PREVALENCE AND RISK FACTORS ASSOCIATED WITH CHRONIC KIDNEY DISEASE AMONG HYPERTENSIVE PATIENTS IN WAJIR COUNTY, KENYA

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DECLARATION

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This thesis is my original work and has not been presented for a degree in any other University or for any other award.

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DEDICATION

This thesis is dedicated to my family particularly to my brother Mohamed Abikar, whose unwavering love, support, and encouragement have been my foundation throughout this journey. I also dedicate this work to my mentors and supervisors, whose guidance and insight have shaped my academic and personal growth. Your patience and encouragement have been invaluable.

Lastly, this thesis is dedicated for my friends, who have stood by me through the highs and lows, providing both distraction and motivation when needed.

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ABBREVIATIONS AND ACRONYMS

ACR	Albumin Creatinine Ratio
BMI	Body Mass Index
CKD	Chronic Kidney Disease
C**KD-EPI**	Chronic Kidney Disease Epidemiology Collaboration
DM	Diabetes Mellitus
GFR	Glomerular Filtration Rate
KDOQI	Kidney Disease outcome and quality initiative
KNH	Kenyatta National Hospital
KU	Kenyatta University
NSAIDs	Non-steroidal anti-inflammatory drugs
SBP	Systolic blood pressure
USRDS	United states renal system
WCRH	Wajir County Referral Hospital
WHO	World health organization

DEFINITION OF OPERATIONAL TERMS

Hypertension	High blood pressure
Proteinuria	Presence of protein in the urine.
Prevalence	Proportion of given population with a particular condition at a specific point in time.
Estimated glomerular filtration rate	A test to measure levels of kidney function and determine the stage of kidney disease calculated using blood creatinine level, age, weight and gender.
Chronic kidney disease	Progressive loss of kidney function that can occur over many years

ABSTRACT

Chronic Kidney Disease (CKD) is a significant public health challenges both locally and globally, with its prevalence increasing, particularly in developing countries especially in Sub-Saharan Africa. CKD is common among older adults and is strongly associated with medical conditions such as hypertension, diabetes and obesity. However, to our knowledge there is no published data on prevalence of CKD and risk factors associated among the hypertensive adult patients in Wajir County. This study aimed at estimating the prevalence and establishing risk factors associated with CKD among hypertensive patients in Wajir County and sought to recommend viable preventive measures. An analytical cross-sectional study was conducted among sampled 293 hypertensive patients. This study utilized consecutive sampling where the subject who meet the selection criteria were interviewed. Structured questionnaires were administered for data collection. Key findings revealed that nearly half of hypertensive patients have CKD (45.40%), highlighting a critical health concern in the region. The study revealed most CKD cases were in early stages (Stages1 and 2), some had progressed to severe stages (Stages 4 and 5). Regression analysis identified several demographic and clinical factors associated with CKD development, including age, gender, and education, and employment status, family history of CKD, stroke history, and difficulty in medication compliance. Moreover, analysis of results revealed that notable associations, with individuals aged 51-60 years having significantly higher odds of developing CKD compared to younger counterparts (OR=2.462, CI 2.623-44.612, P-value < 0.001), and females being more susceptible than males (OR=5.928, CI 0.401-0.921, P-value < 0.001). Clinical factors like uncontrolled blood pressure and difficulty in taking medication also emerged as key risk factors; hypertensive patients non-compliant to medication are at a significantly higher risk of CKD (OR=3.036, CI 2.948-6.937, P-value<0.001). Furthermore, family history of hypertension (OR=2.881, CI 2.381-2.823, P-value < 0.001) and CKD (OR=5.271, CI 3.816-11.838, P-value < 0.001), history of stroke (OR=3.283, CI 2.182-2.910, P-value < 0.001), BMI between 25 and 29.9 (OR=2.462, CI 2.381-6.712, P-value < 0.001), and proteinuria (OR=2.722, CI 2.361-4.381, P-value < 0.001) were identified as significant contributors to CKD development. The study concludes that there is high prevalence of CKD among hypertensive adults in Wajir County. With nearly half of hypertensive patients also suffering from CKD, these poses significant public health concern at hand in Wajir County. In view of these findings, the study recommends that the county government of Wajir should focus on viable preventing measures such as targeted screening programs of CKD in hypertensive population, health education on medication compliance and engaging in healthy behavior like exercise.

CHAPTER ONE: INTRODUCTION

1.1 Background of study

Health of the people in a nation is a key determinant of socioeconomic growth and healthy nation is a working nation. Lifestyle disease are becoming the nightmare of the health system globally with its upward trend and overtaking the communicable diseases in relation to public health burden (Boutayeb *et al.*, 2005). CKD is one of emergent non-communicable disease and it is of global public health concern with increasing incidence of patients requiring renal replacement therapy. It is defined as reduction of functional or structural capacity of the kidney evidence by glomerular filtration rate (GFR) less than 60ml/min per 1.73m2 for a period more than three months and it has resulted over a million deaths in the year 2017 becoming among top 15th cause of global mortality (Rotich *et al.*, 2017). CKD has been rising in prevalence globally and is estimated to be between 10% and 13% globally. In sub-Saharan Africa, it has a significant public health challenge with a prevalence of 15.8% for stage 1-5 (Stanifer *et al*., 2014). The prevalence is 12.4% in urban and 16.6% in rural sub-Saharan Africa. Locally, there is notable rise in CKD prevalence, which is associated with high risk factors such as lifestyle diseases such as hypertension, diabetes and obesity (Sigamani, 2012). Study contacted in Kericho county hospital among adult medical admissions estimated CKD mean prevalence of 0.4% (Rotich *et al.,* 2017). Mwenda *et al*. (2019) estimated CKD prevalence of 38.6% among medical inpatients at Kenyatta National Hospital (KNH) with 14.4% having end-stage kidney disease. Majority of CKD patients (54%) were rural inhabitants although study conducted on CKD in Sub-Saharan Africa which was systematic review and meta-analysis of studies did not find significant difference in the prevalence of CKD in rural and urban populations (Stanifer *et al*., 2014).

Hypertension affects almost one billion people globally and is one of the commonest causes of mortality. Hypertension is also second major cause of CKD (USRDS), 2011). Both CKD and hypertension have serious implication on modern day society due to

transformation in the lifestyle that predispose to emerging diseases. Studies have found timely diagnosis and appropriate management of kidney disease comorbid with diabetes and hypertension can slow or prevent progression into chronic kidney disease and it is economic friendly (Jha *et al*., 2013)

Globally, non-communicable disease contributes 63% of the deaths with developing countries accounting for 80% of this mortality (Kenya STEPS, 2015). Modifiable risk factors such as hypertension, diabetes mellitus (DM), obesity and smoking are the main reason for increased rise in CKD prevalence. Studies report that the prevalence of CKD is 13.4% in general population (Hill et al., 2016). While in another study on the prevalence of CKD in patients with hypertensive was 24.7% higher as compared to the general population (Goro *et al*., 2019). About 1.2 million deaths due to CKD indicated rise of the condition by 98.02% with escalation of the burden due to hypertension happening very fast in developing countries than in the first world countries (Kaze *et al*., 2018). Worldwide, hypertension was reported among 1.4 billion adult populations with a prevalence of CKD reported to be 30% in United States among hypertension adult (Chow *et al*., 2012). WHO report in 2018 (WHO, 2018) accounted hypertension as the leading risk factor for CKD.

In Sub Saharan Africa, CKD affects mainly young adults and is a substantial cause of death in the young adults (Stanifer *et al*., 2016). The prevalence of CKD stands at 32.3% among hypertensive patients mainly from urban populations. Ghana prevalence is 46.9% among hypertensive population (Osafo *et al*., 2011) while Nigeria recorded 10.7%. Study in Ethiopia by Hunegnaw et al. reported 17.6% prevalence of CKD among adult hypertensive patients. Long duration of hypertension (Hunegnaw *et al.,* 2021) and elevated systolic blood pressure (SBP) are the key risk factors linked to the incidences of CKD among hypertensive patients (Hailu *et al*., 2022). Hospital based study that was conducted in North Western Region of Tanzania, demonstrated that hypertension was number one cause of CKD (Peck et al., 2013). There is inadequate data on general prevalence of CKD in Kenya. A research by Rotich et al in Kericho County estimated the

prevalence of CKD at 0.41% in Kericho (Rotich, 2017) to a high of 10%-26% based on the global estimates of CKD. The Kenya STEPS survey 2015 reported no significant variation in DM and hypertension prevalence data in both rural and urban population.

Determining the related risk features of CKD among hypertensive patients is paramount for prevention of development and progression of CKD. In Wajir County, there is no published available data related to the prevalence and the risk factors associated of this ailment, mainly among the study population which are the hypertensive patients. Therefore, this study aims to assess the prevalence and associated risk factors of CKD among hypertensive patients attending Wajir county referral hospitals. The study findings may contribute towards prevention and control of the CKD.

1.2 Problem Statement

Chronic Kidney Disease (CKD) is a global health concern, particularly in resource-limited regions like Wajir County, Kenya, where hypertension—a major CKD risk factor—is prevalent due to lifestyle changes and limited healthcare access. While global CKD prevalence is 13.4%, and Sub-Saharan Africa's rate is 15.8%, no data exists for Kenya (Muyodi et al., 2020). In Kenya, only 8% of hypertensive patients are on therapy, with 4.6% achieving blood pressure control (Kenya STEPS, 2015). This lack of data on CKD prevalence among hypertensive individuals hinders effective interventions, increasing morbidity and healthcare strain. Understanding CKD prevalence and risk factors is essential for targeted policies and improved outcomes this study addresses this gap (Bahrey et al., 2009).

1.3 Justification

Hypertension is significant public health concern globally, and its prevalence is rising steadily in Kenya, including Wajir County. As a major risk factor for chronic kidney disease (CKD), hypertension contribute to significant morbidity and mortality if left unmanaged. Despite this established link, there is limited data on the burden of CKD among hypertensive patients in Wajir County. This knowledge gap hinders effective planning and implementation of preventive measures tailored to the regions unique socio-

economic and cultural context (Murray et al.,2020). CKD is often asymptomatic in its early stages, leading to late diagnosis and complications. Early identifications of CKD among high-risk groups, such as hypertensive patients, is critical to preventing progression and reduce healthcare cost. A region-specific study will highlight the burden of CKD and identify associated risk factors, enabling early detection and improved outcomes (stanifer et al.,2016).

The study will serve as an evidence base for policymakers, enabling allocation of resource to CKD prevention and management programs in Wajir County. It aligns with Kenya national strategies for tackling non-communicable diseases and addressing growing burden of hypertension and its complication like CKD. By providing data on CKD prevalence and risk factor, this study will support effort to improve healthcare delivery and resource distribution in undeserved regions like Wajir (Kenya Ministry of Health,2020).

1.4 Significant of the Study

There is necessity for evidence centered studies on the prevalence of CKD among hypertensive patients in Wajir County and nationally. These study findings provides data on the subject that is currently scarce locally. The study established risk factors associated with the developing CKD and recommend viable preventive measures.

1.5 Research Question

1. What is the prevalence of chronic kidney disease among patient attending hypertension clinic in Wajir County Referral Hospital?
2. What are the risk factors associated with chronic kidney disease development among hypertensive patient in Wajir County?
3. What is the level of preparedness of Wajir county referral Hospital in management, referral and linkage of hypertensive patients?

1.6 Hypothesis

1.6.1 Null hypothesis

H_{01}: No significant relationship between social-demographic factors and CKD development

H_{02}: No significant relationship between clinical factors and development of CKD.

H_{03}: No significant relationship between behavioral factors and development of CKD.

1.7 Objectives

1.7.1 Broad Objective

To determine the prevalence and associated risk factors of chronic kidney disease among hypertensive patients in Wajir county referral hospital.

1.7.2 Specific objectives

1. To determine the prevalence of chronic kidney disease among hypertensive patient in Wajir County.
2. To establish risk factor associated with the development of chronic kidney diseases among hypertensive patient in Wajir County.
3. To determine the preparedness of Wajir county referral Hospital in management, referral and linkage of hypertensive patients.

1.8 Limitation of the study

The study was snap shot in design and there was likelihood of some patient with chronic kidney disease might have been missed due to slow progression nature of the condition. This study could not establish temporality of CKD and hypertension as one could lead to the other.

1.9 Delimitation of the study

The study data collection was conducted for a period of 3 months to address potential time frame bias. The study utilizes both urinalysis and blood test(UEC) to make diagnosis of chronic kidney disease.

1.10 Conceptual Framework

As illustrated in figure 1.1 the dependent variable is prevalence of CKD among the hypertensive patient which is influenced by independent variables namely; sociodemographic factor, clinical factors and behavioral factors

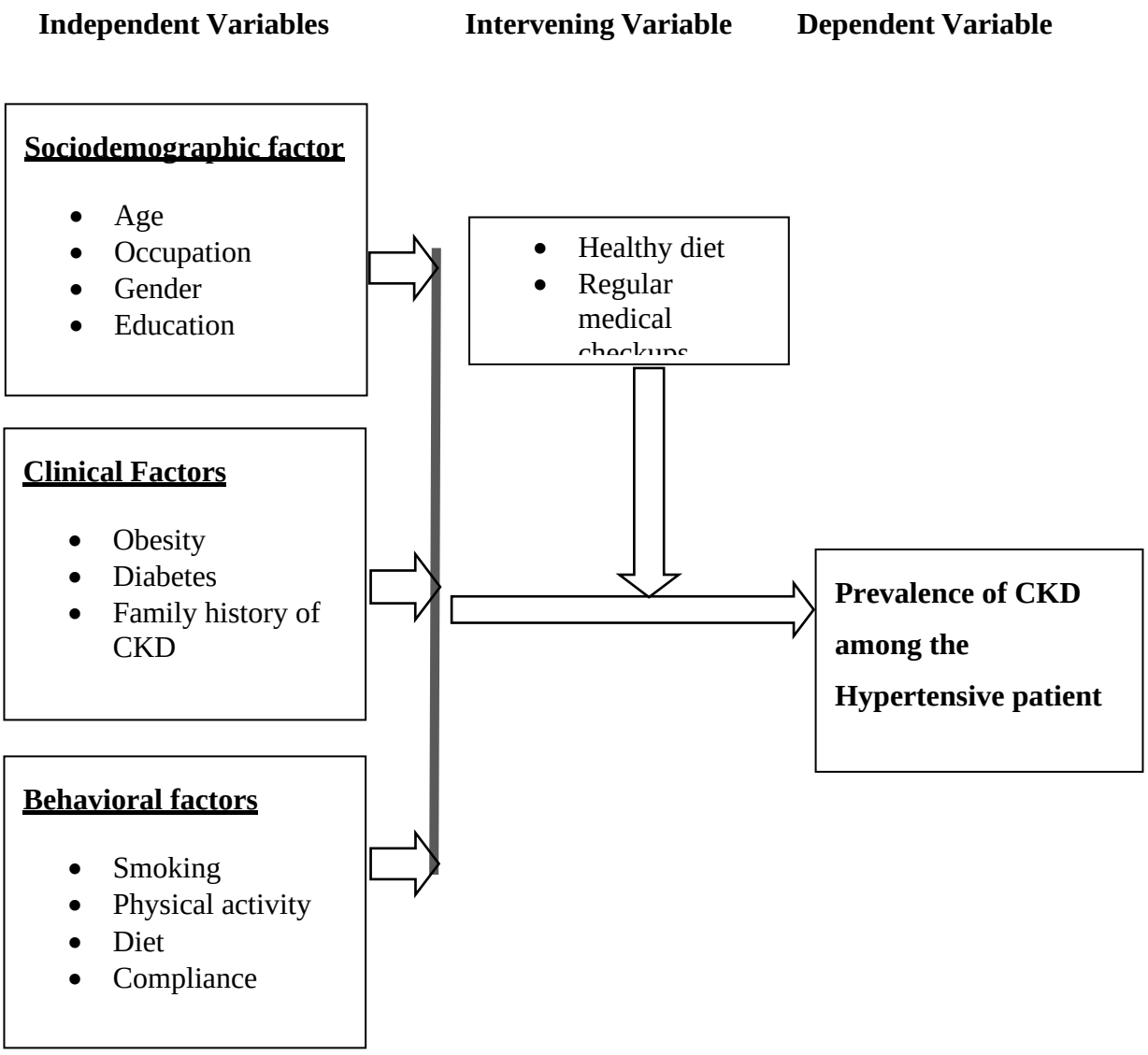


Figure 1.1: Conceptual framework showing relationship between study variables

CHAPTER TWO: LITERATURE REVIEW

2.1 Chronic Kidney Disease

Chronic Kidney Disease is chronic condition affecting 10% of the population globally and continues receiving increasing attention as one public health nightmare (Verniso *et al*., 2019). It is defined as an alteration of kidney structure or function present or reduction in eGFR for a period more than 3 months. GFR is calculated using serum markers such as serum creatinine (KDIGO, 2017) with its elevated levels being indicative of chronic renal disease. CKD is a five staged disease contingent on the level of glomerular filtration rate which defines the progressive nature of the disease (KDIGO 2012, Meyers *et al*., 2015; Levey *et al*., 2009). The stages are reflection of the kidney function status with stage one least severe and five being most severe. CKD has major impact on patients' health, lifestyle and productivity (Bae et al., 2015). Accurate diagnosis and management of chronic renal disease depends on proper clinical history, examination and targeted laboratory and radiological investigation. Because of limited resources in African countries, only few patients receive renal replacement therapy, despite its high demand (Moosa *et al*., 2016).

According to Liyanage *et al.* (2022), millions of people are affected globally by Chronic Kidney Disease (CKD) posing significant health impact. Stepwise loss of renal function is the main feature of CKD leading to complication before the diagnosis of the disease, complication includes cardiovascular disease, anemia, bone disease, and ultimately, kidney failure. The progression of CKD is often silent and insidious, making early detection and intervention critical to slowing the disease's progression and improving patient outcomes (Kovesdy, 2022; Rao *et al.*, 2023). A lot of studies have focused on identifying risk factors, which include diabetes, hypertension, obesity, and a family history of kidney disease (Nawaz, et al., 2023; Burnier & Damianaki, 2023). These studies underscored the importance of managing underlying conditions to prevent or delay the onset of CKD particularly control of hypertension.

According to Wang *et al.* (2023), development in our understanding of CKD have been significantly shaped by research into its pathophysiology, the study of how the disease develops and progresses at a molecular and cellular level. This research has revealed that CKD is not a single disease but a multifactorial disease involving interplay of a genetic, environmental exposure, and lifestyle factors (Pandey & Loscalzo, 2023; Adamson *et al.*, 2023). The effect of inflammation and the pathway of renin-angiotensin-aldosterone system (RAAS) in CKD progression has been a particular focus, leading to targeted therapies that aim to mitigate these pathological pathways (Catanese *et al.,* 2023). Additionally, the identification of biomarkers for early detection and monitoring of CKD has been a major focus, with proteins in the urine and abnormalities in blood tests being key indicators of kidney damage and function.

Mao *et al.* (2023) observe that management strategies for CKD have evolved significantly, guided by evidence from multiple clinical trials. The mainstay of treatment involves controlling blood pressure and blood sugar levels, which can slow the progression of kidney damage, especially in the early stages of CKD (Farrell & Vassalotti, 2024). The use of medications such as ACE inhibitors or ARBs has been shown to be beneficial in protecting kidney function. Moreover, lifestyle modifications, including dietary changes, exercise, and smoking cessation, are recommended to manage CKD risk factors effectively. Recent research has also explored the potential of novel therapeutic agents and interventions, including stem cell therapy and regenerative medicine, offering hope for more effective treatments in the future (Blazek & Bakris, 2023; Al-Ghamdi *et al.*, 2023; Zhang *et al.*, 2023).

Studies have shown that the impact of CKD extends beyond the individual, affecting families and healthcare systems due to its chronic nature and the need for long-term management (Tangri *et al*, 2023; Tuttle & Lam, 2023). Jha et al. (2023) notes that the economic burden of CKD is substantial, with costs associated with treatment, including dialysis and kidney transplantation, being significant contributors to healthcare expenditure. This has prompted research into cost-effective management strategies and

healthcare policies that aim to improve access to care and support for patients with CKD (Zhang *et al.,* 2023). Public health initiatives focusing on early screening and prevention, particularly in high-risk populations, are crucial for reducing the prevalence and impact of CKD.

2.2 Prevalence of Chronic Kidney Disease

CKD has been rising in prevalence globally and is estimated to be between 10% and 13% globally. In sub-Saharan Africa, it has a significant public health challenge with a prevalence of 15.8% for stage 1-5 (Stanifer *et al*., 2014) which is higher compared to north Africa with a prevalence of 6.1% (Kaze et al., 2018). The prevalence is 12.4% in urban and 16.6% in rural sub-Saharan Africa. A study that was conducted in Tanzania estimated the CKD prevalence to be 63.7% (Meremo *et al*., 2017) while in Uganda, CKD prevalence was 15.2% (Kalyesubul *et al*., 2017). In Kenya, there is notable rise in CKD prevalence, which is associated with high risk factors such as lifestyle diseases such as hypertension, diabetes and obesity (Sigamani, 2012). Study contacted in Kericho county hospital among adult medical admissions estimated CKD mean prevalence of 0.4% (Rotich *et al.,* 2017). Mwenda *et al*. (2019) estimated CKD prevalence of 38.6% among medical inpatients at Kenyatta National Hospital (KNH) with 14.4% having end-stage kidney disease. Majority of CKD patients (54%) were rural inhabitants although study conducted on CKD in Sub-Saharan Africa which was systematic review and meta-analysis of studies did not find significant difference in the prevalence of CKD in rural and urban populations (Stanifer *et al*., 2014).

2.3 CKD and Hypertension

Hypertension is the leading silent killer non-communicable disease and is one of the principal cause of end stage renal disease because hypertension has deleterious effect on the renal blood vessels resulting from rising intraglomerular pressure that diminish glomerular filtration. This result to failure of the kidney to filter the protein at the glomerular level hence presence of abnormally high protein in the urine (proteinuria). A study conducted in Ethiopia found that hypertension was a significantly associated with

the high prevalence of chronic kidney disease and it was revealed the uncontrolled or poor control and longer period of hypertension as the sovereign predictor of chronic kidney disease (Carmen *et al*., 2005). The study also noted hypertensive patient using angiotensin converting inhibitors medication have protective effects against CKD

Renal disease may be the etiology or a consequence of hypertension hence cyclic nature of the relation. Multicenter analysis of Karen Hospital Data showed the prevalence as high normal blood pressure (18%) and hypertension (30%) with different grade hypertension showing different ranges of prevalence; grade 1 (10%), grade 2 (25%), grade 3 (2%) and isolated hypertension 13% (Nshimirimana *et al*., 2019). Hypertensive patients with optimum control of blood pressure have lower risk of progression of renal disease with target BP of less than 130/80 mmHg for CKD patient.

A study by Nawaz *et al.* (2023) evaluated obesity as key determinant of chronic kidney disease using a recent review. The study has utilized an electronic library to search literature that elaborate the current body of knowledge on the interplay between overweight, obesity and CKD. Obesity as lifestyle risk factor to most non communicable diseases may contribute to the development of CKD directly as the pathogenesis of it is linked to the histological findings of obesity-related glomerular diseases and indirectly as a modifiable risk factor of atherosclerosis, hypertension, and type 2 diabetes (Wang *et al.*, 2022). The study has also revealed a number of biochemical and endocrine products of adipose tissue may lead to pathophysiological processes such as inflammation, oxidative stress, endothelial dysfunction, and proteinuria. Intervention involving lifestyle modification that prevent obesity and as well as the management of obesity have proven critical in counteracting both the development and progression of CKD. Moreover, abdominal adiposity estimated with waist circumference as part of metabolic syndrome are generally associated with worse morbidity and mortality in individuals receiving maintenance hemodialysis. The study concluded central obesity as part of metabolic disease is a significant risk factor for the initiation and advancement of CKD and should

be recognized as a potential target for a preventive medicine approach to reduce CKD prevalence and incidence in the general population.

The pathophysiological mechanisms linking CKD and hypertension are multidimensional. The kidneys play a critical role in regulating blood pressure through the renin-angiotensin-aldosterone system (RAAS), which controls blood vessel constriction and sodium and water retention (Hsu & Tain, 2021). In CKD, reduced kidney function can lead to an inappropriate activation of the RAAS, contributing to hypertension. Additionally, CKD can lead to fluid overload and altered vascular function, further exacerbating blood pressure increases. The damage to the nephrons, the filtering units of the kidneys, in CKD can also lead to an increased production of vasoactive substances, promoting hypertension. Understanding these mechanisms is crucial for developing targeted therapies that can address the underlying causes of hypertension in CKD patients.

Epidemiologically, the prevalence of hypertension in patients with CKD is significantly higher than in the general population. Studies have shown that as kidney function declines, the prevalence of hypertension increases, highlighting the close link between these two conditions (Hsu & Tain, 2021; Seravalle & Grassi, 2023). This association is particularly concerning given the role of hypertension as a major risk factor for cardiovascular disease, which is the leading cause of death in patients with CKD. According to Fay and Cohen (2021), the management of hypertension in CKD patients is therefore not only aimed at reducing blood pressure but also at mitigating the risk of cardiovascular events and slowing the progression of kidney disease.

The clinical management of hypertension in CKD involves a multidimensional approach that includes lifestyle modifications, pharmacotherapy, and monitoring for complications Kalantar-Zadeh *et al.,* 2022). Lifestyle interventions such as dietary sodium reduction, weight loss, and increased physical activity are foundational in managing hypertension. Pharmacological treatment typically involves the use of antihypertensive agents that have been shown to be effective in CKD, such as angiotensin-converting enzyme inhibitors

(ACEIs) and angiotensin receptor blockers (ARBs), which can also slow the progression of kidney disease (Garcia *et al.,* 2022). The choice of antihypertensive therapy in CKD patients requires careful consideration of the stage of kidney disease, comorbid conditions, and potential drug-related side effects.

Recent research has focused on identifying novel biomarkers and therapeutic targets for managing hypertension in CKD (Lousa *et al.,* 2020; Sen *et al.,* 2023). For instance, studies are exploring the role of oxidative stress, inflammation, and the gut microbiome in the pathogenesis of hypertension in CKD patients. These emerging insights could lead to more personalized and effective treatment strategies, potentially improving outcomes for patients with CKD and hypertension. Additionally, there is ongoing research into the benefits of novel antihypertensive agents and their ability to protect kidney function, beyond their blood pressure-lowering effects (Upadhya *et al.,* 2022).

Burnier and Damianaki (2023) evaluated high blood pressure as significant cardiovascular risk factor for the development chronic kidney disease. The study found that hypertension is number one modifiable etiology of premature death and hence is one of the main targets of World Health Organization for prevention. Hypertension is the second leading cause chronic kidney disease (CKD) after diabetes mellitus. Both hypertension and CKD are intrinsically related, in terms of etiology each can lead to the other with advanced kidney disease is one of the secondary cause of hypertension. This etiological relationship is consistent with current literature supporting with finding of high prevalence of hypertension across CKD stages and the benefits of strict control of blood pressure with antihypertensive providing protection against renal and cardiovascular morbidity and mortality.

According to Horowitz *et al.* (2015), achieving desired targets of blood pressure (BP) is inevitable in order to prevent adverse outcomes of uncontrolled hypertension and to achieve this target almost most of the patient will need polypharmacy antihypertensive and lifestyle modification. However, it also requires a proper monitoring of BP measurements (eg, 24-hour ambulatory BP monitoring, home BP), particularly for

populations already at risk like patients with CKD where masked and resistant hypertension are prevalent and lack of recognition is associated with a poor cardiovascular and renal outcome. Among the CKD the optimum BP targets, which remain debated with most of the guidelines recommending BP<130/80 mmhg. The residual cardiovascular risk is still elevated after achieving the target hence modification of other risk factors. Current prescription pattern of antihypertensive have enriched with novel agents that reduce significantly existing renal and cardiovascular risks, such as angiotensin converting enzyme inhibitors/angiotensin receptor blockers.

A study by Olanrewaju *et al.* (2023) with objective to determine cardiovascular risk factor burden and association with development of CKD in Ghana and Nigeria. In the study, participant who have CKD and those without CKD in Ghana and Nigeria were recruited. The findings revealed that the prevalence of abnormally high blood pressure (59%), diabetes mellitus (20%), and hypercholesterolemia (9.9%), was remarkably higher among CKD patients than in the control population ($P < 0.001$). Prevalence of risk factors was significantly higher in Ghana than Nigeria. Hypertension, hypercholesterolemia, old age >50 years, and underweight (BMI) <18.5 kg/m2 were independently associated with CKD.

Another study by Sarfo, et al. (2021) evaluates the risk factors associated with chronic kidney disease among cerebrovascular accident survivors in Ghana. The data were obtained from Stroke registry an out-patient neurology clinic in Ghana for period slightly over two years starting on Jan 2108. The risk associated with Chronic Kidney Disease were determined using varying logistic regression model. Among the participant who were 759 post stroke survivors both male and female, 159 of them had CKD giving a remarkable prevalence of 21.0% (95%CI: 18.1% - 23.8%). The majority of participant with CKD were elderly with average age 61years compared with those without the disease (CKD) with mean age of 57 years. This means that patient with cardiovascular disease are more likely to develop CKD especially the elderly population or the population with CKD have increased risk of developing cardiovascular complication like

stroke, myocardial infarction and sudden death. Locally there is no significant literature on CKD prevalence specifically on hypertensive population despites studies showing hypertension to be second most common cause of nephropathy.

2.4 Mechanism of renal deterioration due to hypertension

Glomerular injury resulting from glomerular hypertension and hypertrophy is poorly understood. It is thought to be multifactorial etiology (Rennke *et al*., 1989). Direct endothelial cell damage with raised vascular wall stress and widened glomerular diameter causes epithelial cells detachment from the wall of glomerular capillaries. This increase permeability with influx of water and solutes with large circulating macromolecules which are unable to cross the glomerular basement membrane being trapped in the sub-endothelial space. The continued accumulation of these deposits leads to narrowing of the capillary lumens thereby obstructing glomerular blood flow and filtration. The increased strain on meningeal cells can stimulate them to produce cytokines (Cortes et al., 1999) such as transforming growth factor-beta contributes to the glomerular injury by mediating the rise in matrix synthesis.

According to Russo *et al.* (2023), the relationship between hypertension and renal deterioration is complex, involving both direct and indirect mechanisms. Directly, increased systemic blood pressure leads to damage within the kidneys' filtering units, the glomeruli. This damage manifests as glomerulosclerosis, a condition characterized by scarring and hardening of the glomeruli, impairing the kidneys' ability to filter waste effectively (Schnaper, 2019). Additionally, hypertension can lead to the narrowing of renal blood vessels, reducing blood flow to the kidney tissues, a condition known as ischemia, which exacerbates kidney damage (Lee et al., 2019). The interplay between these factors accelerates the decline in kidney function, underscoring the critical need for effective blood pressure management in patients with CKD (Mehta et al., 2019).

Beyond the direct hemodynamic impacts, hypertension activates various neurohormonal pathways that further contribute to renal damage (Díaz-Morales *et al.,* 2023). The renin-angiotensin-aldosterone system (RAAS) is particularly significant in this context.

Activation of this system leads to the production of angiotensin II, a potent vasoconstrictor that increases blood pressure and contributes to kidney damage by promoting inflammation and fibrosis (Mehta et al., 2019). The sympathetic nervous system and the endothelin system are also activated in hypertension, contributing to renal injury through mechanisms that include increased renal vascular resistance and promotion of inflammatory processes within the kidney (Kumar et al., 2020). These pathways highlight the multidimensional nature of hypertension-induced renal damage and the importance of targeting these systems in the treatment of hypertensive patients with CKD (Zhao et al., 2020).

Piko *et al.* (2023) opine that oxidative stress and inflammation are pivotal in the progression of renal damage induced by hypertension. The increased production of reactive oxygen species (ROS) in hypertensive conditions leads to oxidative damage and endothelial dysfunction within the kidneys. This oxidative stress, in conjunction with inflammation, contributes significantly to the pathogenesis of CKD by promoting fibrosis and the loss of renal function (Kumar et al., 2020). The infiltration of immune cells into the kidney and the subsequent release of pro-inflammatory cytokines exacerbate renal tissue damage, highlighting the intertwined roles of oxidative stress and inflammation in CKD progression (Lee et al., 2019). Addressing oxidative stress and inflammation is therefore a crucial aspect of managing CKD in the context of hypertension (Zhao et al., 2020).

Structural changes within the kidneys due to hypertension also play a significant role in renal deterioration (Russo *et al.*, 2023). Arteriosclerosis of the renal arteries and the resultant narrowing of these vessels lead to reduced renal blood flow and ischemia, compounding the effects of direct glomerular damage. The consequent hypoxia, or lack of oxygen to the kidney tissues, promotes further injury and fibrosis, contributing to the vicious cycle of hypertension-induced CKD progression (Schnaper, 2019). These structural changes underscore the importance of early detection and management of hypertension to prevent irreversible kidney damage (Lee et al., 2019).

Recent studies have also highlighted the role of genetic and epigenetic factors in the susceptibility to hypertension-induced renal damage. Variations in genes related to blood pressure regulation and kidney function can influence an individual's risk of developing CKD in the setting of hypertension. Moreover, epigenetic changes, such as DNA methylation and histone modifications, can alter gene expression in response to hypertensive conditions, potentially affecting the progression of renal disease (Zhao et al., 2020). Understanding these genetic and epigenetic influences is crucial for identifying individuals at higher risk of CKD and tailoring treatment strategies accordingly (Kumar et al., 2020).

In conclusion, the mechanism of renal deterioration due to hypertension involves a complex interplay of hemodynamic changes, neurohormonal activation, oxidative stress, inflammation, structural alterations, and genetic and epigenetic factors. These mechanisms collectively contribute to the progression of CKD in hypertensive patients. The multifaceted nature of this relationship underscores the need for comprehensive treatment approaches that address both blood pressure control and the underlying pathological processes contributing to renal damage (Schnaper, 2019; Mehta et al., 2019; Zhao et al., 2020). Further research into these mechanisms and their interactions will be crucial for developing more effective strategies to prevent and treat hypertension-induced renal deterioration.

2.5 Factors associated with CKD in hypertension

2.5.1 Age and Gender

A population based study on epidemiology of CKD that was conducted in Eastern China found that age was the leading risk factor of chronic kidney disease (Andong *et al*., 2019). A study conducted in East Africa, Tanzania, revealed old age as one of the factor associated with impaired kidney function (Kaze *et al*., 2018). It was noted that old age is directly proportional to the risk of developing CKD. The study reported higher prevalence of the disease among participant older than 60 years. Generally, renal function declines with age and elder persons being more prone to CKD after renal injury hence age is

independent risk factor for CKD (Kaze *et al*., 2018). However, study conducted in Ethiopia established no link between advancing age and CKD (Kumela *et al*., 2019). Studies have reported that CKD in Sub-Sahara Africa affects mostly young adults and females (Naicker, 2013; Kilonzo *et al*., 2016.) A study conducted in China among elderly population also reported high prevalence of CKD in females compared with the males (Andong *et al*., 2019).

A study by Astley *et al.* (2023) assessing gender as the risk factor of cardiovascular disease in elderly population diagnosed with advanced chronic kidney disease. Varying method analyzing the relation and identify gender difference were used e.g. regression and cumulative incidence competing risk curves in MACE risks in Germany, Italy, the Netherlands, Poland, Sweden and the UK. Mediation analysis was used to identify variables which may explain risk differences between men and women. The study found that a total of 417 men out of 1134 (37%) and 185 women out of 602 women (31%) experienced at least one MACE, over a follow-up period of 5 years. However, the study established that women had an 18% lower risk of first MACE compared with men, which was attenuated after adjusting for pre-existing cardio metabolic comorbidities and cardiovascular risk factors. There were no significant gender differences in the risk of recurrent MACE or fatal MACE.

According to WHO (2022), Chronic Kidney Disease (CKD) is a global health concern, with its prevalence and progression influenced by various factors, including age and gender. Studies across different parts of the world have highlighted the significant impact of these factors on CKD among hypertensive patients. For instance, a study by Coresh *et al.* (2007) conducted in the United States found that the prevalence of CKD increases with age among hypertensive individuals, attributing this trend to the cumulative damage from hypertension over time and the natural decline in kidney function associated with aging. Similarly, research in Europe reported an increased incidence of CKD in older hypertensive patients, suggesting that aging kidneys might be more susceptible to the

damaging effects of high blood pressure, potentially due to reduced renal reserve or age-related vascular changes (Roderick *et al.,* 2009).

Gender differences in the prevalence and progression of CKD among hypertensive patients have also been a subject of research. A study from Asia observed that hypertensive men had a higher risk of developing CKD compared to women, proposing that this could be due to differences in lifestyle factors, hormonal influences, or genetic predispositions that may affect renal susceptibility to hypertension (Chen et al., 2018). In contrast, research from Africa reported a higher prevalence of CKD among hypertensive women, suggesting that biological differences, such as the impact of menopause on renal function, might contribute to this disparity (Osei & Maxwell, 2019).

The role of gender-specific risk factors in the context of hypertension and CKD has been further explored in various studies. For example, a study in North America highlighted that hypertensive women with a history of pregnancy-related complications such as preeclampsia are at an increased risk of CKD later in life, pointing towards the long-term impact of such conditions on renal health (Garcia et al., 2020). On the other hand, research from South America identified that hypertensive men with unhealthy lifestyle choices, such as smoking and excessive alcohol consumption, had a higher incidence of CKD, indicating the influence of environmental and behavioral factors on the progression of kidney disease (Rodriguez et al., 2018). These findings points to the relationship that exists between age, gender, and other risk factors in the prevalence and progression of CKD among hypertensive patients. They highlight the necessity for healthcare professionals to consider these variables when assessing risk and tailoring management strategies for CKD in hypertensive individuals.

Elsewhere Peng *et al.* (2023) assessed the gender differences in the determination of relationship between exercise or physical activity and mortality/morbidity in Chronic Kidney Disease in reference to the results from the National Health and Nutrition Examination Survey (2011–2018). Among males' population the multivariable Cox regression analysis found that the lower level of physical activity (low-active group) and

higher level of physical activity (high-active group) were independently associated with lower risks for all-cause mortality, compared to the group with sedentary lifestyle. It has been part of widely research risk factor and most of the existing knowledge agrees that sedentary lifestyle is significant risk factor for cardiovascular disease as well as renal disease and vice versa is true.

2.5.2 Non-Steroidal Anti-Inflammatory drugs and CKD

CKD patients' management is multidisciplinary involving nephrologist, physician, cardiologist and nutritionist and emphasis is on using lifestyle change, control of hypertension and adjustment medication in background of CKD because one of the kidney function is to excrete medication and its end product (Moore *et al*., 2015). NSAID drugs used in pain management inhibits cyclooxygenase enzyme leading to reduction in synthesis of the vasodilator prostaglandins hence decrease in renal blood flow leading in kidney disease (Leowattana, 2018). Their use contributes to CKD progression (Hsu *et al*., 2015). Studies have found NSAIDs to raise blood pressure significantly on patient already treatment for hypertension resulting from increase in peripheral resistance and blood volume (Wilson *et al*., 2007). Due to its significant benefits of NSAID in management of several medical condition like rheumatoid arthritis, chronic low back pain there is continued use of the them among patient with renal disease.

Non-Steroidal Anti-Inflammatory Drugs (NSAIDs) are among the most commonly used medications worldwide, known for their pain-relieving, anti-inflammatory, and antipyretic properties (Moilanen & Vuolteenaho, 2019; Cherumanalil *et al.*, 2023; Garg & Azim, 2021). However, their use is also associated with a range of adverse effects, notably on renal function. NSAIDs can lead to Chronic Kidney Disease (CKD) through several mechanisms. Primarily, they inhibit the cyclooxygenase (COX) enzymes, which are crucial for the production of prostaglandins. Prostaglandins play a vital role in maintaining renal blood flow, especially in conditions where vasoconstriction might otherwise compromise kidney perfusion Goetz *et al.,* 2017). By reducing prostaglandin synthesis, NSAIDs can decrease renal blood flow, leading to acute kidney injury (AKI),

which, if recurrent or chronic, may progress to CKD. Studies have shown that even short-term NSAID use can impair kidney function, particularly in vulnerable populations such as the elderly or those with pre-existing renal impairment (Schneider et al., 2018).

Baker and Perazella (2020) observes that the risk of NSAID-induced CKD varies among individuals, influenced by factors such as dosage, duration of use, and the presence of underlying renal conditions. Research indicates that the prolonged use of NSAIDs, even at low doses, leads to a gradual decline in kidney function over time (Modig & Elmståhl, 2018; Han *et al.*, 2020). This effect is compounded in patients with conditions such as diabetes or hypertension, which already predispose them to renal damage. A systematic review highlighted the dose-dependent nature of NSAID-induced renal effects, suggesting that both the frequency of use and the potency of the NSAID contribute to the risk of developing CKD (Xu et al., 2019).

A study by Ingrasciotta *et al.* (2015) revealed that certain populations are at an increased risk of NSAID-related renal damage. For instance, elderly patients, who the study found that were more likely to suffer from chronic pain and thus use NSAIDs regularly, have a diminished renal reserve, making them particularly susceptible to the adverse effects of these drugs. Additionally, individuals with pre-existing renal conditions or those on medications that affect renal hemodynamics (such as ACE inhibitors or diuretics) were found to be facing a heightened risk when using NSAIDs. These drugs thus exacerbates renal impairment through a synergistic effect, further reducing renal perfusion and accelerating the progression to CKD (Gooch et al., 2018).

Joy and Vijayan (2022) while evaluating miscellaneous etiologies of acute kidney injury, found that the clinical presentation of NSAID-induced CKD varies, ranging from minimal changes in renal function tests to more severe forms of renal injury, including acute interstitial nephritis (AIN), a condition characterized by inflammation and edema of the renal interstitium. The researcher observed that AIN can lead to significant renal impairment and is often associated with the use of specific NSAIDs. The diagnosis is typically confirmed through renal biopsy, which reveals interstitial inflammation and

edema. The management of NSAID-induced AIN involves discontinuing the offending agent and, in some cases, the use of corticosteroids to reduce inflammation (Perazella, 2019).

Given the potential for NSAIDs to induce or exacerbate CKD, it is crucial for healthcare providers to consider the risk-benefit ratio when prescribing these medications, especially for long-term use. Patients should be informed about the potential renal risks associated with NSAIDs and advised to use the lowest effective dose for the shortest possible duration. Alternative pain management strategies, such as acetaminophen or non-pharmacological interventions, should be considered, particularly in high-risk individuals. Ongoing research into the renal effects of NSAIDs and the development of safer analgesic alternatives remains a priority in the field of nephrology (Zhao et al., 2020).

2.5.3 Overweight, Obesity and CKD

Overweight and obesity are key risk factor of hypertension and CKD (Wachukwu *et al*., 2015). They elevate proteinuria in the body resulting to hyperfiltration and gradual reduction of normal glomerular filtration rate (Wickman and Kramer, 2013). Study by shown that abdominal obesity is associated with inferior renal results (Kovesdy *et al*., 2017). Obesity deteriorate patients with prevailing nephropathies and may increase chance of graft failure after kidney transplant. Rotich et al. (2017) found that the risk for CKD observed among obese individual is allied to the increased prevalence of hypertension and/or type II diabetes (Rotich, 2017). Comparative study which was survey based done in Turkish established that 29% of the obese population had Chronic Kidney Disease compared to 20% among the normal range BMI population (Mkuu *et al*., 2018).

Overweight and obesity are increasingly recognized as major public health challenges worldwide, with significant implications for the development and progression of chronic kidney disease (CKD), particularly in individuals with hypertension. The interplay between excess body weight and hypertension is complex and multifaceted, influencing

renal function through various mechanisms. Epidemiological studies have consistently shown that overweight and obesity are associated with an increased risk of developing CKD. This relationship is partly attributed to the fact that excess adiposity, especially visceral fat, contributes to systemic inflammation and oxidative stress, which are key pathways in the pathogenesis of CKD. Moreover, obesity-related glomerulopathy, characterized by glomerular hypertrophy and focal segmental glomerulosclerosis, is an emerging entity that further underscores the direct impact of obesity on kidney health (Kovesdy et al., 2018).

In hypertensive individuals, the risk of CKD attributable to overweight and obesity is even more pronounced. Hypertension itself is a well-established risk factor for renal damage, and when combined with excess weight, the risk is synergistically increased. The mechanisms underlying this enhanced risk include the exacerbation of hypertension by obesity through volume expansion, increased renal sodium reabsorption, and activation of the renin-angiotensin-aldosterone system (RAAS). These pathophysiological changes not only elevate blood pressure but also directly impair renal function by inducing glomerular hyperfiltration and increasing intraglomerular pressure, which, over time, can lead to glomerulosclerosis and a decline in renal function (Hall et al., 2019).

Moreover, obesity and overweight are closely linked with metabolic syndrome, a cluster of conditions that includes insulin resistance, dyslipidemia, and hypertension, all of which contribute to the risk of CKD. Insulin resistance, in particular, has been implicated in the development of CKD by promoting hyperfiltration and increasing the demand on the kidneys. Additionally, the lipid abnormalities associated with metabolic syndrome can lead to lipid deposition in the kidneys, exacerbating renal damage. The cumulative effect of these metabolic disturbances in hypertensive patients significantly accelerates the progression of CKD, highlighting the importance of managing metabolic risk factors in this population (Cheung et al., 2018).

The global variation in the prevalence of obesity-related CKD among hypertensive patients points to the influence of genetic, environmental, and lifestyle factors. Studies from diverse populations have reported varying degrees of risk associated with obesity and overweight, suggesting that genetic predisposition, dietary habits, physical activity levels, and socioeconomic factors all play roles in the development of CKD in the context of obesity and hypertension. For instance, research in Asian populations, where there is a higher propensity for visceral fat accumulation at lower body mass index (BMI) levels, has shown a strong association between obesity and CKD in hypertensive individuals, indicating a possible genetic susceptibility to the renal effects of obesity in these populations (Wang et al., 2019).

Interventional studies have demonstrated the potential benefits of weight loss, through lifestyle modifications or bariatric surgery, on improving renal outcomes in obese hypertensive patients. Weight reduction has been shown to decrease proteinuria, a marker of kidney damage, and improve glomerular filtration rate (GFR), suggesting a direct beneficial effect on renal health. These improvements are likely mediated by reductions in blood pressure, amelioration of metabolic abnormalities, and decreased renal hyperfiltration following weight loss. Such findings underscore the importance of incorporating weight management strategies into the comprehensive care of hypertensive patients with or at risk for CKD (Navaneethan et al., 2019).

2.6 Diagnosis and management of CKD

Screening of CKD is not common and especially in developing countries. Since most individuals with CKD are asymptomatic, screening is paramount for early detection and intervention and preventive measures to lower chances of progression to CKD (Inker et al., 2012). Laboratory measurement of both serum creatinine and urine protein are the common kidney profile tests established by National Kidney Foundation. A risk-based approach to screening is recommended in those above 60 years and those with history of DM or hypertension (Inker *et al*., 2012; Bilo *et al*., 2015). CKD screening is also recommended in those with clinical comorbidity such as diabetes mellitus, obesity, those

with family history of CKD, reduced kidney mass and exposure to NSAIDs. Screening of high-risk populations for CKD is a strategy that should be implemented and recommended which is done in most medical outpatient clinics particularly those with comorbidities (Naicker, 2013).

According to reports by WHO (2021), Chronic Kidney Disease (CKD) represents a significant health concern worldwide, characterized by the gradual loss of kidney function over time. The literature on CKD emphasizes early diagnosis and comprehensive management to slow the progression of the disease and mitigate associated complications (Kakitapalli *et al.* (2020; Ruiz-Ortega *et al.,* 2020). According to Sobrinho *et al.* (2020), diagnosis of CKD primarily involves assessing kidney function through blood tests to measure glomerular filtration rate (GFR), and urine tests to detect abnormalities such as proteinuria, which indicates kidney damage. Imaging tests and kidney biopsies may also be used to determine the underlying cause of the kidney damage and to guide treatment strategies. A study by Ameh *et al.* (2020) indicated that management of CKD requires a proper approach that addresses the underlying causes and risk factors, such as diabetes and hypertension, which are the leading causes of CKD. The literature lays emphasis on the importance of controlling blood pressure and blood sugar levels to slow kidney damage. Moreover, Schrauben *et al.* (2022) contend that lifestyle modifications, including a healthy diet, regular physical activity, and smoking cessation, are also emphasized as critical components of effective CKD management. These changes can help improve patient outcomes by reducing the risk of further kidney damage and other complications.

Research has also shown that pharmacological treatments play a pivotal role in CKD management, with a focus on medications that lower blood pressure, manage diabetes, and reduce proteinuria (Gembillo *et al.,* 2021; Karoui *et al.,* 2024; Ruggenenti *et al.,* 2012). Angiotensin-converting enzyme (ACE) inhibitors and angiotensin II receptor blockers (ARBs) are commonly prescribed to protect kidney function and manage hypertension. A study by Sugahara et al. (2021) stressed the importance of addressing

complications of CKD, such as anemia and bone disease, through appropriate medications and supplements. Advanced CKD may require more intensive interventions, including dialysis or kidney transplantation. The decision between hemodialysis, peritoneal dialysis, and transplantation depends on various factors, including the patient's overall health, preferences, and the availability of resources (Wang *et al.*, 2023). The literature discusses the benefits and challenges associated with each of these treatment options, emphasizing the need for individualized care plans that consider the patient's quality of life and treatment goals. Finally, ongoing monitoring and support are crucial for individuals with CKD. The literature advocates for regular follow-up appointments to monitor kidney function and adjust treatments as needed.

2.7 Diagnosis of CKD and hypertension

The criteria for making a diagnosis of chronic kidney disease according to (KDIGO, 2013):

1- GFR less than 60 mL/min/1.73m2 for a period not less than 3 month

and/or

2- Renal damage for a period not less than 3 months which is manifested as abnormalities in kidney structure or function. This can be picked by a laboratory test like urea and creatinine levels, bone biochemistry and proteinuria and imaging like renal ultrasound

The study utilized serum creatinine which is a blood test that is marker of kidney function and is used to calculate the Glomerular Filtration Rate (GFR) and urinalysis which estimates the protein level in urine.

Glomerular filtration rate

The glomerular filtration is a vital process in the kidneys that filters blood, removing excess waste product and fluids to form urine. GFR is the rate at which plasma is filtered by the kidney glomeruli and an important measurement of kidney function. It measures the serum creatinine level a byproduct of creatinine phosphate breakdown in the muscles

and it is cleared by from the by the kidney despite produced at fairly constant rate. It rises in any kidney pathology that impairs its normal functioning.

There are several techniques that has been developed for calculation of the GFR. The study utilized the most recent method which is the CKD-EPI (Chronic Kidney Disease Epidemiology Collaboration) formula, published in 2009 (Levey et al., 2009; Levey et al., 2010b).

The CKD-EPI equation it takes into account the person's age, gender and race

The Equation formula

$GFR_{CKD\text{-}EPI} = 141X \min [Scr/k, 1]^{a} x \max [Scr/k,1]^{-1.209} x\ 0.993^{age} x\ 1.018$ [if female] x1.159[if black]

- Scr: Serum creatinine
- κ: 0.7 for females and 0.9 for males
- α -0.329 for females and -0.411 for male

STAGES OF CKD BASED ON GFR

GFR STAGES	**GFR(ml/min/1.73 m2)**
Stage 1	90 or More
Stage 2	60-89
Stage 3a	45-59
Stage 3b	30-44
Stage 4	15-29
Stage 5/ESRD	<15

Albuminuria

Albumin is a type of protein which is a marker of kidney disease when excreted in the urine. When it is found in the urine is called albuminuria. Generally, urine dipstick is the most convenient widely available method of detecting proteins in the urine and it is highly specific but less sensitive. The albumin-to-creatinine ratio (ACR) is more sensitive and more confirmatory and ACR values that is less than 30 mg/g are usually considered normal or mildly increased (KDIGO, 2013).

Albuminuria categories in chronic kidney disease

Category	**ACR(mg/g)**
Albuminuria category 1	<30
Albuminuria category 2	30-300
Albuminuria category 3	>300

Hypertension

Hypertension is defined based on Joint National Committee (JNC 8) blood pressure of 140/90mmhg or more in two separate occasions or patients who are already on antihypertensive medication.

Classification of Hypertension

Category	**Systolic (mmHg)**	**Diastolic (mmHg)**
Normal	<120	<80
Prehypertension	120-139	80-89
Grade 1 hypertension	140-159	90-99
Grade 2 hypertension	>/= 160	>/= 100

Adapted from JNC 8.

CHAPTER THREE: MATERIALS AND METHODS

3.1 Study design

The study adopted analytical cross sectional as the quantitative approach, while qualitative approach utilized a key informant interview approach. This type of study design was cost effective, time conscious and gave the appropriate association of the variables.

3.2 Study variables

3.2.1 Dependent Variable

(i) Presence or absence of Chronic kidney disease

3.2.2 Independent Variables

(i) Sociodemographic characteristics: age, sex, educational status, occupation, income,
(ii) Clinical characteristic: Obesity, diabetes family history of CKD, class of medication used, duration of drugs, number of drugs, comorbidity
(iii) Lifestyle characteristics: smoking, physical activity, compliance to medication, dietary habit

3.2.3 Intervening Variables

They included healthy diet, regular medical checkups

3.3 Study Area

This study was carried out in Wajir County which is located North-Eastern region of Kenya and has population of 781,263. The study site was Wajir County Referral Hospital (WCRH) at Medical Outpatient Clinic (MOPC). The Hospital serves six constituencies in Wajir County. The constituencies are: Wajir-north, Wajir-East, Wajir-west, Wajir-south, Tarbaj and Eldas. WCRH is the largest referral Hospital in the county that provides

service to the resident across all the six constituencies making the study population true reflection of the whole county.

The study did not include private since there was no established private facilities in the county and most resident could not afford to go small private clinics hence prefer WCRH because of availability of expertise and investigative capacity.

3.4 Study population

The study participants were selected from adult hypertensive patients attending Medical Outpatient Clinic (MOPC) at Wajir County Referral Hospital. The sample of study was drawn from all consenting adult both male and female who have been diagnosed with hypertension. Patient under age of 18 years were not eligible for the study.

3.5 Selection Criteria

3.5.1 Inclusion criteria

The study participants included adult with hypertension (18 years and above) who gave consent to participate the study.

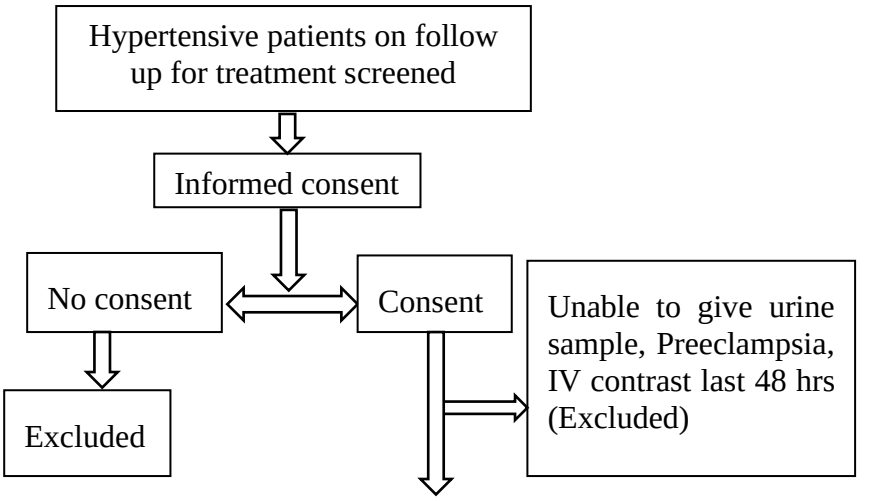
3.5.2 Exclusion criteria

The study excluded pregnant women with preeclampsia, patients who had on intravenous contrast the last 48-72 hours, patients with gastroenteritis the last 48-72 hours and patient diagnosed with obstructive uropathy.

3.6 Sampling techniques

The study utilized consecutive sampling method where the subject who meet the selection criteria are interviewed until the required sample size is met. Participant were sampled during Monday and Thursday medical outpatient clinics. The patients were approached and informed about the study in detail and allowed to understand it through questions and answers. Written informed consent form provided and data collected upon signing.

Screening and consenting chart



362 patients were recruited in the study

- Dully filled Questionnaire administered
- Consented
- Met all inclusion criteria
- Blood and urine sample taken

3.7 Sample Size Determination

The sample size was calculated using the formula (Daniel, 1999)

$$\underline{n = z^2pq}$$

$$d^2$$

n = is the minimum sample size

z = is the normal standard deviation which in this study was 1.96

d = is the margin of error (i.e., 0.05 = ± 5%)

p = prevalence of CKD among hypertensive patients. The Kenya national prevalence is estimated to be about 38% (1000 per 10,000), which is based on Mwenda *et al*. (2019)

estimated CKD prevalence among medical inpatients at Kenyatta National Hospital (KNH)

q = is 1-p=1-0.10

$n= (1.96)^2 x0.38x (1-.38)/0.05^2$

n=362

3.8 Pre-Testing

Pre-testing study was conducted in Garissa County Referral Hospital from which 36 respondents were randomly selected for the purposes of pre-testing to demonstrate clarity and objectivity of research instrument. The respondents that participated in the pre-test was excluded in the main study**.**

3.8 Validity

To ensure content validity, the questionnaire was subjected to thorough examination by University Supervisors. They were asked to evaluate the statements in the questionnaire for relevance and whether they are meaningful, clear and objective. The personnel who were recruited for the research assistants were trained. This ensures standard procedures as outlined in the research process are used when collecting information from the participant.

3.9 Reliability

In this study, reliability was measured using Cronbach alpha α, as a coefficient of internal consistency where reliability of 0.7 and above was considered reliable for this study (Philip, 2011). The value for Cronbach alpha is 0.7 to 1.0 is considered acceptable according to Abouserie (1992).

3.10 Data Collection

The method of data collection for the study was cross-sectional for primary data and secondary (laboratory results). The study utilized standardized tool comprising both quantitative and qualitative data. The questionnaire was structured in such a way that it included both open ended questions and closed ended questions, had four sections. Section one and two focused on the sociodemographic and behavioral information respectively, the other section focused on medical specific information including medical history, anthropometric and laboratory test, this information was collected from existing secondary data in patients' medical record and prospect prospectively. Key informant interview was conducted on facility in charge, clinic in charge, clinician and nurses.

3.10.1 Data collection techniques

Clients seeking MOPC clinic service were identified from the registration desk at the identified facilities. All consecutive patients meeting the inclusion criteria were recruited to participate in the study. Every client who met the inclusion criteria and gave a verbal and written informed consent in their preferred language was recruited consecutively until the desired sample size was achieved, this was done during Monday and Thursday clinics day. Recruitment was done by research assistants trained on good clinical practice and conduct of the research. Face to face interview was then conducted by the research assistant using a pretested structured questionnaire. Upon conclusion, the participant was thanked for their participation. Further, the researcher obtained laboratory test results (secondary data) of the respondents. In addition, all the respondents whose secondary data were not available, the cost of the laboratory tests of the respondents were paid by the researcher. The appropriately filled questionnaires, laboratory results and consent forms were collected and arranged in a box file. For confidentiality purpose, the file was placed safely in a cabinet under lock and key for future analysis.

3.10.2 Diagnosis of Chronic Kidney Disease

The diagnosis of chronic kidney disease was based on eGFR that is less than 60ml/mi/1.73m^2 that is calculated using CKD-EPI formula that puts into consideration the gender, race, age and serum creatinine level and or urine dipstick proteinuria =/> 1+ in known or newly diagnosed hypertensive patients. We further categorized the participant on the stages of CKD they fall using the EGFR level.

3.10.3 Blood pressure Measurement

The blood pressure was measured after the client had rested for five minutes in upright seated position using mercury sphygmomanometer**.** Blood pressure in both arms was measured.

3.10.4 Laboratory Methods

The participant were asked to provide 10mls of midstream urine sample that is taken to the laboratory. The presence or absence of proteinuria which is marker of kidney disease is identified. Two milliliters of venous blood is also taken from a peripheral veins and the level of blood creatinine measured and GFR was calculated using the CKD-EPI (Chronic Kidney Disease Epidemiology Collaboration) formula, published in 2009 (Levey et al, 2009; Levey et al., 2010b). The CKD-EPI equation it takes into account the person's age, gender and race

3.11 Data Analysis

Once the appropriately filled questionnaires were availed and analyzed for completeness, the data in hard copy were entered in Microsoft Excel, reviewed for consistency and completeness and analyzed using statistical package for social sciences (SPSS) software 26.0 to aid in coding, entry and analysis of the quantitative data in relation to the research objectives. Frequencies were presented as absolute values and percentages. Associations between categorical variables and CKD prevalence were assessed using contingency tables and Chi-square tests. Strength of association was measured using 95% confidence

intervals. The categorical data was summarized as graphs, frequency charts and tables then association done by Chi-square. Binary logistic regression was carried out to find the significant risk factor for CKD prevalence among hypertensive patients. For all tests, $p \leq 0.05$ (5% level of significance) was considered to be statistically significant. Qualitative was analyzed using thematic analysis to establish themes and trends.

3.12 Dissemination and Community Consideration

The research findings would be disseminated to the Wajir County department of Health to improve policies that may lead better management of patients living with hypertension and improve prevention of its complication like Chronic Kidney Disease. The research findings would also be disseminated to NACOSTI.

3.13 Ethical Consideration

3.13.1 Ethical Review and Approval

The study was approved by the Graduate School, ethical clearance was sought from Kenyatta University Ethics review committee who reviewed the proposal and approved all study procedures. Research permit to conduct the study was thereafter obtained from the National Commission for Science, Technology and Innovation (NACOSTI). Research authorization was given by the Wajir County Department Medical Services, Public Health and Sanitation. All study personnel were trained in ethical issues related to study participants. Study participants were informed about the study objectives and procedures for data collection, and their right to refuse to participate, to decline to answer any questions, and to withdraw from the study at any time. A written consent was obtained from all study participants. All interviews were carried out by trained research assistant. The participants were assured of confidentiality and anonymity as there were no personal identifiers on the administered questionnaires. The computer used was password protected to protect the privacy of the participants. Any adverse findings were reported to those responsible for their care and to the Ethics and Review Committee. Medical advice was provided whenever necessary.

CHAPTER FOUR: RESULTS

4.0 Overview

This study was carried out with the purpose of examining the prevalence and risk factors associated with chronic kidney disease among the hypertensive patients in Wajir County, Kenya. The specific objectives of the study were; to determine the prevalence of chronic kidney disease among hypertensive patient in Wajir County, to establish risk factor associated with the development of chronic kidney diseases among hypertensive patient in Wajir County and to determine the preparedness of Wajir county referral Hospital in management, referral and linkage of hypertensive patients. This chapter presents the findings of the study which are organized as follows: Response rate results, the socio-demographic variables, descriptive statistics on the study variables, bivariate analysis and logistics binary regression analysis. SPSS was utilized to obtain descriptive data and assess the correlation between the study variables. Data was summarized in textual tables, charts, and graphs to provide a more logical and comprehensible picture of the outcomes.

4.1 Rate of Response

The target population of the study comprised adult hypertensive patients attending Medical Outpatient Clinic (MOPC) at Wajir County Referral Hospital. The sample of study was drawn from all consenting adult both male and female who had been diagnosed with hypertension. The sample size was made up of 362 respondents to whom questionnaires were administered. From the 362 questionnaires administered, 293 were dully filled and returned, yielding a response rate of 81%. A response rate of 60% or higher according to Dillman (2002) is considered good, while rates over 70% are considered very good. For some medical or scientific research, higher response rates of 80% or even 90% may be aimed for to ensure the results are as accurate as possible (Rattray & Jones, 2007). The completed surveys were utilized to collect data. Higher response rate like the one of this study is considered better because it tends to make the results more reliable and less likely to be biased.

4.2 Socio-Demographic Characteristics of hypertensive patients in Wajir County.

The results presented in Table 4.1 shows a comprehensive overview of the demographic characteristics of adult hypertensive patients attending the Medical Outpatient Clinic at Wajir County Referral Hospital.

Table 4.1: Sociodemographic Characteristics of hypertensive patients in Wajir County.

Variable	Category	Frequency (N=293)	Percentage
Age	<40 years	64	21.9
	41-50 years	66	22.5
	51-60 years	47	16.0
	More than 60 years	116	**39.6**
Gender	Male	215	73.4
	Female	78	26.6
Religion	Islam	265	90.4
	Christian	28	9.6%
Marital Status	Single	22	7.5
	Married	261	89.1
	Widowed/ Separated/divorced	10	3.4
Education	No formal Education	112	38.2
	Primary	93	31.7
	Secondary	69	23.5
	Tertiary/Post-secondary	19	6.6
Employment Status	Unemployed	109	37.2
	Housewife	77	26.3
	Self-employed	69	23.5
	Formal employment	38	13.0

The findings show that majority of respondents had no formal education (38.2%), this implies that hypertension was common among low literacy population in the County. The most significant age group affected by hypertension was those over 60 years old, making up 39.6% of the sample. Additionally, a large majority of respondents were found to be male (73.4%), suggesting that men are either more likely to be hypertensive, more likely to seek treatment, or both. The results further show that most respondents were of Islamic faith (90.4%) and were married (89.1%). Regarding employment status most were unemployed at 37.2% as shown in table 4.1 above.

4.3 Prevalence of Chronic Kidney Disease among hypertensive patients in Wajir County.

To determine the prevalence of chronic kidney disease among hypertensive patient in Wajir County. Figure 4.1 shows the prevalence of CKD among the studied respondents. Result of the study shows that a significant proportion of the respondents (133, 45.4%) had CKD. Conversely, 160 (54.6%) of the respondents did not have CKD.

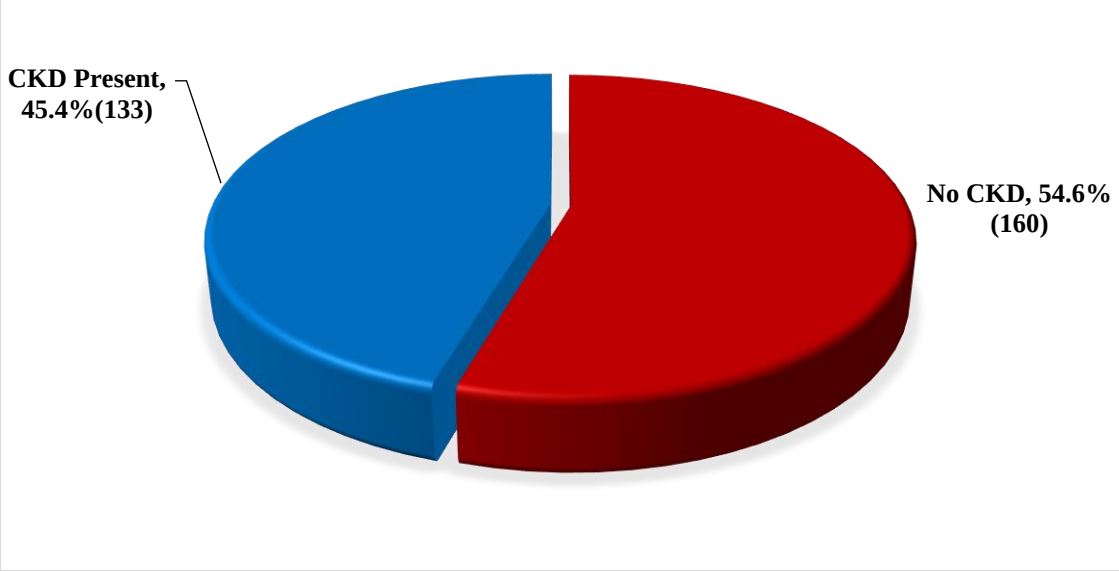


Figure 4.1: Prevalence of Chronic Kidney Disease among hypertensive patients in Wajir County.

4.3.1 Pattern of BMI among hypertensive patients in Wajir County.

BMI finding are presented in table 4.2. The results show that 13.7% of the respondents had a BMI of less than 18.5, basically indicating that they underweight. On the healthier spectrum, 32.8% of the study participants fell within the 18.5-24.9 range, aligning with the World Health Organization's criteria for a normal BMI. Notably, 31.1% of the participants had a BMI between 25 and 29.9, placing them in the overweight bracket. Moreover, 22.5% of the participants had a BMI exceeding 30, classifying them as obese.

Table 4.2: Pattern of BMI among hypertensive patients in Wajir County.

BMI	Frequency	Percentage
<18.5	40	13.7
18.5-24.9	96	32.8
25-29.9	91	31.1
>30	66	22.5
Total	**293**	**100**

4.3.2 Association between BMI and development of CKD

The study sought to establish the association between BMI and CKD.

The results are presented in Table 4.3, shows that there was a significant association between Body Mass Index (BMI) and the presence of Chronic Kidney Disease (CKD), supported by a chi-square value of 21.961 and a p-value of 0.001, indicating statistical significance. The results show that individuals with a BMI of less than 18.5 showed a CKD prevalence of 22.5%, suggesting that underweight status is associated with CKD to some extent. However, the study found that CKD prevalence was common among those in higher BMI categories, where those with a BMI of 25-29.9 (overweight) had a 65.9% prevalence of CKD, and this prevalence increased to 81.8% (54) in individuals with a BMI greater than 30 (obese). In contrast, the findings show that the normal BMI range of 18.5-24.9 exhibited the lowest CKD prevalence at only 3.1%.

Table 4.3: Association between BMI and development of CKD among hypertensive patients in Wajir County.

		Presence of CKD		Cross Tabulation Chi-square	
Variable	**Unit**	**Yes, N (%)**	**No, N (%)**	**Value**	**P-value**
BMI	<18.5	9(22.5%)	31(77.5%)	21.961	**0.001**
	18.5-24.9	3(3.1%)	93(96.9%)		
	25-29.9	60(65.9%)	31(34.1%)		
	>30	54(81.8%)	12(18.2%)		

4.3.3 Proteinuria and development of CKD

The study also sought to determine the proportion of the study participants with proteinuria. The results are presented in Figure 4.3. They indicated that 164 (55.90%) of the participants did not have proteinuria, while 129 (44.10%) were found to have proteinuria.

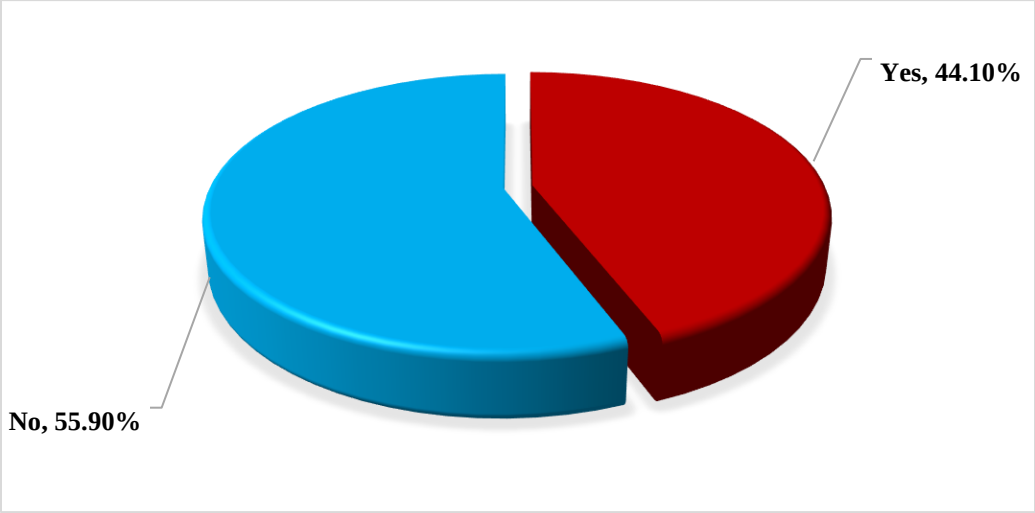


Figure 4.2: Presence of Proteinuria among hypertensive patients in Wajir County.

Stages of CKD

Table 4.4: Prevalence of CKD as per Stages among hypertensive patients in Wajir County.

CKD Stage	Frequency	Percentage
Stage 1	73	**54.6**
Stage 2	19	14.8
Stage 3a	2	1.5
Stage 3b	17	12.6
Stage 4	20	15.0
Stage 5/ESRD	2	1.5
Total	**133**	**100**

The study further sought to determine the CKD stages among the study participants who were found to have CKD. The findings are presented in Table 4.4. The results show that more than half of the respondents (54.6%) were in Stage 1 of CKD. Regarding other stages of CKD 14% of the respondents were found to be in Stage 2, 1.4% of the study participants were in Stage 3a, However, 12.6%, were in Stage 3b,15% the respondents had Stage 4 CKD and only 2% were in Stage 5, also known as end-stage renal disease (ESRD.

4.4 Risk Factor Associated with the Development of Chronic Kidney Diseases

The second objective of the study was to establish risk factor associated with the development of chronic kidney diseases among hypertensive patient in Wajir County. This section presents binary logistics regression analysis regarding the association between risk factors and development of CKD among hypertensive patient in Wajir County.

4.4.1 Association between Demographic Characteristics and Development of CKD

The results of association between demographic characteristics and development of CKD are presented in Table 4.5. Findings show that there was a significant association between

the age of hypertensive patients and the development of chronic kidney disease (CKD) in Wajir County. Specifically, the results show that patients aged between 51-60 years were more likely to develop CKD compared to those aged less than 40 years (OR=2.462, CI 2.623-44.612, P-value < 0.001). Gender of the respondent was also found to be significantly associated with the development of CKD. Females were more likely to develop CKD than their male counterparts (OR=5.928, CI 0.401-0.921, P-value < 0.001). Other variables such as education and employment status were also significantly associated with the development of CKD. The study found that patients with tertiary or post-secondary level of education were 0.981 times less likely to develop CKD compared to those with no formal education (OR=0.981, CI 2.281-2.791, p-value < 0.001). Additionally, those in formal employment were 0.945 times less likely to develop CKD compared to the unemployed ones (OR=0.945, CI 0.581-0.832, p-value < 0.001).

Table 4.5: Association between Demographic Characteristics and Development of CKD among hypertensive patients in Wajir County.

Variable	Category	OR	Lower	Upper	P-value	95% (CI)
Age	<40	Ref				
	40-50 years	4.261	0.536	8.292	0.107	
	51-60 years	2.462	2.623	44.612	<0.001	
	>60 years	3.981	0.723	1.120	0.126	
Gender	Male	Ref				
	Female	5.928	0.401	0.921	<0.001	
Religion	Muslim	Ref				
	Christian	0.520	0.993	11.055	0.735	
Marital status	Single	Ref				
	Married	0.328	2.201	8.921	<0.001	
	Widowed /separated	0.917	0.291	1.027	1.032	
Education	No formal education	Ref 0.790				
	Primary	0.625	0.243	11.119	0.116	
	Secondary	0.981	0.511	1.103	0.073	
	Tertiary		2.281	2.791	<0.001	
Employment status	Unemployed	Ref				
	Housewife	0.705	0.511	1.989	0.231	
	Self employed	0.620	0.453	1.119	0.104	
	Formal employment	0.945	0.581	0.832	<0.001	

4.4.2 Association between Clinical Factors and Development of CKD

The study also sought to assess the association between clinical factors and development of CKD among hypertensive adults in Wajir County.

Type of Antihypertensive Medication used by hypertensive patients in Wajir County.

The type of antihypertensive medication are presented in Figure 4.3. the results depicts that the majority of the study participants used combination of CCB (Calcium Channel Blockers) and Thiazides (55.10%). This implies that this combination is likely to be the first line of treatment or the most preferred therapeutic approach for hypertension in Wajir County. In addition, single-agent CCB use was reported by 14.20% of the respondents,

indicating that a significant portion of the hypertensive population were on it as the initial medication for hypertension management or they respond well to this monotherapy.

Moreover, the combinations of ARBs (Angiotensin II Receptor Blockers) and Thiazides and ACEI (Angiotensin-Converting Enzyme Inhibitors), CCB, and Beta blockers were used by 11.60% and 8.10% of the respondents respectively. The usage of multiple drug combinations suggests that a portion of the hypertensive population in Wajir County have resistant or more severe forms of hypertension, requiring multiple drugs to achieve blood pressure control. Furthermore, 7.50% of the patients were on a combination of CCB, ARBs, and Beta blockers, and 3.50% were on Thiazides and centrally acting drugs.

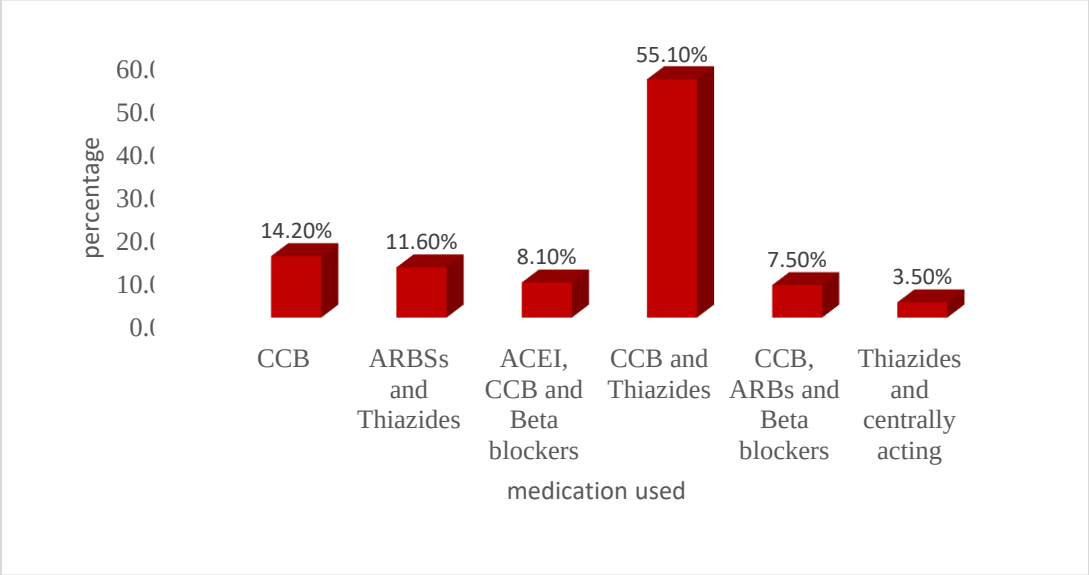


Figure 4.3: Type of Antihypertensive Medications used among hypertensive patients in Wajir County.

Compliance with Antihypertensive Medication among hypertensive patients in Wajir County.

The results are presented in Figure 4.4 shows that majority (186, 63.50%) of respondents found difficulty in taking their antihypertensive medication, suggesting most of the hypertensive adults in Wajir are not compliant. In contrast, 107 (36.50%) of respondents expressed no challenges with compliance.

The respondents (hypertensive adults) were also asked to indicate if they found difficulty in taking blood pressure medicine (compliance). The results are shown in Figure 4.4.

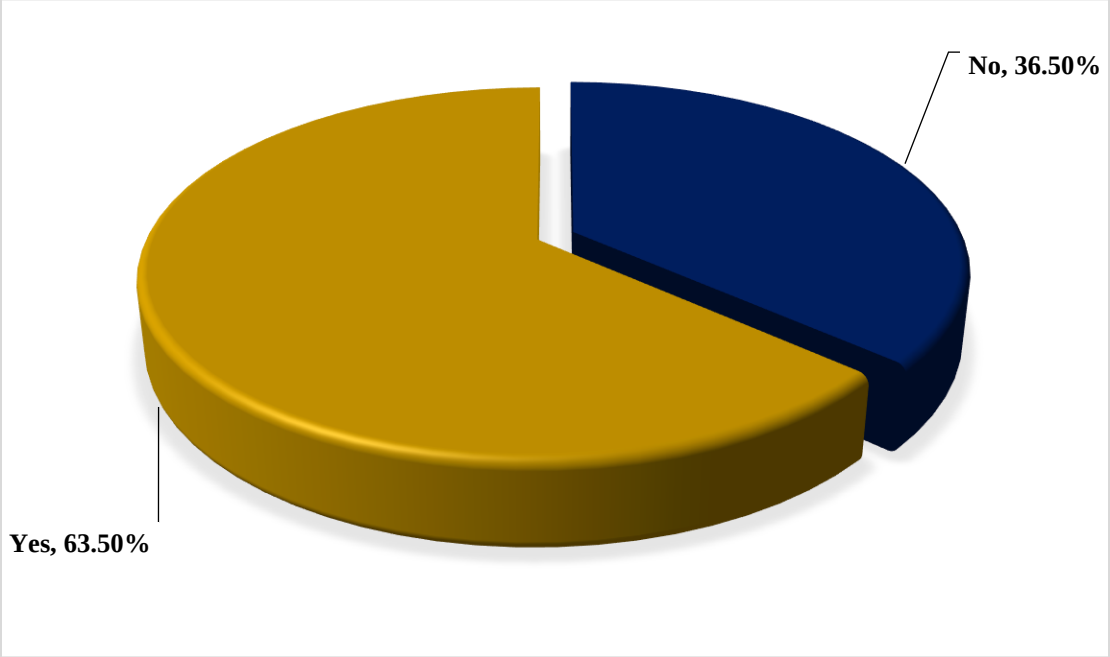


Figure 4.4: Compliance to antihypertensive medication among hypertensive patients in Wajir County.

Presence of Diabetes among hypertensive patients in Wajir County.

The respondents were also asked to indicate if they had been diagnosed with diabetes of not. Based on the results, majority (241, 82.30%) of respondents, reported that they did not have diabetes. However, there remains 52(17.70%) confirmed they were diabetic.

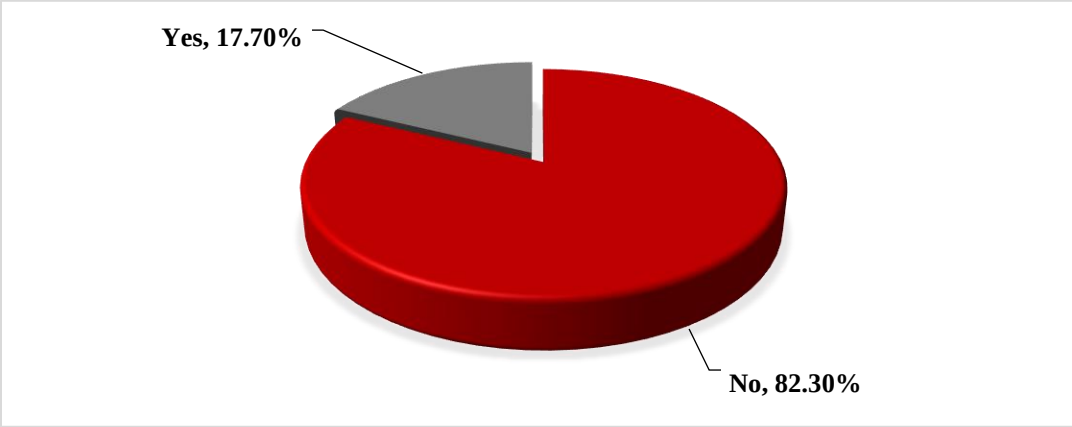


Figure 4.5: Presence of Diabetes among hypertensive patients in Wajir County.

Diabetes Medication

For those who reported to have diabetes, they were asked to indicate the medications they were using for their debates. The results show that combination of Metformin and Sulphonylureas was the most popular treatment choice for respondents with diabetes, with 35.70% of the respondents using these medications. The second most common treatment combination was found to be Metformin and DPP4 INHIBITORS, with 22.20% of respondents using this combination Moreover, about 19.90% of the respondents are using Metformin alone. The results also show that 12.50%, of respondents were using DPP4 INHIBITORS alone. Only 9.70% of the respondents were found to be on Insulin therapy.

Table 4.6: Diabetes Medication used among hypertensive patients with diabetes in Wajir County

Diabetes Medication	**Frequency**	**Percentage**
Metformin and Sulphonylureas	19	35.70
Metformin and DPP4 INHIBITORS	12	22.20
Metformin	10	19.90
DPP4 INHIBITORS	7	12.50
Insulin	4	9.70
Total	**52**	**100.00**

4.4.3 Association Diabetes and CKD

The researcher also sought to establish the proportion of diabetic patients with CKD. The results in Figure 4.6 reveals that a significant number 20 (39.30%) of diabetic adults in Wajir County reported having CKD. However, it is also important to note that the majority of diabetic patients, at 32 (60.70%), reported not having CKD.

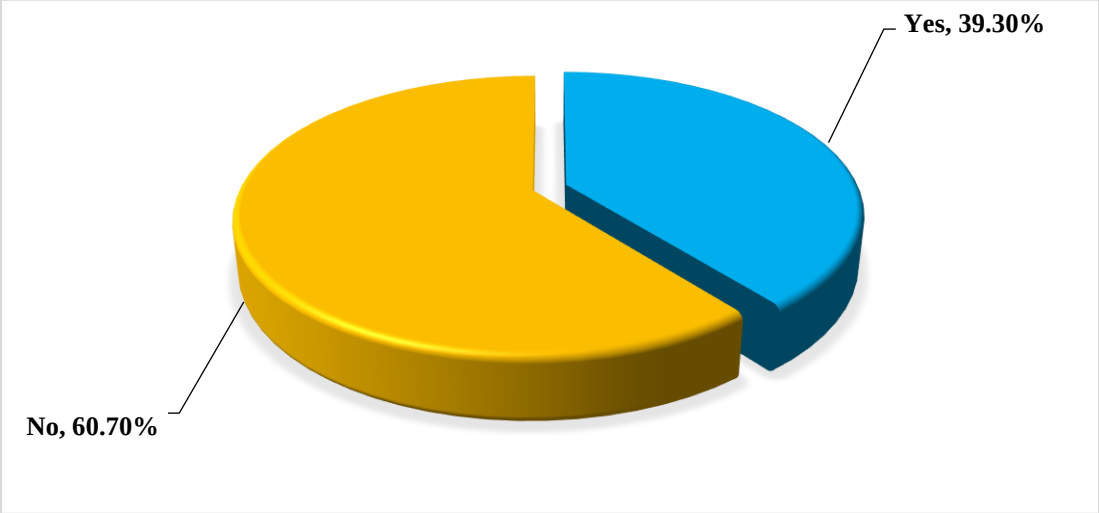


Figure 4.6: Diabetes and development of CKD among hypertensive patients in Wajir County.

4.4.4 Association between Clinical Factors and Development of CKD

The study sought to establish risk factors associated with the development of chronic kidney diseases among hypertensive patient in Wajir County. The results are presented in Table 4.7. The findings indicate that various clinical factors significantly associated with the development of chronic kidney disease (CKD) among hypertensive adults in Wajir County. Specifically, the results show that adults who had elevated levels were significantly more likely to develop CKD as compared to those with normal blood pressure (OR=1.384, CI 1.234-1.572, P-value < 0.001). Additionally, those who experienced difficulty taking blood pressure medication were more prone to CKD compared to those who had no difficulty taking medications, with the odds being high (OR=3.036, CI 2.948-6.937, P-value<0.001).

The study also found that individuals with a family history of hypertension had about 2.9 times the odds of developing CKD compared to those whose families had no history of the condition (OR=2.881, CI 2.381-2.823, P-value < 0.001). Moreover, adults with a family history of CKD themselves had over five times the odds of developing CKD compared to those that did not have such history in their families (OR=5.271, CI 3.816-11.838, P-value < 0.001). The study also found that history of stroke was a strong risk factor for CKD (OR=3.283, CI 2.182-2.910, P-value < 0.001). Moreover, for individuals who had undergone radiology, the results indicate an increased odd of developing chronic kidney disease (CKD) compared to those who had not undergone radiology (OR= 3.383, CI 2.062-5.092, p-value <0.001).

Another significant factor was BMI, the study found that adults with a BMI between 25 and 29.9 were about 2.5 times more likely to develop CKD compared to those with BMI of between 18.5 and 24.9 (OR=2.462, CI 2.381-6.712, P-value < 0.001). Moreover, it is evident that adults who were satisfied with the services at their healthcare facility had a lower risk of developing CKD compared to those who were not satisfied, a finding that was statistically significant (OR=0.729, CI 0.371-0.862, P-value < 0.001). Finally, proteinuria, was significantly associated with CKD development as those with proteinuria were three times more likely to develop CKD compared to those without (OR=2.722, CI 2.361-4.381, P-value < 0.001).

The study further examined the association between the use of specific antihypertensive medications and the development of chronic kidney disease (CKD) among hypertensive patients. The analysis of antihypertensive medications revealed a notable finding for hypertensive patients who were prescribed a combination of calcium channel blockers (CCBs) and thiazides. These patients had a reduced likelihood of developing chronic kidney disease (CKD) as compared to those using CCBs alone (OR = 0.703, 95% CI: 0.281-0.850, p-value < 0.001). The results indicated that diabetic respondents who were on insulin therapy were 3 times more likely to develop CKD compared to those using a

combination of Metformin and Sulphonylureas (OR =2.721, 95% CI: 1.043-7.115, p-value < 0.001).

Table 4.7: Association between Clinical Factors and the Development of CKD among hypertensive patients in Wajir County.

			95% (CI)		P-value
Variable	**Category**	**OR**	**Lower**	**Upper**	
Antihypertensive medication		Ref			
	Yes	0.682	0.371	2.821	0.288
Difficulty taking Medication		Ref			
	Yes	3.036	2.948	6.937	**<0.001**
Diagnosed with diabetes		Ref			
	Yes	1.983	0.782	2.018	0.228
Follow up in diabetic clinic		Ref			
	Yes	0.626	0.273	2.182	0.109
Had stroke		Ref			
	Yes	3.283	2.182	2.910	**<0.001**
Family history with diabetes		Ref			
	Yes	2.381	0.471	2.328	0.114
Family history with Hypertension		Ref			
	Yes	2.881	2.381	2.823	**<0.001**
Family history with CKD		Ref			
	Yes	5.271	3.816	11.838	**<0.001**
Family history with Heart diseases		Ref			
	Yes	2.638	1.627	2.911	**<0.001**
Family member with history		Ref			
	Both parents	3.893	2.111	18.351	**<0.001**
	Sibling	1.073	0.892	12.103	1.021
Undergone radiology		Ref			
	Yes	3.383	2.062	5.092	**<0.001**
Use of pain medication		Ref			
	Only on prescription by clinician	0.544	0.289	2.110	0.282
	Rarely	1.055	0.736	1.923	0.527
BMI		Ref			
	18.5-24.9	0.263	0.122	1.081	**0.109**
	25-29.9	2.462	2.381	6.712	**<0.001**
	>30	4.824	4.021	12.923	0.093

Variable	Category	OR	95% (CI)		P-value
			Lower	Upper	
Proteinuria	Yes	Ref 2.722	2.361	4.381	**<0.001**
Antihypertensive Medication being used by hypertensive respondent	ARBSs and Thiazides	Ref 2.456	1.892	6.024	0.301
	ACEI, CCB and Beta blockers	0.639	0.591	11.623	1.071
	CCB and Thiazides	0.703	0.281	0.850	**<0.001**
	CCB, ARBs and Beta blockers	3.901	2.572	14.062	0.837
	Thiazides and centrally acting	0.553	0.378	3.485	0.101
Diabetes Medication being used by diabetic respondents	Metformin and DPP4 INHIBITORS	Ref 0.753	0.591	11.063	0.833
	Metformin	1.972	0.932	6.024	0.511
	DPP4 INHIBITORS	0.462	0.389	8.347	0.901
	Insulin	2.721	1.043	7.115	<0.001

4.4.5 Association between Behavioral Factors and the Development of CKD

The study sought to determine the proportion of hypertensive adults in Wajir County who had smoked tobacco products, such as cigarettes, hand-rolled, cigars, water pipes/shisha, or pipes/kiko. The results from Figure 4.3 indicate that within the hypertensive adult population of Wajir County, minority have a history of tobacco use, with only 34 (11.60%) confirming ever smoked products like cigarettes, hand-rolled, cigars, water pipes/shisha, or pipes/kiko. However, majority (259, 88.40%) of the respondents reported no such history.

The study also sought to establish the association between Table 4.6 shows the association between behavioral factors and development of CKD.

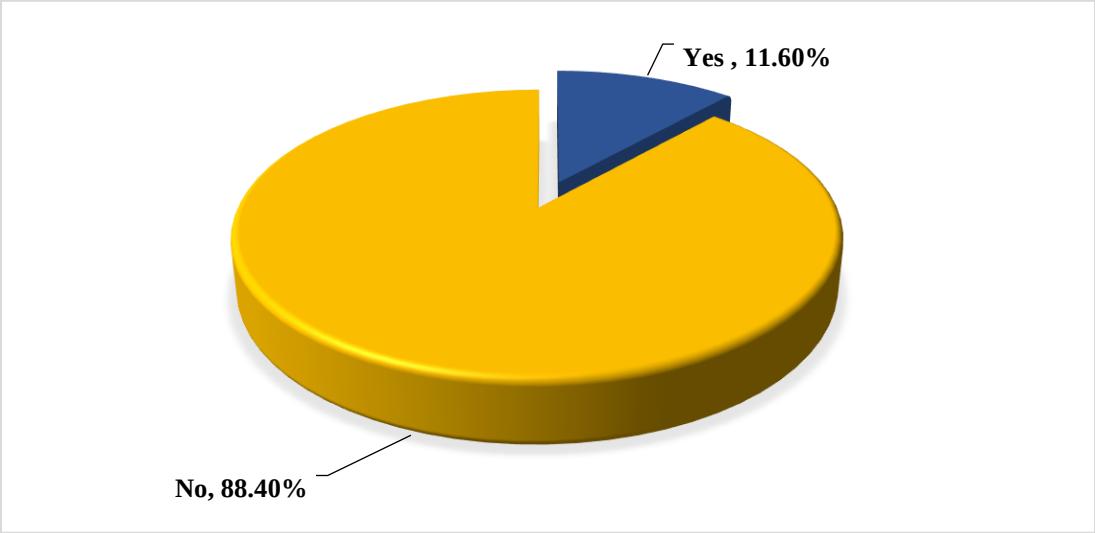


Figure 4.7: Smoking History among hypertensive patients in Wajir County.

Table 4.8: Association between Behavioral Risk Factors of hypertensive patients and the Development of CKD in Wajir County.

			95% (CI)		P-value
Variable	**Category**	**OR**	**Lower**	**Upper**	
Smoked any tobacco products	Yes	Ref 3.912	3.071	5.118	**<0.001**
Regular physical exercise	Yes	Ref 0.361	0.062	0.261	**<0.001**
Engaged in sport	Yes	Ref 0.292	0.144	1.221	0.735

The results in Table 4.8 shows a strong association between smoking tobacco products and the development of CKD. Specifically, individuals who smoked had about 3.9 times the odds of developing CKD compared to those who did not smoke (OR=3.912, CI 3.071-5.118, P-value < 0.001). Individuals who engaged in regular physical exercise were significantly less likely to develop CKD, with about 0.36 times the odds compared to those who didn't exercise (OR=0.361, CI 0.062-0.261, P-value < 0.001).

Engagement in sports did not show a significant correlation with CKD development. Those who engaged in sports had about 0.29 times the odds of developing CKD compared to those who did not, but this result was not statistically significant (OR=0.292, CI 0.144-1.221, P-value=0.735).

The results show that demographic factors, clinical factors and behavioral factors are the major associated factors of CKD in Wajir County. Demographically, age and gender had significant impacts. Specifically, patients aged between 51-60 years had a much higher likelihood of developing CKD compared to those aged 18-30 years (OR=2.462, CI 2.623-44.612, P-value < 0.001). Females were also more likely to develop CKD than males (OR=5.928, CI 0.401-0.921, P-value < 0.001). Regarding education and employment status, those with no formal education were more susceptible (OR=2.481, CI 2.281-2.791, P-value < 0.001), as were the unemployed (OR=2.705, CI 2.511-3.012, P-value < 0.001).

Clinical factors also were found out to be contributing factors of CKD in the county. Elevated blood pressure significantly increased the risk (OR=1.384, CI 1.234-1.572, P-value < 0.001), and difficulty in taking blood pressure medicine was a major risk (OR=3.036, CI 2.948-6.937, P-value < 0.001). Family history was another key factor: those with a family history of hypertension (OR=2.881, CI 2.381-2.823, P-value < 0.001) or CKD (OR=5.271, CI 3.816-11.838, P-value < 0.001) were at higher risk. The Body Mass Index (BMI) was also impactful, with adults having a BMI between 25 and 29.9 being 2.5 times more likely to develop CKD (OR=2.462, CI 2.381-6.712, P-value < 0.001). Smoking was a significant risk factor, with smokers being nearly four times as likely to develop CKD (OR=3.912, CI 3.071-5.118, P-value < 0.001). On the other hand, regular physical exercise appeared to offer some protection, reducing the risk substantially (OR=0.361, CI 0.062-0.261, P-value < 0.001). Engagement in sports didn't show a significant impact (OR=0.292, CI 0.144-1.221, P-value=0.735).

4.4.6 Association between Diabetes medication use, Medical History and CKD

The study sought to establish the association between behavioral risk factors, medical history and CKD and the findings were as shown in Table 4.9. The Based on the findings,

compliance with medication showed a significant association with CKD ($\chi2 = 56.142$, $p = 0.003$), with a higher proportion of CKD cases observed among non-compliant individuals (66.4%) compared to compliant ones (9.1%). Family history also exhibited significant associations with CKD; particularly, a significant prevalence of CKD was noted among those with family history of diabetes (83.0%, $\chi2 = 33.457$, $p = 0.000$), hypertension (89.0%, $\chi2 = 33.457$, $p = 0.000$), CKD itself (87.1%, $\chi2 = 33.457$, $p = 0.000$), and heart diseases (59.4%, $\chi2 = 33.457$, $p = 0.000$). Moreover, the use of diabetes medication demonstrated a significant association with CKD ($\chi2 = 9.170$, $p = 0.038$), with a higher prevalence of CKD among individuals not taking diabetes medication (40.7%) compared to those taking it (3.9%). However, history of smoking did not show a significant association with CKD ($\chi2 = 4.873$, $p = 0.318$).

Table 4.9: Association between Behavioral Risk Factors, Medical History and development of CKD among hypertensive patients in Wajir County.

		Presence of CKD		**Cross Tabulation**	
Variable	**Unit**	**Yes, N (%)**	**No, N (%)**	**Chi-square Value**	**P-value**
Compliance with Medication	Compliant	17(9.1%)	169 (90.9%)	56.142	**0.003**
	Not Compliant	71(66.4%)	36(33.6%)		
Family History	Diabetes	93(83.0%)	19(17.0%)	33.457	**0.000**
	Hypertension	113(89.0%)	14(11.0%)		
	CKD	88(87.1%)	13(12.9%)		
	Heart diseases	41(59.4%)	28(40.6%)		
Using Diabetes Medication	Yes	2(3.9%)	50(96.1%)	9.170	**0.038**
	No	98(40.7%)	143(59.3%)		
History of Smoking	Yes	19(55.9%)	15(44.1%)	4.873	0.318
	No	81(31.3%)	178(68.7%)		

4.5 Preparedness of Wajir County Referral Hospital

The third objective of the study was to determine the preparedness of Wajir county referral Hospital in management, referral and linkage of hypertensive patients. In an interview, with KII who comprised facility in charges, clinic in charge/clinician, they were asked to indicate the top five non-communicable disease that were prevalent in Wajir County. According to the key informants at Wajir County Referral Hospital, hypertension and diabetes mellitus were among the top non-communicable diseases (NCDs) affecting the local population. The facility in-charges noted that a large proportion of the patients they see are presenting with complications related to these conditions. They highlighted that these diseases are often diagnosed at advanced stages due to low awareness and limited access to preventive healthcare services within the county. The clinic in-charge emphasized the chronic nature of these conditions and the challenges they pose, including the need for ongoing medication, lifestyle modifications, and regular follow-ups. They explained that;

> *"In our facility, we have observed a high prevalence of hypertension and diabetes among our patients. I have personally seen a steady influx of individuals presenting late in the course of these diseases, often with serious complications. The lack of early screening and preventive measures in our community contributes to this trend. Managing these chronic conditions is an ongoing battle that requires continuous medication, lifestyle changes, and patient education, which is quite challenging given our resource constraints."*

The KII further explained that;

> *"Cardiovascular diseases, including heart failure, and respiratory conditions such as asthma and chronic obstructive pulmonary disease, are also common here. These illnesses frequently coexist with hypertension, exacerbating the patients' health burden. The surge in such cases is alarming, and I believe it reflects shifts in our way of life and environmental factors. The hospital faces*

> *difficulties in dealing with these diseases due to our limited diagnostic and treatment capabilities. We urgently need better equipment and more specialized training to handle these complex cases more effectively.''*

Moreover, one of the in charges indicated that;

> *Cancer cases, specifically breast, cervical, and prostate cancers, are on the rise. We are also diagnosing more cases of chronic kidney disease, particularly in patients with longstanding hypertension or diabetes. Our ability to provide adequate care for these conditions is hampered by the lack of specialized facilities and the necessity for patient referrals to tertiary centers. It's clear that our healthcare infrastructure needs significant enhancement to manage and mitigate the impact of non-communicable diseases in Wajir County.*

In an interview, with KII who comprised facility in charges, clinic in charge/clinician, they were asked to explain the level of preparedness by Wajir County in preventing and managing existing cases of hypertension. They were also asked to focus on prevention interventions, treatment and appropriate referral and linkage.

In response, one of the KII explained that;

> *''We've established a specific clinic within our facility that specializes in hypertension and other chronic diseases. This clinic operates twice a week and is staffed by healthcare providers trained in cardiovascular care. This specialized focus enables us to offer targeted preventive care and treatment. However, we do have some limitations. For instance, we lack advanced diagnostic equipment like ECHOCARDIOGRAM machines. So, when we encounter severe or complex cases, we often have no choice but to refer patients to more equipped facilities''.*

In addition, the second KII indicated that;

> *"In terms of prevention, we have been quite active in the community. We organize regular educational sessions where we talk to community members about hypertension, its risks, and the importance of regular check-ups. However, the challenge remains in changing deeply rooted cultural beliefs. Many people in our community still prefer traditional remedies over modern medicine, which sometimes delays crucial early intervention and treatment."*

To reinforce the sentiments of the first two KIIs, the third KII had this to say;

> *"On the treatment front, we do have a list of recommended medications and treatment guidelines that our staff follows. We are also working on creating a digital patient database to help with long-term care. But challenges remain. We often face medication stock-outs, and the high cost of certain medications is a barrier for many patients. While we offer some subsidized rates, making treatment accessible to everyone is still a work in progress."*

The study further found out that the county was up to date in terms of recording keeping as explained by the fourth KII who explained that;

> *"In the last year, we've made significant strides in terms of record-keeping. We've switched to a digital system that allows us to better track patient histories, which in turn helps in more effective follow-up care. The downside is that our staff levels have remained the same while the number of hypertension cases continues to grow. This puts a strain on our existing resources and affects the quality of care we can provide."*

Moreover, the county was found to have established networks and linkages with some hospitals with better facilities as indicated by the fifth KII. He explained that;

> *"Regarding referrals and linkages, we've developed a solid network with regional hospitals and specialized cardiac and Nephrology centers. When we get a severe case that we cannot manage here, we can quickly refer them to the appropriate facility. However, one major barrier to this is transportation and affordability by the patients and next of kin. The long distances between facilities and poor road conditions often delay the timely transfer of patients, which can be detrimental in severe cases."*

Furthermore, the study found that the county government of Wajir had put in place prevention programs to reduce the development of CKD. The sixth KII explained that;

> *"We've also begun prevention programs focused on lifestyle changes. We offer workshops on diet, exercise, and stress management to educate people about lowering their risk of developing hypertension. These programs have shown promise, but sadly, due to lack of sufficient funding, we haven't been able to expand them to cover more areas of the county. More resources could really help us make a bigger impact."*

The Key Informant Interviews (KIIs) reveal several important facts of Wajir County's approach to hypertension management. The county has initiated specialized clinics that operate twice a week, focusing on hypertension and other chronic diseases. The clinics are staffed by healthcare providers trained in cardiovascular care, indicating a targeted approach to both prevention and treatment. In terms of prevention, there are community outreach efforts to educate the public on the risks of hypertension and the importance of regular medical check-ups. However, there are challenges including the lack of advanced diagnostic equipment, deep-rooted cultural beliefs favoring traditional remedies, and logistical issues related to medication availability and costs.

The findings also how that another strong aspect of Wajir County management strategy is in record-keeping and referrals, in which healthcare facilities have adopted digital systems for more effective patient tracking and follow-up care. Additionally, they have established strong networks with regional hospitals for the quick referral of severe cases. However, these efforts are hampered by unchanged staffing levels despite an increase in hypertension cases, and poor transportation infrastructure which makes it difficult to transfer patients to better-equipped facilities in a timely manner.

These findings imply that, while Wajir County has made significant strides in specialized care, community education, and establishing networks for referrals, several challenges must be addressed to fully optimize the healthcare delivery system. Issues like medication shortages, the high cost of treatment, inadequate staffing, and poor transportation must be tackled to ensure comprehensive and effective hypertension management. The current initiatives are promising but indicate a need for more resources and systemic changes to meet the growing healthcare demands effectively.

CHAPTER FIVE: DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

This study was a cross-sectional analytical study conducted with the aim of determining the prevalence and associated risk factors of chronic kidney disease among hypertensive patients in Wajir county referral hospital. This chapter provides the summary of the findings, discussion, conclusions and recommendations of the study based on the research questions and objectives of the study.

5.1 Discussion

5.1.1 Prevalence of Chronic Kidney Disease (CKD)

The first objective was to determine the prevalence of chronic kidney disease among hypertensive patient in Wajir County. The study revealed that almost half of the hypertensive respondents, specifically 45.4%, were found to have CKD. This significant proportion highlights the urgency for targeted medical interventions aimed at both the prevention and management of CKD within this specific demographic. The high prevalence of CKD among hypertensive adults in Wajir County implied that a one-dimensional approach to hypertension management was insufficient. The healthcare infrastructure needed to be equipped for comprehensive screenings, timely diagnosis, and effective treatments to manage or even reverse CKD in hypertensive patients. These findings are consistent with the findings of a study by Carmen *et al*., (2005) which was conducted in Ethiopia and found that hypertension was a significantly associated with the high prevalence of chronic kidney disease and it was revealed the uncontrolled or poor control and longer period of hypertension as the sovereign predictor of chronic kidney disease. The study findings also concur with the observations made by Nshimirimana *et al*., (2019) that, hypertensive patients with optimum control of blood pressure have lower risk of progression of renal disease with target BP of less than 130/80 mmHg for CKD

patient. This serves as a glaring indicator of the public health problem facing Wajir County.

The study also showed that 37.6% of the participants had proteinuria, a sign of potential CKD. Proteinuria is a significant indicator of kidney damage and a critical predictor of the progression of CKD and an indication for the need for rigorous screening processes for kidney health, especially among hypertensive individuals. Routine checks for proteinuria needed to be incorporated into healthcare plans for this population, to enable early detection and treatment of CKD. The findings on the prevalence of stages of CKD among the participants revealed over half were in Stage 1, reflecting the progressive nature of the disease and the importance of screening and early diagnosis, a concerning percentage were found to be in more advanced stages of the disease. Specifically, 15% were in Stage 4, and 2% were in Stage 5, also known as end-stage renal disease. These findings indicate that not only was CKD prevalent among hypertensive individuals, but it was also reaching advanced, that require renal replacement therapy with significant economic impact. Moreover, In Nigeria Akinwusi et al. (2020) found a high prevalence of CKD among hypertensive patients, with a considerable proportion progressing to end-stage renal disease. This indicates the importance of early detection and management of hypertension to prevent CKD complications in the Nigerian population and in agreement with the outcomes of the current study.

The findings on prevalence of CKD in Wajir County indicates an urgent need for a multi-faceted approach to healthcare in Wajir County, one that combines hypertension management with targeted interventions for CKD. The focus should be not only on effective treatment but also on preventive measures including lifestyle changes and regular screenings. The findings emphasized the need for systemic improvements in healthcare services, including staff training, facility upgrades, and public health initiatives aimed at education and early intervention. This agrees with the outcome of a study by Oduor et al. (2020) which assessed the impact of hypertension and obesity on renal function among adults in a rural community in Kenya. The study demonstrated a strong

correlation between hypertension, obesity, and CKD prevalence, indicating a synergistic effect of these risk factors on renal health. These findings underscore the urgent need for comprehensive healthcare interventions targeting hypertension and obesity management to prevent CKD in rural African populations.

The observation of a high prevalence of CKD among hypertensive individuals concur with findings of similar studies such as Mwenda et al. (2019), which reported a CKD prevalence of 38.6% among medical inpatients at Kenyatta National Hospital (KNH). Additionally, the association between CKD and hypertension, diabetes, and obesity, as identified in the current study, is supported by previous research conducted in Kenya, including studies by Sigamani (2012) and Rotich et al. (2017), which highlighted lifestyle diseases as significant risk factors for CKD.

However, there are disagreements between the findings of the current study and those of other research conducted in different regions and settings. For instance, while the current study identified a high prevalence of CKD among hypertensive patients in Wajir County, studies such as the one conducted by Rotich et al. (2017) in Kericho County Hospital reported a lower CKD prevalence of 0.4% among adult medical admissions. Furthermore, the study by Stanifer et al. (2014) found no significant difference in CKD prevalence between rural and urban populations in sub-Saharan Africa, contrary to the suggestion in the current study that rural inhabitants may bear a higher burden of CKD. These inconsistencies can be attributed to variations in study populations, methodologies, and healthcare infrastructure across different regions and settings, highlighting the need for further research to better understand the epidemiology of CKD and its risk factors in diverse populations.

5.1.2 Risk Factor Associated with the Development of Chronic Kidney Diseases

The second objective was to establish risk factor associated with the development of chronic kidney diseases among hypertensive patient in Wajir County. The findings showed that majority of respondents had a degree level of education (43.6%), this implies that hypertension was common among educated population in the County. The most

significant age group affected by hypertension was those over 60 years old, making up 39.6% of the sample. This implies that hypertension is more prevalent in older patients in Wajir County. This is consistent with previous studies such as a study by Kaze *et al*. (2018) which reported old age as one of the factor associated with impaired kidney function. It was noted that old age is directly proportional to the risk of developing CKD. The study reported higher prevalence of the disease among participant older than 60 years. The findings are however contrary to the findings by Kaze *et al*., (2018) which reported that renal function declines with age and elder persons being more prone to CKD after renal injury hence age is independent risk factor for CKD. Additionally, these findings disagree with those of Kumela *et al*., (2019) conducted in Ethiopia and established no link between advancing age and CKD. Studies have reported that CKD in Sub-Sahara Africa affects mostly young adults and females (Naicker, 2013; Kilonzo *et al*., 2016.) A study conducted in China among elderly population also reported high prevalence of CKD in females compared with the males (Andong *et al*., 2019).

Regarding gender, the study found that a large majority of respondents were male (73.4%), suggesting that men were either more likely to be hypertensive, more likely to seek treatment, or both.The results further show that most respondents were of Islamic faith (87.0%) and were married (89.1%), which may have cultural or social implications for disease prevalence and treatment adherence. Moreover, employment was spread across several categories, but the largest was self-employed at 37.9%. These demographics are important for interpreting the prevalence and risk factors of CKD in this specific population, as it helps in identifying trends and enables the formulation of targeted prevention and treatment strategies.

The study had sought to identify various risk factors associated with the development of chronic kidney disease (CKD) among hypertensive patients in Wajir County. One of the key findings was the association between demographic characteristics and CKD development. The study found that age was a determining factor of developing CKD among the adults. The study found that the age group of 51-60 years had shown a higher

likelihood of developing CKD compared to those aged between 18-30 years (OR=2.462, CI 2.623-44.612, P-value < 0.001). In addition, gender had also been a significant variable; females were found to be more likely to develop CKD than males (OR=5.928, CI 0.401-0.921, P-value < 0.001). Further, educational level and employment status had been significantly correlated with CKD. Individuals with no formal education (OR=2.481, CI 2.281-2.791, P-value < 0.001) and those who were unemployed (OR=2.705, CI 2.511-3.012, P-value < 0.001) were more likely to develop the condition. These findings concur with the conclusion made by Moore *et al*. (2015) that, CKD patients' management is multidisciplinary involving nephrologist, physician, cardiologist and nutritionist and emphasis is on using lifestyle change, control of hypertension and adjustment medication in background of CKD because one of the kidney function is to excrete medication and its end product.

In addition to demographic characteristics, the study had also examined the role of clinical factors. Based on the findings, high blood pressure levels were found to be a significant risk factor of CKD (OR=1.384, CI 1.234-1.572, P-value < 0.001), as was difficulty in taking blood pressure medication (OR=3.036, CI 2.948-6.937, P-value < 0.001). Family history had also been a strong predictor; a history of hypertension in the family was associated with a higher risk of developing CKD (OR=2.881, CI 2.381-2.823, P-value < 0.001). Moreover, those with a family history of CKD had over five times the odds of developing the disease themselves (OR=5.271, CI 3.816-11.838, P-value < 0.001).This is in support of the observations by Leowattana (2018) that NSAID drugs used in pain management inhibits cyclooxygenase enzyme leading to reduction in synthesis of the vasodilator prostaglandins hence decrease in renal blood flow leading in kidney disease. Their use contributes to CKD progression (Hsu *et al*., 2015). Studies have found NSAIDs to raise blood pressure significantly on patient already treatment for hypertension resulting from increase in peripheral resistance and blood volume (Wilson *et al*., 2007).

Among the other clinical variables, the study found a strong association between CKD and a history of stroke (OR=3.283, CI 2.182-2.910, P-value < 0.001). Body Mass Index

(BMI) was another significant variable; individuals with a BMI between 25 and 29.9 were more likely to develop CKD compared to those with a BMI between 18.5 and 24.9 (OR=2.462, CI 2.381-6.712, P-value < 0.001). Proteinuria, or the presence of excess proteins in the urine, was associated with a higher risk of developing CKD (OR=2.722, CI 2.361-4.381, P-value < 0.001).

Behavioral factors had also been examined, and smoking was identified as a significant risk factor for CKD (OR=3.912, CI 3.071-5.118, P-value < 0.001), Smoking is a known risk factor that can exacerbate hypertension and accelerate kidney damage, potentially leading to CKD thus, smoking habits provides insights into potential additional risks within the population. On the other hand, regular physical exercise had been found to lower the risk of CKD substantially (OR=0.361, CI 0.062-0.261, P-value < 0.001). Interestingly, engagement in sports did not show a significant protective effect (OR=0.292, CI 0.144-1.221, P-value=0.735). Regarding the Body Mass Index (BMI), the findings indicated that only about a third of the respondents were within the World Health Organization's normal BMI range, the majority of hypertensive patients were either underweight, overweight, or obese. These conditions are known risk factors for both hypertension and CKD. This indicates that a significant percentage of the hypertensive population were overweight or obese hence higher risk for CKD, stressing the need for lifestyle interventions alongside medical treatments. These findings are consistent with those of Okpechi et al. (2019) in South Africa which found a significant burden of CKD among hypertensive patients, particularly in urban areas, highlighting the need for targeted interventions to prevent CKD progression in this population. These findings are in agreement with the observations by Wachukwu *et al*. (2015) that overweight and obesity are key risk factor of hypertension and CKD. Moreover, Study by Wickman and Kramer (2013) shown that abdominal obesity is associated with inferior renal results. Obesity deteriorate patients with prevailing nephropathies and may increase chance of graft failure after kidney transplant. Rotich et al. (2017) found that the risk for CKD observed among obese individual is allied to the increased prevalence of hypertension

and/or type II diabetes (Rotich, 2017). Comparative study which was survey based done in Turkish established that 29% of the obese population had Chronic Kidney Disease compared to 20% among the normal range BMI population (Mkuu *et al*., 2018).

Majority of the study participants were on CCB and thiazide combination (55.1%). This is first line choice of antihypertensive according to Kenya cardiovascular guideline 2018 for population with no other comorbidities. The study found majority of the participant (63.5%) were not compliant to medication, this might explain the high prevalence of CKD in this population as poorly controlled is the second leading cause of diabetic nephropathy (Hunegnaw *et al.,* 2021). The study has found that a myriad of factors, ranging from demographic and clinical to behavioral, are associated with the development of CKD among hypertensive adults in Wajir County. Notable risk factors included older age, being female, lack of formal education, unemployment, elevated blood pressure, difficulty in taking medication, and family history of CKD and hypertension. On the other hand, regular exercise had been found to be a protective factor. These findings may offer important insights for healthcare providers and policymakers aiming to tackle the prevalence of CKD among hypertensive patients.

5.1.3 Preparedness of Wajir County Referral Hospital

The third objective of the study was to determine the preparedness of Wajir county referral Hospital in management, referral and linkage of hypertensive patients. The study found both advancements and challenges in the management, referral, and linkage of hypertensive patients in Wajir County. The study found that the facilities within Wajir County had a specialized clinic focusing on hypertension and cardiovascular care, providing targeted preventive care and treatment. However, the hospitals in the County faces limitations in terms of advanced diagnostic equipment, such as ECG machines, Echocardiogram and an important lab test these limits their ability to handle severe cases in-house. On the other hand, community outreach programs aimed at preventive education are active but face cultural barriers that affect early intervention. These findings imply that while the healthcare system has made efforts to offer specialized care, the lack

of equipment and resistance from the community toward modern healthcare approaches could jeopardize the effectiveness of these programs. These findings are in agreement with the study by Ndlovu et al. (2019) in Zimbabwe reported similar challenges in resource availability, particularly in rural healthcare facilities, where the lack of advanced diagnostic equipment and medication shortages hindered effective hypertension management. Similarly, research by Mutevedzi et al. (2020) in Malawi echoed the findings regarding the strain on healthcare resources due to the increasing burden of hypertension cases against static staffing levels. This study highlighted the need for innovative strategies to optimize care delivery and address manpower shortages.

In terms of treatment, there are structured guidelines and medications available. The hospital is also making strides in digitalization, working on a patient database for more effective long-term care. But they face challenges in medication availability and affordability, issues that disproportionately affect the economically disadvantaged population. Moreover, the quality of care is strained by the growing number of hypertension cases against static staff levels. These conditions suggest that resource constraints, both in terms of manpower and medication, are significant bottlenecks that could compromise patient outcomes. On the issue of record-keeping, the study found that the hospital has switched to a digital system for tracking patient histories, allowing for more effective follow-up care. However, the growing patient load strains the existing resources, affecting the quality of care provided. The implications here are twofold: while digital systems improve efficiency and care quality, they are not a solution to the fundamental issue of insufficient staffing, which requires urgent attention to meet the growing healthcare needs. These findings are contrary to the findings of a study by Abegaz et al. (2020) in Ethiopia which provided mixed findings, indicating both advancements and challenges in hypertension management across different healthcare facilities within the country. While some facilities demonstrated improvements in digitalization and patient record-keeping, others faced similar resource constraints and logistical challenges as observed in Wajir County.

The study moreover found that Wajir County has networks and linkages with better-equipped hospitals and is also investing in prevention programs aimed at reducing the development of Chronic Kidney Disease (CKD). These prevention programs are aimed at lifestyle changes and have shown promise but are limited by lack of funding. The problem of transportation for referred patients was highlighted as a significant issue. This implies that while the hospital has a good referral system in place, logistical challenges undermine the effectiveness of this network. Additionally, the prevention programs, though promising, are underfunded and, thus, not as impactful as they could be. These findings show a more comprehensive approach involving better funding, community education, and resource optimization is needed to effectively manage hypertension in the county. In contrast, a study by Kamadjeu et al. (2019) in Cameroon found that while resource constraints were indeed prevalent, community outreach programs aimed at preventive education were more successful in overcoming cultural barriers and achieving early intervention compared to what was observed in Wajir County. This suggests that contextual factors may influence the effectiveness of preventive programs. Additionally, research by Toure (2020) in Senegal revealed better-equipped hospitals in urban centers, with more comprehensive referral networks and stronger linkages compared to what was observed in Wajir County. However, transportation challenges for referred patients were still highlighted as significant barriers to accessing specialized care.

5.2 Conclusions

Based on the stated specific objectives, this study concluded that:

1. The prevalence of Chronic Kidney Disease (CKD) among hypertensive adults in Wajir County remains high at about, 45.4%.
2. Socio-demographic characteristics such as older age (aged above 60 years), gender (more women than men), low education level (no formal education) and unemployment may contribute to high prevalence of CKD among hypertensive patients in Wajir County. The first hypothesis that stated there is no significant relationship between sociodemographic factors and development of CKD was rejected since statistical results showed that age, education, employment status and gender were significantly related to CKD.
3. Risk factors like obesity, smoking, poor medication compliance, comorbidities(DM) and family history of hypertension were significantly associated with the development of CKD. However, physical exercise was noted to be protective. The second hypothesis that stated there is No significant relationship between clinical factors and development of CKD was rejected since there was statistically significant relationship found between family history of hypertension, compliance to antihypertensive, BMI and development of CKD.
4. The preparedness of Wajir county in management of hypertension was noted to be challenging due to poor investigative capacity and understaffing. However, the county has Community outreach programs and good referral system with better equipped hospital.

5.3 Recommendations

5.3.1 Recommendations from the study

Based on the study results and conclusions drawn from the study, the following are the recommendations:

1. The study recommends to Wajir county government to develop a policy for a targeted screening for CKD for all patient diagnosed with hypertension. All patients coming to hypertension clinic should undergo baseline test to screen for complication and this should include serum creatinine and urinalysis which this would help in early detection and treatment of CKD.
2. Socio-demographic characteristics such as age, gender, etc… being key drivers of high prevalence of CKD there should be focus on awareness, creation trainings manual and guidelines on CKD prevention at the facility and county level. Community health talks, social media campaigns, and informational pamphlets can be utilized for this purpose.
3. Given that lifestyle factors like Body Mass Index (BMI), lack of exercise, and smoking significantly contribute to CKD, community programs focused on lifestyle modifications should be rolled out including free community exercise classes, smoking cessation support groups, and nutrition counseling.
4. Following devolution of health care, county health officers need to address regional programmatic issues pertaining to logistics; supply chains, understaffing and ensure adequate resource allocation for the establishment of preventive mechanism and proper care to hypertensive population. This would improve preparedness of the county to management generally the rising non communicable diseases.

5.3.2 Recommendations for further research

1. Since the current study was conducted in Wajir County and identified a high prevalence of CKD among hypertensive adults in the County, the study suggests that there is need for future researchers to explore whether similar trends exist in other counties within Kenya and even beyond Kenya's boarders. This may help to determine if the findings can be generalized across a broader population and to compare healthcare infrastructures.
2. Since the current study was a cross-sectional one, the study suggests that there is need for a longitudinal study that tracks the progression of CKD stages among hypertensive patients in Wajir County over time ads this may provide invaluable data on the effectiveness of existing healthcare interventions for CKD management.
3. While the current study examined a myriad of risk factors associated with CKD, future research should focus solely on unexplored or less understood risk factors like environmental factors, dietary habits, or specific occupational risks that haven't been studied in depth that might be unique to Wajir County.

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APPENDICES

Appendix I: Informed Consent

My name is Abdirahman Mohamed Ali I am a Master student from Kenyatta University. I am conducting a study titled "Prevalence And Associated Risk Factors Of Chronic Kidney Disease Among Hypertensive Patients In Wajir County, Kenya"

The information will be used this study is going to establish prevalence of chronic kidney disease among people living with hypertension in Wajir County as well as coming up with viable preventive approaches of CKD among hypertensive patients.

Procedures to be followed

Participation in this study will require that I ask you some questions and I also examine you in order to screen you for Chronic Kidney Disease. I will ask in confidential and all your answers will be recorded. Most of the questionnaires have choice and it will require to recall something in the past. I will also do physical examination to look for signs and complications of chronic kidney disease.

Standard laboratory technique will be utilize. My assistant or I will take sample of blood (2 mls) from your either arm which will be sent to the laboratory to measure creatinine level and will also ask to collect sample of urine (10mls) to test for proteins in the urine. This result will also be shared with you and it will be used for your continued care.

Voluntarism

You have the right to refuse participation in this study. You will get the same services and care whether you agree to join the study or not and your decision will not change the care you will receive. Please remember the participation in this study is voluntarily. You may ask questions related to the study at any time.

You may refuse to respond to any questions and you may stop an interview at any time. You may also stop being in the study at any time without any consequences to the services you receive here or any other organization now or in the future.

Discomforts and Risks

Some of the questions you will be asked are on intimate subject and may be embarrassing or make you uncomfortable. If this happens, you may refuse to answer these questions if you so choose. You may also stop the interview at any time. The interview may add approximately half an hour to the time you wait before you receive your routine services. During the removal of blood there will be some pain or discomfort but we will try our best to minimize this by being gentle.

Risk of Investigation

The collection of blood of sample approximately 2mls was done using peripheral veins preferably antecubital veins. This may carry small risk of bleeding from the puncture site and pain during pricking. The investigator made sure pressure was applied until the bleeding ceased and emergency contact was provided to the patient in case of unforeseen complication.

Benefits

If you participate in this study you will help us to learn how to provide effective screening services that can improve prevention of chronic Kidney Disease.

You will also benefit from being screened for chronic Kidney Disease and if you are found to have a problem you will be advised on the treatment.

Reward

There are no rewards or any payment to you if you participate.

Confidentiality

The interviews and examinations will be conducted in a private setting within the clinic. Your name will not be recorded on the questionnaire. The questionnaires will be kept in

a locked cabinet for safe keeping at Kenyatta University. Everything will be kept private and only shared with the study team.

Contact Information

If you have any questions about the study call the Abdirahman Mohamed, TEL: 0722467306 or Supervisors Dr. Harun Kimani, TEL:0725552475 OR Dr. Gordon Ogweno, TEL:0725715623

However, if you have questions about your rights as a study participant: You may contact Kenyatta University Ethical Review Committee Secretariat on chairman.kuerc@ku.ac.ke,

Participant's statement

The above information regarding my participation in the study is clear to me. The study has been explained to me and I have been given a chance to ask questions and my questions have been answered to my satisfaction. My participation in this study is entirely voluntary. I understand that my records will be kept private and that I can leave the study at any time. I understand that I will still get the same care and medical treatment whether I decide to leave the study or not and my decision will not change the care that I will receive from the clinic today or that I will get from any other clinic at any other time.

Name of Participant:

_____

_____ _____

Signature or Thumbprint Date

_____ _____

Name of Representative/Witness Relationship to Subject

Investigators statement

I, the undersigned, have explained to the volunteer in a language s/he understands, the procedures to be followed in the study and the risks and benefits involved

_____

Name of Interviewer

_____ _____

Signature Date

Inclusion criteria: All adult hypertensive patient who consent to participate

Exclusion criteria: pregnant women with preeclampsia, IV contrast the last 48-72hrs, gastroenteritis the last 48-72 hours and patient diagnosed obstructive uropathy.

Appendix II: Map of Study Area (Wajir County)

Appendix III: Questionnaire

STUDY PROFORMA

Name (initials)…….

Study ID number……

QUESTIONAIRE

SOCIO-DEMOGRAPHIC

1. County ……... Sub-County……
   location……
2. Age: …… (years)

a) 18-30 years
b) 31-40 years
c) 41-50 years
d) 51-60 years
e) More than 60 years

3. Gender
   a) Male
   b) Female
4. Religion
   a) Islam
   b) Christian
   c) Traditionalist
   d) Others, (specify)……...
5. Marital status (tick where appropriate)
   a) Single
   b) Married
   c) Widowed
   d) Separated/divorced
   e) Other, specify……...

6. Highest level of formal education attained
    a) Primary
    b) Secondary
    c) Tertiary/Post-secondary
    d) None
7. Employment status
    a) Self-employed
    b) Unemployed
    c) Housewife
    d) Formal employment
    e) Student

BEHAVIORAL RISK FACTORS

1. Have you ever smoked any tobacco products, such as cigarettes, hand-rolled, cigars, water pipes/shisha, or pipes/kiko?
    a) Yes
    b) No

    IF YES

2. Please, specify which type of tobacco product? …….
3. When did you start smoking (year)?.....
4. If stopped smoking which year?.....
5. How many cigarettes do you smoke in a day?.....
6. Are you currently involve in any of the following activity?

a) Any sport
b) Regular physical exercise/activity
c) Occupation that involve physical activity
d) Any other physical activity

MEDICAL HISTORY

1. Have you ever been diagnosed with high blood pressure?
    a) Yes
    b) No
2. When were you diagnosed with high blood pressure (year)?.....
3. Are you on any antihypertensive medication?
    a) Yes
    b) No
4. Which type of medication have you been taking?
    a) ACEI
    b) ARBs
    c) CCB
    d) Thiazides
    e) Beta blockers
    f) centrally acting
    g) Herbals
5. Do you find difficulty in taking your blood pressure medicine?
    a) Yes
    b) No
6. If yes, why?
    a) Adverse effect
    b) Medication expensive
    c) I got well
    d) Medication not helpful
    e) Others, specify----------
7. Have you ever been diagnosed with diabetes-?
    a) Yes

b) No

If yes, which year…….

8. Are you on follow up in any diabetic clinic
   a) Yes b) No

9. Which medication are you using for your diabetes?
   a) Metformin
   b) Sulphonylureas
   c) SGLT2
   d) DPP4 INHIBITORS
   e) Insulin
10. Have you ever been told by a health care practitioner you have a heart disease?
    a) Yes b) no
11. Have you ever had any stroke?
    a) Yes b) no
12. Any family history of any of the following diseases? (if none go to next section)
    a) Diabetes [ ]
    b) Hypertension [ ]
    c) CKD [ ]
    d) Heart diseases { }

    If yes, who in your family?

a) 1 parent
b) both parents
c) sibling
d) others ----------

13. Have you ever underwent any radiological that requires intravenous contrast?

a) Yes b) No

If yes, which year? ……

14. How often do you use pain medication?

a) Everyday over the counter

b) Only on prescription by clinician

c) Rarely

9) Which of the following pain killer medication do you use?

a) NSAID (Non-Steroidal Anti-inflammatory Drugs)

b) Paracetamol

c) Opioid

d) Others, specify……

15. Are you satisfied with the service provided to you at the health facility

Yes/ no

If no why

If yes explain

13. Do you think the facility is well prepared to manage people with hypertension

Yes no

If yes explain

If no why

PHYSICAL EXAMINATION AND INVESTIGATION

1. Blood pressure in mmHg Right arm……. Left arm…..
2. Weight in KG……..
3. Height in CM……
4. BMI= Wight(KG)/Height in M^2 …….
5. URINE ANALYSIS

a) Microalbuminuria
b) Proteinuria
c) Red blood cells
6. Serum creatinine leve in mmol/l……..
7. Estimated GFR in ml/min……

KEY INFORMANT INTERVIEW

Kii- facility in charges, clinic in charge/clinician

1) What are the top five non-communicable disease that are prevalent in this county?
2) How prevalent is hypertension in this county?
   If the prevalent is high –what could be the driver?
3) How common are kidney diseases in this county?

   If it is a problem, what do you think is the cause?

4) Please, explain the l
5) evel of preparedness by the county in preventing and managing existing cases of hypertension? (probe for prevention interventions, treatment and appropriate referral and linkage)
6) What are some of the complications associated with hypertension among hypertensive patients?
7) Among those complications associated with hypertension, how would you describe ckd as one of the complication?
8) If ckd is one of them, how widespread is the problem?
9) In your own opinion, do you think resource allocated to prevent and manage hypertension is sufficient?
   If yes, why?
   If no, why?
10) How do you think ckd due to hypertension can be prevented?

Appendix IV: Approval of Research from Graduate School

KENYATTA UNIVERSITY
GRADUATE SCHOOL

E-mail: dean-graduate@ku.ac.ke
Website: www.ku.ac.ke

P.O. Box 43844, 00100
NAIROBI, KENYA
Tel. 020-8704150

Internal Memo

FROM: Executive Dean, Graduate School **DATE:** 26th July, 2023

TO: **Mr. Abdirahman M. Ali**
C/o Department of Community Health & Epidemiology

REF: Q57/CTY/PT/21122/2020

SUBJECT: APPROVAL OF RESEARCH PROPOSAL

This is to inform you that Graduate School Board, at its meeting on **12th July, 2023**, approved your Research Proposal for the M.P.H. Degree entitled, **"Prevalence and Risk Factors Associated with Chronic Kidney Disease among the Hypertensive Patients in Wajir County, Kenya"**

You may now proceed with your Data collection, subject to clearance with the Director General, National Commission for Science, Technology & Innovation and Ethics Review Committee, Kenyatta University.

As you embark on your data collection, please note that you will be required to submit to Graduate School completed Supervision Tracking and Progress Report Forms per semester. The forms are available at the University's Website under Graduate School webpage downloads.

Also, please ensure that you publish article(s) from your thesis before submitting it to Graduate School for examination as per the Commission for University Education and Kenyatta University guidelines.

Thank you.

KENYATTA UNIVERSITY OFFICE OF EXECUTIVE DEAN 26 JUL 2023

DR. HARRIET ISABOKE
FOR: EXECUTIVE DEAN, GRADUATE SCHOOL

CC. Chairman, Community Health & Epidemiology Department
Supervisors:

1. Dr. Harun Kimani
   C/o Department of Community Health & Epidemiology
   Kenyatta University

2. Dr. George Ogweno
   C/o Department of Medical Physiology
   Kenyatta University

Appendix V: Research Authorization from Graduate School

KENYATTA UNIVERSITY
GRADUATE SCHOOL

E-mail: dean-graduate@ku.ac.ke
Website: www.ku.ac.ke

P.O. Box 43844, 00100
NAIROBI, KENYA
Tel. 020-8704150

Our Ref: Q57/CTY/PT/21122/2020

DATE: 26th July, 2023

Director General,
National Commission for Science, Technology
and Innovation
P.O. Box 30623-00100
NAIROBI

Dear Sir/Madam,

RE: RESEARCH AUTHORIZATION FOR MR. ABDIRAHMAN MOHAMED ALI
REG. NO. Q57/CTY/PT/21122/2020

I write to introduce Mr. Abdirahman Mohamed Ali who is a Postgraduate Student of this University. He is registered for M.P.H. degree programme in the Department of Community Health & Epidemiology.

Mr. Abdirahman intends to conduct research for a M.P.H. thesis Proposal entitled, **"Prevalence and Risk Factors Associated with Chronic Kidney Disease among the Hypertensive Patients in Wajir County, Kenya"**

Any assistance given will be highly appreciated.

Yours faithfully,

KENYATTA UNIVERSITY OFFICE OF EXECUTIVE DEAN
26 JUL 2023
GRADUATE SCHOOL NAIROBI

PROF. ELISHIBA KIMANI
EXECUTIVE DEAN, GRADUATE SCHOOL

KM/ewv

Appendix VI: Ethics Approval

KENYATTA UNIVERSITY
CENTRE FOR RESEARCH ETHICS AND SAFETY

Fax: 8711242/8711575
Email: chairman.kuerc@ku.ac.ke
Nairobi, 00100

P. O. Box 43844,

Tel: 8710901/12

Website: www.ku.ac.ke
Our Ref: **KU/ERC/APPROVAL/VOL.1**

Date: 21st August, 2023

Abdirahman Mohamed Ali
P.O Box 43844, 00100
Nairobi.

Dear Mr. Abdirahman,

1. **APPLICATION NUMBER: PKU/ PKU/2786/I1911- PREVALENCE AND RISK FACTORS ASSOCIATED WITH CHRONIC KIDNEY DISEASE AMONG THE HYPERTENSIVE PATIENTS IN WAJIR COUNTY KENYA**

This is to inform you that ***KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE*** has reviewed and approved your above research proposal. Your application approval number is **PKU/2786/I1911.** The approval period is **21st** ***/08/2023 to 21st /08/2024***

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 ***KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE***
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 ***KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE*** 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 ***KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE*** 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 ***KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE***

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

To serve you better, researchers are kindly requested to access and complete a customer feedback form and sent it back online as you continue with research and upon completion of data collection found on the following website link; ;(https://docs.google.com/forms/d/1ytWefDwvyz5h1oz_VIn0xbxg3uGdlDzMXFWNDsMrRPQ/edit?usp=sharing

Yours sincerely

Prof. Judith Kimiywe

Director: Centre for Research Ethics and Safety

Appendix VII: Research Permit

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **262626**

Date of Issue: **08/September/2023**

RESEARCH LICENSE

This is to Certify that Dr.. ABDIRAHMAN MOHAMED ALI of Kenyatta University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Wajir on the topic: PREVALENCE AND RISK FACTORS ASSOCIATED WITH CHRONIC KIDNEY DISEASE AMONG THE HYPERTENSIVE PATIENTS IN WAJIR COUNTY, KENYA. for the period ending : 08/September/2024.

License No: **NACOSTI/P/23/28981**

262626

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

See overleaf for conditions

Appendix VIII: Research Authorization Wajir County

DEPARTMENT OF MEDICAL SERVICES, PUBLIC HEALTH AND SANITATION, WAJIR

When replying, please
Quote our Ref & Date

Ref: WCG/P031/2023

WAJIR HEALTH SERVICES
RESEARCH & DEVELOPMENT,
P O Box 2 – 70200
WAJIR

14th September 2023

Dr. Abdirahman Mohamed Ali,
PO Box 43844, 00100,
Nairobi

Re: Authorization to conduct study titled Prevalance and risk factors associated with chronic Kidney disease among the hypertensive patients in Wajir County, Kenya

Wajir County Health Research and Development Directorate has granted Dr. Abdirahman Mohamed, a MPH student at the Kenyatta University, authorization to conduct the above-mentioned study in Wajir County effective 14th September 2023 as part of his coursework. This authorization includes access to current and historical data, and interviews with key informants, as needed for study purposes.

Your approval number is WCG/HR&D/P031/2023 and it is valid for six (6) months. Please ensure that all ethical issues including customary and beliefs of the community are observed and respected throughout the study.

You are also required to share with us the final report of the study for our own consumption as a county.

Please do not hesitate to contact the undersigned for any other query.
Yours Sincerely,

Dr. Mohamed A. Ahmed
Director of Health Research & Development, Wajir

CDRO Contact: 0722689038