distribution for the potassium levels in CKD patients undergoing haemodialysis

Since the log rank test statistics had a p value <0.0001* at df of 1 with a Chi-Square $\chi 2$ of 23.284, therefore, the difference in potassium was statistically significant to influence survival in CKD patients undergoing haemodialysis (Figure 4.33).

4.2.2.16 Influence of chloride level on survival of CKD patients

This study was able to evaluate if the chloride levels have an influence on survival/mortality in AKI patients undergoing haemodialysis in the renal unit, Kakamega County.

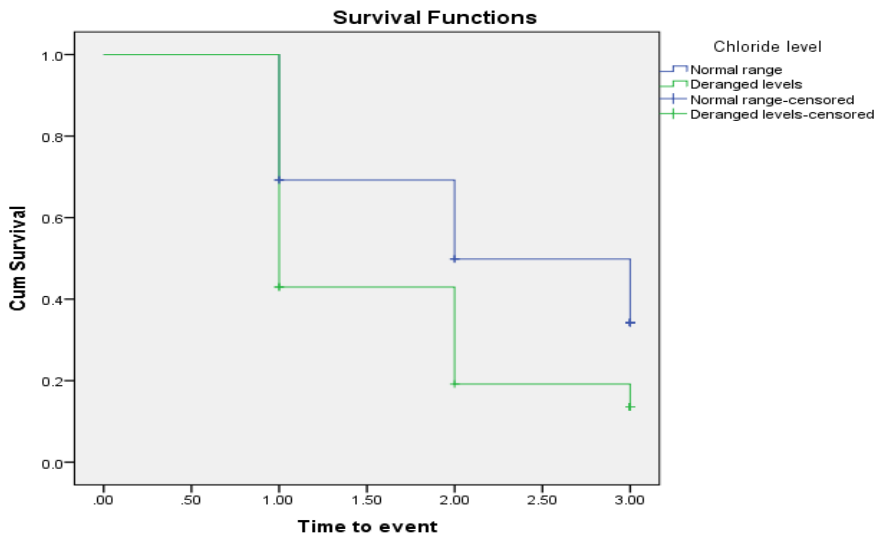

Figure 4.34: Test of equality of survival distribution for the chloride levels in CKD patients undergoing haemodialysis

Since the log rank test statistics had a p value <0.001* at df of 1 with a Chi-Square $\chi 2$ of 11.095, therefore, the difference in chloride level was statistically significant to influence survival in CKD patients undergoing haemodialysis (Figure 4.34).

The Cox-regression analysis is a semi-parametric analysis that was used to investigate the effect of independent variable (age and gender) on confounder variable and survival of CKD patients. The hazard ratio of > 1 is associated with poor ratio/poor hazard/poor survival. On the other hand, a hazard ratio of < 1 is associated with good ratio/good hazard/good survival. The hazard ratio, the p value and 95% confidence intervals were used to interpret the Cox-regression analysis by reporting the variable in the equation table found in the SPSS output.

4.2.2.17 Effect of gender on creatinine level and survival of CKD patients

This current study was able to evaluate if the creatinine level was predictive for survival in the gender of CKD patients undergoing haemodialysis in the renal unit, Kakamega County.

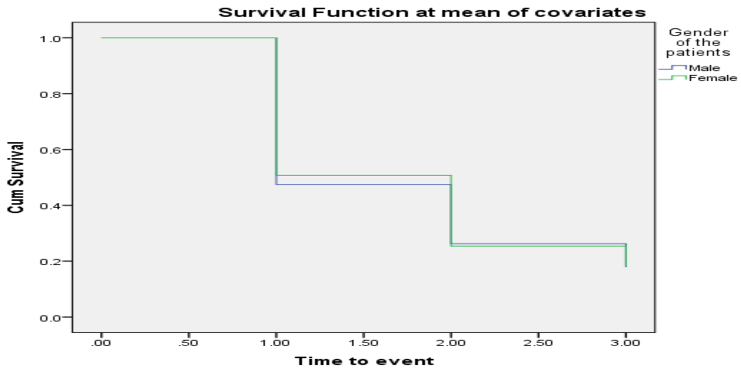

Figure 4.35: Cox-regression to test investigate if the creatinine level is predictive for survival in the gender of CKD patients undergoing haemodialysis

The hazard ratio of 1.280 is > 1 and this is associated with poor survival, however, a p value of 0.589, was observed at 95% confidence interval (CI) of 0.523 – 3.131 therefore, the creatinine level did not significantly predict survival in the gender among CKD patients undergoing haemodialysis (Figure 4.35).

4.2.2.18 Effect of gender on urea level and survival of CKD patients

This study was able to evaluate if the urea level was predictive for survival in the gender of CKD patients undergoing haemodialysis in the renal unit, Kakamega County.

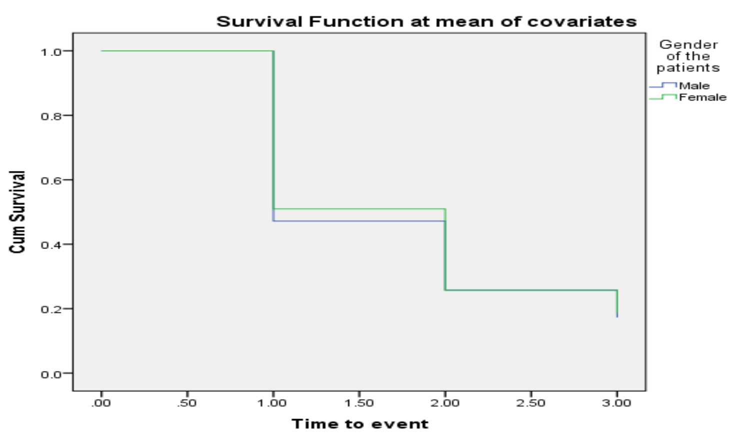

Figure 4.36: Cox-regression to test investigate if the urea level is predictive for survival in the gender of CKD patients undergoing haemodialysis

The hazard ratio of 1.454 is > 1 and this is associated with poor survival, however, a p value of 0.377, was observed at 95% confidence interval (CI) of 0.634 – 3.339 therefore, the urea level did not significantly predict survival in the gender among CKD patients undergoing haemodialysis (Figure 4.36).

4.2.2.19 Effect of gender on phosphate level and survival of CKD patients

This current study was able to evaluate if the phosphate level was predictive for survival in the gender of CKD patients undergoing haemodialysis in the renal unit, Kakamega County.

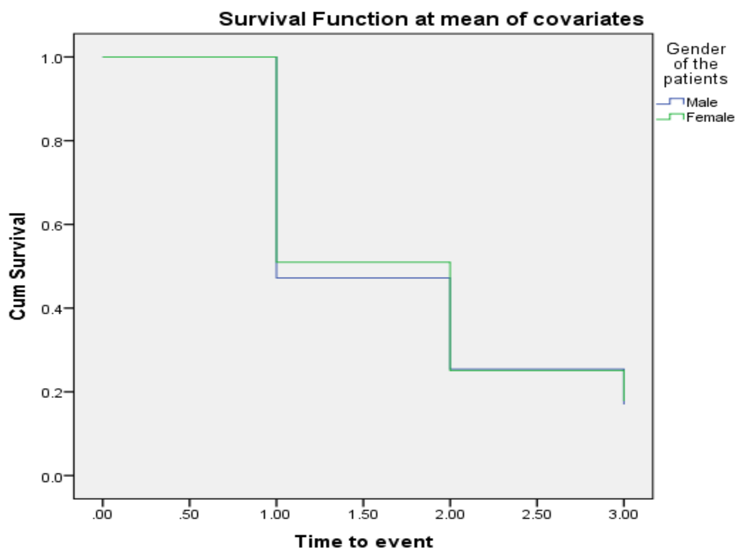

Figure 4.37: Cox-regression to test investigate if the phosphate level is predictive for survival in the gender of CKD patients undergoing haemodialysis

The hazard ratio of 1.768 is >1 and this is associated with poor survival, however, a p value of 0.033*, was observed at 95% confidence interval (CI) of 1.046 – 2.989 therefore, the phosphate level significantly predict survival in the gender among CKD patients undergoing haemodialysis (Figure 4.37).

4.2.2.20 Effect of gender on calcium level and survival of CKD patients

This current study was able to evaluate if the calcium level was predictive for survival in the gender of CKD patients undergoing haemodialysis in the renal unit, Kakamega County.

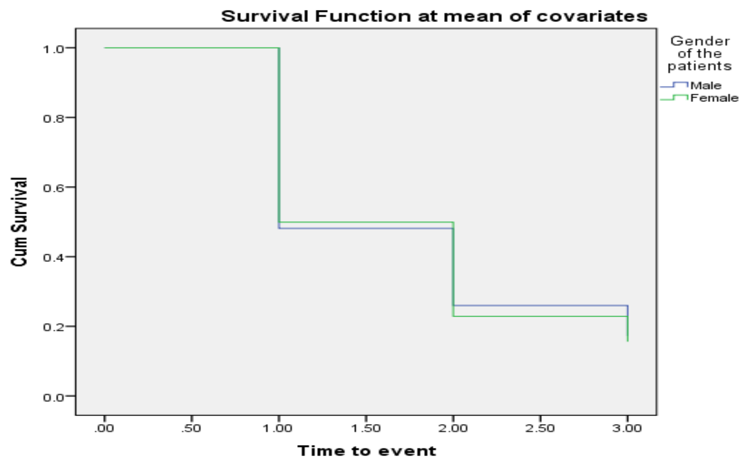

Figure 4.38: Cox-regression to test investigate if the calcium level is predictive for survival in the gender of CKD patients undergoing haemodialysis

The hazard ratio of 1.887 is > 1 and this is associated with poor survival, however, a p value of 0.002*, was observed at 95% confidence interval (CI) of 1.251 – 2.847 therefore, the calcium level significantly predict survival in the gender among CKD patients undergoing haemodialysis (Figure 4.38).

4.2.2.21 Effect of gender on sodium level and survival of CKD patients

This study was able to evaluate if the sodium level was predictive for survival in the gender of CKD patients undergoing haemodialysis in the renal unit, Kakamega County.

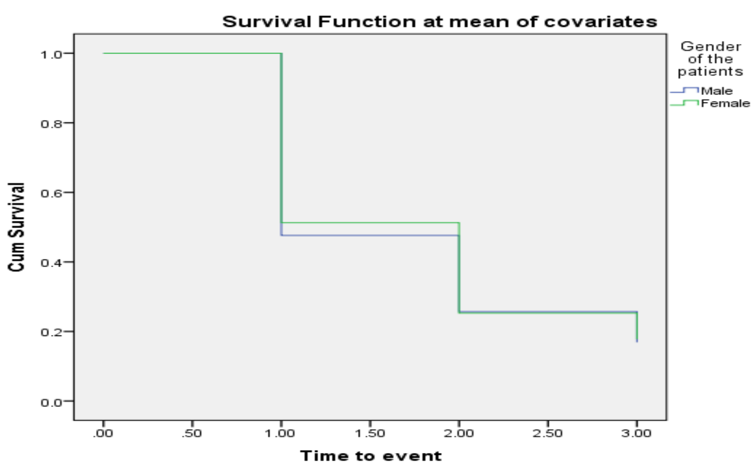

Figure 4.39: Cox-regression to test investigate if the sodium level is predictive for survival in the gender of CKD patients undergoing haemodialysis

The hazard ratio of 2.007 is > 1 and this is associated with poor survival, however, a p value of 0.014*, was observed at 95% confidence interval (CI) of 1.152 – 3.498 therefore, the sodium level significantly predict survival in the gender among CKD patients undergoing haemodialysis (Figure 4.39).

4.2.2.22 Effect of gender on haemoglobin level and survival of CKD patients

This current study was able to evaluate if the haemoglobin level was predictive for survival in the gender of CKD patients undergoing haemodialysis in the renal unit, Kakamega County.

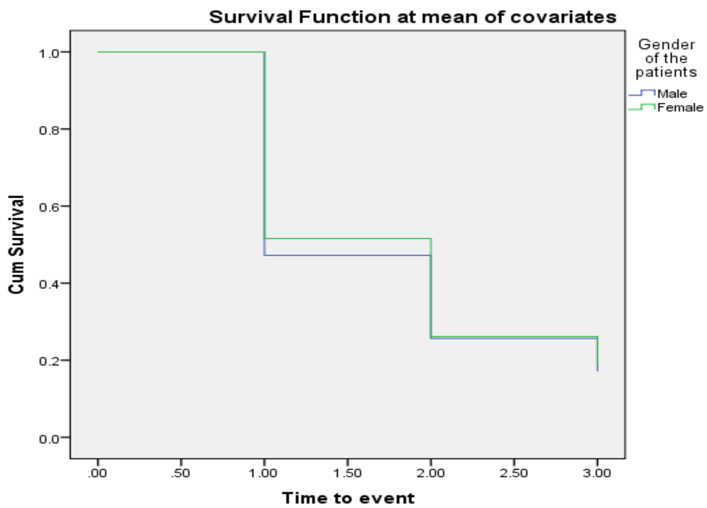

Figure 4.40: Cox-regression to test investigate if the haemoglobin level is predictive for survival in the gender of CKD patients undergoing haemodialysis

The hazard ratio of 2.256 is > 1 and this is associated with poor survival, however, a p value of 0.110, was observed at 95% confidence interval (CI) of 0.831 – 6.128 therefore, the haemoglobin level did not significantly predict survival in the gender among CKD patients undergoing haemodialysis (Figure 4.40).

4.2.2.23 Effect of gender on potassium level and survival of CKD patients

This current study was able to evaluate if the comorbidity status was predictive for survival in the gender of CKD patients undergoing haemodialysis in the renal unit, Kakamega County.

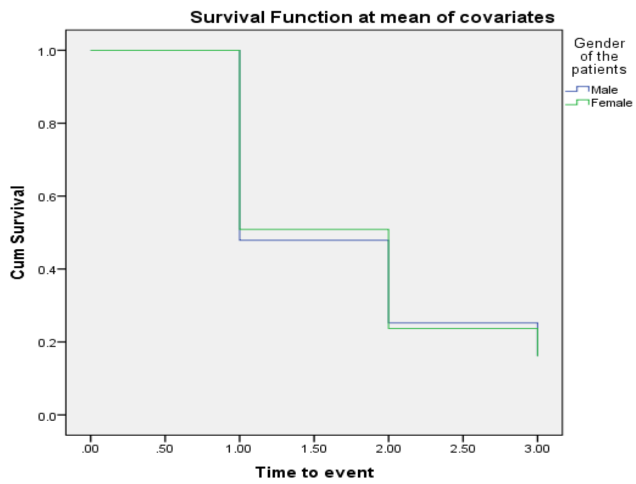

Figure 4.41: Cox-regression to test investigate if the potassium level is predictive for survival in the gender of CKD patients undergoing haemodialysis

The hazard ratio of 1.967 is > 1 and this is associated with poor survival, however, a p value of 0.001*, was observed at 95% confidence interval (CI) of 1.337 – 2.895 therefore, the potassium level significantly predict survival in the gender among CKD patients undergoing haemodialysis (Figure 4.41).

4.2.2.24 Effect of gender on chloride level and survival of CKD patients

This present study was able to evaluate if the chloride level was predictive for survival in the gender of CKD patients undergoing haemodialysis in the renal unit, Kakamega County.

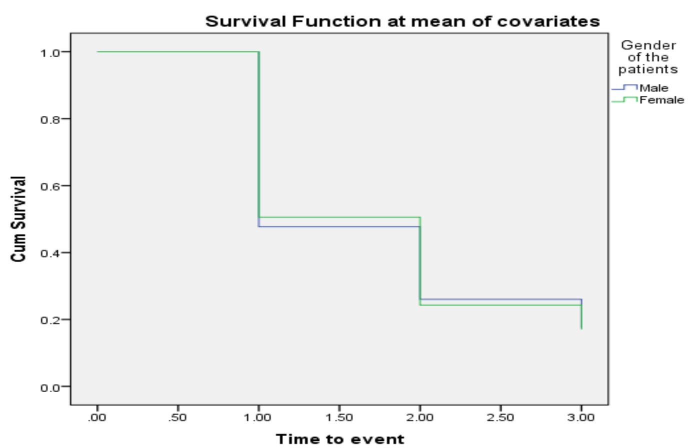

Figure 4.42: Cox-regression to test investigate if the chloride level is predictive for survival in the gender of CKD patients undergoing haemodialysis

The hazard ratio of 1.720 is > 1 and this is associated with poor survival, however, a p value of 0.016*, was observed at 95% confidence interval (CI) of 1.105 – 2.679 therefore, the chloride level significantly predict survival in the gender among CKD patients undergoing haemodialysis (Figure 4.42).

4.3 Prognostic factors as a survival indicator of patients undergoing hemodialysis at Kakamega County general teaching and referral hospital, Kenya

4.3.1Prognostic factors as a survival indicator of AKI patients undergoing hemodialysis

In table 4.5, the study findings showed that majority 73.9% (51) of the patients with acute kidney injury were still alive and undergoing dialysis. Comorbidity observed to be present in 98.6% (68) of the patients with acute kidney injury. Majority 58% (40) of the patients had other comorbidities besides hypertension, diabetes mellitus, and pre-eclampsia. Approximately 57% (39) patients with acute kidney injury were not on any form of treatment or intervention that would help in the management of kidney to prevent failure.

Table 4.5: Prognostics characteristics of AKI patients undergoing hemodialysis (n = 69 patients)

Characteristics		**frequency**	**percentage (%)**
Survival status			
	Alive	51	73.9
	Died	18	26.1
Comorbidity status			
	Comorbidity present	68	98.6
	Comorbidity absent	1	1.4
Type of comorbidity			
	Hypertension	14	20.3
	Diabetes mellitus	3	4.3
	Pre-eclampsia	11	15.9
	Other comorbidities	40	58.0
	Without comorbidity	1	1.4
Number of comorbidities			
	One comorbidity	53	76.8
	Two comorbidities	14	20.3
	> Two comorbidities	1	1.4
	Without comorbidity	1	1.4
Treatment status			
	On treatment	30	43.5
	Not on treatment	39	56.5

4.3.1.1 Relationship between prognostic factors and survival of AKI patients undergoing hemodialysis

In this study, the prognostic indicators that were used for acute kidney patients were presence or absence of comorbidity, the type of comorbidity present, the number of comorbidities present and treatment status. In the treatment status, the study reviewed the records and ascertained whether these patients were on any medication to manage the comorbidity if present, and or manage the acute kidney injury incurred. Binomial logistic regression analysis was used to establish if there was any relationship between prognostic indicators (Comorbidity status, Treatment status, Creatinine, Urea, Phosphates, Calcium, Sodium, Hb, Potassium and Chloride levels) and survival status of AKI patients. Whereas multinomial logistic regression was used to determine relationship between the types of comorbidities, number of comorbidities and survivals status of AKI patients.

4.3.1.2 Relationship between comorbidity status and survival of AKI patients undergoing hemodialysis

In this study, patients who had comorbidity present, 51 were alive and 17 died. Only one patient did not have a comorbidity and was reported to have died. A binary logistic regression showed a p value of 1.00 at 1 df with 95% confidence interval (CI) of 0.00 – 1, therefore accepting the null hypothesis that there was no statistically significant relationship between the comorbidity status and survival status of a patient with AKI. These two variables comorbidity status and survival were independent to each other.

4.3.1.3 Relationship between type of comorbidity and survival of AKI patients undergoing hemodialysis

Out of the 68 patients who had comorbidity, the study was able to further review the type of comorbidity that these patients had. It was observed that for hypertension, 12 were alive and 2 died, diabetes mellitus 1 was alive and 2 died, pre-eclampsia 9 were alive and 2 died, other types of comorbidities 29 were alive and 11 died. The other types of comorbidities included malaria, prostate cancer, HIV, sickle cell anaemia, urethral syndrome, septicemia and septic shock. The multinomial logistic regression had a p value of 0.523 at 1 df with 95% CI of 0.721 – 1.902, therefore we accept the null hypothesis that there was no statistically significant relationship between the type of comorbidity status and survival status of a patient with AKI. Further analysis indicated that hypertension was the type of comorbidity that showed a no significant predictor for the survival of AKI patient with a p value of 0.085 at 1 df with 95% CI of 0.709 – 203.135. The relative risk of 12.00 indicated that AKI patient with the type of comorbidity was 12.00 times more likely to be die than be alive. Diabetes mellitus was not a significant predictor for the survival of AKI patient with a p value of 0.792 at 1 df with 95% CI of 0.157 – 11.356. The relative risk of 1.333 indicated that AKI patient with the type of morbidity was 1.333 times more likely to be die than be alive. Pre-eclampsia was not a significant predictor for the survival of AKI patient with a p value of 0.329 at 1 df with 95% CI of 0.437 – 11.851. The relative risk of 2.276 indicated that AKI patient with the type of morbidity was 2.276 times more likely to be die than be alive.

4.3.1.4 Relationship between treatment status and survival of AKI patients undergoing hemodialysis in the renal unit, Kakamega County

Results of this study showed that patients who were on treatment, 26 were alive and 4 died. Patients who were not on treatment, 25 were alive and 14 died. Binary logistic regression showed a p value of 0.041□ at 1 df with 95% CI of 1.054 – 12.571, therefore we accept the alternative hypothesis that there was statistically significant relationship between the treatment status and survival of a patient with AKI. These two variables treatment status and survival were dependent to each other. It was observed that those on treatment were more likely to be alive compared to those who were not on treatment at a relative risk of 3.640. The AKI patients on treatment were 3.640 times more likely to be alive compared to those who were not on treatment.

Since this study was able to establish a significant (p value < 0.05) relationship between treatment status and survival of AKI patients undergoing hemodialysis in the renal unit, Kakamega County, further analysis was carried out to investigate whether there was a significant association between age and treatment status and between gender and treatment.

To establish the association between age and treatment status, the Pearson Chi-square value was 0.29 at 1 df with a p value of 0.866, therefore we accept the null hypothesis that there was no statistically significant association between the age and treatment status of a patient with AKI. These two variables age and treatment status were independent to each other. It was observed that the risk of 18- 33 years of age being on treatment compared to those who had more than 33 years of age was 1.086 at a 95% CI 0.419 – 2.817. The 18- 33 years of age were 1.086 times more likely to be on treatment compared to those who had more than 33 years of age. The relative risk of being on treatment at 18- 33 years of age was 1.048 at 95% CI of 0.611 – 1.797 compared to those who had more than 33 years of age. The relative risk of not being on treatment at 18- 33 years of age was 0.965 at 95% CI of 0.638 – 1.459 compared to those who were more than 33 years of age.

To establish the association between gender and treatment status, the Pearson Chi-square value was 0.645 at 1 df with a p value of 0.422, therefore we accept the null hypothesis that there was no statistically significant association between the gender and treatment status of a patient with AKI. These two variables gender and treatment status were independent to each other. It was observed that the males were more likely to be on treatment compared to females at an relative risk of 1.479 at a 95% CI 0.568 – 3.85. The males were 1.479 times more likely to be on treatment compared to the females. The relative risk of being on treatment among the males was 1.247 at 95% CI of 0.727 – 2.139 compared to the female patients with AKI. The relative risk of males not being on treatment compared to female patients who had AKI was 0.843 at 95% CI 0.553 – 1.285.

The Kaplan Meier (KM) analysis was used in this study to establish which variable (prognostic) had an influence on survival.

4.3.1.5 Influence of comorbidity status on survival of AKI patients

This study was able to evaluate if comorbidity status has an influence on survival of AKI patients undergoing haemodialysis in the renal unit, Kakamega County.

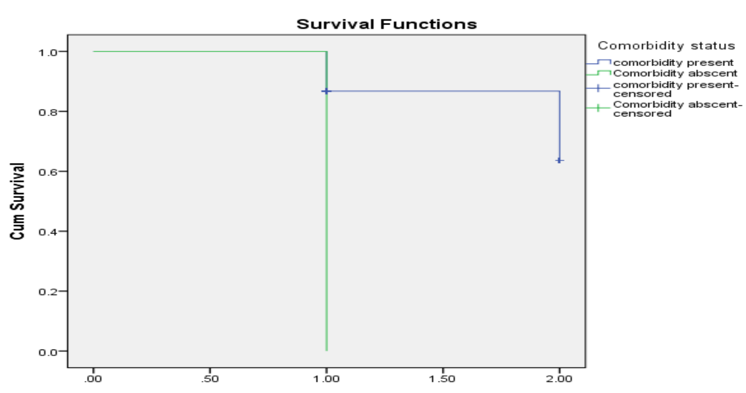

Figure 4.43: Test of equality of survival distribution for comorbidity status in AKI patients undergoing haemodialysis

Since the log rank test statistics had a p value 0.015 at df of 1 with a Chi-Square $\chi 2$ of 5.9.00, therefore, comorbidity status significantly influences survival in patients undergoing haemodialysis (Figure 4.43).

4.3.1.6 Influence of the type of comorbidity on survival of AKI patients

This study was able to evaluate if the type of comorbidity has an influence on survival of AKI patients undergoing haemodialysis in the renal unit, Kakamega County.

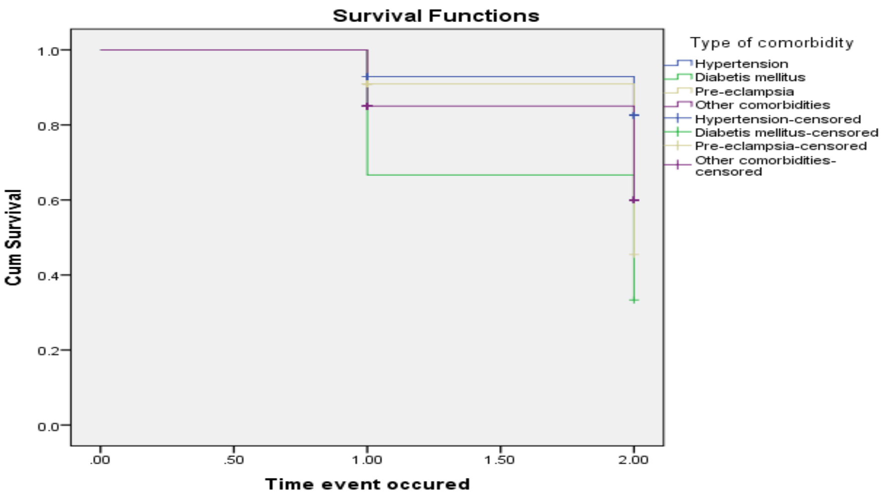

Figure 4.44: Test of equality of survival distribution for the types of comorbidity status in AKI Patients undergoing haemodialysis

Since the log rank test statistics had a p value 0.37 at df of 3 with a Chi-Square $\chi 2$ of 3.16, therefore, the types of comorbidity status do not significantly influence survival in patients undergoing haemodialysis (Figure 4.44).

4.3.1.7 Influence of the number of comorbidities on survival of AKI patients

This study was able to evaluate if the number of comorbidities has an influence on survival of AKI patients undergoing haemodialysis in the renal unit, Kakamega County.

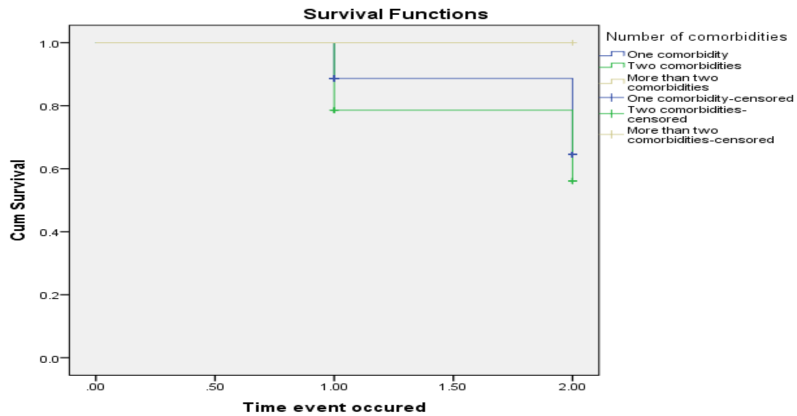

Figure 4.45: Test of equality of survival distribution for the number of comorbidity status in AKI Patients undergoing haemodialysis

Since the log rank test statistics had a p value 0.57 at df of 2 with a Chi-Square $\chi2$ of 1.11, therefore, the number of comorbidity status do not significantly influence survival/mortality in patients undergoing haemodialysis (Figure 4.45).

4.3.1.8 Influence of treatment status on survival of AKI patients

This study was able to evaluate if the treatment status has an influence on survival of AKI patients undergoing haemodialysis in the renal unit, Kakamega County.

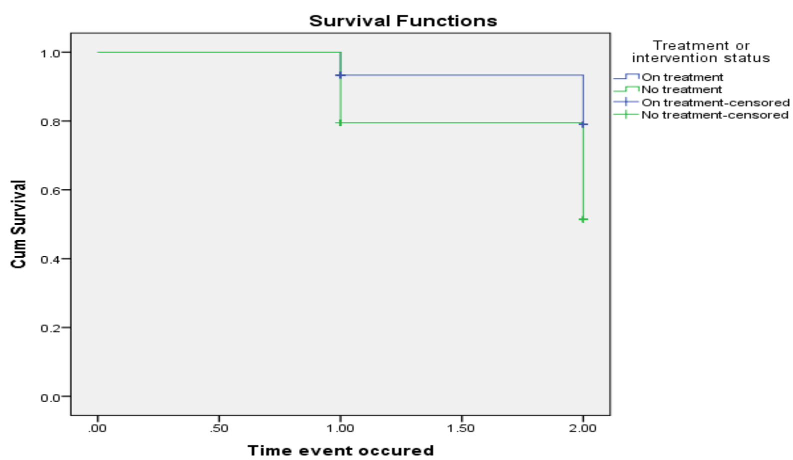

Figure 4.46: Test of equality of survival distribution for the treatment status in AKI patients undergoing haemodialysis

Since the log rank test statistics had a p value 0.045 at dfof 1 with a Chi-Square $\chi2$ of 4.017, therefore, the treatment status significantly influences survival/mortality in AKI patients undergoing haemodialysis (Figure 4.46).

4.3.1.9 Effect of gender on comorbidity status and survival of AKI patients

This study was able to evaluate if the comorbidity status was a predictor for survival in the gender of AKI patients undergoing haemodialysis in the renal unit, Kakamega County.

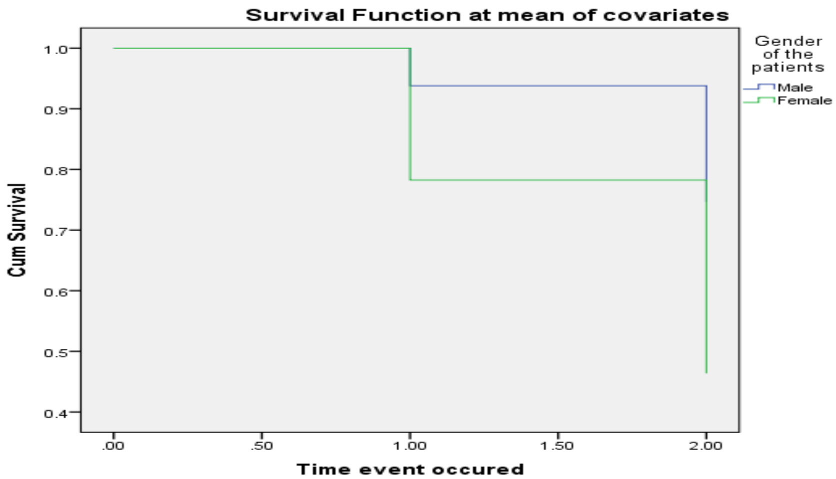

Figure 4.47: Cox-regression to test investigate if the comorbidities status is predictive for survival in the gender of AKI ppatients undergoing haemodialysis

The hazard ratio of 5.00 is > 1 and this is associated with poor survival, however, a p value of 0.132, was observed at 95% confidence interval (CI) of 0.615 – 40.64 therefore, the comorbidity status did not significantly predict for survival in the gender of AKI patients undergoing haemodialysis (Figure 4.47).

4.3.1.10 Effect of gender on type of comorbidity and survival of AKI patients

This present study was able to evaluate if the type of comorbidity was predictive for survival in the gender of AKI patients undergoing haemodialysis in the renal unit, Kakamega County.

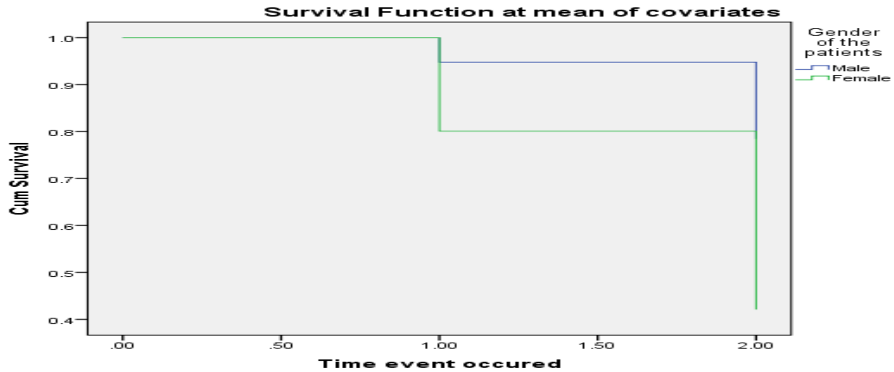

Figure 4.48: Cox-regression to test investigate if the type of comorbidity is predictive for survival in the gender of AKI patients undergoing haemodialysis

The hazard ratio of 3.99, 1.38 and 2.85 are > 1 and this is associated with poor survival, however, a p value of 0.167, 0.751 and 0.182 was observed at 95% confidence interval (CI) of 0.560 – 28.40, 0.186 – 10.307 and 0.613 – 13.22 respectively therefore, the type of comorbidity did not significantly predict for survival in the gender of AKI patients undergoing haemodialysis (Figure 4.48). There was a significant association between the gender and type of comorbidities at a p value of 0.004* at 3 df with a Pearson Chi-square value of 13.172. Pre-eclampsia was leading type of comorbidity at 31.4% (11) and a potential risk factor for acute kidney injury.

4.3.1.11 Effect of gender on the number of comorbidities and survival of AKI patients

This study was able to evaluate if the number of comorbidities was predictive for survival in the gender of AKI patients undergoing haemodialysis in the renal unit, Kakamega County.

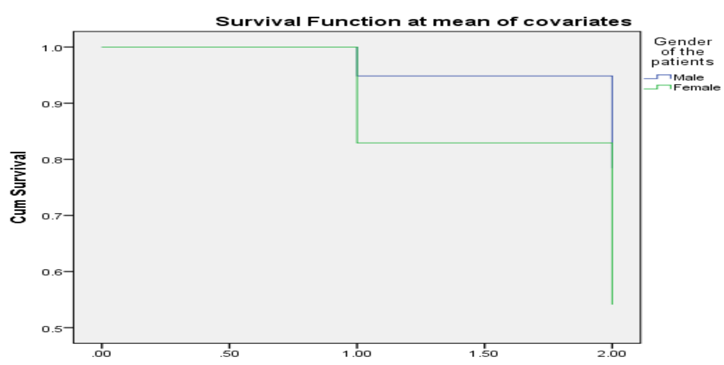

Figure 4.49: Cox-regression to test investigate if the number of comorbidities is predictive for survival in the gender of AKI patients undergoing haemodialysis

The hazard ratio of 1.51 is > 1 and this is associated with poor survival, however, a p value of 0.443, was observed at 95% confidence interval (CI) of 0.529 – 4.28 therefore, the number of comorbidities does not significantly predict for survival in the gender of AKI patients undergoing haemodialysis (Figure 4.49).

4.3.1.12 Effect of gender on treatment status and survival of AKI patients

This study was able to evaluate if the treatment status was predictive for survival in the gender of AKI patients undergoing haemodialysis in the renal unit, Kakamega County.

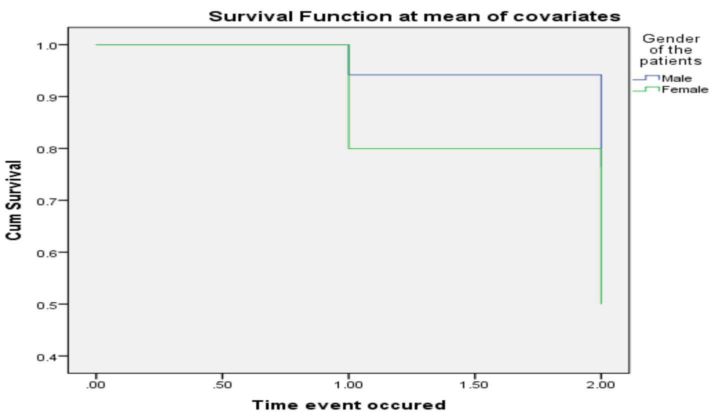

Figure 4.50: Cox-regression to test investigate if the treatment status is predictive for survival in the gender of AKI patients undergoing haemodialysis

The hazard ratio of 2.499 is > 1 and this is associated with poor survival, however, a p value of 0.107, was observed at 95% confidence interval (CI) of 0.821 – 7.61 therefore, the treatment status did not significantly predict for survival/mortality in the gender of AKI patients undergoing haemodialysis (Figure 4.50).

4.3.1.13 Effect of age on comorbidity status and survival of AKI patients

This current study was able to evaluate if the comorbidity status was predictive for survival in the age of AKI patients undergoing haemodialysis in the renal unit, Kakamega County.

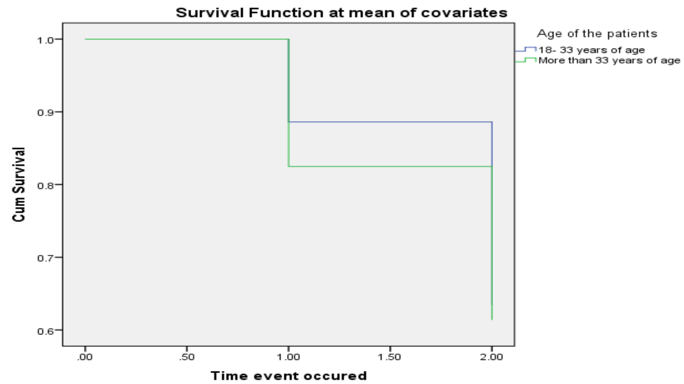

Figure 4.51: Cox-regression to test investigate if comorbidity status is predictive for survival in the age of AKI patients undergoing haemodialysis

The hazard ratio of 6.41 is > 1 and this is associated with poor survival, however, a p value of 0.09 was observed at 95% confidence interval (CI) of 0.749 – 54.8, therefore, the comorbidity status did not significantly predict for survival in the age of AKI patients undergoing haemodialysis (Figure 451).

4.3.1.14 Effect of age on type of comorbidity and survival of AKI patients

This study was able to evaluate if the type of comorbidity was predictive for survival in the age of AKI patients undergoing haemodialysis in the renal unit, Kakamega County.

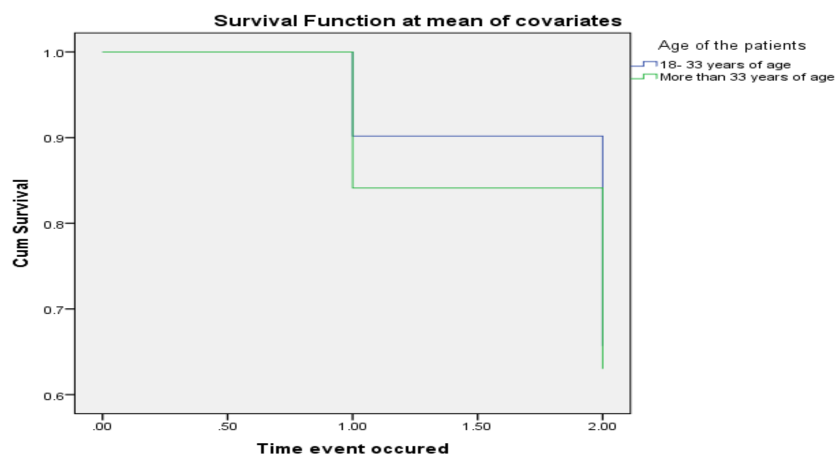

Figure 4.52: Cox-regression to test investigate if the type of comorbidity is predictive for survival in the age of AKI patients undergoing haemodialysis

The hazard ratio of 4.95, 2.26 and 2.55 are > 1 and this is associated with poor survival, however, a p value of 0.112, 0.424 and 0.229 was observed at 95% confidence interval (CI) of 0.690 – 35.60, 0.31 – 16.77 and 0.56 – 11.75 respectively therefore, the type of comorbidity did not significantly predict for survival in the age of AKI patients undergoing haemodialysis (Figure 4.52).

4.3.1.15 Effect of age on the number of comorbidity and survival of AKI patients

This present study was able to evaluate if the number of comorbidities was predictive for survival in the age of AKI patients undergoing haemodialysis in the renal unit, Kakamega County.

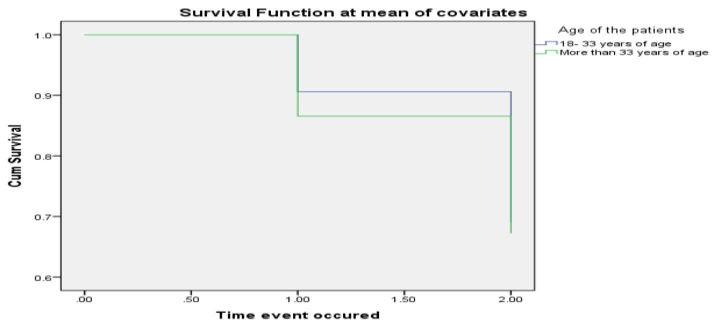

Figure 4.53: Cox-regression to test investigate if the number of comorbidities is predictive for survival in the age of AKI patients undergoing haemodialysis

The hazard ratio of 1.43 is > 1 and this is associated with poor survival, however, a p value of 0.50, was observed at 95% confidence interval (CI) of 0.50 – 4.07 therefore, the number of comorbidities did not significantly predict for survival in the age of AKI patients undergoing haemodialysis (Figure 4.53).

4.3.1.16 Effect of age on treatment status and survival of AKI patients

This study was able to evaluate if the treatment status was predictive for survival in the age of AKI patients undergoing haemodialysis in the renal unit, Kakamega County.

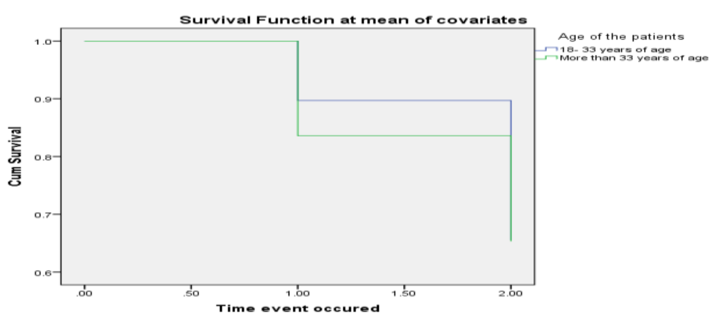

Figure 4.54: Cox-regression to test investigate if the treatment status is predictive for survival in the age of AKI patients undergoing haemodialysis

The hazard ratio of 2.72 is > 1 and this is associated with poor survival, however, a p value of 0.079, was observed at 95% confidence interval (CI) of 0.891 – 8.295 therefore, the treatment status did not significantly predict for survival/mortality in the age of AKI patients undergoing haemodialysis (Figure 4.54).

4.3.2 Prognostic factors as a survival indicator of CKD patients undergoing hemodialysis

In table 4.6, the study findings showed that majority 79.9% (139) of the patients with CKD had died even though they were undergoing dialysis. Comorbidity observed to be present in 98.9% (172) of the patients with CKD. Majority 46.5% (80) of the patients had hypertension. Approximately 58% (101) patients with CKD were not on any form of treatment or intervention that might have contributed to their survival.

Table 4.6: Prognostics characteristics of CKD patients undergoing hemodialysis (n = 174 patients)

Characteristics		frequency	percentage (%)
Survival status			
	Alive	35	20.1
	Died	139	79.9
Comorbidity status			
	Comorbidity present	172	98.9
	Comorbidity absent	2	1.1
Type of comorbidity			
	Hypertension (HTN)	80	46.5
	HTN & Diabetes mellitus	47	27.3
	Other comorbidities	45	26.2
Number of comorbidities			
	One comorbidity	93	54.1
	Two comorbidities	69	40.1
	> Two comorbidities	10	5.8
Treatment status			
	On treatment	73	42
	Not on treatment	101	58

4.3.2.1 Relationship between prognostic factors and survival of CKD patients undergoing hemodialysis

In this study, the prognostic indicators that were used for CKD patients were presence or absence of comorbidity, the type of comorbidity present, the number of comorbidities present and treatment status. In the treatment status, the study reviewed the records to ascertain whether these patients were on any medication to manage the comorbidity if present, and or manage the CKD.

Binomial logistic regression analysis was used to establish if there was any relationship between prognostic indicators (Comorbidity status, Treatment status, and Creatinine, Urea, Phosphates, Calcium, Sodium, Hb, Potassium and Chloride levels) and survival status of CKD patients. Whereas multinomial logistic regression was used to determine relationship between the types of comorbidities, number of comorbidities and survivals status of CKD patients.

4.3.2.2 Relationship between comorbidity status and survival of CKD patients undergoing hemodialysis

In this study, CKD patients who had comorbidity present, 35 were alive. Out of the 139 CKD patients who died, 137 had comorbidities present and two did not present with any form of comorbidity. A binary logistic regression showed a p value of 0.99 at 1 df with 95% confidence interval (CI) of 0.00 – 1, therefore accepting the null hypothesis that there was no statistically significant relationship between the comorbidity status and survival status of a patient with CKD. These two variables comorbidity status and survival were independent to each other.

4.3.2.3 Relationship between type of comorbidity and survival of CKD patients undergoing hemodialysis

Out of the 172 CKD patients who had comorbidity, the study was able to further review the type of comorbidity that these patients had. It was observed that for hypertension, 26 were alive and 54 died, those that had both hypertension and diabetes mellitus 6 were alive and 41 died, those that had other types of comorbidities 3 were alive and 42 died. The other types of comorbidities included malaria, prostate cancer, HIV, sickle cell anaemia, urethral syndrome, septicemia and septic shock. The multinomial logistic regression had a p value of 0.001* at 1 df with 95% CI of 1.23 – 2.362, therefore we accept the alternative hypothesis that there was statistically significant relationship between the type of comorbidity status and survival status of a patient with CKD. Further analysis indicated that hypertension was the type of comorbidity that showed a significant predictor for the survival of CKD patient with a p value of 0.017* at 1 df with 95% CI of 0.115 – 0.807. The relative risk of 1.704 indicated that a CKD patient with the type of comorbidity was 1.704 times more likely to be die than be alive.

4.3.2.4 Relationship between treatment status and survival of CKD patients undergoing hemodialysis

Results of this study showed that CKD patients who were on treatment, 23 were alive and 50 died. Chronic kidney disease patients who were not on treatment, 12 were alive and 89 died. Binary logistic regression showed a p value of 0.002 at 1 df with 95% CI of 1.565 – 7.436, therefore we accept the alternative hypothesis that there is statistically significant relationship between the treatment status and survival of a patient with CKD. These two variables treatment status and survival were dependent to each other. It was observed that those on treatment were more likely to be alive compared to those who were not on treatment at a relative risk of 3.412. The CKD patients on treatment were 3.412 times more likely to be alive compared to those who were not on treatment.

Since this study was able to establish a significant (p value < 0.05) relationship between treatment status and survival of CKD patients undergoing hemodialysis in the renal unit, Kakamega County, further analysis was carried out to investigate whether there was a significant association between age and treatment status and between gender and treatment.

To establish the association between age and treatment status, the Pearson Chi-square value was 0.523 at 1 df with a p value of 0.470, therefore we accept the null hypothesis that there was no statistically significant association between the age and treatment status of a patient with CKD. These two variables age and treatment status were independent to each other. It was observed that the risk of 18- 33 years of age being on treatment compared to those who had more than 33 years of age was 0.749 at a 95% CI 0.342 – 1.641. The 18- 33 years of age were 0.749 times more likely to be on treatment compared to those who had more than 33 years of age. The relative risk of being on treatment at 18- 33 years of age was 0.841 at 95% CI of 0.515 – 1.371 compared to those who had more than 33 years of age. The relative risk of not being on treatment at 18- 33 years of age was 1.122 at 95% CI of 0.835 – 1.507 compared to those who were more than 33 years of age.

To establish the association between gender and treatment status, the Pearson Chi-square value was 1.202 at 1 df with a p value of 0.273, therefore we accept the null hypothesis that there was no statistically significant association between the gender and treatment status of a patient with CKD. These two variables gender and treatment status were independent to each other. It was observed that the males were more likely to be on treatment compared to females at an relative risk of 0.712 at a 95% CI 0.388 – 1.308. The males were 0.712 times more likely to be on treatment compared to the females. The relative risk of being on treatment among the males was 0.823 at 95% CI of 0.581 – 1.164 compared to the female patients with CKD. The relative risk of males not being on treatment compared to female patients who had CKD was 1.155 at 95% CI 0.888 – 1.502.

The Kaplan Meier (KM) analysis is a non-parametric statistic used to calculate survival by estimating the survival function from time to event or lifetime data. It is used to measure the fraction of patients living for a certain amount of time after treatment or intervention has been administered. In this study, we had binary (two) events to measure the KM analysis which are alive and died. The log-rank test was used in the KM to calculate the p value. The Kaplan Meier (KM) analysis was used in this study to establish which confounder variable (prognostic) had an influence on survival.

4.3.2.5 Influence of comorbidity status on survival of CKD patients

This study was able to evaluate if comorbidity status had an influence on survival of CKD patients undergoing haemodialysis in the renal unit, Kakamega County.

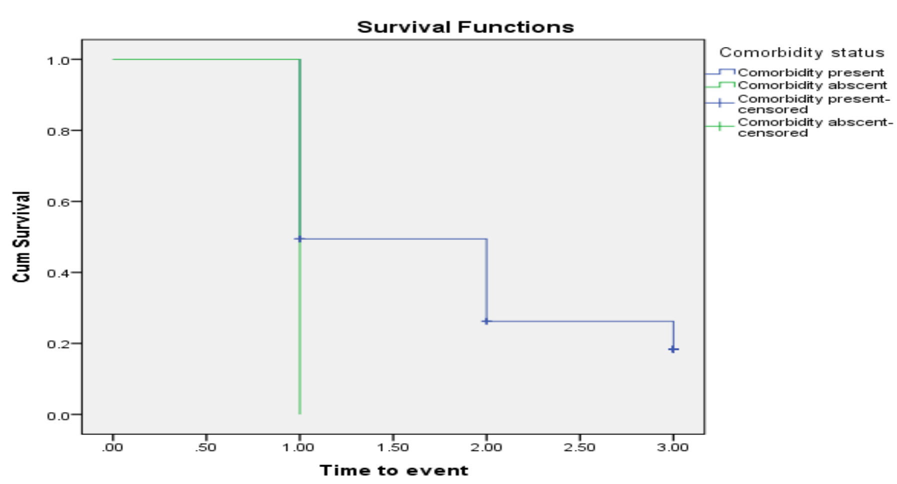

Figure 4.55: Test of equality of survival distribution for comorbidity status in CKD patients undergoing haemodialysis

Since the log rank test statistics had a p value 0.166 at df of 1 with a Chi-Square $\chi 2$ of 1.921, therefore, the difference in comorbidity status was not statistically significant to influence survival in CKD patients undergoing haemodialysis (Figure 4.55).

4.3.2.6 Influence of the type of comorbidity on survival of CKD patients

This study was able to evaluate if the type of comorbidity has an influence on survival of CKD patients undergoing haemodialysis in the renal unit, Kakamega County.

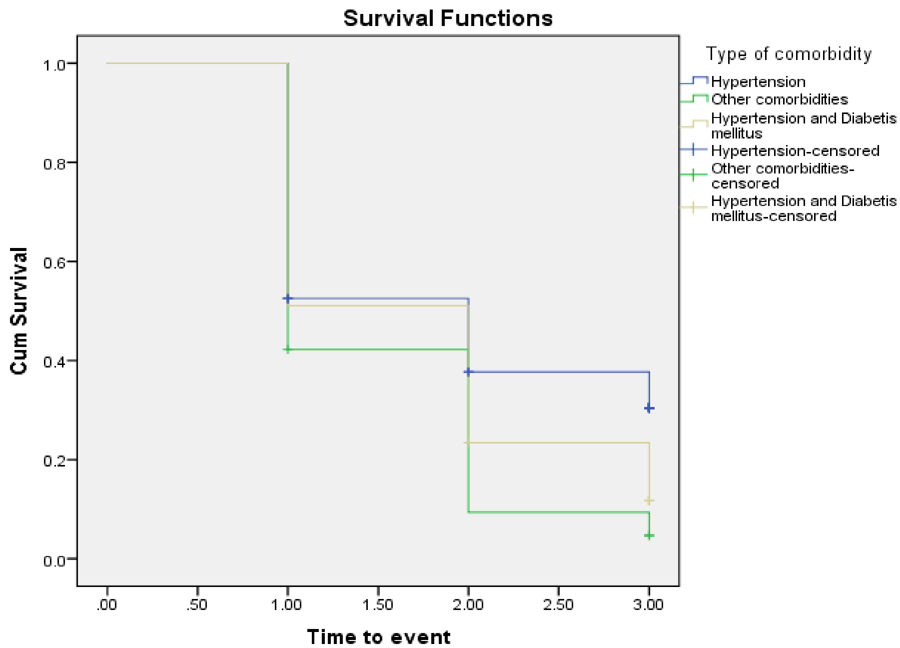

Figure 4.56: Test of equality of survival distribution for the types of comorbidities status in CKD patients undergoing haemodialysis

Since the log rank test statistics had a p value 0.005* at df of 2 with a Chi-Square $\chi 2$ of 10.576, therefore, the difference in types of comorbidities was statistically significant to influence survival in CKD patients undergoing haemodialysis (Figure 4.56).

4.3.2.7 Influence of the number of comorbidities on survival of CKD patients

This study was able to evaluate if the number of comorbidities has an influence on survival of CKD patients undergoing haemodialysis in the renal unit, Kakamega County.

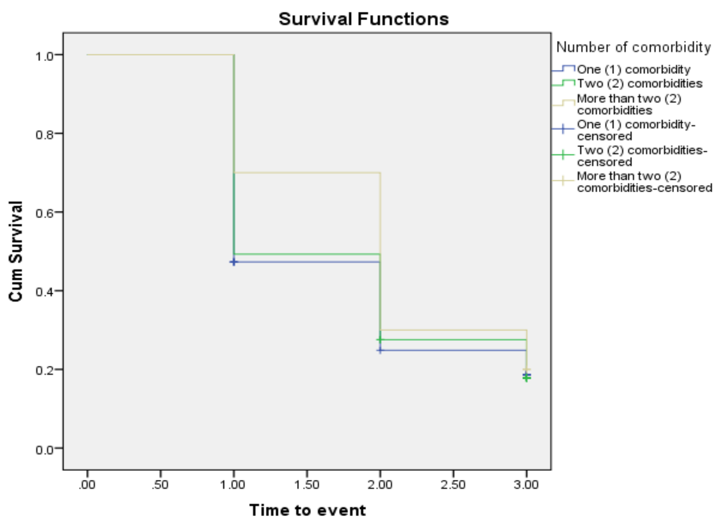

Figure 4.57: Test of equality of survival distribution for the number of comorbidity status in CKD patients undergoing haemodialysis

Since the log rank test statistics had a p value 0.839 at df of 2 with a Chi-Square $\chi 2$ of 0.352, therefore, the difference in the number of comorbidities was not statistically significant to influence survival in CKD patients undergoing haemodialysis (Figure 4.57).

4.3.2.8 Influence of treatment status on survival of CKD patients

This study was able to evaluate if the treatment status has an influence on survival of CKD patients undergoing haemodialysis in the renal unit, Kakamega County.

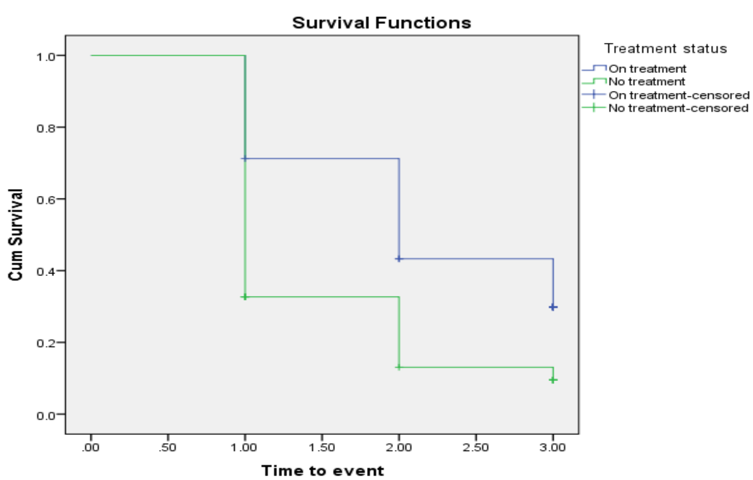

Figure 4.58: Test of equality of survival distribution for the treatment status in CKD patients undergoing haemodialysis

Since the log rank test statistics had a p value <0.0001* at df of 1 with a Chi-Square $\chi 2$ of 23.270, therefore, the difference in treatment status was statistically significant to influence survival in CKD patients undergoing haemodialysis (Figure 4.58).

The downside of Kaplan Meier analysis is that it does not give point estimate like hazard ratio, it is not possible to adjust for other confounders and therefore other forms of analysis are essential to supplement the KM and the other forms of analysis mostly used is the Cox-regression. The Cox-regression analysis is a semi-parametric analysis that was used to investigate the effect of independent variable (age and gender) on confounder variable and survival of CKD patients. The hazard ratio of > 1 is associated with poor ratio/poor hazard/poor survival. On the other hand, a hazard ratio of < 1 is associated with good ratio/good hazard/good survival. The hazard ratio, the p value and 95% confidence intervals were used to interpret the Cox-regression analysis by reporting the variable in the equation table found in the SPSS output.

4.3.2.9 Effect of age on comorbidity status and survival of CKD patients

This current study was able to evaluate if the comorbidity status was predictive for survival in the age of CKD patients undergoing haemodialysis in the renal unit, Kakamega County.

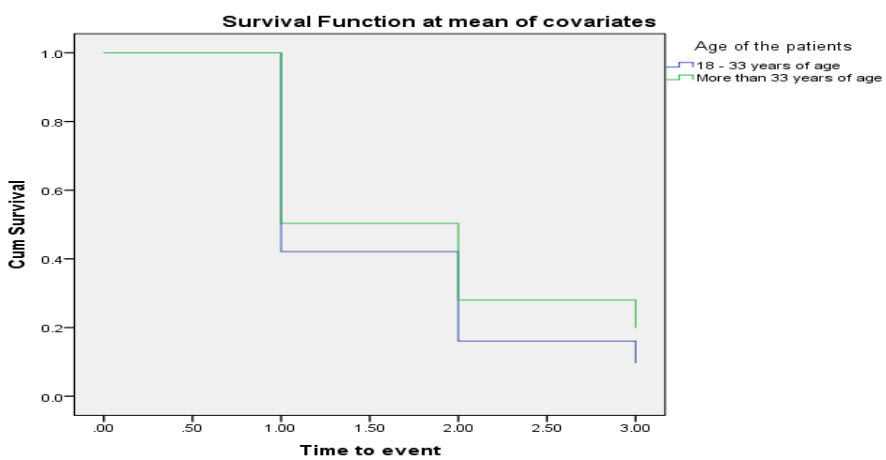

Figure 4.59: Cox-regression to test investigate if comorbidity status is predictive for survival in the age of CKD patients undergoing haemodialysis

The hazard ratio of 0.489 is < 1 and this is associated with good survival, however, a p value of 0.318 was observed at 95% confidence interval (CI) of 0.120 – 1.993, therefore, the comorbidity status did not significantly predict for survival in the two categories of age groups in CKD patients undergoing haemodialysis (Figure 4.59).

4.3.2.10 Effect of age on type of comorbidity and survival of AKI patients

This study was able to evaluate if the type of comorbidity was predictive for survival in the age of CKD patients undergoing haemodialysis in the renal unit, Kakamega County.

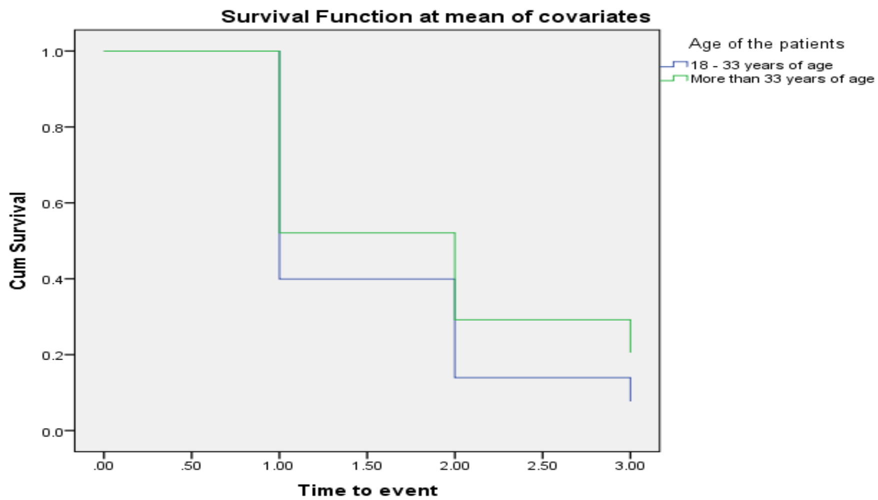

Figure 4.60: Cox-regression to test investigate if the type of comorbidity is predictive for survival in the age of CKD patients undergoing haemodialysis

The hazard ratio of 1.149 is > 1 and this is associated with poor survival, however, a p value of 0.039* was observed at 95% confidence interval (CI) of 1.007 – 35.60, therefore, the type of comorbidity significantly predicts for survival in the two categories of age groups in CKD patients undergoing haemodialysis (Figure 4.60). Multinomial logistic regression was tested, and the results showed that other types of comorbidities had a significant influence in predicting survival in age of CKD patients undergoing haemodialysis at a p value 0.007* at 1 df with a 95% CI of 1.467 – 10.824 and the relative risk was 3.985. Hypertension had a p value 0.118 at 1 df with a 95% CI of 0.787 – 8.299 and the relative risk was 2.556, whereas duo-comorbidity of hypertension and diabetes mellitus p value 0.505 at 1 df with a 95% CI of 0.140 – 2.635 and the relative risk was 0.607.

4.3.2.11 Effect of age on the number of comorbidity and survival of CKD patients

This present study was able to evaluate if the number of comorbidities was predictive for survival in the age of CKD patients undergoing haemodialysis in the renal unit, Kakamega County.

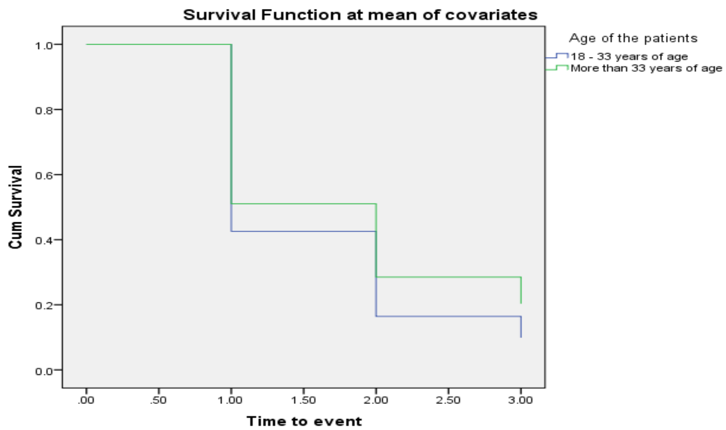

Figure 4.61: Cox-regression to test investigate if the number of comorbidities is predictive for survival in the age of CKD patients undergoing haemodialysis

The hazard ratio of 0.986 is < 1 and this is associated with good survival, however, a p value of 0.9200, was observed at 95% confidence interval (CI) of 0.744 – 1.306 therefore, the number of comorbidities did not significantly predict for survival in the two categories of age groups in CKD patients undergoing haemodialysis (Figure 4.61).

4.3.2.12 Effect of age on treatment status and survival of CKD patients

This study was able to evaluate if the treatment status was predictive for survival in the age of CKD patients undergoing haemodialysis in the renal unit, Kakamega County.

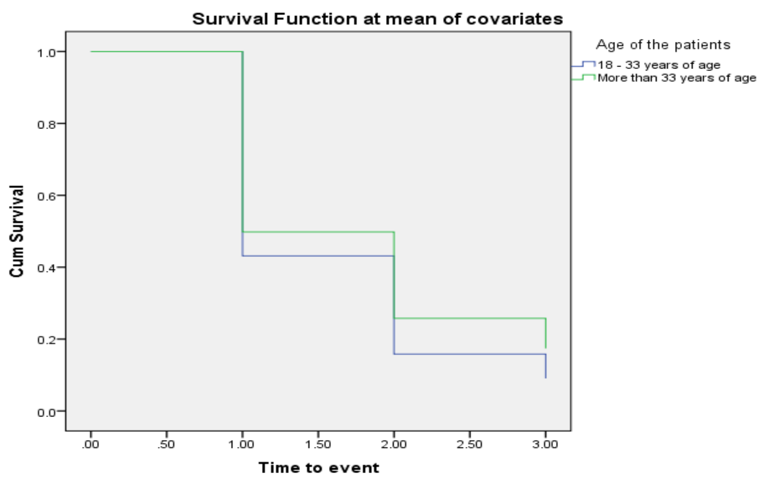

Figure 4.62: Cox-regression to test investigate if the treatment status is predictive for survival in the age of CKD patients undergoing haemodialysis

The hazard ratio of 0.542 is < 1 and this is associated with good survival, however, a p value of 0.001* was observed at 95% confidence interval (CI) of 0.379 – 0.774, therefore, the treatment status significantly predicts for survival in the two categories of age groups in CKD patients undergoing haemodialysis (Figure 4.62).

4.3.2.13 Effect of age on creatinine level and survival of CKD patients

This current study was able to evaluate if the creatinine was predictive for survival in the age of CKD patients undergoing haemodialysis in the renal unit, Kakamega County.

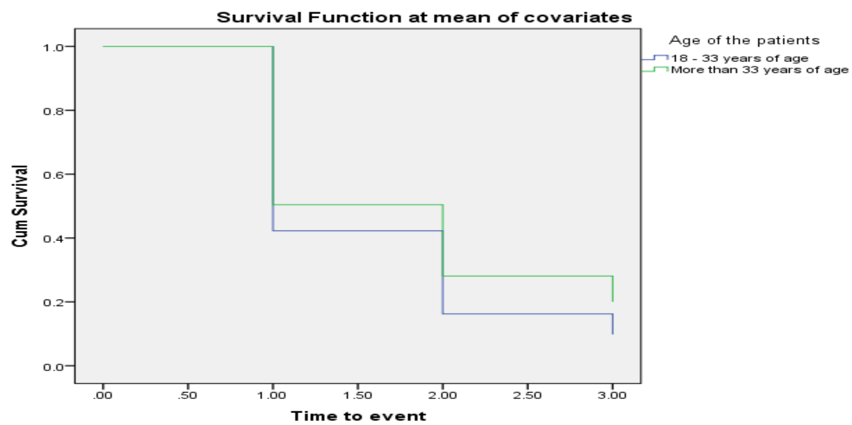

Figure 4.63: Cox-regression to test investigate if the creatinine level is predictive for survival in the age of CKD patients undergoing haemodialysis

The hazard ratio of 0.768 is < 1 and this is associated with good survival, however, a p value of 0.564, was observed at 95% confidence interval (CI) of 0.314 – 1.880 therefore, the creatinine level did not significantly predict for survival in the two categories of age groups in CKD patients undergoing haemodialysis (Figure 4.63).

4.3.2.14 Effect of age on urea level and survival of CKD patients

This current study was able to evaluate if the urea level was predictive for survival in the age of CKD patients undergoing haemodialysis in the renal unit, Kakamega County.

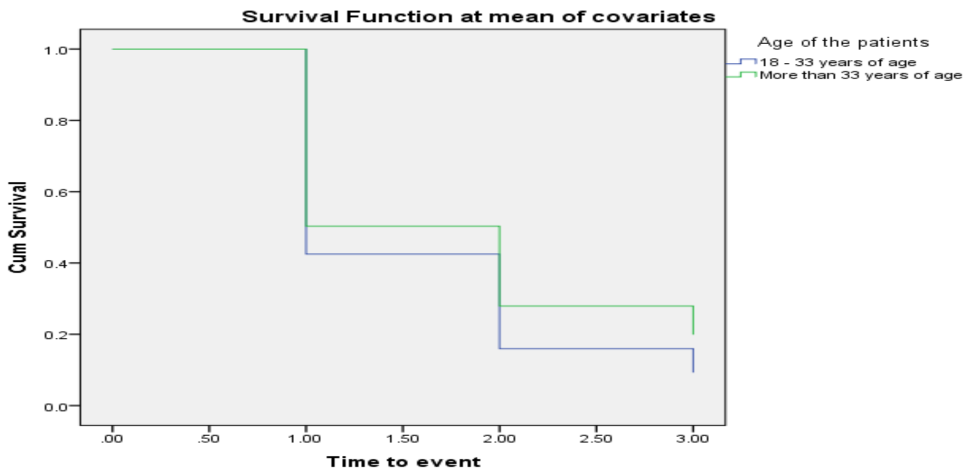

Figure 4.64: Cox-regression to test investigate if the urea level is predictive for survival in the age of CKD patients undergoing haemodialysis

The hazard ratio of 0.7697 is < 1 and this is associated with good survival, however, a p value of 0.390, was observed at 95% confidence interval (CI) of 0.307 – 1.586 therefore, the urea level did not significantly predict for survival in the two categories of age groups in CKD patients undergoing haemodialysis (Figure 4.64).

4.3.2.15 Effect of age on phosphate level and survival of AKI patients

This study was able to evaluate if the phosphate level was predictive for survival in the age of CKD patients undergoing haemodialysis in the renal unit, Kakamega County.

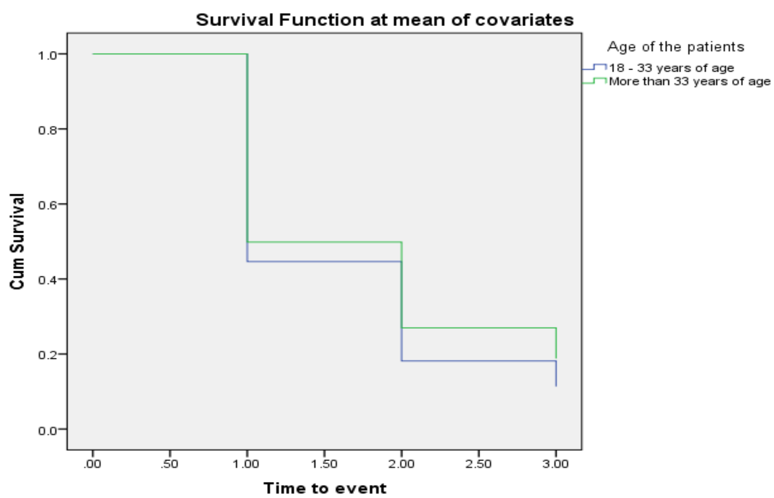

Figure 4.65: Cox-regression to test investigate if the phosphate level is predictive for survival in the age of CKD patients undergoing haemodialysis

The hazard ratio of 0.580 is < 1 and this is associated with good survival, however, a p value of 0.044* was observed at 95% confidence interval (CI) of 0.342 – 0.986, therefore, the phosphate levels significantly predict for survival in the two categories of age groups in CKD patients undergoing haemodialysis (Figure 4.65).

4.3.2.16 Effect of age on calcium level and survival of CKD patients

This present study was able to evaluate if the calcium level was predictive for survival in the age of CKD patients undergoing haemodialysis in the renal unit, Kakamega County.

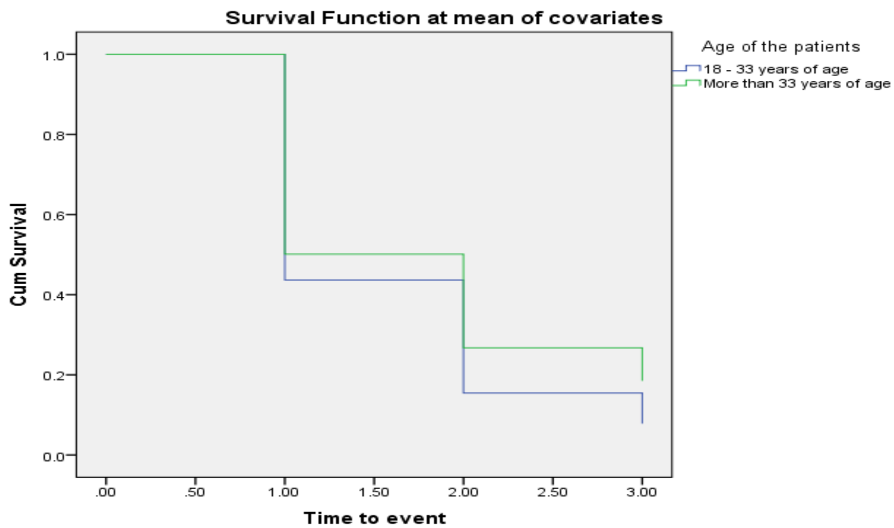

Figure 4.66: Cox-regression to test investigate if the calcium level is predictive for survival in the age of CKD patients undergoing haemodialysis

The hazard ratio of 0.534 is < 1 and this is associated with good survival, however, a p value of 0.003* was observed at 95% confidence interval (CI) of 0.354 – 0.805, therefore, the calcium levels significantly predict for survival in the two categories of age groups in CKD patients undergoing haemodialysis (Figure 4.66).

4.3.2.17 Effect of age on sodium level and survival of CKD patients

This current study was able to evaluate if the sodium level was predictive for survival in the age of CKD patients undergoing haemodialysis in the renal unit, Kakamega County.

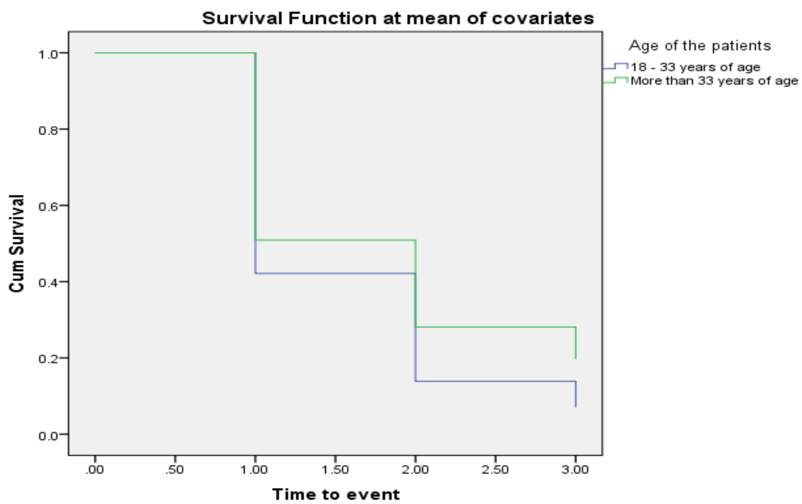

Figure 4.67: Cox-regression to test investigate if the sodium level is predictive for survival in the age of CKD patients undergoing haemodialysis

The hazard ratio of 0.483 is < 1 and this is associated with good survival, however, a p value of 0.011* was observed at 95% confidence interval (CI) of 0.276 – 0.846, therefore, the sodium levels significantly predict for survival in the two categories of age groups in CKD patients undergoing haemodialysis (Figure 4.67).

4.3.2.18 Effect of age on haemoglobin level and survival of CKD patients

This current study was able to evaluate if the haemoglobin level was predictive for survival in the age of CKD patients undergoing haemodialysis in the renal unit, Kakamega County.

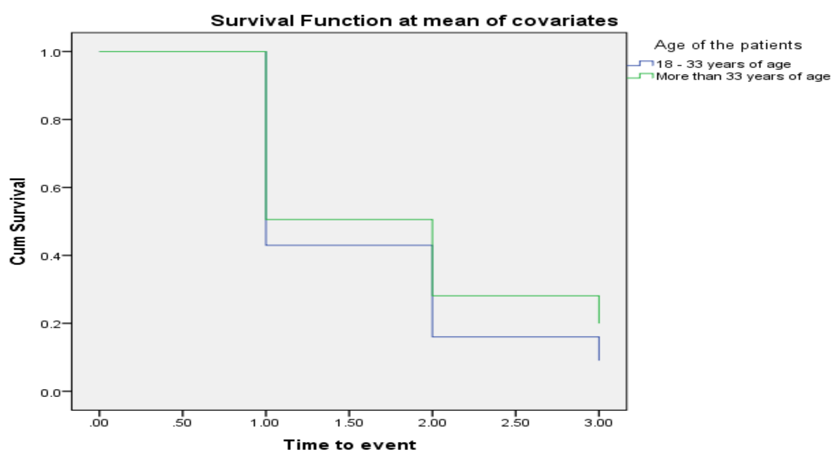

Figure 4.68: Cox-regression to test investigate if the haemoglobin level is predictive for survival in the age of CKD patients undergoing haemodialysis

The hazard ratio of 2.245 is >1 and this is associated with poor survival, however, a p value of 0.112 was observed at 95% confidence interval (CI) of 0.829 – 6.081, therefore, the haemoglobin levels did not significantly predict for survival in the two categories of age groups in CKD patients undergoing haemodialysis (Figure 4.68).

4.3.2.19 Effect of age on potassium level and survival of CKD patients

This study was able to evaluate if the potassium level was predictive for survival in the age of CKD patients undergoing haemodialysis in the renal unit, Kakamega County.

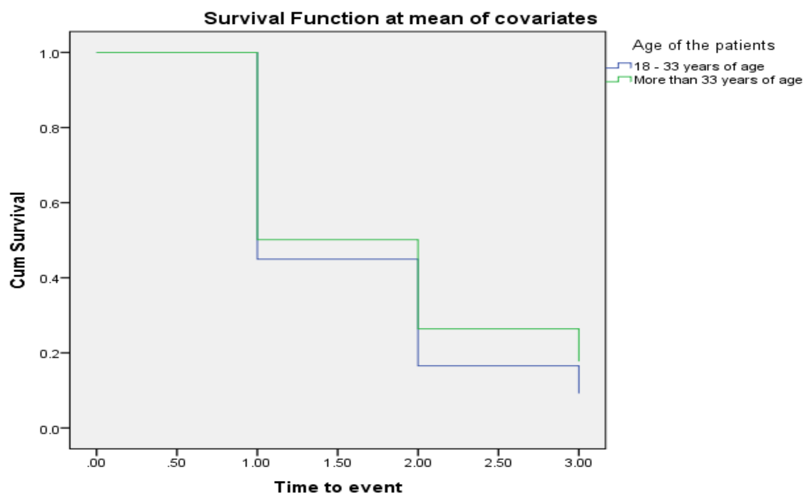

Figure 4.69: Cox-regression to test investigate if the potassium level is predictive for survival in the age of CKD patients undergoing haemodialysis

The hazard ratio of 0.513 is < 1 and this is associated with good survival, however, a p value of 0.001* was observed at 95% confidence interval (CI) of 0.276 – 0.846, therefore, the potassium levels significantly predict for survival in the two categories of age groups in CKD patients undergoing haemodialysis (Figure 4.69).

4.3.2.20 Effect of age on chloride level and survival of CKD patients

This present study was able to evaluate if the chloride level was predictive for survival in the age of CKD patients undergoing haemodialysis in the renal unit, Kakamega County.

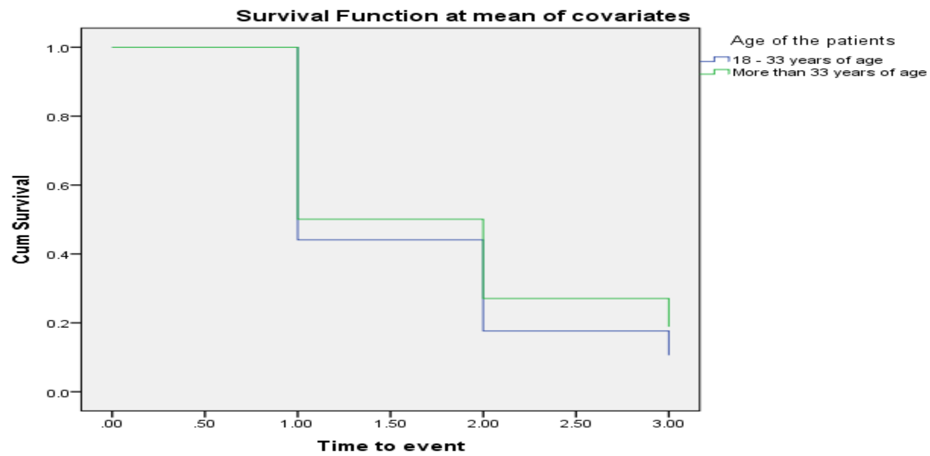

Figure 4.70: Cox-regression to test investigate if the chloride level is predictive for survival in the age of CKD patients undergoing haemodialysis

The hazard ratio of 0.592 is < 1 and this is associated with good survival, however, a p value of 0.021* was observed at 95% confidence interval (CI) of 0.379 – 0.923, therefore, the chloride levels significantly predict for survival in the two categories of age groups in CKD patients undergoing haemodialysis (Figure 4.70).

4.3.2.21 Effect of gender on comorbidity status and survival of CKD patients

This current study was able to evaluate if the comorbidity status was predictive for survival in the gender of CKD patients undergoing haemodialysis in the renal unit, Kakamega County.

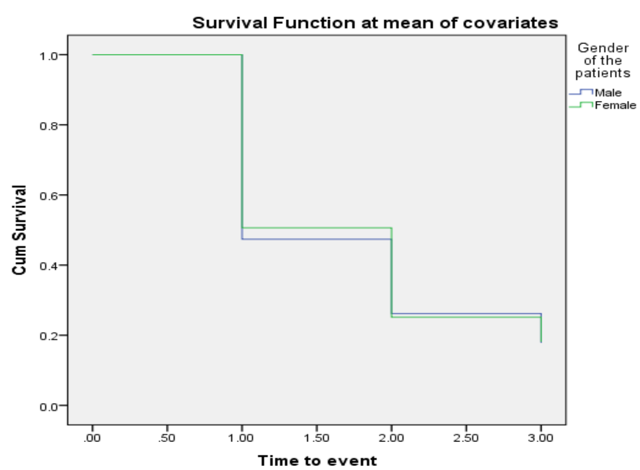

Figure 4.71: Cox-regression to test investigate if the comorbidities status is predictive for survival in the gender of CKD patients undergoing haemodialysis

The hazard ratio of 0.503 is < 1 and this is associated with good survival, however, a p value of 0.337, was observed at 95% confidence interval (CI) of 0.124 – 2.044 therefore, the comorbidity status did not significantly predict for survival in the gender among CKD patients undergoing haemodialysis (Figure 4.71).

4.3.2.22 Effect of gender on type of comorbidity and survival of CKD patients

This present study was able to evaluate if the type of comorbidity was predictive for survival in the gender of CKD patients undergoing haemodialysis in the renal unit, Kakamega County.

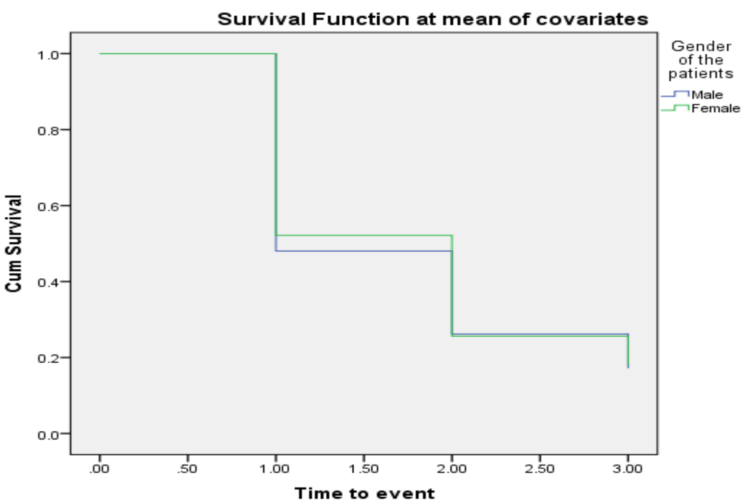

Figure 4.72: Cox-regression to test investigate if the type of comorbidity is predictive for survival in the gender of CKD patients undergoing haemodialysis

The two major types of commodities recorded in this study included hypertension and diabetes mellitus. For hypertension, the hazard ratio of 1.614 which was > 1 and this was associated with poor survival, however, a p value of 0.021* at 95% confidence interval (CI) of 1.074 – 2.426 therefore, the hypertension was considered statistically significant predictor for survival in the gender of CKD patients undergoing haemodialysis (Figure 4.72). On the other hand, diabetes mellitus, the hazard ratio of 1.326 which was > 1 and this was associated with poor survival, however, a p value of 0.175 at 95% confidence interval (CI) of 0.882 – 1.995 therefore, the diabetes mellitus was not statistically significant predictor for survival in the gender among CKD patients undergoing haemodialysis.

4.3.2.23 Effect of gender on the number of comorbidities and survival of CKD patients

This study was able to evaluate if the number of comorbidities was predictive for survival in the gender of CKD patients undergoing haemodialysis in the renal unit, Kakamega County.

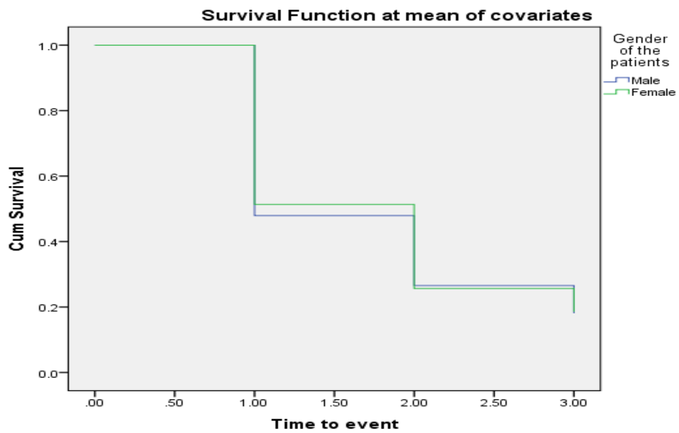

Figure 4.73: Cox-regression to test investigate if the number of comorbidities is predictive for survival in the gender of CKD patients undergoing haemodialysis

The hazard ratio of 0.952 is < 1 and this is associated with good survival, however, a p value of 0.728, was observed at 95% confidence interval (CI) of 0.724 – 1.253 therefore, the number of comorbidities does not significantly predict survival in the gender among CKD patients undergoing haemodialysis (Figure 4.73).

4.3.2.24 Effect of gender on treatment status and survival of CKD patients

This study was able to evaluate if the treatment status was predictive for survival in the gender of CKD patients undergoing haemodialysis in the renal unit, Kakamega County.

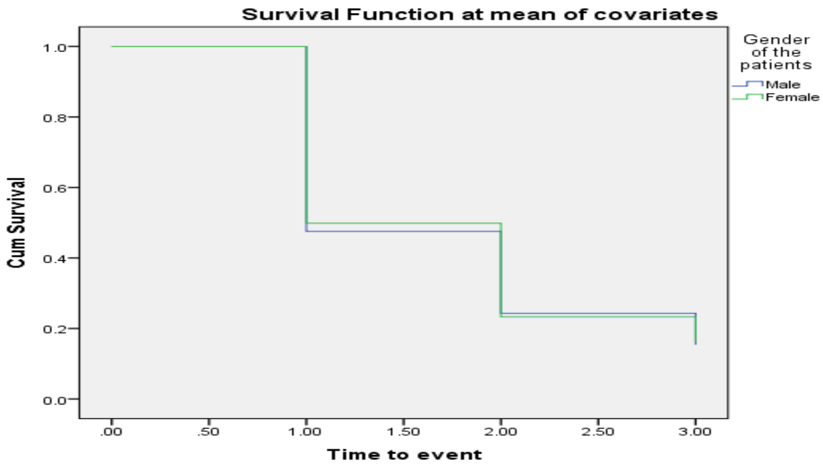

Figure 4.74: Cox-regression to test investigate if the treatment status is predictive for survival in the gender of CKD patients undergoing haemodialysis

The hazard ratio of 1.867 is > 1 and this is associated with poor survival, however, a p value of 0.001*, was observed at 95% confidence interval (CI) of 1.306 – 2.668 therefore, the treatment status significantly predict survival in the gender among CKD patients undergoing haemodialysis (Figure 4.74).

CHAPTER FIVE

DISCUSSION

5.1 Discussion

This chapter discusses the results of this current study on AKI and CKD, compares with related studies, and explain the likely reasons for the current study findings. In this section, focus was on acute kidney injury and chronic kidney disease patients undergoing hemodialysis where summary of the key findings and interpretation was discussed in a clear and concise manner, comparing, and contrasting to previous studies, highlighting the strength and limitations of this current study, discuss any unexpected findings, rejecting or accepting the hypotheses and providing a take-away statement.

5.1.1 Demographic characteristics influencing the survival of AKI patients undergoing hemodialysis

Acute kidney injury is worldwide problem associated with in-patient mortality (Hansrivijit *et al.*, 2021). According to Asmus *et al.*, (2021), acute kidney injury has no treatment measures that can speed up the repair or recovery of the kidneys once an acute damage has evolved. In Africa, the disease burden of acute kidney injury remains high (Yousif *et al.*, 2018), and this has been marked with challenges in diagnosis and treatment due to scarce medical resources (Feehally, 2016). In the year 2014, ‘‘global snapshot’’ on the epidemiology of AKI showed that it is incompletely understood in developed countries whereas, most cases were reported in low and lower middle-income countries (Feehally, 2016). In this present study, a hospital-based retrospective cohort, targeting adult AKI patients who were undergoing hemodialysis in the renal unit in Kakamega County were studied. In this study, sixty-nine (69) AKI patients were reviewed over a period of five (5) years from January 2015 to December 2021. The findings showed that majority 52.2% (36) of the patients with acute kidney injury were of age group 18 to 33 years. The results of this study further indicated that there was not statistically significant (p value 0.830) relationship between age and survival of AKI patients. Other studies (Asmus *et al.*, 2021; Chavez-Iniguez *et al.*, 2021; Brothers *et al.*, 2022), have also demonstrated that there is no statistically significant relationship between age and survival status of patient diagnosed with AKI. Arising from the results of this study, the null hypothesis that age is not statistically significant predictor of survival for AKI patient is accepted. Furthermore, this study was not able to establish why mortality rate was higher in age group over 33 years. There is need to establish why elevated cases of AKI was witnessed in age group over 33 years. However, due to high mortality rate and poor outcomes associated with AKI, there is need for continued vigilant monitoring of these patients to reduce the risk of mortality. The most likely explanation is that even though the kidney disease can develop at any age, advancement in age and confoundering factors such as comorbidities are a potential risk factor to develop renal disease.

In developed countries the onset of AKI is mostly witnessed in older populations, and this contrasts the observations made in sub-Saharan Africa where preponderance is observed among younger age groups (Adu *et al.*, 2016; Dlamini *et al.*, 2017; Fenna., Erasmus., & Zemlin, 2019). A study by Kahindo *et al.,* (2022), reported that the incidence of acute kidney injury is often witnessed among ageing populations who use treatment methods that pose a risk of damaging the kidneys. It is worth noting that AKI often causes an abrupt decrease in kidney function. It is however reversible when detected and treated promptly (Koza, 2016).

Findings of this study reported that there was no statistically significant (P value 0.157) relationship between gender and survival of AKI patients who were undergoing haemodialysis in Kakamega County. It was however observed that more females 52.2% (36) compared to males 47.8% (33) with acute kidney injury were dialyzed in the period 2015 to 2021. Furthermore, there was a statistically significant (p value 0.004) association between gender and types of comorbidities. Out of the 52.2% (36) females who had acute kidney injury, 31.4% (11) had pre-eclampsia which might have been the potential risk factor for acute kidney injury. In a study conducted in Blantyre, Malawi, Cooke *et al.*, (2018) also observed that 73.1% of females who were diagnosed to have acute kidney injury presented with pre-eclampsia/eclampsia as the leading comorbidity. Other studies (Bentata *et al.,* 2012; Ayansina *et al.,* 2016; Prakash, & Ganiger, 2017; Bokhari *et al.,* 2018; Conti-Ramsden *et al.,* 2019; Novotny *et al.,* 2020; Cavin, Roberts, & Jim, 2021; Sharma *et al.,* 2021; Shemies *et al.,* 2022) have also reported that a major contributor to acute kidney injury in low resource settings which also causes mortality and morbidity is obstetric conditions known as pre-eclampsia/eclampsia.

In consistence with the results of this current study, other studies (Aylward *et al.,* 2019; Chavez-Iniguez *et al.,* 2021; Asmus *et al.,* 2021; Brothers *et al.,* 2022) have also reported that gender was not a predictor of mortality among patients with acute kidney injury. Observation made by other studies (Olowu *et al.,* 2016; Yousif *et al.,* 2018; Aylward *et al.,* 2019; Kahindo *et al.,* 2022) in

Africa, have reported the male gender to be a risk for acute kidney injury and in these studies preponderance among males was attributed to the fact that their female counterparts had poor access to healthcare thus were less recorded. The results from this study accept the null hypothesis that gender was not statistically significant predictor of survival for AKI patient, however, there is need to be observant on obstetric-related acute kidney injury due to pre-eclampsia/eclampsia.

5.1.2 Demographic characteristics influencing the survival of CKD patients undergoing hemodialysis

In the year 2019, Chen, Knicely, & Grams observed that CKD was the 16th disease causing mortality globally. Kovesdy in the year 2022, reported that chronic kidney disease affects more than 10% of the general population globally amounting to more than 800 million people. Kovesdy, (2022) further observed that CKD had emerged as one of the leading causes of mortality globally in low- and middle-income countries and was prevalent in older women who presented with other comorbidities like diabetes mellitus and hypertension. Chronic kidney disease causes renal dysfunction and over time the condition progresses to an end-stage kidney disease and cardiovascular disease later manifest (Evans *et al.*, 2021).

The prevalence of CKD has been on the rise, and this has been attributed to the demographic such as population growth and age (Lin, *et al.*, 2014). In China, a study conducted by Lin *et al.*, (2022), observed that more male (53%) than females (47%) had CKD (Lin *et al*., 2022). In this study, majority 81% (141) of the patients with chronic kidney disease were of age group more than 33 years. On further analysis, it was observed that there wasn't statistically significant (p value 0.211) relationship between age and survival of CKD patients. In the year 2019, Mwenda *et al.,* in Kenya observed that out of 306 CKD patients in the renal clinic attending Kenyatta National hospital, their median age was 40 years. Otieno *et al.*, (2020) on the other hand observed that among the 385 CKD patients in Kenyatta National hospital, the mean age was 63.3 years, males had mean age of 65.7 whereas females were 62.1. Even though both studies on CKD that were conducted in Kenya, by Mwenda *et al.*, (2019) and Otieno *et al.,* (2020) were not studying influence of age on survival status, what came out clear was consistent with this current study finding in Kakamega was that CKD was more prevalent in patients above the age of 40.

Findings of this study showed that the gender distribution of the patients with chronic kidney disease reported more males 56.9% (99) were dialyzed in the period 2015 to 2021. On further analysis, it was observed that there wasn't statistically significant (p value 0.974) relationship between gender and survival of CKD patients. The global perspective of CKD burden shows that the disease prevalence is 8.6% and 9.6% in men and women respectively in high-income countries and 10.6% and 12.5% in men and women respectively in low-income countries (Mills *et al.,* 2015; Hill *et al.*, 2016). In China, Lin *et al.*, (2022), the mean age of patients with CKD was 59 years (Lin *et al*., 2022).

In a study conducted by Kabinga *et al.,* (2019), on CKD patients in Nairobi, it was observed that more (76.9%) females than males were registered at renal clinic. In the year 2019, Mwenda *et al.,* in Kenya observed that out of 306 CKD patients in the renal clinic attending Kenyatta National hospital, 52.9% (162) were males. Otieno *et al.,* (2020) on the other hand observed that among the 385 CKD patients in Kenyatta National hospital, 65.5% (252) were females. Even though both studies on CKD that were conducted in Kenya, by Mwenda *et al.*, (2019) and Otieno *et al.,* (2020) were not studying influence of gender on survival status but what came out clear that was consistent with this current study finding in Kakamega was that CKD was more prevalent in male patients. This study findings therefore accept the null hypothesis that demographic characteristics do not significantly influence survival of CKD patients undergoing heamodialysis in Kakamega County hospital.

5.2 Renal biochemical parameters as survival predictors of AKI patients undergoing hemodialysis

According to Perazella, (2015), there is need to collect blood and urine sample to test for serum creatinine, albumin, electrolytes, and blood cell counts to guide in the diagnostics of acute kidney injury. In this current study, the following predictor factors, creatinine, urea, phosphate, calcium, haemoglobin, sodium, and chloride levels were not statistically significant to determine the survival of acute kidney injury patient undergoing hemodialysis. However, it was observed that potassium level was statistically significant (0.017) to determine the survival of acute kidney injury patient undergoing hemodialysis in Kakamega County. Further statistical analysis indicated that potassium level was predictive for survival in the ages between 18 -33 years of AKI patients undergoing haemodialysis at a p value of 0.038. Kellum *et al.,* (2012) points out that acute kidney injury is diagnosed by an absolute elevated serum creatinine levels of more than 25% from the baseline within seven days and by a urine output volume of less than 0.5mL/Kg/h for at least six hours.

The significance of testing for potassium levels while monitoring AKI patients undergoing dialysis cannot be underestimated. Palmer & Clegg, (2018) observed that patients with acute kidney injury are associated with hyperkalemia which is an indication of elevated tubular pressure causing direct injury to the nephron. Other studies (An *et al.,* 2012; Jain *et al.,* 2012; Khanagavi *et al.,* 2014; Li, Li, & Zhou, 2022; Rostami *et al.,* 2022) have reported that an increase on potassium level (hyperkalemia) has been shown to be unpredictable and is life-threatening resulting in sudden death. The findings of this study, therefore, accept the alternative hypothesis that potassium level was a significant parameter that acted as a survival predictor of acute kidney injury patients undergoing hemodialysis in Kakamega County. The results of this study on the impact of potassium level in determining the survival of AKI patients are consistent with Gao *et al.,* (2019) who also observed that potassium levels were linked with survival among AKI patients and that elevated potassium level was a predictor of worse clinical outcomes. It is worth mentioning that the current study also accepts the null hypothesis that creatinine, urea, phosphate, calcium, haemoglobin, sodium, and chloride levels were not statistically significant parameters that acted as a survival predictors of acute kidney injury patients undergoing hemodialysis in Kakamega County. Even though this study did not find creatinine, urea, phosphate, calcium, haemoglobin, sodium, and chloride levels to be statistically significant parameters for survival in acute kidney injury patients undergoing hemodialysis in Kakamega County, they are still considered essential in monitoring AKI patients undergoing dialysis as per the Kidney Disease Improving Global Outcomes (KDIGO) classification of 2012.

5.2.1 Renal biochemical parameters as a survival predictor of CKD patients undergoing hemodialysis

An assay on serum biochemistry, urinalysis and glomerular filtration test has been shown to help in the early diagnosis of patients with CKD (Bednářová, & Šafránková, 2022). According to Gounden, Bhatt, & Jialal, (2022), the role of the kidney is to excrete waste products and toxins such as creatinine, urea, uric acids, and electrolyte, regulate extracellular fluid volume and produce erythropoietin hormone, vitamin D and renin.

In this study, among the CKD patients, creatinine, urea, potassium, phosphate, sodium, chloride, haemoglobin, and calcium levels were determined to assess the renal function. The relationship between predictive indicators and survival of CKD patients undergoing hemodialysis in the renal unit, Kakamega County were established, and it was observed that creatinine and urea levels were not statistically significant, whereas phosphate, calcium, haemoglobin, sodium, potassium, and chloride were statistically significant (p value <0.05). On further analysis by Kaplan Meier and Cox regression analysis to evaluate if the confounder variable (predictor indicators) has an influence on survival of CKD patients, it was again observed that creatinine and urea levels were not statistically significant, whereas phosphate, calcium, haemoglobin, sodium, potassium, and chloride were statistically significant (p value <0.05). The same results were also seen when age and gender were being evaluated to establish their effect on these predictive indicators and survival of CKD patients. The findings of this current study therefore accept the null hypothesis that creatinine and urea levels were not statistically significant to influence the survival of CKD patients in Kakamega by age and gender. The results of this study therefore accept the alternative hypothesis that phosphate, calcium, haemoglobin, sodium, potassium, and chloride levels were statistically significant to influence the survival of CKD patients in Kakamega by age and gender.

The statistical significance findings notwithstanding, the study strongly encourages regular monitoring of renal function parameters among CKD patients to improve their clinical outcomes. Levey & James, (2017) reported that it is imperative to determine serum creatinine levels when there is an indication of renal dysfunction. Mehmood *et al.,* (2022) when assessing the serum biochemical derangements in CKD patients also concluded that it was essential to monitor serum electrolyte levels in CKD patients to slow the disease progression.

5.3 Prognostic factors as a survival indicator of AKI patients undergoing hemodialysis

In this study, the prognostic parameters that were used as survival indicators of acute kidney injury patients undergoing hemodialysis in Kakamega County were comorbidity status, types of comorbidities, number of comorbidities a patients had and whether they were on any form of treatment to improve renal function. Among the Kenyan population in Nairobi, a study done by Neto, Ndemo, & Karimi, (2021), it was observed that decompensated heart failure was the most prevalent comorbidity among AKI patients, however, other comorbidities seen in these population were obstructive uropathies, HIV, hypertension, and sepsis. In Southern Africa, Aylward *et al.,* (2019), observed diabetes mellitus, hypertension, ischemic heart disease, active tuberculosis, HIV, CKD, and epilepsy as the comorbidities among AKI patients. Other studies (Evans *et al.*, 2017; Halle, *et al.,* 2018; Regassa, Gete, & Mekonnen, 2019; Magboul, Osman, & Elnour, 2020; Tassew, Birhan, & Zewdu, 2021; Kahindo *et al.*, 2022) conducted in sub-Saharan Africa observed diabetes mellitus, obesity, cardiovascular disease was among the comorbidities that possess as the major risk factors for AKI.

An observation made from the findings of this current study indicated that none of the prognostic's parameters had a statistically significant (p value > 0.05) relationship between age and survival status of AKI patients. It was also observed in this study that none of the prognostic parameters had a statistically significant (p value > 0.05) relationship between gender and survival status of AKI patients. There was a statistically significant (P value 0.045) association between treatment status and survival of AKI patients undergoing hemodialysis in the renal unit, Kakamega County. This implies that well controlled comorbidities among AKI patients increases their survival. It is worth mentioning that clinically, acute kidney injury is associated with high rate of hospitalization and mortality despite the current findings of nonstatistical significance. This reasoning is consistent with Kahindo *et al.,* (2022); Sohaney *et al.*, (2022), who observed short-term and long-term mortality among hospitalized AKI patients. The findings of this study therefore accept the null hypothesis that gender and age do not significantly influence the relationship between prognostics parameters and survival status of acute kidney injury patients.

5.3.1 Prognostic parameters as a survival indicator of CKD patients undergoing hemodialysis

According to George *et al.,* (2022), in low-and middle-income countries, diabetes is becoming an increasingly major public health concern among patients with chronic kidney disease. Globally, hypertension and diabetes are the commonest causes of CKD (Gounden, Bhatt& Jialal, 2022).

In this present study, comorbidity status and number of comorbidities did not significantly influence the survival of CKD patients undergoing haemodialysis in Kakamega by age and gender. On the other hand, type of comorbidity and treatment status significantly influenced the survival of CKD patients undergoing haemodialysis in Kakamega by age and gender. The types of comorbidities observed among CKD patients undergoing haemodialysis in Kakamega County hospital included hypertension, diabetes mellitus, malaria, prostate cancer, HIV, sickle cell anaemia, urethral syndrome, septicemia and septic shock. Out of the 172 CKD patients who had comorbidities, it was observed that for hypertension, 26 were alive and 54 died, those that had both hypertension and diabetes mellitus 6 were alive and 41 died. Findings of this current study therefore accepted the alternative hypothesis that there was statistically significant (p value 0.001) relationship between the type of comorbidity status and survival status of a patient with CKD undergoing haemodialysis in Kakamega hospital. Further analysis indicated that hypertension was the type of comorbidity that showed a significant predictor (p value 0.017) for the survival of CKD patient undergoing haemodialysis in Kakamega hospital. In consistence with this present study, presence of comorbidities among CKD patients have also been observed in other studies (Kabinga *et al.,* 2019; Mwenda *et al.,* 2019; Otieno *et al.*, 2020) done in Kenya and it was reported that hypertension and diabetes are among illness witnessed in these patients. In a study conducted among CKD patients attending Kenyatta National Hospital in Nairobi, Kabinga *et al.,* (2019) observed that hypertension and diabetes were the leading comorbidities. A cross-sectional study conducted in Nyeri by Otieno *et al.,* (2020), observed that hypertension and diabetes were the risk factors of developing CKD. Mwenda *et al.,* (2019) reported that hypertension was among the comorbidity that was prevalent in CKD patients seeking treatment at Kenyatta National hospital.

Results of this study showed that among the CKD patients who were on treatment, 23 were alive and 50 died. Chronic kidney disease patients who were not on treatment, 12 were alive and 89 died. The study accepted the alternative hypothesis that there is statistically significant (p value 0.002) relationship between the treatment status and survival of a patient with CKD. Chronic kidney disease patients should be screened for the presence of comorbidities and if present, it is imperative that they seek treatment to enhance their survival. According to the Whelton, Carey, & Aronow, (2018), many guidelines have provided an algorithm to be use for treatment of hypertension in CKD patients.

CHAPTER SIX

CONCLUSION & RECOMMENDATIONS

6.1 Conclusion

1. The demographic characteristic with respect to survival status was not statistically significant among acute kidney injury and chronic kidney disease patients undergoing hemodialysis in the renal unit, Kakamega County. In comparison to CKD, it was observed that AKI patients had the worse overall survival outcomes over-time after clinical diagnosis despite being on hemodialysis.

2 a) Potassium levels were a significant parameter that acted as a survival predictor of acute kidney injury patients undergoing hemodialysis in Kakamega County. Whereas the creatinine, urea, phosphate, calcium, haemoglobin, sodium, and chloride levels were not significant parameter that acted as survival predictors of acute kidney injury patients undergoing hemodialysis in Kakamega County.

b) Creatinine and urea levels were not statistically significant to influence the survival of CKD patients undergoing haemodialysis in Kakamega by age and gender. On the other hand, phosphate, calcium, haemoglobin, sodium, potassium, and chloride levels was statistically significant to influence the survival of CKD patients undergoing haemodialysis in Kakamega by age and gender.

3 a) Comorbidity status, type of comorbidity, number of comorbidities and treatment status did not statistically significant to influence the survival of AKI patients undergoing haemodialysis in Kakamega by age and gender.

b) The comorbidity status and number of comorbidities did not significantly influence the survival of CKD patients undergoing haemodialysis in Kakamega by age and gender. On the other hand, type of comorbidity and treatment status significantly influenced the survival of CKD patients undergoing haemodialysis in Kakamega by age and gender.

6.2 Recommendations

6.2.1 Recommendation for the study

i. A focused research plan should be considered on community genetics in the context of bioinformatics and genome-wide association to understand the demographic characteristic of acute kidney injury and chronic kidney disease patients undergoing hemodialysis in the renal unit, Kakamega County.

ii. This study recommends the use of biomarkers for early diagnosis, precision medicine and prognosis AKI and CKD disease. The biomarkers for AKI include serum creatinine and urine output and for CKD we have cystatin C β-trace protein (BTP) Neutrophil gelatinase-associated lipocalin (NGAL) urine albumin and kidney injury molecule (KIM). In resource limited facilities, predictive parameters to be used to monitor progress of renal function in AKI and CKD patients.

iii. Prognostic parameters as a survival indicator among AKI and CKD patients need to be clinically monitored and comorbidities well controlled to improve their survival.

6.2.2 Recommendation for further study

1. There is need to conduct a study to establish the causes of AKI and CKD in our population so that prompt therapeutics, intervention, or prevention measures are implemented.

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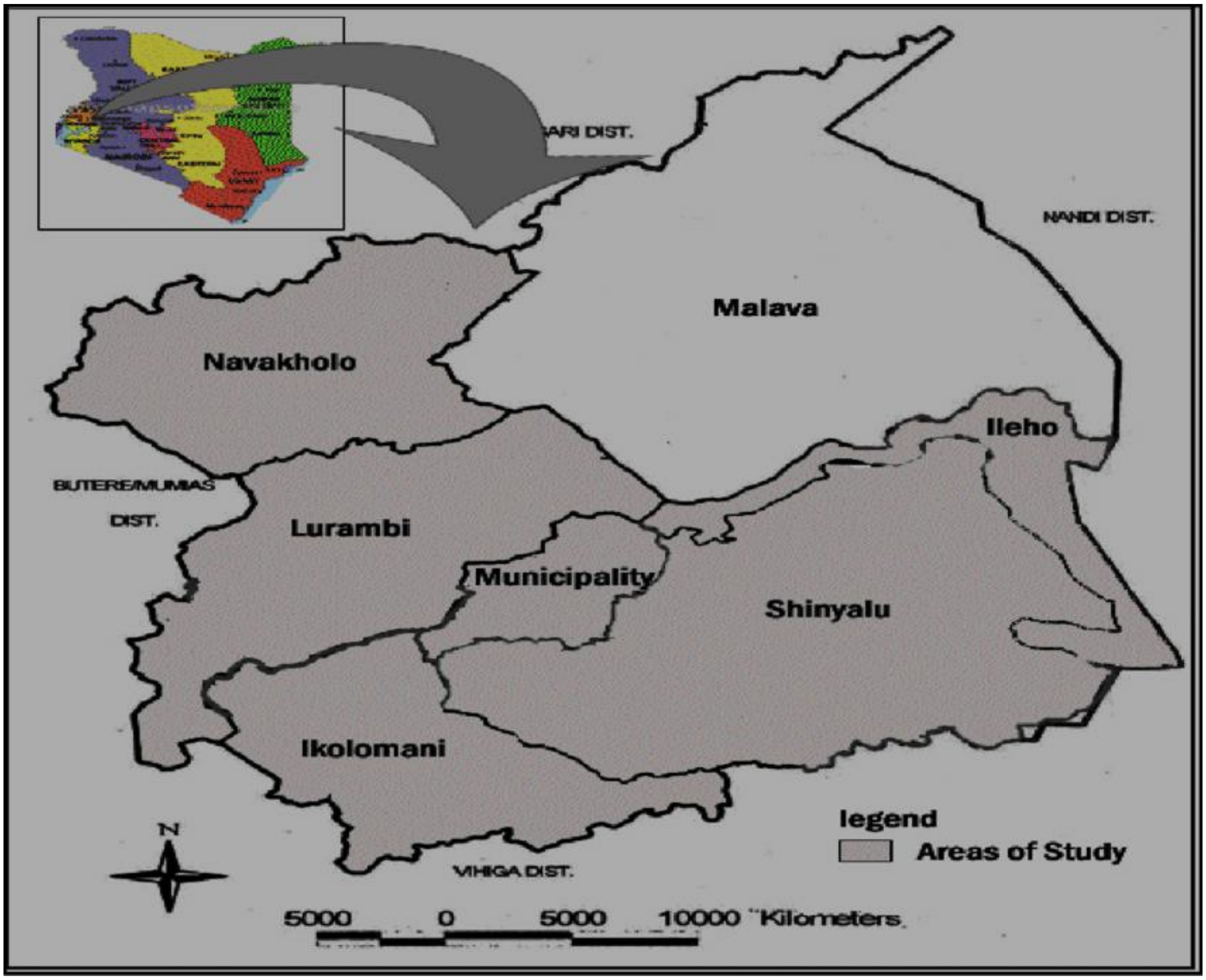
APPENDICES

APPENDIX I: A MAP OF KAKAMEGA COUNTY



A map of Kakamega showing (https://kakamega.go.ke/map-of-kakamega)

APPENDIX II: WRITTEN INFORMED CONSENT FORM

INFORMATION SHEET

Introduction

I, Rodgers Norman Demba, am a postgraduate student at Maseno university, currently doing a masters' degree in Public Health Epidemiology and Population Health. I am conducting my research project for which I request your participation. As you read this form you may ask any questions on what you do not understand.

Purpose of the study

I am carrying out a study to determine the predictors and prognostics survival factors of patients undergoing hemodialysis in the renal unit in Kakamega County general teaching and referral hospital (KCGT&RH). In this study. I intend to focus on acute kidney injury and chronic kidney disease patients enrolled at the renal unit in the hospital. The study is part of my university requirements, but the results of the study will be used to offer recommendations which, if implemented, may lead to improved management and quality of life of patients with acute kidney injury and chronic kidney disease.

Procedures to be followed in the study

Once you agree to participate in the study, you will have to answer questions of a personal nature as outlined in the study data collection tool, as there will be no invasive Procedures.

Confidentiality

All the information you provide will be handled in a confidential manner and will not be divulged to any other person without your consent. Your individual responses will be stored in a locked place under my control and will only be seen by my statistician.

Voluntariness of participation

Your participation in this research is voluntary and if you refuse to allow me to collect the hospital data for this study, your treatment will not be affected. If you choose to allow me collect data from the enrolled patients this will go a long way in my project and patient's knowledge gap bridged. You are free to terminate the interview and withdraw from the study at any time. You are free to ask questions before signing the consent form.

Benefits

Your participation in the study will be used for individual benefit and that of the hospital. Information obtained will improve knowledge to health care givers at Kakamega County general teaching and referral hospital.

Risks

There will be no pain/ discomfort as the study intends to collect data from the record and no invasive procedures on the patients will be done.

Rights

You may choose to withdraw from the study at any time whatsoever with no consequences to your treatment.

PATIENT CONSENT FORM

I, _________________, have read and fully understood the explanation given to me regarding this study. All my questions have been answered satisfactorily by the investigators. I hereby consent to participation in this study.

Signature: ……………….. Date: …………………. Thumb print: ……………..

Witness (PI/Research assistant):

Signature: ……………….. Date: …………………. Thumb print: ……………..

CONTACTS

For further information, you may contact any of the following:

1. Dr. Rodgers Norman Demba (PhD). (Principal investigator)

P.O Box 1864 – 40100, Kisumu. Mobile number: 0723 875756

2. The Secretary of Eastern Africa, Baraton (UEAB) Research Ethics Committee

Telephone. Number: 254(20) 8023018. Approval number: UEAB/ISERC/22/6/2022

3. **National Commission for Science, Technology, and Innovation** (NACOSTI) reference number: 237672 and License No: NACOSTI/P/22/18844

PATIENT ASSENT FORM

I, ______________________, have read and fully understood the explanation given to me regarding this study. All my questions have been answered satisfactorily by the investigators. I hereby assent to participation in this study.

SIGNED (Patient): ………………………………………………………………..

HEAD OF RENAL UNIT / MEDICAL SUPERINTENDANT:

……………………………………………………………………………………….

Witness (PI/Research assistant):

Signature: ……………….. Date: …………………. Thumb print: ……………..

CONTACTS

For further information, you may contact any of the following:

1. Dr. Rodgers Norman Demba (PhD). (Principal investigator)

P.O Box 1864 – 40100, Kisumu. Mobile number: 0723 875756

2. The Secretary of Eastern Africa, Baraton (UEAB) Research Ethics Committee

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3. **National Commission for Science, Technology, and Innovation** (NACOSTI) reference number: 237672 and License No: NACOSTI/P/22/18844

2. FOMU YA MAELEZO YA UTAFITI

Utangulizi

Mimi, Rodgers Norman Demba, ni mwanafunzi katika chuo kikuu cha Maseno. Ninatarajia kufanya uchunguzi kuhusu ugonjwa wa figo na ningependa wewe uhusike. Fomu hii ni ya maelezo yote utakayohitaji ukiamua kama utajiunga na utafiti huu. Unapoisoma na baada ya kusoma fomu hii, uko huru kuuliza maswali yoyote kama kuna sehemu hujaelewa vyema.

Je,utafiti huu unalenga kutambua nini?

Ninafanya utafiti kwa wagonjwa wenye figo ili kujua wangapi kati yao wana matatizo ya figo na kulinganisha matatizo hayo na muda wa ugonjwa.

Utafiti huu unahitajika kama sehemu ya masomo yangu lakini matokeo yatakayopatikana yatatumika kutoa nasaha, ambayo ikiwa itatumika inaweza kuleta manufaa katika matibabu na hali ya maisha ya wagonjwa wa figo.

Utaratibu wa utafiti:

Utakapokubali kujiunga na utafiti huu, utahitajika kujibu maswwali ya kibinafsi kama yalivyodokezwa katika karatasi ya maswali

Hatari na gharama inayohusika

Hauta hisi uchungu yeyote kw akua utowaji yad amu haitajiki.

Haki zako

Kujiunga na utafiti huu ni kwa hiari yako. Hutabaguliwa kimatibabu ukikataa kujiunga na utafiti huu. Ukijiunga na utafiti huu na ushindwe kujibu mojawapo au maswali mengine tutakayouliza, ni sawa. Una uhuru wa kutoka kwenye mahojiano na kujitoa kwa utafiti huu wakati wowote.

Una uhuru wa kuuliza maswali yoyote uliyo nayo kabla ya kutia sahihi fomu ya makubaliano. Maelezo yako yote yatawekwa pahali pa siri. Ni mtafiti mkuu na mwanatakwimu wake pekee ambao wataangalia maelezo yako.

Manufaa ya utafiti huu

Kujiunga na utafiti huu na vipimo vya maabara vitatumika kwa manufaa yako. Matokeo ya utafiti yatasaidia wauguzi katika hospitali ya Kakamega County.

Cheti cha ridhaa

Nimesoma, au nimesomewa maelezo yaliyopewa. Nimepata fursa ya kuuliza maswali kuhusu utafiti na maswali yote niliyouliza yamejibiwa vyema. Ninakubali kuhusika katika utafiti huu.

Jina la mhusika:……………………………

Sahihi/Alama ya kidole gumba cha kushoto :………………………....

Tarehe:………………………………

KAULI YA MTAFITI:

Mimi, mtafiti mkuu, nimemweleza mhusika vilivyo kuhusu utafiti huu.

Sahihi (mtafiti mkuu/msaidizi): _______________Tarehe: ___________________

MAWASILIANO

Ukiwa na maswali yoyote ya ziada, unaweza kuwasiliana na wafuatao:

1. Dr. Rodgers Norman Demba (PhD). (Principal investigator)

P.O Box 1864 – 40100, Kisumu. Mobile number: 0723 875756

2. The Secretary of Eastern Africa, Baraton (UEAB) Research Ethics Committee

Telephone. Number: 254(20) 8023018. Approval number: UEAB/ISERC/22/6/2022

3. **National Commission for Science, Technology, and Innovation** (NACOSTI) reference number: 237672 and License No: NACOSTI/P/22/18844

APPENDIX III: PAPER-BASED DATA COLLECTION FORM

1. **Patient identifier (Serial number):** ……………………………………….
2. **Age/ Date of Birth:** ………… **Gender:** ……………… **Marital status:** ……………….
3. **Residence:** ……………………………...
4. **Primary diagnosis:** ………………………… **Underlying diagnosis:** a) AKI b) CKD
5. **Remark on patient status a) Dead:** … **b) Resolved**: … **c) On follow-up:** …………..
6. **Date/Year of Diagnosis: …………… Date/Year of Death: …………………………..**
7. **Serum creatinine levels:**

   ……………………………………………………………………...
8. **Serum urea levels:** …………………………………………………………………….
9. **Phosphate levels:** …………………………………………………………………….
10. **Calcium levels:** ……………………………………………………………………….
11. **Sodium level:** ………………………………………………………………..………
12. **Potassium level:** ……………………………………………………………………..
13. **Hemoglobin level:** …………………………………………………………………..
14. **Chloride level:** ……………………………………………………………………….
15. **Current medication and treatment:** ……………………………………………………
16. **Indicate presence (specify the type) or absence of comorbidity:** ………………………
17. **Any other comment:** ……………………………………………………………….

APPENDIX IV: APPROVAL LETTER FROM SCHOOL OF GRADUATE STUDIES, MASENO UNIVERSITY

MASENO UNIVERSITY

SCHOOL OF GRADUATE STUDIES

Office of the Dean

Our Ref: EL/ESM/07021/020

Private Bag, MASENO, KENYA
Tel:(057)351 22/351008/351011
FAX: 254-057-351153/351221
Email: sgs@maseno.ac.ke

Date: 08th June, 2022

TO WHOM IT MAY CONCERN

RE: PROPOSAL APPROVAL FOR ROGERS NORMAN DEMBA— EL/ESM/07021/2020

The above named is registered in the Master of Public Health degree programme in the School of Public Health and Community Development, Maseno University. This is to confirm that his research proposal titled "Predictors and Prognostics Survival Factors of Patients Undergoing Hemodialysis in the Renal Unit Kakamega, County" has been approved for conduct of research subject to obtaining all other permissions/clearances that may be required beforehand.

DEAN, SCHOOL OF GRADUATE STUDIES, MASENO UNIVERSITY, 08 JUN 2022, P.O. Box PRIVATE BAG, MASENO

Prof. J Agure
DEAN, SCHOOL OF GRADUATE STUDIES

Maseno University *ISO 9001:2008 Certified*

APPENDIX V: APPROVAL FROM EASTERN AFRICA, BARATON (UEAB) RESEARCH ETHICS COMMITTEE

OFFICE OF THE CHAIRPERSON
INSTITUTIONAL SCIENTIFIC ETHICS REVIEW COMMITTEE
UNIVERSITY OF EASTERN AFRICA, BARATON
P.O. BOX 2500-30100, Eldoret, Kenya, East Africa

B2230062022 June 30, 2022

TO: Rogers Norman Demba
Department of Public Health
School of Public Health and Community Development
Maseno University

Dear Rogers,

RE: Predictors and Prognostics Survival Factors of Patients Undergoing Hemodialysis in the Renal Unit, Kakamega County

This is to inform you that the Institutional Scientific Ethics Review Committee (ISERC) of the University of Eastern Africa Baraton has reviewed and approved your above research proposal. Your application approval number is UEAB/ISERC/22/6/2022. The approval period is 29th June, 2022 – 29th June, 2023.

This approval is subject to compliance with the following requirements;

i. Only approved documents including (informed consents, study instruments, MTA) will be used.

ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by the Institutional Scientific Ethics Review Committee (ISERC) of the University of Eastern Africa Baraton.

iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to the Institutional Scientific Ethics Review Committee (ISERC) of the University of Eastern Africa Baraton within 72 hours of notification.

iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to the Institutional Scientific Ethics Review Committee (ISERC) of the University of Eastern Africa Baraton within 72 hours.

v. Clearance for export of biological specimens must be obtained from relevant institutions.

vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.

vii. Submission of an executive summary report within 90 days upon completion of the study to the Institutional Scientific Ethics Review Committee (ISERC) of the University of Eastern Africa Baraton.

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://oris.nacosti.go.ke and also obtain other clearances needed.

Sincerely yours,

Jackie K. Obey

Prof. Jackie K. Obey, PhD
Chairperson, Institutional Scientific Ethics Review Committee

University of Eastern Africa, Baraton
30 JUN 2022
P. O. Box 2500-30100, ELDORET
Research Ethics Committee

A SEVENTH-DAY ADVENTIST INSTITUTION OF HIGHER LEARNING
CHARTERED 1991

APPENDIX VI: PERMIT FROM NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY, AND INNOVATION (NACOSTI)

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **237672**

Date of Issue: **13/July/2022**

RESEARCH LICENSE

This is to Certify that Dr.. Rodgers Norman Demba of Maseno University, has been licensed to conduct research in Nairobi on the topic: PREDICTORS AND PROGNOSTIC SURVIVAL FACTORS OF PATIENTS UNDERGOING HEMODIALYSIS IN THE RENAL UNIT KAKAMEGA, COUNTY for the period ending : 13/July/2023.

License No: **NACOSTI/P/22/18844**

237672

Applicant Identification Number

Director General

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code