PREVALENCE AND FACTORS ASSOCIATED WITH HYPERTENSION AMONG PERSONS LIVING WITH HIV IN MOMBASA COUNTY, KENYA

BY

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DECLARATION

This thesis is my original work and has not been presented for an award of a degree in any other university.

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Chair of Department, Dept. Epidemiology and Medical Statistics – For the late Prof. Paula Braitstein

DEDICATION

This thesis is dedicated to my husband for his immense support and encouragement during my entire study period. I further dedicate this to all persons living with HIV and suffering from hypertension in Mombasa County

ABSTRACT

Background: Hypertension is a non-communicable disease defined as blood pressure greater than 140/90 millimeters of mercury. The global prevalence of hypertension among Persons Living with HIV(PLHIV) was estimated to be 35% in 2021. The overall prevalence of hypertension in Kenya has been estimated to be at 24% and the prevalence among PLHIV during the same year was 18.9% in a study done in central Kenya. However, the factors associated with hypertension among PLHIV in Mombasa County are unknown.

Objectives: To determine the prevalence of hypertension, describe factors associated with hypertension, and knowledge, attitude, and practices related to hypertension among PLHIV in Mombasa County.

Methods: A cross-sectional study design was used among adult patients on HIV follow-up at Comprehensive Care Clinics in Mombasa County. Systematic sampling was used to identify the sample size of 235. Questions derived from validated questionnaires were used for collection of quantitative data. Frequencies and proportions were calculated for the categorical variables and measures of central tendency and dispersion for continuous variables. Bivariate analysis was done by calculating the prevalence ratio (PR). Multivariate analysis was done by calculating the adjusted Prevalence Ratio (aPR). Knowledge, attitude, and practice scores were computed where higher scores suggested higher knowledge, positive attitudes toward hypertension, and better hypertension prevention practices.

Results: A total of 235 participants were enrolled. The majority (71%) of the participants were females. The mean age of the participants was 42.8 (±10.7) years with the age group 35–44 years having the largest proportion at 35%. The prevalence of hypertension was 25%. The factors associated with hypertension were Body Mass Index between 25 and 29.9 [aPR 2.41 (C. I 1.30 – 4.42)], BMI greater than 30 [aPR 3.37 (C. I 1.69–6.73)] and use of a tenofovir-based regimen [aPR 0.32 (C.I 0.17 – 0.60)]. There was good knowledge and attitudes toward hypertension. Good practices were reported in both hypertensive and non-hypertensive participants.

Conclusion: There was a higher prevalence of hypertension compared to previous studies. Participants with a high BMI had a higher prevalence ratio of hypertension and participants on tenofovir-based regimens had a lower prevalence ratio of hypertension. The participants were knowledgeable about hypertension, had a positive attitude towards hypertension, and carried out fair hypertension prevention practices.

Recommendations: We recommend that weight monitoring and management as well as tenofovir-based therapy should be utilized among PLHIV to reduce their risk of developing hypertension.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS AND ACRONYMS

ABC	Abacavir
ART	Anti-Retroviral Therapy
AZT	Zidovudine
BP	Blood Pressure
CCC	Comprehensive Care Clinic
CHD	Coronary Heart Disease
CKD	Chronic Kidney Disease
COPD	Chronic Obstructive Pulmonary Disease
CRD	Chronic Respiratory Disease
CVD	Cardiovascular Disease
DALY's	Disability-Adjusted Life Years
DTG	Dolutegravir
EFV	Efavirenz
GFR	Glomerular Filtration Rate
IREC	Institutional Research and Ethics Committee
HIV	Human Immunodeficiency Virus
HPV	Human Papilloma Virus
HSV	Herpes Simplex Virus
KENPHIA	Kenya Population-based HIV Impact Assessment
3TC	Lamivudine
LMIC	Low- and Middle-Income Countries
NCD	Non-Communicable Disease
NACOSTI	National Commission for Science, Technology, and Innovation
NVP	Nevirapine
PLHIV	Persons Living with HIV
PMTCT	Prevention of Mother-to-Child Transmission
TDF	Tenofovir
UNAIDS	United Nations Programme on HIV/AIDS
VIF	Variable Inflation Factor
WHO	World Health Organization
WHIV	Women with Human Immunodeficiency Virus

OPERATIONAL DEFINITION OF TERMS

Acquired Immunodeficiency Disease – Advanced HIV disease accompanied by CD4 cell count less than 200 cells/mm^3.

Anti-retroviral Drugs – Treatment with drugs that inhibit the ability of the Human immunodeficiency virus or other types of retroviruses to multiply in the body.

Anti-retroviral Therapy – Treatment of people infected with the Human Immunodeficiency Virus using antiviral drugs

Asthma – Any person with a documented diagnosis of asthma OR documentation of the use of bronchodilators in the patient file

Cancer – A disease caused by the uncontrolled division of abnormal cells in a part of the body.

Cardiovascular disease – A group of disorders that affect the heart and blood vessels.

Chronic Kidney Disease – A long-term condition caused by progressive damage and loss of function of the kidneys.

Clinic waiting time was defined as the average time that it took between a participant arriving at the CCC and being attended to by the clinician. The time was determined by asking the participant how long it took between when they arrived at the clinic and when they were seen by the clinician.

Diabetes – Any person with a documented history of diabetes OR a documented random blood glucose reading > 11.1mmol/L or fasting blood glucose > 7.0 mmol/L OR documentation of the use of hypoglycemic drugs in the patient file.

Human Immunodeficiency Virus - Any person with a documented positive result from an HIV antibody or combination antigen/antibody test.

Hypertension – A documented history of 2 or more blood pressure readings of >140mmHg for a systolic reading and/or >90mmHg for a diastolic reading within one year, OR any history of being on an antihypertensive, OR a repeat high blood pressure reading greater than 140/90mmHg that is taken during the time of the clinic visit, for a patient with only one high blood pressure reading previously.

Non-communicable diseases - Chronic diseases that do not result from an acute infectious process.

Normal weight - A person having a Body Mass Index between 18 to 24.9kg/m^2.

Overweight - A person having a Body Mass Index between 25 to 29.9kg/m^2.

Obese - A person having a Body Mass Index greater than 30kg/m^2.

Underweight – A person having a Body Mass Index less than 18 kg/m^2.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Non-communicable diseases (NCDs) are chronic diseases that do not result from an acute infectious process (CDC, 2011). These diseases develop throughout one's life and often require lifelong treatment. In 2016, NCDs accounted for 41 million (71%) of the world's 57 million deaths. Fifteen million deaths were premature and the greatest burden at 78% occurred in low and middle-income countries (LMIC) (CDC, 2016.). In Africa, the burden of NCDs has been on the rise. In 2017 the Disability Adjusted Life Years (DALY's) attributable to NCDs were estimated at 151.3 million (Gouda et al., 2019)

The main types of NCDs are cardiovascular diseases, cancers, chronic respiratory diseases, obesity, chronic kidney disease, and diabetes (Mudie et al., 2019). Hypertension is one of the cardiovascular diseases with an estimated 1.13 billion people living with the disease globally (WHO, 2021.). Hypertension is defined as persistently elevated blood pressure with a systolic reading greater than 140mm/Hg and/or diastolic blood pressure greater than 90mm/Hg (MOH, 2018). The prevalence of hypertension in sub-Saharan Africa is estimated to be 25.9% (Guwatudde et al., 2015). This has been attributed to the rise in smoking, changes in diet, and lifestyles that are risk factors for the disease (El-Sadr & Goosby, 2018). The estimated prevalence of hypertension in Kenya is 22% (Mogaka et al., 2022).

The Human Immunodeficiency Virus (HIV) is an infectious agent that attacks the immune system of a person (WHO,2020). Globally in 2019, there were 1.7 million

incident cases with approximately 690,000 deaths from HIV (WHO, 2020.). As of 2019, more than 35 million deaths have been reported due to the virus. Approximately two-thirds of the global burden of deaths due to HIV occurred in sub-Saharan Africa (Coetzee et al., 2019). In Kenya, there are 36,000 new HIV cases annually (*KENPHIA 2018*.). The number of AIDS-related deaths is on the decline, 53,900 deaths were reported from AIDS in 2010 as compared to 28,200 deaths occurring in 2017 (*National Aids Control Council*, 2017.). In Kenya, in 2017 there were 1.5 million persons living with HIV (PLHIV) as compared to 1.3 million persons in 2018 with a prevalence of 4.9% (*KENPHIA 2018*.; *National Aids Control Council*, 2017). There is also an improvement in access to care for persons living with HIV (PLHIV). Globally over 20 million persons have had access to Anti-Retroviral Therapy (ART) and thus there is an improvement in their life expectancy and quality of life (El-Sadr & Goosby, 2018). Between 2011 and 2021, adult ART coverage increased from 61% to 79% (Odhiambo et al., 2014; Unaids, 2021). This improvement in access to treatment for PLHIV has resulted in a longer life expectancy for HIV patients. The PLHIV are thus able to have fewer opportunistic infections and less AIDS related complications. As a result, PLHIV are now experiencing an increase in their NCDs just like HIV-negative persons.

Hypertension has been reported to be the leading risk factor for mortality worldwide. Globally, among HIV-positive individuals who are on ART, the prevalence of hypertension has been estimated to be at 35% compared to HIV-negative persons with an estimated prevalence of 30% (Fahme et al., 2018). This may allude to the fact that hypertension prevalence may be higher in PLHIV than in HIV-negative individuals and that either the virus or the ART may play a role in the prevalence of hypertension among PLHIV. Furthermore, among HIV-positive individuals who have been on treatment for a long period of time and are aged more than 50 years, reports have shown that 1 out of

every two patients has hypertension (Fahme et al., 2018). As the age of individuals increase the prevalence of hypertension increases in both PLHIV and HIV-negative persons. Although this is true the rate of hypertension may still be higher among PLHIV than in HIV-negative individuals. The risk of hypertension in Africa has also been shown to be lower than the risk of hypertension in other parts of the world such as in North America (Davis et al., 2021). The factors that influence the prevalence of hypertension are multiple and can also vary based on geographical regions. The more developed regions of the world are known to have higher rates of NCDs such as hypertension with the developing regions of the world known to have a double burden of disease with a high prevalence of communicable diseases as well as high prevalence of NCDs.

The risk factors for hypertension include unhealthy diets such as high salt intake, high consumption of saturated and trans fats, inadequate intake of fruits and vegetables, high alcohol and tobacco consumption, physical inactivity, and being overweight (WHO, 2021.). The risk factors for HIV include having unprotected sex, having other sexually transmitted infection (gonorrhea, syphilis, Herpes Simplex Virus (HSV), among others), sharing contaminated needles and syringes, receiving unsafe injection, blood transfusions, and tissue transplantation, and experiencing accidental needle stick injuries (WHO, 2020). The PLHIV have an approximately two times higher risk of getting an NCD in patients who are older, of male sex, and have had a longer duration on ART, and approximately three times higher risk in patients with a higher Body Mass Index (BMI) and patients with concurrent diabetes as compared to PLHIV (Fiseha et al., 2019). These risk factors are similar to HIV-negative persons as well as being specific to PLHIV.

The patient knowledge attitude and practices also affect the prevalence of hypertension as well as contribute to the development of complications in those already diagnosed with the disease. Patients who have a good knowledge of hypertension have been shown to have better controlled blood pressure (Haron et al., 2021). Patients with a good knowledge of hypertension and who then proceed to apply that knowledge to their daily lives are more likely to have better controlled blood pressure and also have fewer complications from the disease. A patient's attitude toward blood pressure also affects their disease outcomes. Patients with a positive attitude are more likely to be receptive to advice from healthcare workers and thus more likely to be adherent to their medication. However, patients who have a negative attitude are more likely to not follow the advice given by healthcare workers and thus are more likely to have poorer disease outcomes. Hypertension prevention practices are also known to affect patient outcomes. A previous study showed that patients were least responsive to exercise as a hypertension prevention practice (Abdalla & Mirghani, 2021). The lack of uptake of exercise is likely to contribute to the development of disease in the non-hypertensive that are at risk and to worsening of disease in those that are already hypertensive. This will also lead to more complications such as stroke and heart failure in those already diagnosed with the disease.

The increased morbidity of PLHIV with NCD necessitates the need for an integrated approach to the management of PLHIV (Adeyemi et al., 2021). This integrated approach in management will need to be patient-centered to ensure the best outcome for all the patients. It will ensure that patients are managed comprehensively in the CCCs without the need for follow-up in two separate clinics. This approach is effective, requires fewer human resources, and is also cost-effective.

The overall knowledge of hypertension and other NCDs among PLHIV is low with little knowledge being demonstrated on the risk factors of the diseases as well as the possible complications of the diseases (Kagaruki et al., 2018). The low knowledge of the risk factors of the diseases affects the practices that these individuals undertake which indirectly affects the prevalence of disease. The low knowledge about the complications of the disease also affects the efforts that PLHIV who are hypertensive put in to prevent the complications. A negative attitude towards hypertension prevention practices has also been demonstrated among PLHIV (Kagaruki et al., 2018). The negative attitude toward hypertension prevention practices accompanied by being unknowledgeable of the risk factors and complications of the disease increases the likelihood of a higher prevalence of disease among PLHIV.

Mombasa County is an urban city located in the southeastern region of Kenya with a total population of 1,208, 333 and a male population of 610,257 (50.5%) (*KNBS 2019*.). Mombasa is the smallest county in Kenya and borders Kilifi County to the north, Kwale County to the southwest, and the Indian Ocean to the east. It lies between latitudes 3º56'and 4º10' south of the equator and longitudes 39º34'and 39º46'east. It covers an area of 229.7km² and is subdivided into 4 divisions: Mombasa Island, Changamwe, Likoni, and Kisauni, and 6 sub-counties: Changamwe, Jomvu, Kisauni, Nyali, Likoni, and Mvita.

Mombasa County has a prevalence of HIV at 5.6% which was higher than the national prevalence of HIV at 4.9% (*KENPHIA 2018*.). Mombasa County was also leading in Kenya in terms of the use of at least one substance of abuse at 34.4%. Analysis of individual drugs indicated that 12.6 % of residents in the Coast Region were using alcohol, 14.7% tobacco, 12.0% khat/ miraa, 4.5% bhang, 2.3% heroin, 1.3% prescription drugs/ sleeping pills, 0.9% cocaine, and 0.4% hashish. Analysis of alcohol

and drug dependence in the Coast Region showed that 8.1% of the residents were dependent on tobacco, 7.3% were dependent on alcohol, 7.1% were dependent on khat/ miraa, 4.8% were dependent on bhang, 3.0% were dependent on heroin, 1.2% were dependent on cocaine while 0.7% were dependent on prescription drugs (*The county governments of Mombasa, Kilifi, Kwale, Lamu, Tana River and Taita Taveta,"* 2016).

Mombasa is the main tourism hub in the country, and this serves as the main economic activity in the county. Tourism increased prostitution rates which promotes the transmission of HIV (Quevedo-Gómez et al., 2020).

1.2 Problem Statement

There is an increase in hypertension among PLHIV due to the great strides in increased access to HIV care and treatment (Achwoka et al., 2020). As more PLHIV live longer, they are more likely to experience hypertension like other HIV-negative persons. The current test and treat guidelines in the country requires all HIV patients to be on ART increasing their duration of treatment. A study done in Ethiopia reported a 2-fold higher risk of hypertension in PLHIV who were on ART for greater than five years (Fiseha et al., 2019). Mombasa County has a high prevalence of tobacco use, alcohol abuse, drug abuse, and sex work, which are risk factors for hypertension and HIV. According to the Kenya STEPS survey of 2015, the prevalence of tobacco and alcohol use is at 13.3% and 19% respectively in Kenya. In Mombasa, 24.1% and 33.8% of their residents are reported to have ever, used tobacco and alcohol respectively in their lifetime (MOH; KNBS; WHO, 2015; Nacada, 2016). A previous study in central Kenya reported that the highest prevalence of hypertension was 18.9% in PLHIV. However, the prevalence of hypertension among PLHIV in a context like Mombasa that is favorable for NCDs is unknown (Mbuthia et al., 2021). The cited study was conducted in Kiambu, and

patient records were reviewed to determine the hypertension status of PLHIV. As such, the study does not represent the hypertension status of HIV patients in other geographical settings in Kenya. There is no published literature on hypertension among HIV patients in Mombasa County and data from the study in Kiambu are not representative of the hypertension status of PLHIV in Mombasa County.

1.3 Justification

Understanding the prevalence and risk factors of hypertension among PLHIV in settings with different HIV prevalence is essential to help inform targeted prevention and control public health strategies. The HIV prevalence in Kenya varies by county and a previous study on hypertension and PLHIV was conducted in a county with the lowest HIV prevalence. There is no published literature on Hypertension among PLHIV in Mombasa County. Therefore, conducting the study in Mombasa allows the determination of the public health burden of hypertension of PLHIV in a county with high prevalence. This study aimed to identify the prevalence of hypertension among PLHIV in Mombasa, and further identify the factors associated with hypertension among them. The results of this study could improve the overall care of HIV patients in Mombasa, ultimately improving the survival rate of patients with co-morbidities in Kenya.

1. 4 Research Questions

1. What is the prevalence of hypertension among PLHIV in Mombasa County?
2. What are the factors associated with hypertension among PLHIV in Mombasa County?
3. What is the knowledge, attitude, and practices on hypertension among PLHIV in Mombasa County?

1.5 Objectives

i. To determine the prevalence of hypertension among PLHIV in Mombasa County

ii. To describe the factors associated with hypertension in PLHIV in Mombasa County

iii. To assess the knowledge, attitude, and practices on hypertension among PLHIV in Mombasa County

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

The survival rate of PLHIV globally and in Sub-Saharan Africa has improved due to the availability of ARTs (Smit et al., 2018). The availability of ART medication has enabled PLHIV to have better access to treatment delaying development of stage IV diseases and the accompanying opportunistic infections which lead to death. The incidence rate of HIV and the associated AIDS-related deaths has also decreased in the region contributing to an aging population of HIV patients (Coetzee et al., 2019). With better access to treatment, the viral load of PLHIV is lower thus leading to a lower possibility of infection to those exposed to infectious body fluids. As the HIV-positive population increases with age they become more prone to other age-related diseases, especially NCDs. NCDs are thus becoming the new cause of morbidity and mortality among PLHIV. Some studies have shown the disproportionate burden of NCDs among PLHIV (Achwoka et al., 2020). Among PLHIV these studies have shown higher rates of NCDs such as hypertension, diabetes, other cardiovascular diseases, chronic kidney disease etc. NCDs are estimated to become the leading cause of death by 2030 (Coetzee et al., 2019). By 2030, NCDs may be more prevalent than communicable diseases thus resulting in more deaths being attributable to NCDs. In addition, NCDs may have a higher morbidity and mortality rate than communicable diseases thus leading to more NCD-related deaths.

A study in Zimbabwe shows that the prevalence of NCDs in PLHIV is 19.6% with 4.6% having more than one co-morbidity (Smit et al., 2018). This translates to 1 out of 5 patients with HIV currently suffering from an NCD. It has been predicted that by the

year 2035, adult PLHIV had double the risk of having an NCD as compared to a person that is HIV-negative (Smit et al., 2018). However, one study is reported to have found no difference in the rates of NCDs among PLHIV as opposed to HIV-negative persons (Van Heerden et al., 2017). This may imply that HIV and the use of ARTs do not affect NCDs in PLHIV. In contrast one of the reviewed study found that the risk of hypertension among PLHIV was lower than in HIV-negative persons (Davis et al., 2021). These findings show that the relationship between HIV and other NCDs such as hypertension is still yet to be clearly understood and hence the need for more research to better understand if ART decreases or increases the prevalence of NCDs among PLHIV or have no effect in these people.

Among PLHIV, some differences have been observed when comparing males to females. For example, in Kenya females have been shown to have a higher prevalence of HIV at 6.6% compared to their male counterparts with a prevalence of 3.1% (*KENPHIA 2018*.). The higher prevalence of HIV among females compared to males may be attributable to several factors. The female anatomy allows for easier transmission of the HIV compared to the male anatomy. In addition, more females than males are known to be involved in sex work activities and thus are at an increased risk of transmission of the disease. Further differences observed between men and women living with HIV are that men were found to have an older median age and more advanced disease at their baseline in comparison to their female counterparts (Magodoro et al., 2016; Zungu et al., 2019). This may be due to men naturally having relations with women who are younger than them. Men have also been shown to have poor health-seeking behavior and are reported to wait longer before seeking medical assistance as compared to the female gender.

2.2 Prevalence of hypertension among PLHIV

Globally, data has shown that 23.6% to 35% of PLHIV who are on ART have hypertension compared to HIV-negative individuals (Bigna et al., 2020; Fahme et al., 2018). This data reveals the higher burden of disease in PLHIV especially regarding NCDs such as hypertension. In addition, people who have been on treatment with ARTs for a longer period were shown to have an even higher prevalence of hypertension. Over 50% of PLHIV who are 50 years and older were also reported to have hypertension (Fahme et al., 2018). In Sub-Saharan Africa, the prevalence of hypertension among PLHIV has been estimated to be at 18% (Musekwa et al., 2021). While this may be much lower than global estimates, the prevalence is still high and global estimates reveal what may be the future trends of hypertension for the rest of the world. In support of these findings another study has shown that the risk of developing NCDs such as hypertension was markedly lower in Africa as compared to other regions of the world such in North America (Davis et al., 2021). These findings further illustrate the need for more research especially in Africa regions where the burden of HIV is high and the burden of NCDs is on the rise.

The most common NCDs are expected to be hypertension, CKD, depression, cancer, asthma, diabetes mellitus type 2, and congestive cardiac failures (Magodoro et al., 2016; Patel et al., 2018; Smit et al., 2018). Hypertension is expected to be the most prevalent NCD among PLHIV. There is therefore a need to screen PLHIV for hypertension to identify and treat them early to reduce the morbidity and mortality from the disease (El-Sadr & Goosby, 2018). The screening for hypertension still needs to include screening for other common NCDs such as diabetes, chronic kidney disease, mental illnesses, and others to allow for the patients to be managed adequately in the early stages of disease for better outcomes. PLHIV have been reported to have higher

rates of smoking and drinking that may also predispose them to hypertension (Jespersen et al., 2021; Smit et al., 2018). This may be attributed to the riskier lifestyles among these populations in comparison to other populations. The use of alcohol, cigarettes, and other forms of drug abuse contributes to an impairment in judgement and exposes these persons to HIV, other sexually transmitted diseases, and other diseases transmitted through intravenous drug use.

In contrast, some studies found that when comparing PLHIV versus HIV-negative persons, there was no difference in the rates of hypertension, diabetes, and hyperlipidemia, however, PLHIV were found to have a higher rate of being overweight than the HIV-negative persons (Van Heerden et al., 2017). The higher prevalence of being overweight or obese among PLHIV may indirectly affect the prevalence of NCDs among PLHIV. Many NCDs such as hypertension, diabetes, and other cardiovascular diseases have been shown to be propagated by weight gain and have had prevention of disease or complications by ensuring a decrease in weight of the patients. In PLHIV, those who are in the WHO stage I had a higher proportion of obesity as compared to those in the other stages (Patrick et al., 2021). The higher proportion of overweight HIV-positive may suggest that there is a higher proportion of hypertension in this population however this was not identified. This may also be attributable to the fact that when PLHIV are in stage I they are often in a healthier stage but as the disease progresses to stage IV then PLHIV become more wasted and emaciated.

In addition, the prevalence of obesity was greater by 14.7% for PLHIV versus those that are HIV-negative. The prevalence of obesity rose by another 14% for persons that were on ART (Coetzee et al., 2019). These results show that there may be higher rates of hypertension among PLHIV on treatment compared to those who are treatment

naïve. It further shows that there may be some ARTs that indirectly lead to higher rates of hypertension.

Some studies have also reported lower rates of hypertension among PLHIV as compared to those that were HIV-negative (Kwarisiima et al., 2019). This may also be plausible depending on the stage of the disease. PLHIV in WHO clinical stage IV disease are likely to have lower rates of hypertension due to suffering from AIDs related complications and opportunistic infections. These two complications work synergistically leading to these patients being emaciated and thus at very low risks of being hypertensive. These findings contrast the previous impressions of HIV people and further affirm the great strides that have been made in the improvement of care for PLHIV.

Reports have shown that the prevalence of HIV is often higher among females as compared to males, similarly, in Kenya, the number of females living with HIV is double the population of males living with HIV(*KENPHIA 2018*.). This has been attributed to how the virus is spread, with women more susceptible to acquiring the HIV infection compared to men. The difference in the anatomy of both genders, as well as the differences in the exposure to transmitting infectious fluid, contributes to this (Unaids, 2021). The concurrent infection with another sexually transmitted infection allows for easier transmission of the virus due to the inflammatory response mounted from these other infections. In addition, women are more disadvantaged due to gender inequalities in the financial capabilities of both sexes. Women who use sex as a means of livelihood, are less able to campaign for condom use due to their financial constraints (Unaids, 2021). The use of sex as a means of income in women who are more financially disadvantaged exposes them to multiple sexual partners and increases their risk of contracting the virus. Furthermore, unless condoms are provided free of charge,

these women are unlikely to purchase any form of protection for the work they are involved in. The priorities would be food and shelter and protection from the disease then ceases to be a priority.

A higher mean difference in systolic and diastolic blood pressure has also been reported when comparing HIV patients who are treatment-naive as opposed to those who are on ART (Nduka et al., 2016; Patel et al., 2018). These studies allude to the fact that either the virus or the use of ART may have an indirect effect on the reduction of blood pressure. There was a 14.5% prevalence of clinically diagnosed hypertension in patients on ART, compared to a 10.5% prevalence of hypertension in patients who are HIV positive but treatment-naïve (Nduka et al., 2016). Though the difference may be small, more research is needed to clearly understand the relationship between ART and hypertension. The prevalence of hypertension among PLHIV has been shown to approximately be 11% (Kwarisiima et al., 2019). This shows that approximately one out of every ten persons in this study with PLHIV in Uganda were hypertensive. The factors that have been associated with hypertension among PLHIV are residence, older age, no education, higher wealth index, and higher BMI (Kwarisiima et al., 2019). Geographical location impacts the prevalence of the disease. Areas with factors more associated with a particular disease will have a higher prevalence and areas with factors that may aid the prevention of disease will have a lower prevalence. In addition, people with a higher well index are more prone to have unhealthy diets. These unhealthy diets may then play a role in the development of hypertension in these people.

In addition to BMI, other factors that have been shown to be associated with an increased risk of hypertension are a history of hereditary hypertension and kidney disease at stage 3 or more severe disease (Tsuro et al., 2022). Hereditary hypertension has been shown to be a risk factor for essential hypertension even in HIV-negative

persons. In addition, kidney disease may be brought on by hypertension itself however even when not brought on by hypertension, it affects the volume levels within the body that may indirectly result in a change in blood pressure.

Chronic inflammation, renal disease, and blood vessel damage have also been shown to be possible etiological factors for an increased prevalence of hypertension among PLHIV (Davis et al., 2021). The effect of the virus leads to a chronic inflammatory response which may affect the kidney leading to renal disease and the blood vessels are also affected due to the chronic inflammation leading to blood vessel damage. This shows that the use of ART treatment may be linked to an increase in the systolic and diastolic blood pressure readings of HIV patients. Furthermore, 14% of Zimbabweans who are HIV-negative were diagnosed with at least one NCD in comparison to 33% of PLHIV in the same region (Smit et al., 2018). This again alludes to the fact that the use of ART is associated with increased rates of hypertension in HIV patients and that the virus or the use of ART are the possible etiological factors linked to an increase in NCDs among PLHIV. Moreover, a dose-dependent association has also been identified in HIV patients who are on ART (Nduka et al., 2016). Patients who have been on ART for a higher period have been shown to have progressively higher blood pressure readings versus those who have been on ART for a shorter duration of time. The increased exposure to ART over a prolonged time has been shown to have a cumulative effect and more damage thus leading to higher rates of NCDs in PLHIV who have been on medication for a longer period of time.

The harmful use of alcohol, smoking tobacco, and intravenous drug use (IDU) has also been shown to predispose users to both HIV and the propagation of NCDs (Achwoka et al., 2020). Mombasa County is reported to have a high prevalence of alcohol abuse, tobacco smoking, and IDU. There is also a high prevalence of prostitution in the county

predisposing its residents to higher rates of HIV as compared to the rest of the population. The combination of all these favorable factors suggests that there may be a higher prevalence of NCDs in this population as compared to the rest of Kenya. Previous studies that have focused done in this topic are rare (Davis et al., 2021). These studies have focused more on Western Kenya and thus there is a need to show if there is a disproportionate burden of NCDs in Mombasa located in the South-Eastern part of Kenya. In addition, the focus of NCD-HIV care in the country has not been taken up to the degree that has been recommended, and this proves the need to tailor the care of PLHIV to the specific needs of different regions. Studies have also shown that different regions have a higher or lower burden of NCDs in PLHIV and thus the county may present a picture that is different from the rest of the country (Davis et al., 2021). This study, therefore, aims to determine the prevalence of hypertension among PLHIV in Mombasa County and identify the factors that lead to the development of hypertension among PLHIV.

2.3 Factors Associated with hypertension among PLHIV

The rise in NCDs has been attributed to several factors that affect PLHIV. These include increased age-related degenerative changes due to the virus, ongoing inflammation from the virus, progressive immune dysfunction from the attack of the CD4 cells, and cumulative exposure to drug-related toxicities from ARTs (Kansiime et al., 2019). Endothelial dysfunction from the virus has been shown to cause arterial damage and physiological changes such as glucocorticoid and insulin resistance have all been linked to high blood pressure in these patients (Kwarisiima et al., 2019; Nduka et al., 2016). Endothelial dysfunction may not only lead to hypertension but may also lead to other arterial diseases that may contribute to other NCDs other than hypertension such as

renal diseases. Endothelial dysfunction also affects the blood flow through the kidneys which may eventually result in renal diseases.

The inflammatory markers that are associated with the infection of the virus have also been linked to NCDs (El-Sadr & Goosby, 2018; Jespersen et al., 2021). These inflammatory markers, though intended to fight the virus in the body still lead to other effects that give rise to a higher NCD prevalence in PLHIV. The pro-inflammatory mediated effects of the virus have been linked to cardiovascular diseases, and the side effects of the ART such as increased fat redistribution and metabolic syndrome have also been shown to be risk factors for developing cardiometabolic diseases (Jespersen et al., 2021; Patel et al., 2018; Van Heerden et al., 2017). The cardiometabolic diseases may then lead to a rise in other NCDs such as chronic kidney disease due to the complications of the cardiometabolic diseases. The increased fat re-distribution leads to increased insulin resistance which then leads to the development of diabetes (Coetzee et al., 2019). The fat distribution is directly associated with an increase in BMI and thus may lead to the development of other NCDs other than diabetes.

In addition, the cumulative effect of the virus and the prolonged use of ART has been shown to work synergistically to bring the rise of NCDs in PLHIV (Smit et al., 2018). Thus, the virus and the use of ART have been shown to have an increase in NCDs. Furthermore, the increased survival rate of HIV patients due to better treatment through ART also means that the PLHIV live longer and thus as they age would be subject to age-related NCDs (Coetzee et al., 2019; Smit et al., 2018). As better treatment is made available to PLHIV they thus become more prone to other diseases than affect HIV-negative individuals. The advancement in treatment for PLHIV though good, more research is required to factor in the new challenges with these advancements.

Studies have found that the factors strongly associated with co-morbidities among PLHIV were age groups above 45 years and females were associated with higher co-morbidity and multi-morbidities as compared to males (Kansiime et al., 2019; Magodoro et al., 2016; Zungu et al., 2019). The age of women identified in these studies is still far from the calculated life expectancy and thus the older women get the greater the risk of developing comorbidities and multi-morbidities. This study also reveals that women are more prone to co-morbidities compared to males and this occurs at an even younger age compared to their male counterparts. Women are more physically inactive and thus more overweight than their male counterparts which predisposes them to have an increased likelihood of hypertension (Zungu et al., 2019). The more inactivity or less frequent the exercise regimens the higher the prevalence of hypertension and other NCDs. As the age of HIV-negative people increases, they become more prone to being overweight, obese, and developing diabetes (Coetzee et al., 2019). With an increase in age, there is also a commensurate decrease in the level of physical activity. As a result, there is an increased likelihood of being overweight or obese.

Older women who are HIV positive are thus more likely to have an NCD as compared to their male counterparts (Van Heerden et al., 2017). Considering the findings that women are more prone to be overweight and that older persons are also more prone to be overweight then older women may be at the highest risk of developing hypertension and other NCDs. Women are also known to be infected at higher rates than males and the life expectancy of females is higher than males. For the specific non-communicable diseases, only hypertension and asthma were found to have an association when compared between males and females with females having a higher risk for these conditions (Magodoro et al., 2016). Multiple studies have thus illustrated the higher

prevalence of hypertension among women and the need to pay keen attention to this age group in the prevention and early detection of NCDs.

Other studies have found that males have had a higher prevalence of hypertension compared to their female counterparts (Mbuthia et al., 2021; Mulugeta et al., 2021). The factors that may favor the higher prevalence of hypertension among males compared to females is the higher stress levels among males compared to females. In the African set-up, males are more likely to be the breadwinners and providers of their homestead. In addition, males are more likely to be the head of the home. All these responsibilities may make males more susceptible to stress and thus more prone to stress-related illnesses such as hypertension.

In a global study that reviewed studies from all over the world except North Africa, Asia, the Middle East, and Europe, it was reported that there was no difference in the prevalence of hypertension when comparing men and women (Bigna et al., 2020). This reveals that though there may be differences in the risk factors between males and females, this ultimately does not result in an overall difference in the prevalence of hypertension when comparing males and females. In addition, though there may be age disparities when reviewing the prevalence of hypertension between males and females, these figures eventually balance out leading to no differences between males and females.

In addition to females and age-related associations, a study in South Africa focused on BMI in PLHIV and its associations with hypertension. The study revealed that at the initiation of ART medication, the prevalence of overweight and obesity were 18.1% and 11.5% respectively. In approximately 4 years of being on ART, this prevalence of overweight and obesity rose to 21.4% and 19.6% respectively (Mathebula et al., 2020).

The effect of the increase in BMI resulted in an increase in hypertension prevalence to an ultimate high of 34.6% (Mathebula et al., 2020). These findings show how there is a direct association between BMI and hypertension even among PLHIV.

The prolonged use of ART is also expected to result in a rise in complications in PLHIV (Zungu et al., 2019). The use of drugs for a prolonged period may affect multiple organs such as the liver or kidneys etc. There is expected to be a 40% increase in the complication rates of these patients from drug interactions with the currently recommended ART regimens (Smit et al., 2018). This may necessitate the need to improve on the current ART regimens either through the development of new drugs or the re-structuring of the current regimens as we know them today. It also necessitates the need for close monitoring of PLHIV especially the ones with other comorbidities such as hypertension due to the high pill burden. The use of multiple drugs has a synergistic effect on long term damage to various organs in the body.

A study in Zambia reports that in addition to the age related and BMI related increase in hypertension, the use of dolutegravir based regimens had a two times higher risk of hypertension as compared to previous regimens based on the non-nucleoside reverse transcriptase inhibitors such as nevirapine and efavirenz (Musekwa et al., 2021). This finding may alter the use of dolutegravir based regimens as being the first line drug regimen in many countries. It is of most importance to patients that are at high risk of hypertension. We may need to consider having drug regimens that take into consideration one's potential risk of developing hypertension.

PLHIV that are on tenofovir-based regimens were shown to have lower rates of obesity as compared to those on zidovudine-based regimens (Patrick et al., 2021). The lower rates of obesity are some of the modifiable factors that are used to decrease one's risk

of developing hypertension such as through exercise and diet. The use of tenofovir-based regimens may thus indirectly contribute to a decrease in the prevalence of hypertension in patients that are on these drugs,

In contrast, a study in Ethiopia reports a higher risk of hypertension in patients that are on Zidovudine based regimens compared to other regimens (Mulugeta et al., 2021). This study reports that patients that are on Zidovudine based regimens have almost a three-fold higher risk of developing hypertension compared to patients on other regimens. The reason for this is still not yet well defined and further illustrates the need for more research on ARTs and their effect on developing hypertension and other NCDs in PLHIV.

In addition, another study showed that the use of zidovudine/lamivudine/nevirapine has been shown to have a higher incidence of hypertension in PLHIV (Divala et al., 2016). This study evaluated all three drugs and found that they had a similar effect. Although these drugs are from the Nucleoside Reverse Transcriptase Inhibitors and Non-nucleoside Reverse Transcriptase Inhibitor classifications, it is important to note that they still have a similar effect on hypertension. To better understand the effect of ARTs on hypertension, individual drugs should be assessed to see what their effect is on hypertension and other NCDs.

In Uganda, a study revealed a lower rate of hypertension among PLHIV who are on second line regimens with ritonavir and lopinavir (Lubega et al., 2021). The use of the second line regimens was compared to the first line-based regimens using Nevirapine. The study revealed that patients who were on Nevirapine based regimens had higher odds of hypertension compared to patients who were on the second line lopinavir and ritonavir-based regimens. The use of second line regimens is often among patients who

have failed to have viral load suppression with their first line regimens. Thus, these patients often have advanced disease with other opportunistic infections which may contribute to a lower likelihood of hypertension among these patients.

The availability of ART has also led to fewer opportunistic infections and AIDS-defining cancers with their associated morbidity and mortality (Magodoro et al., 2016). Opportunistic infections among PLHIV are common in stage four of the disease when the viral load is high, and the immune system has also been affected by the virus. However, persons who suffer from opportunistic infections have also been reported to have higher rates of NCDs (Kansiime et al., 2019). This may be attributed to the high pill burden from HIV and having comorbidity that decreases adherence and allows for opportunistic infections. In addition, this may be an indication of the effect that the high pill burden had on the body with an associated rise in NCDs. The ART used by PLHIV may play a role in the development of NCDs either directly or indirectly.

A study in South Africa also found that patients with advanced disease and severe CD4 counts were at increased risk of developing hypertension (Tsuro et al., 2022). Advanced disease may result in an increase in the stress levels of the patient which may contribute to higher blood pressure readings. Other opportunistic infections may also result in high cortisol levels within the body that also contribute the higher blood pressure readings.

Systemic factors associated with poor health care systems in LMICs may also indirectly propagate NCDs including hypertension among PLHIV. These factors include the availability of medications and devices, trained staff, clinic waiting time, clinic hours, staff attitudes, frequency of patient visits, and advanced medical care or simply access to medical care (Kwarisiima et al., 2019; Patel et al., 2018). These impediments may hinder the appropriate investigations and treatment of PLHIV thus increasing the

prevalence of hypertension. If patients are unable to access the health facility due to distance, inadequate transport modalities, or insufficient funds, then they will not have their medication when needed which affects adherence and thus control of the NCDs. If patients are also not agreeable to the clinic waiting times or the time schedules for the clinic, then this also affects their willingness to attend their clinics which also affects drug adherence and control of NCDs. The frequency of drug stockouts for those used to treat hypertension was shown to directly hinder hypertension control by propagating more NCDs (Kwarisiima et al., 2019). Frequent drug stock outs result in patients not receiving medication when they need it and this will also affect drug adherence leading to inadequate control of NCDs, thus a higher prevalence of these due to systemic factors. In addition, patients who have been shown to have more frequent visits than those that are clinically recommended have been shown to have worse BP outcomes (Kwarisiima et al., 2019). This may be because they initially had poorly controlled hypertension thus requiring the need for more visits or drug stockouts leading to periods when they lacked their medications and thus had poorly controlled hypertension. The inability of these patients to take their drugs consistently may also be accompanied by poor drug adherence to ART thus further confounding the effects of the virus on the individuals leading to overall worse outcomes for these patients.

2.4 Knowledge, attitude, and practices of hypertensive PLHIV

2.4.1 Knowledge of hypertension

The knowledge and perception of PLHIV in other comorbidities such as hypertension affect the diagnosis, treatment, and complications that may arise from these conditions. The overall knowledge of comorbidities among PLHIV is low (Kagaruki et al., 2018). The low level of knowledge means that patients are unable to prevent themselves from the common risk factors and may be more prone to these comorbidities and their

complications. Despite the rising burden of NCDs, these findings show that there is still work to be done to educate the public for optimal control of the disease through prevention and early detection. Among HIV-negative individuals the hypertensive patients are more aware of the disease; however, they do little to adopt the precautionary measures that are advised by healthcare workers (MALIK et al., 2014). Hypertensive patients are more likely to have received multiple sessions of education on their disease as they visit their clinic and come into contact with various cadres of health workers. Despite these multiple sessions of education, more is still needed to ensure that these patients incorporate their knowledge into their daily lives. As a result, these patients may develop complications and the complications that may arise due to uncontrolled hypertension may then be more prevalent and this may lead to mortality.

Patients who are found to be well-informed about the modifiable risk factors for hypertension and other non-communicable diseases are patients that are well-educated and have a low CD4 count (Biraguma et al., 2019). Patients that have secondary and tertiary schooling are more likely to have heard about non-communicable diseases. Patients that have a low CD4 count are also likely to have had the disease for a prolonged period and thus have had more interactions with health care workers so are more educated. They are therefore more likely to be adherent to their ARTs which may result in better control of their HIV as well as any other comorbidities they may have.

Among the HIV-negative, patients who were found to have a higher level of education were found to have better knowledge of hypertension (Haron et al., 2021). Patients who have been exposed to secondary and tertiary education are more likely to have been exposed to more general knowledge through their education and exposure as they interact with other people. This therefore makes them more likely to have better knowledge even in areas that may not be of interest to them.

In addition, patients who had better knowledge of hypertension were also found to have better controlled blood pressure in hypertensive patients (Haron et al., 2021)

In a study conducted in Sudan, the most commonly identified knowledge on hypertension was that salt consumption affects blood pressure (Abdalla & Mirghani, 2021). The knowledge that salt intake affects blood pressure is well known by health workers and this is one of the key strategies that is relayed to hypertensive patients to help them decrease their blood pressure. Health workers relay this information and more during the clinic visits to both the patients and their relatives resulting in good knowledge by both the hypertensive and non-hypertensive people on the key prevention strategies of hypertension.

2.4.2 Attitude towards hypertension

In a study conducted in Malaysia, participants were found to have a positive attitude toward hypertension prevention practices such as reduced salt intake (Haron et al., 2021). This positive attitude towards reduced salt intake indicates that the community may have a positive attitude towards hypertension prevention practices such as reduced smoking and exercising. In addition, patients already diagnosed with hypertension will also have a positive attitude in taking up practices that would decrease the severity of their blood pressure and decrease the risk of developing complications.

Moreover, when comparing younger patients to older patients, younger patients were found to have a better attitude toward decreased salt intake to prevent hypertension as compared to older patients (Haron et al., 2021). Younger patients are still learning and thus their thoughts and ideas are more malleable. The older patients are more likely to be more rigid in their thoughts and ideas as they have already established routines and practices that they have been conducting throughout their lives.

2.4.3 Practices towards hypertension

The practices that hypertensive patients were found to be most avoidant of was exercise with almost 60% of patients admitting to not exercising on most days of the week (Abdalla & Mirghani, 2021). Although exercise is one of the key strategies in decreasing blood pressure, it may be one of the most difficult strategies to implement, especially in patients who have a sedentary lifestyle. The sedentary lifestyle predisposes them to hypertension and the reversal of the same decreases their blood pressure. However, this is difficult to implement as it is against what they have been accustomed to.

2.5 Summary of Reviewed Literature

HIV programs, in addition to achieving their 90:90:90 target and the 'test and treat' model, are needed to incorporate systems that cater to NCDs (Smit et al., 2018). This ensures that there is a comprehensive care package for these patients. A comprehensive care package will thus ensure optimal control and management for the PLHIV. Current screening should thus be for hypertension, CKD, depression, and cancers. There is a possibility of incorporating NCD care for HIV-negative patients within the CCCs (Smit et al., 2018). In addition, our integrated NCD and HIV care approach will still require to be tailored to each individual patient to ensure the best outcome possible as no two patients are the same (Adeyemi et al., 2021). This approach is the future of HIV management in both developed and developing nations. This approach was leveraged on the already built structures and systems and thus decreased the resources required to tackle the ever-rising burden of NCDs, especially in the LMICs. A study in Uganda has shown better hypertension control among PLHIV who are on follow up in the integrated clinics as compared to persons who are HIV-negative (Kwarisiima et al., 2019). This may suggest that PLHIV may have a better understanding of the importance of

adherence to medication in terms of disease control and thus may be keener to ensure they take their anti-hypertensive drugs for optimum control of both HIV and hypertension. This further provides evidence for other African countries to adopt the integrated approach in the management of PLHIV who have other co-morbidities.

The high financial implications and increased morbidity and mortality rates from having a concurrent NCD with HIV need to be addressed (Van Heerden et al., 2017). The development of Comprehensive Care Clinics (CCC) for the treatment of HIV patients is a system with a lot to learn from. The treatment of NCDs can borrow a lot from the CCC clinics. The integration of NCD treatment within the already established CCCs was useful in cutting down financial and human resources, decreasing stigma, increasing medication adherence, and improving the overall health of PLHIV (Kwarisiima et al., 2019; Osetinsky et al., 2019; Smit et al., 2018). The benefits to be gained from the integrated clinics far outweigh any disadvantages that may arise from these clinics and thus should be the way forward in the management of PLHIV. These clinics can be run by non-physicians with fixed-dose regimens and algorithms to be followed for HIV patients (El-Sadr & Goosby, 2018). The use of algorithms in these clinics will ensure that the same standard of care is offered to all patients and makes it easier for all cadres who manage these patients to have optimal outcomes. The human resource required to run the clinics can therefore be scaled down to the staff that is more readily available in comparison to physicians. The use of clinical officers has allowed developing countries to offer health care services in multiple areas of the country where doctors and physicians were not readily available or were inadequate to offer the services required by the population.

Psychosocial support is also a key component in the treatment of patients with HIV (El-Sadr & Goosby, 2018). This may highlight the need for integrating psychosocial

support in clinics that cater to long-term illnesses such as NCDs. In addition, we can also learn from the high-income countries that have been tackling NCDs for a longer duration of time. However, care should be taken when adopting these measures in the LMICs as the population suffering from NCDs and HIV is much younger in the LMICs (Coetzee et al., 2019; Van Heerden et al., 2017). The younger population of persons with NCDs may require different approaches to the management of NCDs. The health education sessions will need to be tailored to the activities that are more prone to this age group. In addition, the outreach activities in the community will need to be focused on areas where younger people can be reached so as to ensure the message is delivered to the target age group.

The treatment of PLHIV needs to progress from focusing on the prevention of mother-to-child transmission (PMTCT) to focusing on the concurrent management of HIV and NCDs (Van Heerden et al., 2017). Although the prevention of mother to child transmission of disease is important and decreases the new infections in children born from HIV-positive mothers, the management of PLHIV is multi-faceted and efforts need to be directed to a multi-pronged approach. The aging HIV population may soon pose a challenge as they are more prone to NCDs, and treatment will have to be tailored to accommodate these new co-morbidities. Strategies also need to be employed to have population-based health promotion and risk factor prevention programs for NCDs (Coetzee et al., 2019). This should be applied to both PLHIV and persons who are HIV-negative. These strategies in the management of patients will ultimately lead to better controlled disease leading to a low viral load among PLHIV, A low viral load also decreases the risk of transmission of disease and thus may eventually lead to an overall decrease in the incidence and prevalence of HIV.

Given the anticipated future in the management of HIV patients, as seen in other more advanced countries, this study thus aims to identify the burden of hypertension among PLHIV in Mombasa County, the factors associated with hypertension in this population, and the knowledge attitude and practices about hypertension to best to tailor the treatment to the rising burden of hypertension among PLHIV in Mombasa County.

2. 6 Conceptual Framework

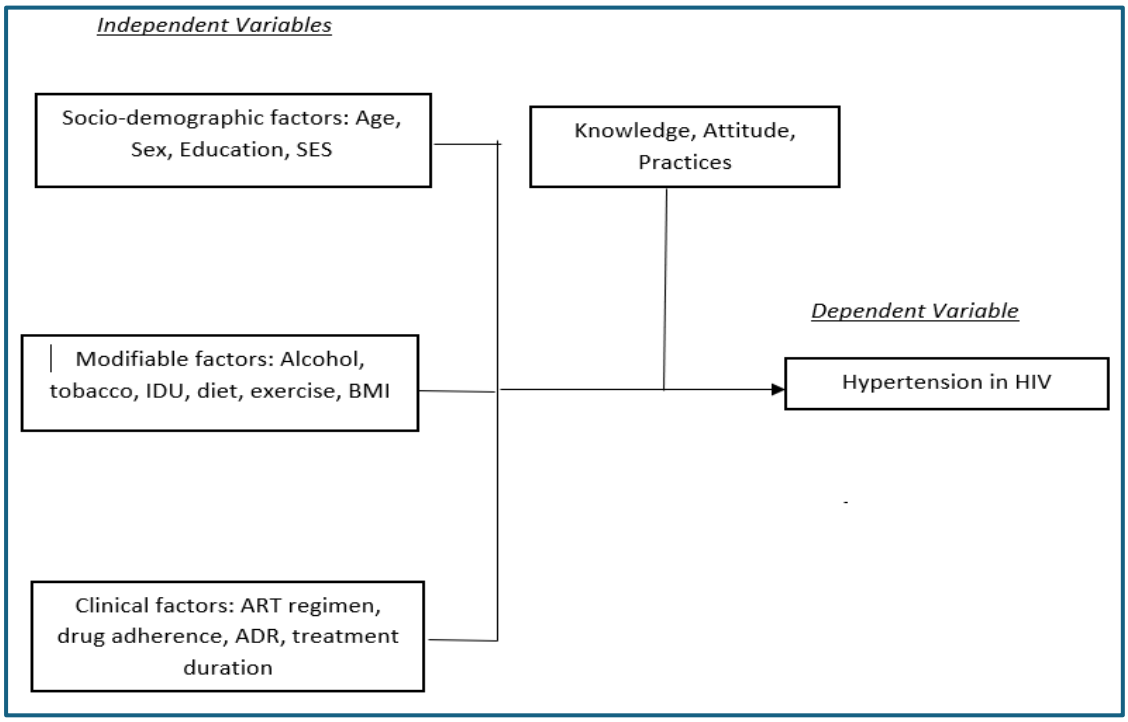

Figure 1: Conceptual Framework of factors associated with hypertension in PLHIV in Mombasa County

The sociodemographic factors are associated with the development of hypertension (Coetzee et al., 2019). As one's age increases there is an increase in the prevalence of hypertension. Females have been shown to have a higher prevalence of hypertension as compared to males(Unaids, 2021). Those who are more educated and have a higher level of income have also been reported to have a higher prevalence of hypertension. The modifiable risk factors also affect the development of hypertension. The use of

alcohol, tobacco, intravenous drug use, poor diet, and a lack of exercise have been shown to increase one's chances of developing hypertension.

Some clinical factors may be associated with hypertension. Some ART regimens, poor drug adherence, adverse drug reactions, and prolonged treatment duration may increase one's chances of developing hypertension. Moreover, the health system may also play a role in the development of hypertension. Lack of screening of patients for hypertension leads to late detection and an overall increase in the prevalence of hypertension.

There are also sociodemographic factors and modifiable factors that influence the rate of HIV transmission(Coetzee et al., 2019). For example, persons of lower socioeconomic status may have increased rates of HIV transmission due to inaccessible prevention measures and the need to solicit sex for money. The IDUs are also prone to increased rates of transmission due to sharing of needles. When all these factors are combined, we eventually get PLHIV who suffer from hypertension.

The knowledge, attitude and practices may also indirectly be associated as factors associated with hypertension (Kagaruki et al., 2018). One's knowledge on the risk factors for hypertension such as high alcohol intake, inadequate exercise, and high salt intake may influence their choices when it comes to these risk factors and others and thus may indirectly influence the outcome of developing hypertension. In addition, a positive attitude towards hypertension and some of its risk factors and complications makes one more receptive to adopting these changes leading to a decreased risk of developing hypertension. Lastly, the practices that one undertakes such as tobacco smoking, alcohol intake, exercise, etc, are associated with developing hypertension as mentioned earlier.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Study Site

The study was carried out in Mombasa County. Mombasa County is in the South-eastern part of the country. The prevalence of HIV is at 5.6% which is higher than the national average of 4.9% (*KENPHIA 2018*). The county has factors that favour hypertension such as a high prevalence of alcohol use and tobacco use. In addition, prostitution and other illicit drug use are predominant in the County which favours a higher prevalence of HIV. This environment makes the County an ideal location to study the interaction of hypertension and HIV.

The County has one level 5 hospital and three level 4 Hospitals. We therefore selected the four highest-burden Comprehensive Care Centers (CCC) that are situated in level 4 and 5 hospitals. The catchment population for these facilities was Mombasa County and the surrounding counties in the coastal region including, Kwale, Lamu, Taita Taveta, and Tana River. The CCCs provided a holistic approach to HIV patients that included clinical care, psychological, socio-economic support, nutritional counseling, palliative care, and stress management.

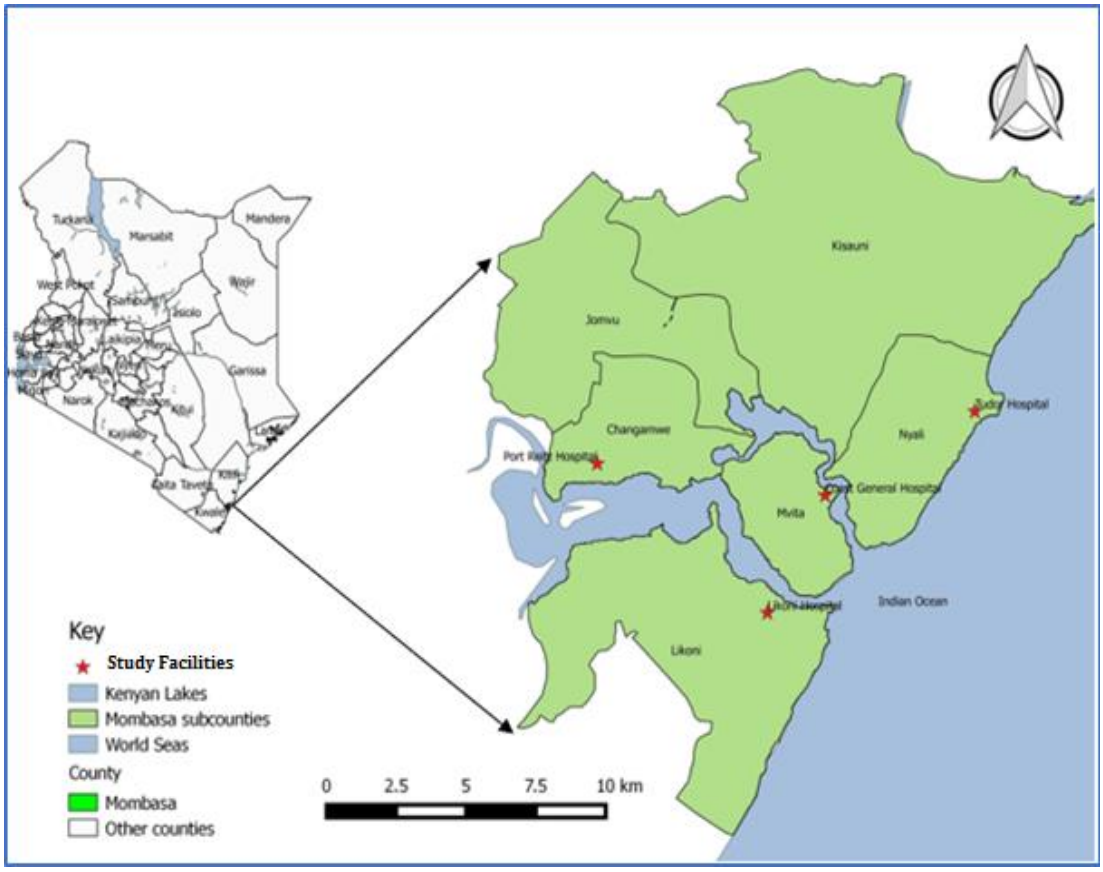

Figure 2: Map of Mombasa County showing study facilities, 2021 – 2022

3.2 Study Population

The study population was patients on HIV follow-up and care at Mombasa County's four highest-burden Comprehensive Care Centers.

3.3 Study Design

The study was cross-sectional in design. Data was collected from the study participants at a single point in time during which the required observations and review of files were conducted.

3.4 Sample Size Estimation

The sample size calculation used was for a cross-sectional study using the Cochran formula (Size, 1992). An assumption that the prevalence of hypertension among HIV

patients was 18.9% based on a study in Kiambu County (Mbuthia et al., 2021), thus the sample size was:

$$\underline{n = Z^2 p q}$$

$$d^2$$

where n was the sample size

Z is 1.96 which was the value from the standard normal distribution equivalent to 95% confidence interval

p was the estimated prevalence of hypertension among PLHIV (18.9%)

q was the value of 1-p and

d was the desired level of precision (5%)

1.96 * 1.96 * 0.189 * 0.811/ 0.05 * 0.05

= 236 patients in total

236 patients plus a 10% non-respondent rate = 260

Assumptions

- The margin of error was 5%
- Baseline prevalence was at 18.9%
- 95% confidence level with a z score at 1.96

The sample size was above 5% of the sampling frame and thus required a finite population correction (FPC): $FPC = \left(\frac{(N-n)}{N-1}\right)^{1/2}$

Where N was the sampling frame and

n was the sample size.

Thus FPC = $((2701 – 260) / (2701 – 1))^{1/2}$

$= (2441 / 2700)^{1/2}$

$= 0.904$

Thus, the sample size was:

0.904 x 260 = **235**

3.5 Sampling Procedure

The Comprehensive Care Centres situated in the level 4 and 5 hospitals in Mombasa County were selected. These facilities represent the highest-burden CCCs in the County. The average number of HIV patients seen at each facility monthly is as follows:

- Coast General Hospital = 862 (31%)
- Port Reitz Hospital = 716 (27%)
- Likoni Hospital = 620 (23%)
- Tudor Hospital = 503 (19%)

  Total = 2701

Using the sampling size as 235, the number of patients sampled from each of the facilities was as follows:

- Coast General Hospital: 31% of 235 = 73
- Port Reitz Hospital: 27% of 235 = 63
- Likoni Hospital: 23% of 235 = 54
- Tudor Hospital: 19% of 235 = 45

Systematic random sampling was applied to identify the study participants. Data were collected over one month. The daily sampling interval in each facility was determined

in three steps. First, the average number of patients per month in the facility was divided by 20 working days (equivalent to one month) to get the average daily number of patients. Second, the target number of participants to enroll daily was obtained by dividing the total participant allocation for the site by the number of days (20) of the study. Finally, the sampling interval was determined by diving the average daily number of patients with the daily enrolment target in the facility. The calculations are outlined below for each facility with all fractions rounded to the nearest number):

- Coast General Hospital daily patients: 862/20 = 43

  Number of patients to be interviewed daily:73/20 =4

  Thus, the sampling interval was: 43/4 =10
- Port Reitz Hospital daily patients: 716/20 = 36

  Number of patients to be interviewed daily: 63/20 = 3

  Thus, the sampling interval was 36/3= 12
- Likoni Hospital daily patients: 620/20 = 31

  Number of patients to be interviewed daily: 54/20 = 3

  Thus, the sampling interval was: 31/3 = 10
- Tudor Hospital daily patients: 503/20 = 25

  Number of patients to be interviewed daily: 45/20 = 2

  Thus, the sampling interval was: 25/2 = 12

The patients were listed according to how they arrived at the clinic for consultation. For the first set of patients equivalent to the sampling interval to visit the clinic, a random starting point was selected based on the intervals identified per facility, and this was then used to identify the first participant to be interviewed for the day. Each K^{th} participant depending on the facility was then invited to participate in the study. In the event a participant failed to give consent or was not eligible for the study, the next

patient was then invited to participate in the study. Once this was complete, the sampling interval was then followed to identify the next patient to be recruited into the study.

All patients who were eligible for the study and had been randomly selected through the sample design method were allowed to be recruited into the study. If the patient understood the study and then proceeded to give consent, they were enrolled in the study.

Inclusion Criteria

Inclusion Criteria: HIV- positive patients 18 years of age and above, who were attending the participating CCCs, and who resided in Mombasa County at the time of the interview.

Exclusion Criteria

Exclusion criteria: Individuals who were physically or mentally unable to participate in the study based on the judgment of the investigator.

3.6 Data Collection Tools and Processes

A pre-designed paper-based questionnaire with questions derived from validated data collection tools was used to interview the patients who gave consent for the study. Verification of patient information such as viral load, CD4 count, and WHO clinical stage of disease was done using the patient medical files. Data were collected by the principal investigator and research assistants. The research assistants were taken through a one-day training in which each of the questions on the questionnaire were discussed. The principal investigator would then review the questionnaires with the research assistants daily, and only the correctly filled questionnaires were used for the study.

The variables collected included the following:

I. Biodemographic data

II. Twelve questions on knowledge of hypertension and preventive or harmful practices were administered. A score of 1 was given for a correct response and a score of 0 for an incorrect response or I don't know (Aubert et al., 1998; Buang Nurul, Rahman Nor, 2019).

III. Five questions on the participants' attitudes towards hypertension were administered. Each question was scored ranging from 1 to 5 based on the participant's agreement to the statement read giving a total of 25 and a minimum of 5 in this section (Kagaruki et al., 2018).

IV. Seven questions on the practices related to increasing the risk of hypertension were administered. A score of 1 was given to harmful practices and a score of zero was given to practices that help in preventing hypertension (Aubert et al., 1998).

V. Behavioral Risk factors for hypertension (Mwenda et al., 2018)

VI. Clinical factors of the patient and their treatment such as WHO stage at the time of review and most recent viral load

VII. Co-morbidities that were present at the time of the interview:

VIII. Factors that were present at the clinic that may influence treatment outcomes for hypertension patients such as patients giving an estimate of how long they take before seeing the clinician, medication stock outs, distance to clinic etc

Clinical measurements of weight, height, and blood pressure were performed on those who did not have written records of these. Only the clinical record of these measurements taken within one year of the time of the interview was considered:

- Weight was measured by asking patients to offload any goods they were carrying, remove their shoes and stand on a weighing scale
- Height was measured after asking patients to remove their shoes, then stand up and the distance from their feet to the tip of their heads was measured in meters.
- Blood pressure was measured after the patient has sat down for at least 15 minutes. An appropriately sized cuff was put on the patient's arm at the level of the heart and then their blood pressure measurement taken

Data collection on biodemographic data, risk factors for NCDs, and systemic factors was collected through interviewer-administered questionnaire *(Appendix 2)* after patient consent *(Appendix 1)* had been given. Data on clinical factors were then abstracted from patient files.

3.7 Data Management

Unique identifiers were used in place of the names of the participants. Data entry on computers was done daily at the end of data collection from the participants. The data was stored in password-protected files. Only the research team had access to the data collected.

3.8 Data Analysis

Data analysis was done using MS Excel, Epi info, and STATA. Frequencies and proportions were calculated for the categorical variables and measures of central tendency and dispersion for continuous variables.

Prevalence of hypertension was determined by dividing the number of participants with comorbid hypertension with all the participants. The prevalence of risk factors was determined by dividing the number of participants by risk factors for hypertension with all participants.

The participants without hypertension were compared to the participants with hypertension for univariable analysis to calculate the prevalence ratio of the assessed factors. The exposure variables that had a p-value of <0.2 on univariable analysis were then subjected to multivariable Poisson regression using the backward elimination method to calculate the adjusted prevalence ratio. The level of significance for multivariate analysis was a p-value < 0.05.

We conducted a bivariate analysis for the factors that were found to be significant for hypertension to identify if they were correlated. If the p-value was less than 0.05 then the factors were correlated. None of the variables identified had a p-value less than 0.05 and thus were not correlated.

To assess multicollinearity, we determined the Variable Inflation Factor (VIF). A value of 5 or more suggested significant multicollinearity.

The analysis of knowledge was done by calculating the percentage of participants giving a correct response to each question. We then compared the percentages between hypertensive and non-hypertensive participants to identify if there was a difference in knowledge between the hypertensive and non-hypertensive participants. A p-value < 0.05 indicated a difference in knowledge between the hypertensive participants and non-hypertensive participants.

In addition to analysing the individual knowledge questions, for each participant, the study summed the scores from each knowledge question to obtain a total score. The percentage score was then calculated based on the maximum possible score for each participant. The knowledge scores were categorized as follows:

A score ≥ 75% was considered knowledgeable and a score < 75 was considered not knowledgeable (Okello et al., 2020).

The analysis of the attitude toward hypertension was done using the Likert scale where:

1 = Strongly disagree, 2 = Disagree, 3 = Neither disagree nor agree, 4 =Agree and 5 = Strongly disagree.

The score for each question ranged from 1 to 5. The average score of each question was calculated and we compared the scores between the hypertensive participants and non-hypertensive participants using the t-test. This identified any difference in attitude between hypertensive and non-hypertensive participants. A p-value < 0.05 was interpreted as a significant difference in attitude between the two groups. We also calculated the total attitude score of each participant and determined the percentage score for all the participants. In addition, we calculated the mean attitude score for all the participants to identify the average attitude toward hypertension prevention practices and complications. The following was used to interpret the attitude scores:

80 – 100% positive attitude, 60 – 79% neutral attitude, and less than or equal to 59% negative attitude (Okello et al., 2020).

The analysis of practices was done by calculating the percentage of participants that conducted a behaviour of interest. We then compared the percentages between the hypertensive participants and non-hypertensive participants to identify any differences in practices. A p value < 0.05 was considered a significant difference between the practices of the two groups. We also calculated the total practices score. This was then converted into percentages and interpreted as follows:

80 – 100% good practice, 60 – 79% fair practice, and less than or equal to 59% as poor practice (Okello et al., 2020).

3.9 Ethical consideration

The study was approved by the Institutional Research and Ethics Committee of Moi University (Approval number 0004013, *Appendix 3*). Approval was also obtained from the National Commission for Science Technology and Innovation (NACOSTI) (Approval number NACOSTI/P/21/14403, *Appendix 4*). Administrative approval was obtained from the County Department of Health in Mombasa County *(Appendix 5)* and all Medical superintendents were informed of the study before data collection. Once the approvals were obtained, only patients who gave their informed consent participated in the study. Unique identifiers were used for the participants. This ensured that confidentiality and privacy were maintained for the participants of the study.

There were no direct benefits to the study participants, however, the results of the study could be used to identify opportunities to improve the treatment of NCDs for all PLHIV in Mombasa County and beyond. The patients who chose not to participate in the study continued to receive care and treatment at the clinic as they were intended to.

CHAPTER FOUR

4.0 RESULTS

4.1 Sociodemographic characteristics of participants

A total of 235 participants were interviewed. The sociodemographic factors of the participants and the hypertensive patients are illustrated in ***Table 1*** below. The majority, (71.1%) of participants were females. The range of patient's age was from 20 years to 76 years. The mean age of the participants was 42.8 (± SD 10.7) years with the age group 35 – 44 contributing the largest proportion of patients at 35.3%. Informal employment was the most common source of livelihood at 32.3%. The largest proportion of patients had only completed primary education at 46.8% and 71.1% earned less than Ksh 15,000 per month.

Table 1: Sociodemographic characteristics of participants in Mombasa County, 2021 - 2022

Variable	**Number (n = 235)**	**Percent (95% Confidence Interval)**
Sex		
Female	167	71.1 (64.8 – 76.8)
Male	68	28.9 (23.2 – 35.2)
Age group (years):		
18 – 34	56	23.8 (18.5 – 29.8)
35 – 44	83	35.3 (29.2 – 41.8)
45 – 54	63	26.8 (21.3 – 33.0)
>55	33	14.0 (9.9 – 19.2)
Employment status:		
Business	58	24.7 (19.3 – 30.7)
Formal Employment	22	9.4 (6.0 – 13.8)
Informal employment	76	32.3 (26.4 – 38.7)
Unemployed	79	33.6 (27.6 – 40.1)
Education Level Completed:		
No education		
Primary School	24	10.2 (6.7 – 17.8)
Secondary school	110	46.8 (40.3 – 53.4)
Tertiary level	69	29.4 (23.6 – 35.6)
	32	13.6 (9.5 – 18.7)
Income level (Ksh):		
< 15,000	167	71.1 (64.8 – 76.8)
15, 000 – < 50, 000	61	26.0 (20.5 – 32.1)
50, 000 - < 100, 000	4	1.7 (0.5 – 4.3)
>100, 000	3	1.3 (0.3 – 3.7)

The clinical characteristics of the participants are illustrated in ***Table 2***. Thirteen percent of the patients had a history of being non-adherent to their ART regimens. The largest proportion of patients at 46.0% had been on ART for more than 10 years and 86.4% were still on the first-line regimens. About three-quarters, (77.0%) of the participants had their most recent viral load reported as undetectable, and 77.0% used Tenofovir/Lamivudine/Dolutegravir (TDF/3TC/DTG). In addition, 88.5% of the participants were at the WHO clinical stage I of HIV with only 8.5% of patients reporting a history of opportunistic infections in the one year before the interview. Twenty-six percent of the patients had associated comorbidity at the time of the interview and hypertension was the most reported comorbidity at 25%. The largest proportion of patients, at 41.7% lived at a distance greater than 5km from the clinic and were attended to within 1 to 2 hours of arriving at the CCC.

Table 2: Clinical Characteristics of PLHIV in Mombasa County, 2021 - 2022

Variable	**Number n = 235**	**Percentage (95% C.I (Confidence Interval))**
History of non-adherence:		
Yes	30	12.8 (8.8 – 17.7)
No	205	87.2 (82.3 – 91.2)
Duration of ART treatment:	66	28.1 (22.4 – 34.3)
<5 years	61	26.0 (20.5 – 32.1)
5 – 10 years	108	46.0 (39.5 – 52.6)
>10 years		
Type of regimen:		
First-line regimen	203	86.4 (81.3 – 90.5)
2nd – line regimen	32	13.6 (9.5 – 18.7)
Most recent viral load:		
Detectable	54	23.0 (17.8 – 28.9)
Undetectable	181	77.0 (71.1 – 82.2)
ART Regimen		
TDF/3TC/DTG	181	77.0 (71.1 – 82.2)
TDF/3TC/EFV	15	6.4 (3.6 – 10.3)
TDF/3TC/ATVr	10	4.3 (2.1 – 7.7)
AZT/3TC/ATVr	9	3.8 (1.8 – 7.2)
ABC/3TC/ATVr	7	3.0 (1.2 – 6.0)
ABC/3TC/DTG	5	2.1 (0.7 – 4.9)
ABC/3TC/LPVr	5	2.1 (0.7 – 4.9)

ABC/3TC/EFV	1	0.4 (0.0 – 2.4)
AZT/3TC/NVP	1	0.4 (0.0 – 2.4)
TDF/3TC/LPVr	1	0.4 (0.0 – 2.4)
WHO Clinical stage at the time of review:		
Stage I	208	88.5 (83.7 – 92.3)
Stage II	17	7.2 (4.3 – 11.3)
Stage III	8	3.4 (1.5 – 6.6)
Stage IV	2	0.9 (0.1 – 3.0)
Opportunistic infections in the past 1 year?		
Yes	20	8.5 (5.3 – 12.8)
No	215	91.5 (87.2 – 94.7)
Family history of comorbidities:		
Yes	98	41.7 (35.3 – 48.3)
No	137	58.3 (51.7 – 64.7)
Comorbidity present at the time of interview:		
Yes	62	26.4 (19.2 – 31.4)
No	173	73.6 (86.5 – 79.8)
Type of Comorbidity:	59	25.1(20.6 – 32.4)
Hypertension	1	0.4 (0.0 – 2.4)
Diabetes	1	0.4(0.0 – 2.4)
Asthma		
Distance to hospital:		
<1km	50	21.3 (16.5 – 27.5)
1km - 5km	87	37.0 (31.4 – 44.3)
>5km	98	41.7 (34.3 – 48.3)
Clinic waiting time:		
< 1 hour	66	28.1 (22.4 – 34.3)
1 – 2 hours	108	46.0 (39.5 – 52.6)
>2 hours	61	26.0 (20.5 – 32.1)

4.2 Prevalence of hypertension among PLHIV

The prevalence of hypertension among the participants was found to be 25.1%. The prevalence among males and females was 26.5% and 24.6% respectively. There was a higher prevalence of hypertension in older age groups and the highest prevalence was 36.4% among those aged greater than 55 years. The prevalence of hypertension among the various sociodemographic factors is illustrated in ***Table 3*** below.

Table 3: Prevalence of hypertension across the sociodemographic factors of PLHIV in Mombasa County, 2021 - 2022

Variable	**Hypertension (n = 235)**		**Prevalence of hypertension % (95% CI)**
	Yes (n= 59)	No (n = 176)	
Overall	59	176	25.1 (19.7 – 31.2)
Sex			
Female	41	126	24.6 (18.2 – 31.8)
Male	18	50	26.5 (16.5 – 38.6)
Age group (years):			
18 – 34	8	48	14.3 (6.4 – 26.2)
35 – 44	19	64	22.9 (14.4 – 33.4)
45 – 54	20	43	31.7 (20.6 – 44.7)
>55	12	21	36.4 (20.4 – 54.9)
Employment status:			
Business	16	42	27.6 (16.7 – 40.9)
Formal Employment	5	17	22.7 (7.8 – 45.4)
Informal	15	61	19.7 (11.5 – 30.5)
employment	23	56	29.1 (19.4 – 40.4)
Unemployed			
Education Level:			
No education	4	20	16.7 (4.7 – 37.4)
Primary School	31	79	28.2 (20.0 – 37.6)
Secondary school	15	54	21.7 (12.7 – 33.3)
Tertiary level	9	23	28.1 (13.6 – 46.8)
Income level (Ksh):			
< 15,000	41	126	24.6 (18.2 – 31.8)
15, 000 – < 50, 000	18	43	29.51 (23.2 – 35.8)
50, 000 - < 100, 000	0	4	0.0
>100, 000	0	3	0.0

4.3 Factors associated with hypertension among PLHIV

In bivariable analysis, several factors were found to have a p-value less than 0.2 as shown in ***Table 4*** below. These factors include age above 45 years at a prevalence ratio of 2.07 (95% C.I: 1.14 – 3.77) in comparison to persons aged 18-45 years, a BMI between 25 to 29.9 at a prevalence ratio of 3.05 (C. I: 1.52 – 6.11) compared to persons with a BMI less than 25, a BMI greater than or equal to 30 at a prevalence ratio of 4.8 (C.I: 2.1 – 10.87)), a tenofovir based regimen at a prevalence ratio of 0.28 (C. I: 0.12 – 0.63) compared to the other regimens, and having an opportunistic infection over the

last year at a prevalence ratio of 0.14 (C.I: 0.02 – 1.09) compared to patients who had not had an opportunistic infection the previous year.

In multivariable analysis, two factors were found to be associated with hypertension among PLHIV, with a p-value less than 0.05 as shown in ***Table 4*** below. A BMI between 25 and 29.9 had a 2.40 (C.I: 1.30 – 4.42) higher prevalence ratio compared to those with a BMI less than 25 and a BMI greater than 30 had a 3.37 (C. I 1.69 – 6.73) higher prevalence ratio compared to a BMI < 25. Lastly, using a tenofovir-based regimen had a 0.32 (C. I 0.17 – 0.60) times lower prevalence ratio compared to those on other regimens.

Table 4: Analysis of factors associated with hypertension among PLHIV, Mombasa, 2021- 2022

Variable	**Prevalence Ratio (95% Confidence Interval)**	**P-value**	**Adjusted Prevalence ratio (95% Confidence Interval)**	**P-value**
Sex			-	-
Female	ref			
Male	0.93 (0.58 – 1.49)	0.758		
Age				
18 - <45 years	ref		ref	
≥45 years	1.71 (1.10 – 2.67)	0.016*	1.56 (0.93 – 2.61)	0.093
Education				
None/Primary	ref		-	-
Secondary/Tertiary	0.91 (0.58 – 1.43)	0.680		
Income			-	-
≥15,000 Ksh	1.10 (0.67 – 1.74)	0.758		
<15,000 Ksh	ref			
BMI				
≥30 and above	3.06 (1.78 – 5.27)	< 0.001*	3.37 (1.69 – 6.73)	0.001*
≥25 – 29.9	2.33 (1.39 – 3.93)	0.001*	2.40 (1.30 – 4.42)	0.005*
<25	Ref	ref	ref	
Uses Alcohol				

Yes	0.84 (0.46 –	0.557	-	-
No	1.53)			
	ref			
Smokes cigarettes				
Yes	0.78 (0.34 –	0.533	-	-
No	1.76)			
	ref			
Exercise ≥ 3 times a				
week	ref		-	-
Yes	1.03 (0.66 –	0.907		
No	1.60)			
Eats fruits/vegetables				
≥ 5 times a week	ref		-	-
< 5 times a week	1.32 (0.85 –	0.225		
	2.05)			
Treatment adherence				
Non-adherent	1.07 (0.57 –	0.833	-	-
Adherent	2.03)			
	ref			
ART Regimen				
Zidovudine based	1.64 (0.74 –	0.267	-	-
Non-zidovudine	3.62)			
based	ref			
ART Regimen				
Tenofovir based	0.28 (0.20 –	<0.001*	0.32 (0.17 –	<0.001*
Other	0.40)		0.60)	
	ref		ref	
ART Regimen				
Protease Inhibitor	1.29 (0.73 –	0.389	-	-
regimen	2.29)			
Other	ref			
Viral load				
Detectable	0.68 (0.37 –	0.203	-	-
Undetectable	1.26)			
	ref			
Opportunistic				
infection	0.19 (0.03 –	0.030*	0.27 (0.04 –	0.207
Yes	1.27)		2.04)	
No	ref		ref	
Clinic waiting time:				
< 1 hour	ref			
1 – 2 hours	0.87(0.52 – 1.47)	0.309	-	-
>2 hours	1.14 (0.60 –	0.351	-	-
	2.17)			

Further analysis was conducted to assess multicollinearity by calculating the Variable Inflation Factor. A VIF greater than 5 indicates multicollinearity, however, none of the

variables in the multivariable model had a VIF above 5 as shown in the ***Table 5*** below. This shows that the significant factors were not related to each other.

Table 5: Results for the Variable Inflation Factor analysis for multicollinearity

Variable	**VIF**	**1/VIF**
BMI ≥25 – 29.9	1.12	0.892561
BMI ≥30 and above	1.12	0.894479
Opportunistic infections in the past 1 year?	1.05	0.953939
ART Regimen Tenofovir based	1.02	0.977648
Age ≥45 years	1.01	0.988121
Mean VIF	1.06	

4.4 Knowledge, Attitude, and Practices of participants

The total scores per question on knowledge were calculated. The difference between the total percentage score of the participants with and without hypertension was not statistically significant. However, only the question on the knowledge of a normal blood pressure reading recorded a statistical difference between participants with hypertension compared to those without hypertension at a p-value of 0.013. Participants with hypertension had a better knowledge of blood pressure readings as compared to their counterparts. All the other questions on hypertension prevention practices and hypertension complications showed no difference in knowledge between participants with hypertension compared to participants without hypertension as displayed by having a p-value greater than 0.05. ***Table 6*** shows the performance of the participants for the various questions on knowledge of hypertension.

Table 6: Results of the questions asked to assess the knowledge of hypertension among PLHIV in Mombasa County, 2021 2022

Question on knowledge of Hypertension	**Response (Correct/ Incorrect)**	**Participants with HTN N=59 n (%)**	**Participants without HTN N=176 n (%)**	**P-value**
1. Is it important to have your blood pressure measured?	Correct	59 (100.0)	166 (94.3)	0.061
	Incorrect	0 (0.0)	10 (5.7)	
2. Is hypertension a disease?	Correct	52 (88.1)	163 (92.6)	0.286
	Incorrect	7 (11.9)	13 (7.4)	
3. Does smoking around others affect their health?	Correct	56 (94.9)	163 (92.6)	0.544
	Incorrect	3 (5.1)	13 (7.4)	
4. Can taking alcohol and smoking cigarettes contribute to a person being diagnosed with hypertension?	Correct	45 (76.3)	122 (69.3)	0.308
	Incorrect	14 (23.7)	54 (30.7)	
5. Can eating food with a lot of salt affect your blood pressure?	Correct	48 (81.4)	127 (72.2)	0.161
	Incorrect	11 (18.6)	49 (27.8)	
6. Can stress increase your chances of being diagnosed with high blood pressure	Correct	55 (93.2)	168 (95.5)	0.500
	Incorrect	4 (6.8)	8 (4.5)	
7. Can talking to friends and family help reduce stress?	Correct	54 (91.5)	166 (94.3)	0.448
	Incorrect	5 (8.5)	10 (5.7)	
8. Can someone have hypertension and not have any symptoms?	Correct	37 (62.7)	119 (67.6)	0.490
	Incorrect	22 (37.3)	57 (32.4)	
9. Is 120/80mmHg a normal blood pressure?	Correct	15 (25.4)	21 (11.9)	0.013*
	Incorrect	44 (74.6)	155 (88.1)	

10. Is stroke a complication of hypertension?	Correct	45 (76.3)	113 (64.2)	0.087
	Incorrect	15 (23.7)	63 (35.8)	
1. Can exercising frequently help reduce one's blood pressure?	Correct	56 (94.9)	155 (88.1)	0.133
	Incorrect	3 (5.1)	21 (11.9)	

In addition to reviewing the scores of the participants per question, we assessed the total knowledge scores of each of the participants. The average score for all the participants was 76.7% (±16.9) and the majority of the participants scored between 90 – 100% as shown in ***Figure 3*** below.

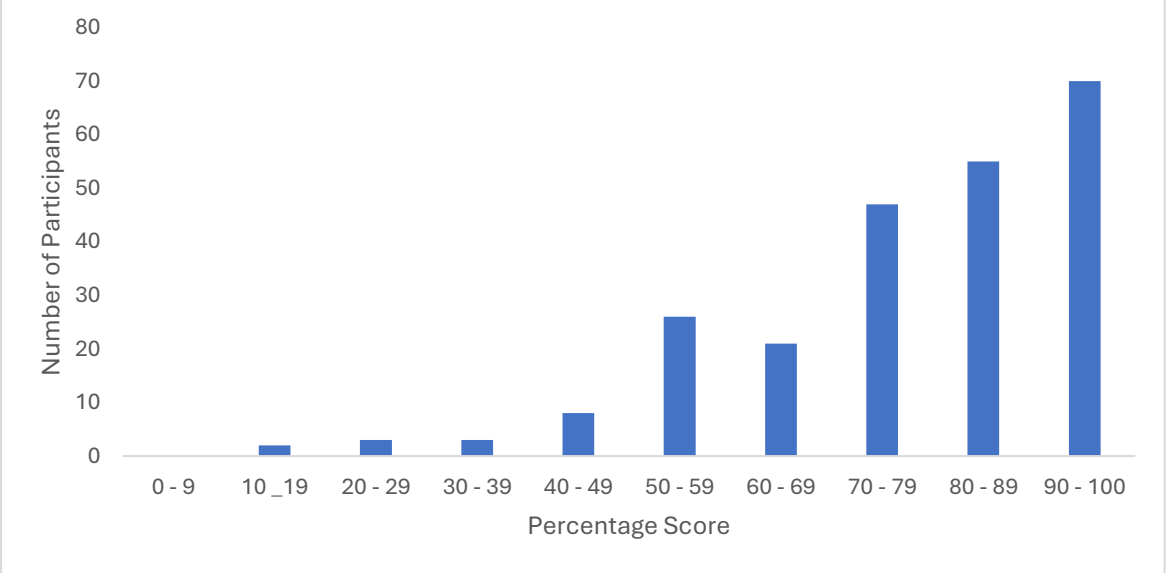

Figure 3: Total percentage scores of the participants on their knowledge of hypertension, Mombasa County, 2021 – 2022

The average score for the participants with hypertension was 79.8% (±17.2) and the majority of the participants scored between 90 – 100% as shown in ***Figure 4*** below. The average score of the participants without hypertension was 75.7% (±16.7) and the majority of participants scored between 90 – 100% as shown in ***Figure 5*** below. The p-value for the comparison of the average knowledge scores for the participants with

hypertension against the participants without hypertension was 0.1070. These results show that there was no statistically significant difference between the total knowledge of the participants with hypertension and participants without hypertension. Both groups were, however, knowledgeable on hypertension risk factors and complications.

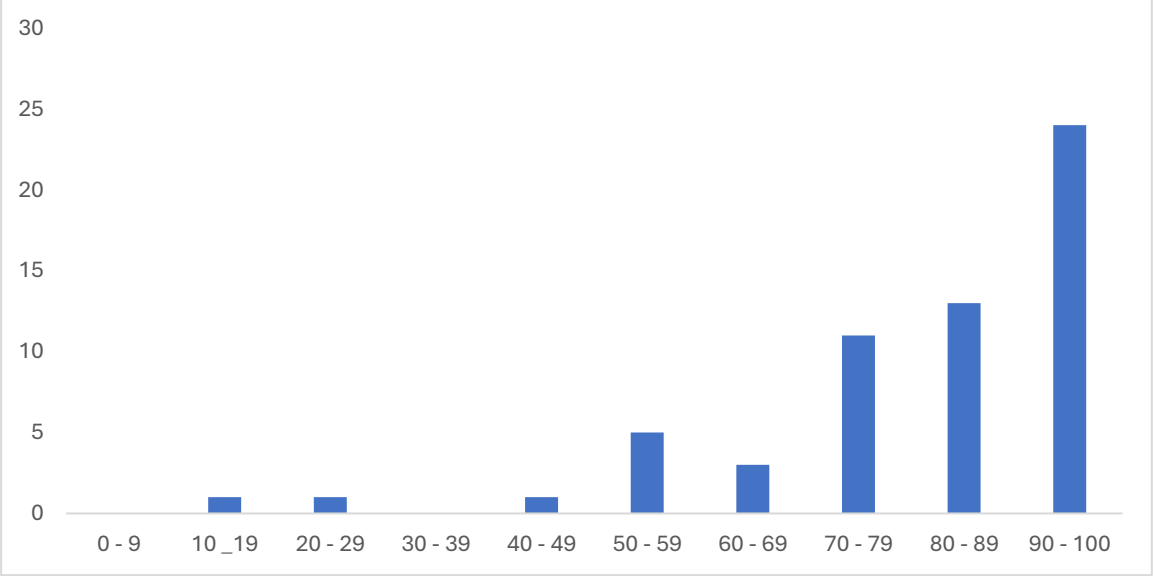

Figure 4: Total Percentage scores of Participants with hypertension on their knowledge of hypertension, Mombasa County 2021 - 2022

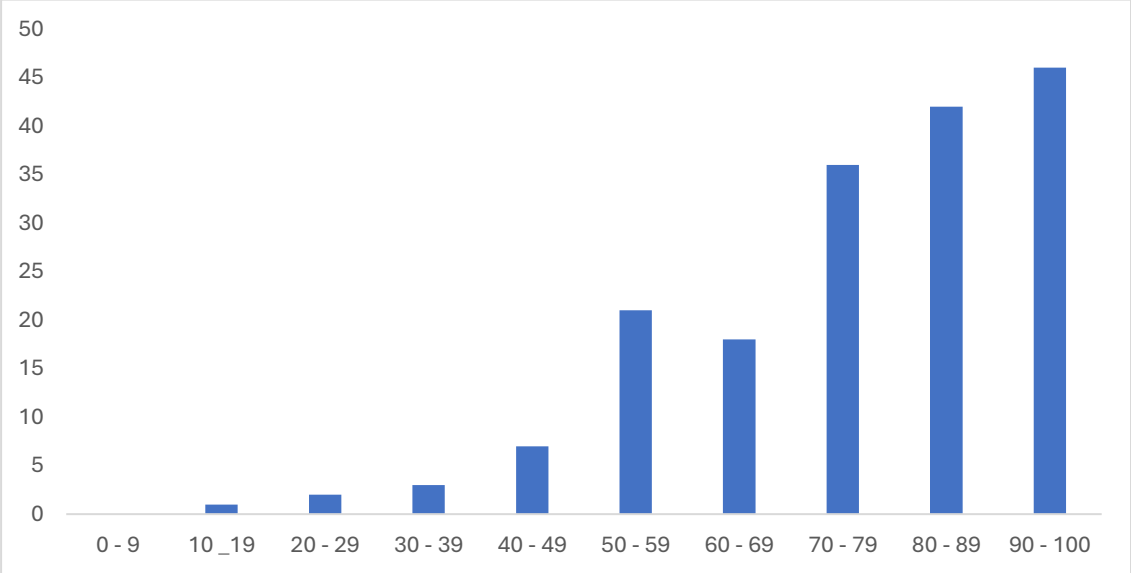

Figure 5: Total Percentage scores of Participants without hypertension on their knowledge of hypertension Mombasa County, 2021 - 2022

Five statements on attitude to high blood pressure were read to the participants to which they responded strongly disagree, disagree, neither disagree/agree, agree, or strongly agree and were given a score of 1 to 5 respectively. The mean total score in the attitude section of the participants with hypertension was 4.32 (C.I 4.21 – 4.43) compared to an average score of 4.36 (C.I 4.31 – 4.41) among participants without hypertension. The difference between the total average scores of the participants with hypertension compared to those without hypertension. None of the attitude statements comparison scores had a p-vale less than 0.05 thus there was no statistically significant difference for each of the questions asked between the hypertensive and non-hypertensive participants. ***Table 7*** below depicts the attitudes of the participants toward hypertension.

Table 7: Participants' attitude towards hypertension in Mombasa County, 2021 - 2022

Questions on Attitude	**The average score of participants (Total score = 5)**		**t- test p-value**
	Participants with HTN (59)	**Participants without HTN (176)**	
1. I don't worry about being diagnosed with hypertension	3.6 (± 1.5)	3.7 (± 1.7)	0.554
2. If I eat healthy and avoid alcohol, I can prevent myself from getting hypertension	4.1 (± 1.5)	4.4 (± 1.2)	0.101
3. I can decrease my blood pressure by exercising frequently	4.7 (± 0.9)	4.7 (± 0.9)	0.703
4. Even if my mother/father had hypertension, I can still prevent myself from getting hypertension	4.5 (± 1.0)	4.3 (± 1.3)	0.238
5. I can prevent myself from the complications of hypertension by adhering to medication	4.7 (± 0.9)	4.7 (± 0.9)	0.761

In addition to reviewing the scores of the participants per question, we assessed the total attitude scores of each of the participants. The scores were then converted into

percentages. The average total attitude percentage score of the participants was 86.8% ± 2.8) and the majority of the participants had a total attitude score between 81- 100% showing a positive attitude toward hypertension as shown in Figure 6 below.

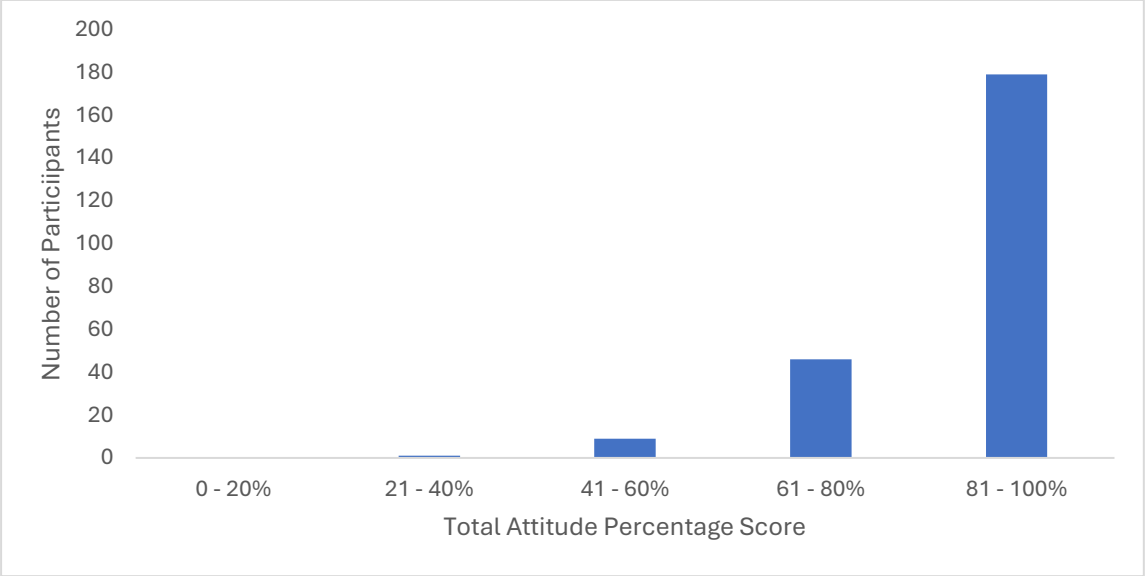

Figure 6: Participants' total attitude score towards hypertension, Mombasa County 2021 - 2022

The analysis of total attitude scores of the participants was also analyzed by comparing the total scores of the participants with hypertension against the participants without hypertension. The participants with hypertension had an average total attitude percentage score of 86.8% (±12.0) and the majority of the participants with hypertension had a score between 81 – 100% as shown in **Figure 7** below. The participants without hypertension had an average total attitude score of 87.2% (±12.8) and the majority of the participants without hypertension had a total score between 81 – 100% as shown in **Figure 8** below. The p-value for the comparison of the average attitude scores for the participants with hypertension against the participants without hypertension was 0.7511. The results show that there was no statistically significant difference between the attitude of the participants with hypertension and participants

without hypertension, however, all the participants demonstrated a positive attitude towards hypertension.

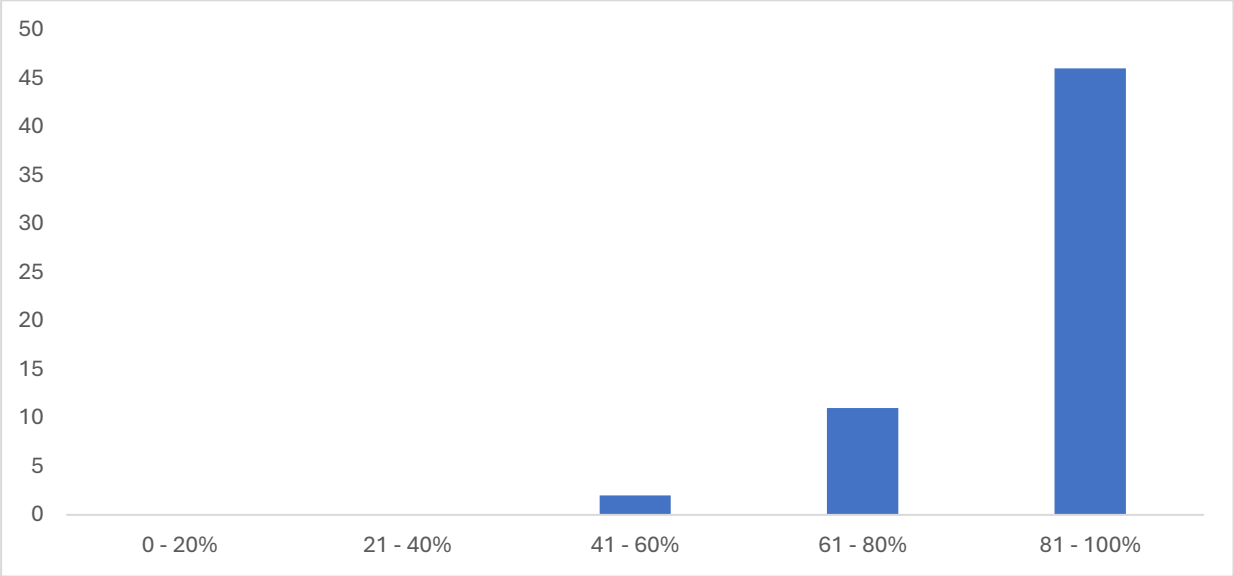

Figure 7: Total attitude percentage score of Participants with hypertension, Mombasa County 2021 - 2022

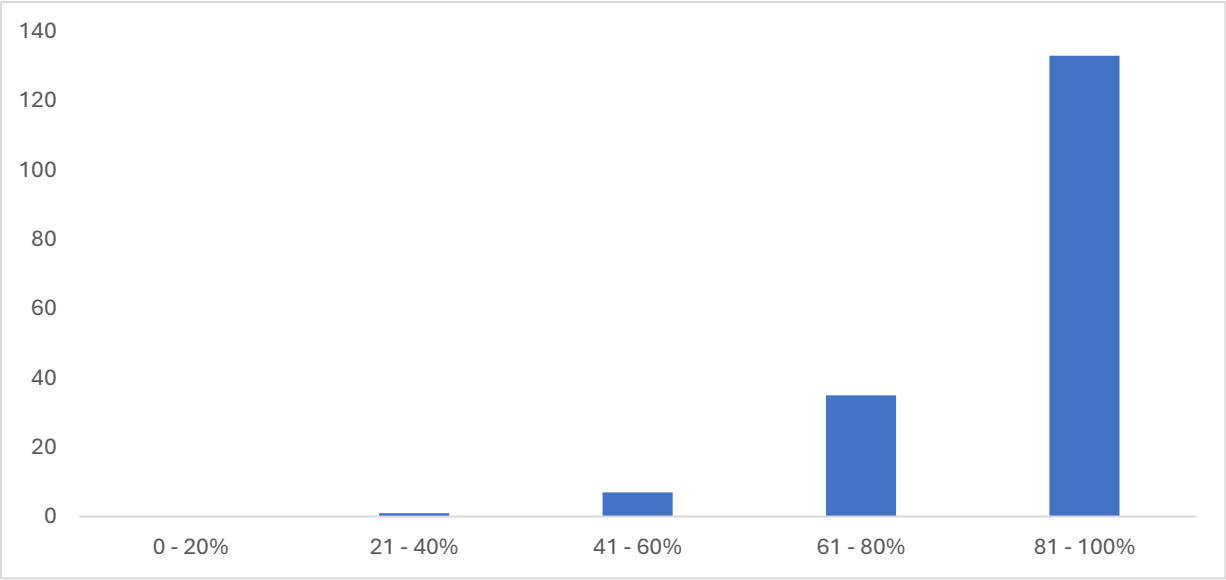

Figure 8: Total Attitude percentage score of participants without hypertension, Mombasa County, 2021 – 2022

In the evaluation of the common practices known to be associated with hypertension, each question was assessed, and the results for the hypertensive participants were compared to the non-hypertensives. None of the practice questions had a p-value less

than 0.05 thus there was no statistically significant difference for each of the questions asked between the hypertensive and non-hypertensive participants. ***Table 8*** below shows the results of the practices section of the questionnaire.

Table 8: Results on practices related to hypertension for PLHIV in Mombasa County, 2021 - 2022

Questions on Practices related to hypertension	**Correct Practice /Incorrect Practice**	**Participants with HTN 59 (%)**	**Participants without HTN 176 (%)**	**P-value**
1. Participants who don't smoke cigarettes	Correct	54 (91.5)	156 (88.6)	0.533
	Incorrect	5 (8.5)	20 (11.4)	
2. Participants who don't take alcohol	Correct	49 (83.0)	140 (79.5)	0.577
	Incorrect	10 (17.0)	36 (20.5)	
3. Participants who don't drink between waking up and midday	Correct	58 (98.3)	169 (96.0)	0.402
	Incorrect	1 (1.7)	7 (4.0)	
4. Participants who have never felt there is a need to reduce the amount of alcohol they drink	Correct	58 (98.3)	169 (96.0)	0.402
	Incorrect	1 (1.7)	7 (4.0)	
5. Participants who exercise more than three times per week	Correct	32 (54.2)	97 (55.1)	0.906
	Incorrect	27 (45.8)	79 (44.9)	
6. Participants who don't add salt to their food after it is already cooked	Correct	35 (59.3)	111 (63.1)	0.608
	Incorrect	24 (40.7)	65 (36. 9)	

7. Participants who eat vegetables/fruits more than 5 times per week	Correct	33 (55.9)	114 (64.8)	0.225
	Incorrect	26 (44.1)	62 (35.2)	

In addition, we assessed the total practice percentage score for all the participants. The average practice percentage score for all participants was 77.4% (C.I 72.7 – 79.8) displaying fair practices with the majority of the participants scoring between 81 – 100% as shown in **Figure 9** below.

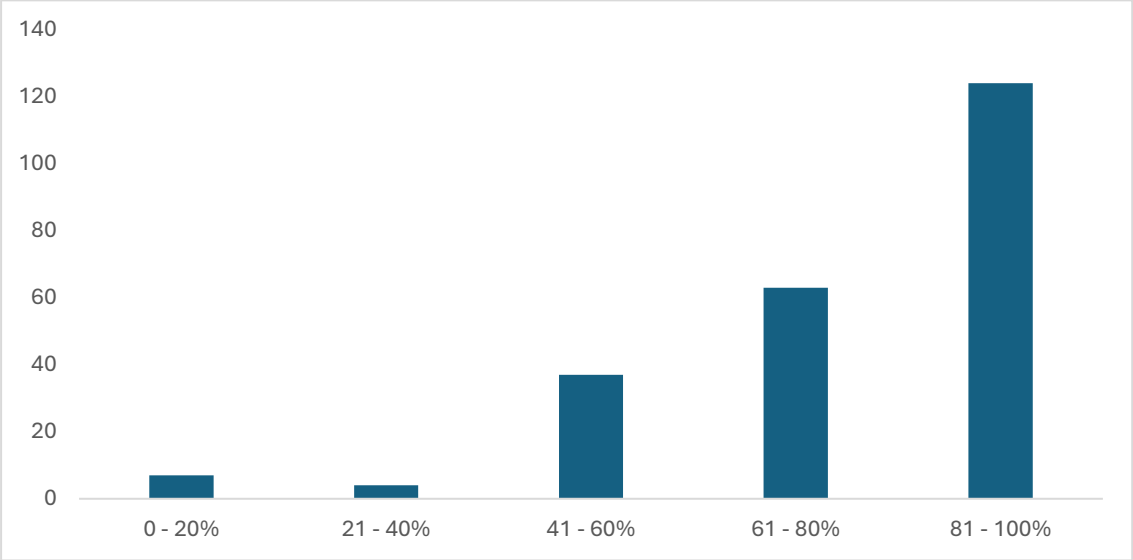

Figure 9: Total percentage score of the hypertension prevention practices for PLHIV in Mombasa County 2021 - 2022

An average of 77.2% (C.I 72.5 – 82.0) of participants with hypertension reported practicing hypertension prevention practices. This corresponds to conducting fair hypertension prevention practices. The majority of the hypertensive participants had a total practice percentage score between 81 – 100% as shown in **Figure 10** below.

The participants without hypertension had an average total practice percentage score of 77.6% (C.I 75.3 – 79.9). This corresponds to conducting fair hypertension prevention practices. The majority of the non-hypertensive participants had a total practice

percentage score between 81 – 100% as shown in **Figure 11** below. The p-value for the comparison of the average practice scores for the participants with hypertension against the participants without hypertension was 0.8911. There was no statistically significant difference between the total practice percentage scores of those with hypertension compared to those without hypertension. However, both groups had average practice scores corresponding to conducting fair hypertension prevention practices.

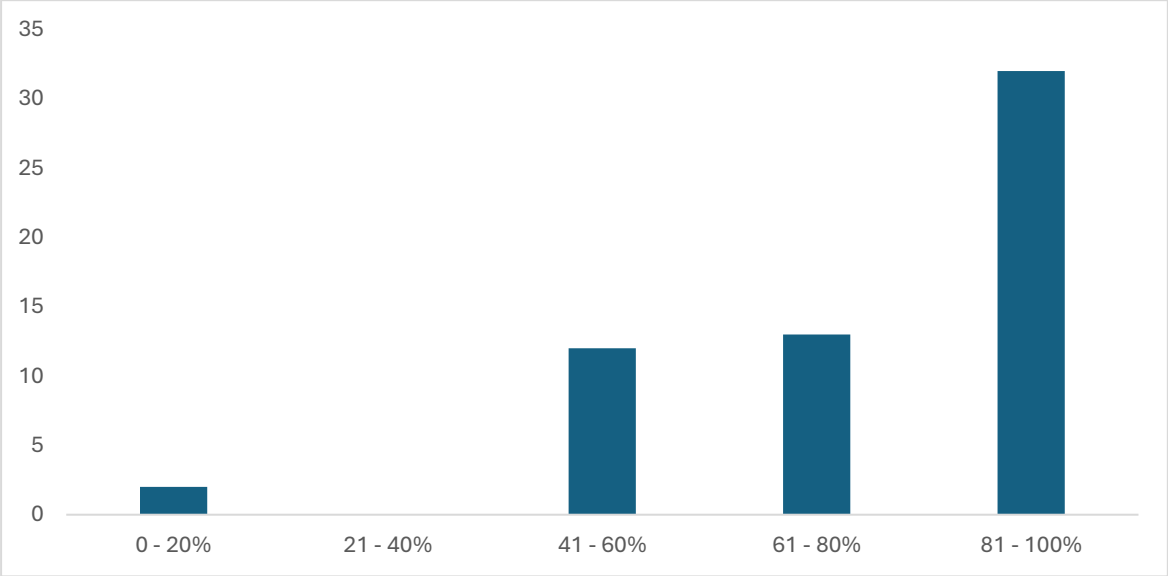

Figure 10: Total percentage score of the hypertension prevention practices for PLHIV with hypertension in Mombasa County 2021 - 2022

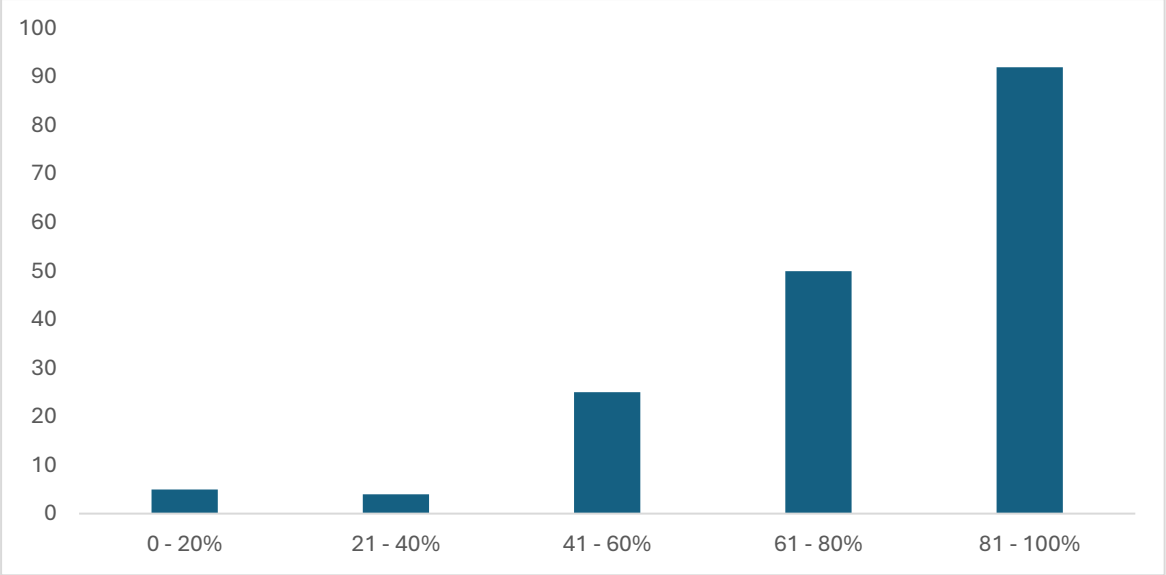

Figure 11: Total percentage score of the hypertension prevention practices for PLHIV without hypertension in Mombasa County 2021 - 2022

CHAPTER FIVE

5.0 DISCUSSION

5.1 Introduction

The results suggest that the prevalence of hypertension among PLHIV in Mombasa County is higher than previously recorded findings with 1 out of every 4 participants having hypertension. The factors that were found to be associated with hypertension in PLHIV are a BMI between 25 to 29.9kg/m^2, a BMI equal to or greater than 30kg/$m^{2,}$ and the use of a tenofovir-based regimen. In general, the participants were knowledgeable of hypertension prevention practices and complications. They also had a positive attitude towards hypertension, and fair hypertension preventive practices were being carried out by the PLHIV in Mombasa County.

5.2 Characteristics of Participants

The study found that most of the participants were female and the age group 35 – 44 years had the largest proportion of participants. Most participants had only received a primary school education and thus the majority were in informal employment earning less than Ksh 15,000 per month.

Just over two-thirds of the participants were females, which is in keeping with other studies that show that females have a higher prevalence of HIV as compared to their male counterparts. In Kenya, the KENPHIA report showed that the prevalence of HIV in women was 6.6% as compared to that in males at 3.1% (*KENPHIA 2018*.) The higher prevalence in women has been attributed to the biological differences between males and females. In addition, the economic empowerment of men often puts women at a greater disadvantage financially, thus the need to exchange sex for financial gain and therefore an increased risk of being infected with HIV (Bazzi et al., 2019). In a similar

study done in Uganda, the ratio of female patients to male patients was three to one which is also in keeping with the findings in our study (Lubega et al., 2021).

About one-third of the participants were aged 35 – 44 years and contributed the largest proportion. Our findings are also in keeping with the KENPHIA report. According to KENPHIA, the highest prevalence of HIV was among their study participants who were aged 40 – 44 years. In this age group, the HIV prevalence among females was 11.9%, and among males was 6.3% (*KENPHIA 2018*.). Our findings are also in keeping with the Kenya AIDS Indicator Survey (KAIS) of 2016 which showed that the highest prevalence of HIV was among patients aged 35 – 39 years at 18.7% among females and 6.6% among men (NACC), 2016). The older patients witnessed in our study may be attributed to the aging HIV population in the country. Due to better treatment, PLHIV are living longer and as such, there is an increase in the mean age group of the participants.

Our findings also showed that most participants had only received a primary school level of education and were in informal employment with a low income. All these findings are related in that those with lower levels of education have fewer employment opportunities and thus lower incomes. Some studies have reported an association between socioeconomic status and HIV showing an increase in the risk of being infected with HIV in persons with lower socioeconomic status (Bunyasi & Coetzee, 2017). Persons with lower economic status are forced to prioritize basic needs such as food and shelter and thus items such as condoms and other family planning devices are not a priority, thus increasing the risk of contracting HIV through unsafe sex. In addition, persons who were at the lower end of the income bracket were shown to be at increased risk of being infected with HIV, especially among the female population. This finding may be attributed to lower income groups and people who are less educated

have less access to information that would assist them in HIV prevention. Despite some HIV prevention measures such as free condoms and free maternity services being made readily available in Kenya, there is still a high burden of disease in the lower income groups. This may be attributed to the inadequate knowledge of HIV in these groups.

5.3 Prevalence of hypertension among PLHIV

Our findings revealed that one in every four participants had hypertension. The prevalence between males and females was similar. In addition, there was noted to be an increasing prevalence of hypertension as age increased with the highest prevalence noted to be in the age group over 55 years.

This study reveals a higher prevalence of hypertension among the participants than that reported in previous studies where the prevalence was between 14.5 to 18.9% (Mbuthia et al., 2021; Nduka et al., 2016). The overall prevalence of hypertension in Kenya has been estimated to be at 24% in previous studies (Ondimu et al., 2019). These findings suggest that the prevalence of hypertension among PLHIV in Mombasa is similar to the general population in Kenya. However, the findings suggest a higher prevalence of hypertension in the PLHIV in Mombasa as compared to other PLHIV in other localities such as Kiambu County (Mbuthia et al., 2021). This may be attributed to the higher obesity rates in urban settings such as Mombasa County compared to other rural settings (*Kenya | World Obesity Federation Global Obesity Observatory*, 2022.) The higher rates of obesity may be attributed to several factors. Urban settings are more likely to have more white-collar jobs where there are more hours spent on desk jobs with minimal physical activity. In rural settings, there is an increased likelihood of blue-collar jobs that include manual labor and thus there is more physical activity incorporated into the work.

In a study done in Uganda, the prevalence of hypertension was found to be at 1 in almost every 4 patients similar to our study (Niwaha et al., 2021). This study also compared the prevalence of hypertension between PLHIV and HIV-negative persons. The study revealed a higher prevalence of hypertension among HIV-negative persons at a prevalence of one out of every three patients compared to a prevalence of hypertension of one out of every four patients in PLHIV.

In comparison to the global trends, our findings revealed that the prevalence of hypertension in PLHIV was lower in Mombasa County (Fahme et al., 2018). This is also in keeping with other global meta-analysis studies that revealed a lower risk of hypertension in African and Asian countries compared to other regions such as North America (Davis et al., 2021). Although the findings revealed a lower prevalence of disease, they reveal the future trends of disease in the context that the findings already reveal a rising burden of disease compared to previous findings. In addition, the global trends revealed that 1 out of every 2 PLHIV aged 50 years and above was hypertensive (Fahme et al., 2018). These findings are similar to our findings that revealed that one out of every three PLHIV above 55 years were hypertensive compared to one out of every seven PLHIV in persons aged 18 to 34 years. Although our findings are not exact to the global trends, they reveal the rising burden of disease with an increase in age and possibly reveal the future trends of disease. Furthermore, these findings reveal the need for studies on hypertension to be differentiated based on specific geographical differences. Different regions reveal a higher or lower prevalence of hypertension based on the preventive or promotive factors of the disease.

Our findings on the prevalence of the disease are also in keeping with a metanalysis done on PLHIV and hypertension that revealed a lower risk of hypertension among Africans as compared to other regions of the world where the risk of hypertension was

noted to be higher (Davis et al., 2021). This reveals the difference in hypertension prevalence among different regions and further justifies the need to identify the prevalence of hypertension for various geographical regions that have different factors that influence the prevalence of the disease.

Our study also reveals no difference in the prevalence of hypertension between males and females for PLHIV in Mombasa County. This finding is similar to a global meta-analysis study that looked at studies from all over the world except, North Africa, Asia, the Middle East, and Europe that revealed no difference in the prevalence of hypertension when comparing males and females (Bigna et al., 2020). This reveals that though there may be differences in the risk factors for hypertension when comparing males and females, these differences do not result in an overall difference in the prevalence of hypertension. In addition, though there may be a difference in the age groups affected by hypertension between males and females, it appears that these differences ultimately balance out resulting in no difference in the prevalence of hypertension when comparing males and females. In contrast, other previous studies have shown a higher prevalence of hypertension among females as compared to males (Kansiime et al., 2019; Magodoro et al., 2016; Zungu et al., 2019). These studies have shown that women are more likely to be overweight and obese due to their increased sedentary lifestyles which then contribute to a higher prevalence of hypertension in females than males. Other studies revealed a higher prevalence of hypertension among males as compared to females (Mbuthia et al., 2021; Mulugeta et al., 2021). The possible reason for men having a higher prevalence of hypertension compared to their female counterparts may be the increased stress encountered by men as they are more likely to be breadwinners in their homes and thus the survival of their families is dependent on them. This study contrasts previous findings of other studies. The possible

lack of a difference in the prevalence may be attributed to the urban setting of this study. Urban populations have been shown to have a higher prevalence of obesity and difficult working environments that may contribute to hypertension.

The prevalence of hypertension was also shown to increase with an increase in age with the age group over 55 years being the most affected. A similar study done in Uganda revealed that the prevalence of NCDs including hypertension was shown to be higher in older patients with patients aged 70 years and older having a prevalence of up to 50% (Kansiime et al., 2019). Another study in Ethiopia also found that the risk of hypertension was almost three times higher in older patients as compared to younger patients (Mulugeta et al., 2021). This finding can also be attributed to the structural changes that occur as age increases. As patients become older, their blood vessels become more rigid. The increased rigidity within the arteries increases the overall blood pressure (Pinto, 2007). As the rigidity increases, the arteries become more stiff and less pliable therefore any increase in volume results in an increase in pressure as the arteries are unable to expand normally to accommodate the increased volume. The high burden of NCD among PLHIV requires an integrated approach to the management of PLHIV(Adeyemi et al., 2021). The integrated approach in the management of patients will require a deeper understanding of how different PLHIV present differently with the wide range of NCDs. In our neighbouring country of Uganda, a study revealed that PLHIV had better controlled hypertension when followed up in the integrated care clinics as compared to HIV-negative persons that were also on follow-up for hypertension (Kwarisiima et al., 2019). This approach in management may thus see the developed nations have better outcomes in PLHIV that may soon be comparable to the more developed nations. The integrated approach in the management of PLHIV will

need to be tailored to each individual patient to ensure optimal outcomes for all our patients.

5.4 Factors associated with hypertension among PLHIV

A BMI equal to or greater than 25 was demonstrated to be associated with a 3 times higher prevalence of hypertension compared to participants with BMI < 25. The prevalence ratio of hypertension was also noted to increase with an increase in BMI. These findings are similar to a study in Kenya in Bomet County, that found that persons with a BMI over 25 have a 3 times greater risk of hypertension as compared to persons with a BMI less than 25 (Ondimu et al., 2019). Similar studies in Ethiopia and Uganda also revealed a higher risk of hypertension among patients with a higher BMI (Lubega et al., 2021; Mulugeta et al., 2021). These findings reveal the direct association of BMI with hypertension. They also show the compounding effect of BMI on hypertension and possibly other NCDs in that patients with a higher BMI in the obese category have a greater risk of hypertension compared to those whose BMI is still over 25 but in the overweight category. They further illustrate the effect that a lifestyle change that lowers or increases BMI can have a direct correlation with lowering or increasing one's risk of getting hypertension.

A study in South Africa also focused on the association of BMI and hypertension among PLHIV. This study revealed an increase in the prevalence of being overweight and obese after being on ART treatment for approximately four years (Mathebula et al., 2020). The result of this increase is a rise in hypertension among PLHIV from 1 in 4 patients to 1 in 3 patients over a four-year period. These findings further elaborate a direct association of BMI oh hypertension prevalence and further reveal the rate at which the increase in the prevalence of hypertension can occur. Thus, there is a need

for prompt prevention of being overweight, and obesity among PLHIV if we are to decrease the overall prevalence of hypertension among PLHIV.

The study in Bomet County, Kenya also revealed that having a relative with hypertension increased the odds of disease, however persons who did not partake alcohol had a lower chance of developing hypertension (Ondimu et al., 2019). Despite collecting these data, our findings did not reveal an association between hypertension and having a family history of the same nor did we find an association with alcohol intake. The lack of an association with alcohol intake may be due to the low number of participants who said that they had a history of alcohol intake or the lack of any means of verification for alcohol intake.

In addition, a tenofovir-based regimen was found to have a 68% lower risk of hypertension among PLHIV. A previous study in Nigeria found that the use of tenofovir-based regimens was associated with a lower risk of obesity (Patrick et al., 2021). Obesity and weight loss are factors that are known to be associated with hypertension (Mwenda et al., 2018). The increase in weight is associated with a commensurate increase in blood pressure and weight loss through exercise or diet which may result in a decrease in blood pressure. The negative association between the tenofovir-based regimen and hypertension is likely because of the lower risk of obesity associated with the TDF regimen. A previous study also reported a lower rate of hypertension among persons that were on dolutegravir as opposed to nevirapine or efavirenz (Musekwa et al., 2021). Unfortunately for our study, this component could not be assessed due to the combined drug regimens that our patients are put on. This makes it difficult to compare the individual effect of dolutegravir on hypertension compared to the individual effect of efavirenz or nevirapine on hypertension.

Another study in Ethiopia also revealed a higher risk of hypertension in patients who were on Zidovudine (Mulugeta et al., 2021). Although our current study findings were not able to illustrate the relationship between zidovudine and hypertension, it is worth noting that zidovudine and tenofovir are both Nucleoside Reverse Transcriptase Inhibitors. Thus, our findings may be in contrast to the findings of the study in Ethiopia or may illustrate that individual drugs have a different response to hypertension despite these drugs being in the same classification as ART. This further illustrates the need for individual analysis of drugs and their effect on hypertension and other NCDs. In Uganda, the second line ART regimens lopinavir and ritonavir were also found to have a lower association with hypertension compared to nevirapine based regimens (Lubega et al., 2021). Our findings in this study revealed no association between the second line regimens and hypertension and thus are in contrast with these findings. The use of second line regimens is often when the first line regimens have failed to produce a decrease in viral load and thus are expected in patients with more severe disease. Thus, this may indirectly affect the association between hypertension and the second line drugs as these patients have advanced disease and are more likely to be wasted and thus less likely to have hypertension.

5.5 Knowledge, Attitude, and Practices of PLHIV in Mombasa County

The findings showed that both the hypertensive and non-hypertensive participants were knowledgeable on matters concerning hypertension. This contrasts with a previous study by Kagaruki et al that found that PLHIV had poor knowledge of comorbidities (Kagaruki et al., 2018). In a further analysis of the knowledge of the participants, we found that the only question that showed a statistically significant difference between participants with hypertension compared to participants without hypertension was the question on normal blood pressure measurement reading. This can be explained by the

fact that hypertensive patients are likely more educated on the normal ranges of blood pressure measurements. In all other questions on knowledge of hypertension, we found no statistically significant difference between the knowledge of hypertensive participants compared to the non- hypertensive participants.

Furthermore, our study finding that hypertensive patients were more knowledgeable about normal blood pressure readings in comparison to non-hypertensive patients is in contrast to the findings from the study conducted in Sudan that revealed that only one out of every hypertensive patient had knowledge of blood pressure readings (Abdalla & Mirghani, 2021). This finding shows us that there may be better knowledge of blood pressure readings in Mombasa compared to other areas. In addition, it shows that more knowledge needs to be relayed to the participants so that in addition to their blood pressure readings they have more information on other prevention strategies for hypertension.

In contrast, a previous study in Lebanon found that in hypertensive patients, there was fair knowledge of hypertension and fair practices being undertaken by the hypertensive patients (Machaalani et al., 2022) These findings are similar to our study that revealed that the participants were knowledgeable about hypertension. This further illustrates that despite being knowledgeable more needs to be done to ensure that the knowledge eventually translates to a decrease in the prevalence of hypertension among PLHIV.

Our study revealed that overall the participants were knowledgeable about hypertension and that the participants were knowledgeable of salt intake which affects blood pressure. A previous study in Sudan had a similar finding where the knowledge that was most common among the patients was that salt prevention was one of the key strategies used in the prevention of hypertension (Abdalla & Mirghani, 2021). These

results show that good efforts have been made by healthcare workers in translating scientific research to their patients helping them have a better understanding of hypertension and the key strategies in decreasing one's blood pressure.

There was also a commensurate positive attitude reported to hypertension across both the hypertensive and non-hypertensive groups. This finding is similar to a study done in Malaysia that showed that participants who were knowledgeable about hypertension had a commensurate positive attitude towards the disease (Buang Nurul, Rahman Nor, 2019). In the analysis of attitudes between hypertensive and non-hypertensive participants, we found no statistically significant difference in any of the statements on the attitude that were provided in the questionnaire. Our finding on a positive attitude toward hypertension may be attributed to the fact that hypertension is now a relatively common disease with participants being able to know a person who suffers from the disease and lives a full productive life. This may also explain why there was no difference between the hypertensive and non-hypertensive participants as both groups have good knowledge of the disease.

In a study in Malaysia, the participants were shown to have a positive attitude toward reducing salt intake as a means of the prevention of hypertension (Haron et al., 2021). This is similar to our study that showed that the participants, both hypertensive and non-hypertensive, had a positive attitude towards hypertension prevention practices such as avoiding alcohol and eating healthily. This positive attitude indicates that if more efforts are employed to ensure to decrease the prevalence of hypertension, then there would be a positive response by the community to these strategies.

Our study revealed that there were fair hypertension prevention practices that were being carried out by the participants. This finding is similar to a study that was carried

out in Lebanon that revealed that there were a fair amount of hypertension practices that were being carried out by the patients (Machaalani et al., 2022). Despite the fair prevention practices being carried out, the overall prevalence of hypertension was still higher than previously recorded findings. This finding shows that there may be a need to review the medications for hypertensive patients and the ART regimens that our participants received to identify which new strategies can be adopted to decrease the prevalence of hypertension.

Our study revealed that both hypertensive and non-hypertensive patients would exercise more than three times a week. This is in contrast to the study findings in Sudan that revealed that almost three out of five patients admitted to not exercising on most days of the week (Abdalla & Mirghani, 2021). The majority of the participants were either unemployed or in informal employment. This translates into most of the participants having blue-collar jobs or being involved in manual labour and thus exercise is naturally incorporated into their daily work. This may explain our finding on most participants exercise more than three times per week.

Finally, we found that in general, there were fair hypertension prevention practices were being conducted across the hypertensive and non-hypertensive participants. We found no statistically significant practices that were being carried out across either of the groups. This is in contrast to a study done in Ethiopia that found that only a minority of hypertensive patients carried out good practices to prevent hypertension (Kebede et al., 2022). The lack of difference between the hypertensive and non-hypertensive participants in terms of harmful hypertension practices may be attributed to the subjective way in which these questions were asked to the participants. There were no means of verification for smoking, alcohol intake, number of fruits or vegetables eaten, etc. As such, it is difficult to make a comparison across the groups.

5.6 Study Limitations

This cross-sectional study on hypertension among PLHIV poses some limitations. Firstly, the study was likely to recruit participants with good adherence to ART and those who are enrolled in HIV care thus there may be an underrepresentation of patients who are not enrolled in care and have poor adherence to ART. This was mitigated by enrolling all persons in the clinic who gave consent regardless of adherence status or whether it was their first clinic visit. In addition, the review of medical records to verify and extract additional information on the participants may introduce bias depending on how well the information was documented. This was mitigated by looking at multiple entries in the participants' files to ensure that not only one clinician's views were considered but considering multiple clinicians' clinical findings to reduce bias. Furthermore, being a cross-sectional study, the change in behaviour over time could not be assessed as the participants were not followed up over a period. This was also mitigated by reviewing multiple entries of the participant's clinic visits to better understand the history of each participant. Lastly, the study was conducted in Mombasa County and may not be generalized to other regions in Kenya. Despite the findings not being generalizable, they can be used as a guide in other regions of Kenya.

CHAPTER SIX

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusion

The following are the conclusions of the study:

i. The prevalence of hypertension among the participants living with HIV in Mombasa County was higher than in previously recorded studies.

ii. The prevalence of hypertension increases with an increase in age.

iii. A BMI greater than 25 increases the risk of one having hypertension.

iv. A tenofovir-based regimen decreases the risk of one having hypertension.

v. The participants were knowledgeable about hypertension.

vi. The participants had a positive attitude towards hypertension prevention mechanisms.

vii. The participants conducted fair practices in preventing hypertension.

viii. The participants' knowledge of hypertension prevention practices is not always translated to a change in lifestyle practices.

6.2 Recommendations

The following are the recommendations from the study:

i. PLHIV should have increased targeted screening for hypertension.

ii. PLHIV noted to have a BMI greater than 25 should be closely followed up to monitor for hypertension.

iii. PLHIV with a BMI greater than 25 should be on a tenofovir-based regimen where there is no contraindication.

iv. The nutrition department and other health workers should initiate home visits to high-risk patients to ensure that the knowledge on hypertension prevention is incorporated into their daily lives to decrease the likelihood of developing hypertension.

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Appendices

Appendix 1: Consent Form

1a: ENGLISH CONSENT FORM

CONSENT FORM

Dear Participant,

You are kindly being requested to take part in a research study. Please read this form carefully. You will be given a chance to ask questions. If you decide to be in the study, you will be given a copy of this consent form for your records. Taking part in this research study is voluntary. You may choose not to take part in the study. You are also free to withdraw from this study at any time.

The purpose of the study is to determine factors associated with hypertension among persons living with HIV (PLHIV) in Mombasa County. This is a facility-based study that involves visiting four selected Comprehensive Care Clinics (CCC) and interviewing PLHIV. You have been randomly selected because you meet the eligibility criteria for the study. The interviews are in the form of a structured questionnaire administered by the research team. Participation in the study will last approximately 30 minutes.

There are no perceived risks or side effects, however, some of the questions may make you uncomfortable or upset, but you are free to decline to answer them if you do not wish to or to withdraw from the study at any time. There are no direct benefits or reimbursement plans in cash or kind for the participants who will be involved in this study. However, it is hoped that the information gained from the study will help to identify strategies and opportunities for improving the treatment of hypertension among PLHIV in the county which will result in the reduction of morbidity and mortality of PLHIV.

Your responses will help us learn more about the factors associated with hypertension among persons living with HIV. All reasonable efforts will be made to keep your

information private and confidential. Your treatment, payment, or enrolment in any health plans or eligibility for benefits will not be affected if you decide not to take part.

In case of any questions or concerns about this study, you may contact Dr. Faith Mudachi at +254721921465 or fmudachi@gmail.com OR Moi University Institutional Research and Ethics Committee on phone No. +254787723677 or irecoffice@gmail.com or irec@mtrh.go.ke

By signing this consent form, you agree to voluntary participation in this study, and you are giving permission ("authorization") to the research team to use and share your Protected Information as described above. You will receive a copy of this form after it is signed.

I have read or have had read to me the description of the research study. The investigator or his/her representative has explained the study to me and has answered all of the questions I have at this time. I have been told of the potential risks and discomforts, as well as the possible benefits of the study. I freely volunteer to take part in this study.

_____	_____	_____
Name of Participant	Signature of subject/thumbprint	Date & Time

_____	_____	_____
Printed Name of Investigator	Signature of investigator	Date & Time

1b: KISWAHILI CONSENT FORM

MAKUBALIANO YA HIARI ILI KUSHIRIKI KWENYE UTAFITI

Mshiriki,

Unaombwa kushiriki katika utafiti. Tafadhali soma fomu hii kwa makini. Utapewa nafasi ya kuuliza maswali. Ukiamua kuwa katika utafiti, utapewa nakala ya fomu hii kwa rekodi zako. Kushiriki katika utafiti huu ni kwa hiari. Unaweza kuchagua kutoshiriki katika utafiti. Pia uko huru kujiondoa kutoka kwa utafiti huu wakati wowote.

Madhumuni ya utafiti huu ni kubainisha mambo yanayohusiana na shinikizo la damu miongoni mwa watu wanaoishi na VVU katika Kaunti ya Mombasa. Huu ni utafiti wa kituo ambao utahusisha kutembelea kliniki nne zilizochaguliwa za CCC na kuwahoji watu wanaoishi na VVU. Umechaguliwa bila mpangilio kwa sababu umetimiza vigezo vya kustahiki kwa ajili ya utafiti. Mahojiano ni katika mfumo wa dodoso iliyoundwa na kusimamiwa na timu ya utafiti. Kushiriki katika utafiti kutachukua takriban dakika 30.

Hakuna hatari au athari zinazoonekana, hata hivyo, baadhi ya maswali yanaweza kukufanya usiwe na raha au uchungu, lakini uko huru kukataa kuyajibu ikiwa hutaki au kujiondoa kwenye utafiti wakati wowote. Hakuna faida za moja kwa moja au mipango ya kurejesha pesa taslimu au aina kwa washiriki ambao watahusika katika utafiti huu. Hata hivyo, inatarajiwa kuwa taarifa zilizopatikana kutokana na utafiti huu zitasaidia kubainisha mikakati na fursa za kuboresha matibabu ya shinikizo la damu miongoni mwa watu wanaoishi na VVU katika kaunti hii ambayo itasababisha kupungua kwa magonjwa na vifo vya watu wanaoishi na VVU.

Majibu yako yatatusaidia kujifunza zaidi kuhusu mambo yanayohusiana na shinikizo la damu miongoni mwa watu wanaoishi na VVU. Juhudi zote zinazofaa zitafanywa ili kuweka

maelezo yako kuwa ya faragha na ya siri. Matibabu, malipo au uandikishaji wako katika mipango yoyote ya afya au ustahiki wa manufaa hautaathiriwa ukiamua kutoshiriki.

Iwapo una maswali au wasiwasi wowote kuhusu utafiti huu, unaweza kuwasiliana na Dk Faith Mudachi kwa +254721921465 au fmudachi@gmail.com AU Kamati ya Utafiti na Maadili ya Chuo Kikuu cha Moi kwa simu +254787723677 au irecoffice@gmail.com au irec@mtrh.go.ke

Kwa kutia sahihi fomu hii ya idhini, unakubali kushiriki kwa hiari katika utafiti huu na unatoa ruhusa ("idhini") kwa timu ya watafiti kutumia na kushiriki taarifa zako zilizolindwa kama ilivyoelezwa hapo juu. Utapokea nakala ya fomu hii baada ya kutiwa sahihi.

Nimesoma au nimeelezewa maelezo ya utafiti huu. Mpelelezi au mwakilishi wake amenieleza utafiti na amejibu maswali yote niliyo nayo kwa wakati huu. Nimeambiwa juu ya hatari na usumbufu unaowezekana, pamoja na faida zinazowezekana za utafiti. Ninajitolea kwa hiari kushiriki katika utafiti huu.

_____ _____

_____

Jina la Mshiriki Sahihi ya mshiriki / alama ya kidole gumba Tarehe na Wakati

_____ _____

_____

Jina la Mtafiti Sahihi ya mtafiti Tarehe na Wakati

Appendix 2: Patient Questionnaire

PATIENT QUESTIONNAIRE: FACTORS ASSOCIATED WITH HYPERTENSION IN PLHIV IN MOMBASA

Unique ID:	
County:	Sub-county:
Hospital:	
A. Sociodemographic data	
1. Age	2. Date of Birth
3. Sex: Male	4. Female
5. Marital status: Married Widowed Divorced Single	
6. Employment status: Student Employed Business Casual Laborer Unemployed Other	
7. Education level completed: No education Primary school Secondary school Tertiary level	

8. Income group: < Ksh.15,000 per month Ksh.15,000 – <50,000 per month Ksh.50,000 - <100, 000 per month > Ksh.100,000			
Knowledge	**Yes**	**No**	**I don't know**
9. Is it important to have your blood pressure measured?			
10. Is hypertension a disease?			
11. Does smoking around others affect their health?			
12. Can taking alcohol and smoking cigarettes contribute to a person being diagnosed with hypertension?			
13. Has a health worker ever spoken to you about the harms of smoking?			
14. Can eating food with a lot of salt affect your blood pressure?			
15. Can stress increase your chances of being diagnosed with high blood pressure?			
16. Can talking to friends and family help decrease stress?			
17. Can someone have hypertension and not have any symptoms?			

18. Is 120/80mmHg a normal blood pressure?	
19. Is stroke a complication of hypertension?	
20. Can exercising frequently help reduce one's blood pressure?	
Attitude	**Strongly disagree, Disagree, Neutral, Agree Strongly Agree**
21. I don't worry about being diagnosed with hypertension	
22. If I eat healthily and avoid alcohol, I can prevent myself from getting hypertension	
23. I can decrease my blood pressure by exercising frequently	
24. Even if my mother/father had hypertension, I can still prevent myself from getting hypertension	
25. I can prevent myself from the complications of hypertension by adhering to medication	
Practices	**Yes** **No**
26. Do you avoid smoking cigarettes?	
27. Do you avoid taking alcohol?	

28. Do you exercise more than 3 times per week?	
29. Do you avoid adding salt to your food after it is already cooked?	
30. Do you eat vegetables/fruits more than 5 times per week?	
31. Last recorded weight	32. Last recorded height
33. Blood pressure measurement?	
34. Duration of ART Regimen?	
35. History of non-adherence to ART? Yes No If yes, duration of non-adherence?	
36. Type of ART Regimen currently being used: First-line Second-line ≥Third-line	
37. Last CD4 count?	
38. Last, recorded WHO HIV clinical stage? I II III IV	
39. Opportunistic infections over the last year? Yes No	
40. Family history of comorbidities? Yes No If so, which one? Diabetes:	

Hypertension: Other cardiovascular disease (coronary heart disease/heart attack/ Cerebrovascular Disease/stroke/ peripheral vascular disease/ heart failure/ rheumatic heart disease/ cardiomyopathy): Chronic respiratory disease (Chronic Obstructive Pulmonary Disease / Asthma/ Pulmonary hypertension / Occupational Lung disease): Cancer: Other:
41. History of other medication or treatment other than ART / prophylactic medication/supplements? Yes No If yes, what type of medication/ treatment? Antihypertensives Other? (Specify)
Health System Factors
42. History of stock out of medication for hypertension for more than 1 month? Yes No
43. Distance to the hospital? <1km 1 km - 5km >5km
44. Clinic waiting time at the CCC <30 minutes 30 mins – 1hr >1 hr.
45. Clinic hours

Morning	Afternoon	All-day
46. Frequency of patient visits		
1 per month	1 every 3 months	1 every 6 months

Appendix 3: IREC Approval

INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE (IREC)

MOI TEACHING AND REFERRAL HOSPITAL
P.O. BOX 3
ELDORET
Tel: 33471//2/3

MOI UNIVERSITY
COLLEGE OF HEALTH SCIENCES
P.O. BOX 4606
ELDORET
Tel: 33471/2/3

Reference: IREC/2021/178
Approval Number: 0004013

4th November, 2021

Dr. Faith Mudachi
Moi University,
School of Public Health,
P.O. Box 4606-30100,
ELDORET- KENYA.

Dear Dr. Mudachi,

PREVALENCE OF AND FACTORS ASSOCIATED WITH HYPERTENSION AMONG PERSONS LIVING WITH HIV IN MOMBASA COUNTY.

This is to inform you that ***MTRH/MU-IREC*** has reviewed and approved the above referenced research proposal. Your application approval number is ***FAN: 0004013.*** The approval period is **4th November, *2021- 3rd November, 2022.***
This approval is subject to compliance with the following requirements;

i. Only approved documents including (informed consents, study instruments, Material Transfer Agreements (MTA) will be used.
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by ***MTRH/MU-IREC***.
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 ***MTRH/MU-IREC*** 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 ***MTRH/MU-IREC*** within 72 hours.
v. Clearance for export of biological specimens must be obtained from ***MOH at the recommendation of NACOSTI*** for each batch of shipment.
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 ***MTRH/ MU-IREC.***

Prior to commencing your study; you will be required to obtain a research license from the National Commission for Science, Technology and Innovation (NACOSTI) https://oris.nacosti.go.ke and other relevant clearances from study sites including a written approval from the CEO-MTRH which is mandatory for studies to be undertaken within the jurisdiction of Moi Teaching & Referral Hospital (MTRH) and its satellites sites.

INSTITUTIONAL RESEARCH & ETHICS COMMITTEE
04 NOV 2021
APPROVED
P.O. Box 4606-30100 ELDORET

Sincerely,

PROF. E. WERE
CHAIRMAN
INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE

cc CEO - MTRH Dean - SOP Dean - SOM
Principal - CHS Dean - SON Dean - SOD

Appendix 4: NACOSTI License

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: 880822

Date of Issue: 20/November/2021

RESEARCH LICENSE

This is to Certify that Dr.. FAITH Nthoki MUDACHI of Moi University, has been licensed to conduct research in Mombasa on the topic: Prevalence of and Factors associated with hypertension among persons living with HIV in Mombasa County for the period ending : 20/November/2022.

License No: **NACOSTI/P/21/14403**

880822

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.

Appendix 5: Approval to conduct study in Mombasa from the Department of Health

OFFICE OF THE COUNTY CHIEF OFFICER
MEDICAL SERVICES

Email : cohealthmsa@gmail.com
When replying please quote

P O Box 90441 – 80100
Mianifu Kombo Street,
MOMBASA

Ref: COH/MSA/RSC/2021/(10)

6th December, 2021

Dr. Faith Mudachi
P. O. Box 1599-00100
GPO, Nairobi

RE: AUTHORIZATION TO CONDUCT RESEARCH IN MOMBASA COUNTY

We refer to your application letter dated 1st December, 2021 on request for permission to undertake research project titled ***'Prevalence of and Factors Associated with Hypertension in Persons Living with HIV in Mombasa County'.***

The proposed study will be done in Mombasa County on hypertensive residents receiving care in Comprehensive Care Centres (CCC) in our Level 4 and 5 facilities including:

- Coast General Training and Referral Hospital
- Tudor Sub County Hospital
- Port Reitz Sub County Hospital
- Likoni Sub County Hospital

This office has no objection to your request and hereby approves the study to be done at the mentioned facilities. By a copy of this letter the CEO, Coast General Training & Referral Hospital and all the Medical Superintendents are requested to accord you the necessary assistance.

On completion of the study, you are required to disseminate the findings to the County Health Management Team for the recommendations to be considered.

Thank you.

16 DEC 2021

DR KHADIJA SOOD SHIKELY, HSC
COUNTY CHIEF OFFICER, MEDICAL SERVICES
COUNTY GOVERMENT OF MOMBASA.

Cc: The CEO – Coast General Teaching & Referral Hospital
All Medical Superintendents