Chapter One

Introduction

1.1. Background of the Study

Enhanced methods for detecting the human immunodeficiency virus (HIV), as well as the availability of more effective management modalities, have both contributed to a reduction in morbidity among people living with HIV (PLHIV) and an improvement in their overall survival rate[1]. Because of this, there has been an increase in the long-term complications of HIV infection, particularly those that are associated with non-communicable diseases such as dyslipidemia, insulin resistance, and hypertension[2].

Hypertension, which is the primary risk factor for cardiovascular and cerebrovascular mortality worldwide, appears to be expected in HIV-infected individuals, and the prevalence of the condition is on the rise. One study reported a prevalence of 11% in rural Uganda; another reported a prevalence of 31.7% in Norway, and a study conducted in South Africa recorded a prevalence of 41.2%. According to the findings of a comprehensive review, the prevalence of hypertension in PLHIV around the world is estimated to be 25.2%. In Nigeria, the prevalence rate can be as low as 12.3% in Ido Ekiti, Ekiti state, to as high as 50.3% in Jos, Plateau state.

The rising incidence and prevalence of hypertension in PLHIV have been attributed to the presence of known risk factors like obesity, diabetes mellitus, and renal insufficiency, as well as HIV-related factors[3]. Therefore, determining the risk factors at an early stage will help in intervention and subsequent control and reduction in the burden of hypertension among PLWHIV

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Similar to other Sub-Saharan African nations, Nigeria is going through an epidemiological transition with a steady rise in cardiovascular and other non-communicable diseases as the leading causes of death and a decline in the prevalence of many infectious diseases[4]. The leading factor in cardiovascular disease, high blood pressure (BP), affects about 1 billion people worldwide[5]. It plays a significant role in the global burden of disease and early mortality, with it being predicted that 1.56 billion adults will have hypertension by 2025[6].

Africa has the highest prevalence of elevated blood pressure among the WHO regions, at 46% for both sexes combined[7]. The prevalence of hypertension among adult Nigerians was the subject of a meta-analysis in 2015, with estimates ranging from 25.1% to 32.8%. Risky habits like sedentary lifestyles, poor diets, and abusing alcohol and tobacco are linked to the onset of hypertension[8]. The prevalence of these behavioural risk factors may be increasing in low- and middle-income nations with high rates of human immunodeficiency virus (HIV) infection as these nations advance in their levels of development and adopt Western lifestyles[9].

In addition to the traditional risk factors for hypertension, such as advanced age, male gender, African race, high body mass index (BMI), and high cholesterol, studies have shown that many people with HIV/AIDS have unhealthy lifestyles regarding their eating, exercise, alcohol consumption, and smoking habits[10],[11]. Therefore, efforts to lower cardiovascular risk in patients should focus on preventing and controlling hypertension because this is a prevalent predictive risk factor that is known to be changeable[12 13].

There is a lack of consistency across available data about the prevalence of hypertension in people living with AIDS. Although several studies report a higher incidence of hypertension in this women's population, when compared to the findings of other studies, the prevalence of

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hypertension is comparable among men and women with HIV/AIDS and individuals who are not infected with HIV as compared to uninfected individuals[14].

There are reasons to conduct a study on the causes of the prevalence of hypertension in HIV/AIDS patients. The first is that due to genetic susceptibility, HIV infection, use of antiretroviral therapy (ART), and age brought on by the rise in survival rates, cardiovascular disease prevention is crucial for these individuals[15] [16]. In addition, detection, treatment and control of hypertension are fundamental to reducing cardiovascular diseases since they increase the number of hospitalizations and lead to high medical and socioeconomic costs.

Antiretroviral therapy (ART) is the only treatment available that provides increased survival and decreases mortality, characterizing the disease as chronic. As a result, the primary focus of treatment has shifted from the disease itself and opportunistic infections related to immunodeficiency to long-term problems caused by the effects of the human immunodeficiency virus (HIV) and ART. These long-term problems include toxicity, drug interactions or resistance to these drugs, as well as the incidence of non-communicable diseases.

Additionally, there has been a rise in the prevalence of cardiovascular disease in HIV-positive individuals, particularly hypertension, which is defined as a systolic blood pressure of at least 140 mmHg and diastolic blood pressure of at least 90 mmHg[17]. It is unknown, though, whether this is because more patients are living longer or to some other factor if the occurrence of cardiovascular diseases is influenced by any one of these factors alone, whether it is connected to HIV infection itself or both [18].

In addition to the traditional risk factors for hypertension, such as advanced age, male gender, African race, high body mass index (BMI), and high cholesterol, studies have shown that many

people with HIV also have unhealthy lifestyles concerning eating, exercising, drinking, and smoking [19]. Therefore, prevention and control of hypertension should be the primary focus of efforts to reduce cardiovascular risk in patients because hypertension is a prevalent, well-known, and modifiable predictive risk factor[20].

There is a lack of consistency across available data regarding the prevalence of hypertension among people living with AIDS. Although several authors report a higher incidence of hypertension in this population when compared to uninfected individuals, other studies present a similar prevalence of hypertension among men and women with HIV/AIDS and individuals uninfected by HIV[21].

1.2. Statement of the Problem

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Hypertension is a significant risk factor for cardiovascular diseases, and it is linked to high morbidity and early mortality, and its prevalence among PLWHIV and AIDS patients is rising. It has been established that among PLWHIV, the causes of high blood pressure are multifactorial and include persistent immunodeficiency, immune activation, inflammations, coagulation disorders, ART itself, and the four general behavioural risk factors for NCDs listed by the WHO action plan for prevention and control of NCDs 2013-2020. (Tobacco use, unhealthy diet, physical inactivity, harmful use of alcohol).

UNAIDs (2015) documented that over 80% of non-communicable related deaths are due to cardiovascular disease 17.5m, cancer 8.2m, chronic respiratory disease 4m, and diabetes mellitus 1.5m[22]. According to a preliminary report published by the Ministry of Health in Kenya in 2011, non-communicable diseases are responsible for more than 50% of all hospital admissions and

hospital deaths, and by the year 2030, they will be responsible for more than 60% of the total national mortality.

According to estimates provided by the WHO in 2009, high blood pressure was responsible for 7.5 million deaths, or approximately 12.8% of all deaths[23]. According to the findings of a community-based survey conducted in 2013 in Abia state, Nigeria, to investigate cardiovascular risk factors and non-communicable diseases, the prevalence of hypertension was measured at 31.8%, and diabetes mellitus was found in 3.6% of the population. While obesity was found in 13.8% of the population, low high-density lipoprotein cholesterol was found in 54.1% of the population[24]. A study conducted at the University of Uyo Teaching Hospital in Uyo, Akwa Ibom State, Nigeria, found that the prevalence of hypertension among people living with HIV and AIDS was 24.9%. However, there is a lack of data on the prevalence of hypertension in Africa, as well as the deaths associated with it among people living with HIV and AIDS[25]. It has also been demonstrated that hypertension is one of the leading causes of both in-patient and outpatient morbidities (stroke, CVD), as well as mortalities, in patients who are living with HIV/AIDS as well as patients who do not have HIV.

The reduction of modifiable risk factors and the underlying social determinants is one of the goals of the WHO global action plan for the prevention and control of noncommunicable diseases 2013-2030[26]. It is essential to identify the risk factors and then work to mitigate them in order to achieve the highest level of control possible. Only then can the risk factors be reduced. This study will help to identify the risk factors that are associated with hypertension, particularly the awareness of preventive and control measures. As a result, the study will be tailored towards early identification and intervention in the upsurge and burden of hypertension, which will ultimately lead to the accomplishment of the WHO 2030 action plan for NCDs.

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1.3. Justification of the Study

The relationship between certain infections and the risk of developing certain chronic diseases is well-known. Compared to the general population, PLHIV is more likely to experience a variety of severe morbidities. Despite growing global concerns about co-morbidity in PLHIV and extensive research into the non-communicable diseases and CVDs that are frequently found among PLHIV in resource-rich settings, less is known about the burden in resource-limited settings. The correlations between these diseases and our knowledge of them will be more crucial for public health as the dual burden of HIV and CVDs increases in Sub-Saharan Africa. To better understand their risk and impact in settings with limited resources and to identify the best models of care to meet this challenge, more research is required. Understanding the prevalence of these CVDs among PLHIV, as well as their causes and consequences of them, is crucial for directing clinical care and health system planning.

1.4. Aim and Objectives of the Study

The aim of the study is to determine the 'risk factors and prevalence of hypertension among women living with HIV in Ibadan, Oyo State.

Specific Objectives

The specific objectives of the study were to:

- **i.** To determine the prevalence of hypertension among women living with HIV in Ibadan, Oyo State.
- **ii.** To identify factors associated with hypertension among women living with HIV in Ibadan, Oyo State.

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1.5. Research Questions

The study answered the following research questions:

1. What is the prevalence of hypertension among women living with HIV in Ibadan, Oyo State?
2. What are the factors associated with hypertension among women living with HIV in Ibadan, Oyo State?

1.6. Hypothesis

Hol1: There are no factors associated with hypertension among women living with HIV in Ibadan, Oyo State.

1.7 Significance of the Study

The findings of the study could be of significance to the stakeholders in the public health sector of the economy, such as the:

Decision-making for sustainable management of people living with HIV (PLWHA) so as to avert the accompanying risk factors by the supervising Federal, State and Local ministries of health; government and private hospitals, primary health care centres (PHC), government and non-government agencies for the control and prevention of HIV/AIDS etc.

The findings from the study would equally impact the knowledge base of healthcare givers managing people living with HIV (PLWHA) using Antiretroviral Therapy (ART) about the unintended consequences of the ART on their patients. Thus helping to calm the panicking condition the patient will come up with.

The findings from the study could further elicit research into therapy that would not come with complications for the patient.

1.8. Scope of the Study

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The study entitled ‘risk factors and prevalence of hypertension among women of reproductive age (18 - 49 years) with HIV in Ibadan, Oyo State will last for two (2) months. It covers clinical data of females of reproductive age (18 – 49) years living with HIV from the sampled health institutions within the local government area.

1.9 Limitation of Study

A limitation inherent in the study pertains to the methodology employed for hypertension assessment, as it relied on self-reported data.

1.10 Operational Definition of Terms

Risk Factors: A risk factor or determinant is a variable linked to a higher risk of illness or infection. A determinant in public health is a health risk that is all-encompassing, abstract, connected to inequalities, and challenging for an individual to control. Risk factors are situations, actions, or other elements that increase the likelihood of an event or series of events that are contrary to the status quo. For instance, a known risk factor for developing scurvy is low dietary intake of vitamin C sources. A significant risk factor for cancer is smoking.

Prevalence: The percentage of people who have a condition or trait in a population. In terms of statistics, prevalence describes how many cases of a disease are present in a given population at any given time, whereas incidence describes how many new cases are discovered over a specific time period. For prevalence, the numerator is the number of existing cases or conditions, and the denominator is the total population or group. For example, the prevalence of type 2 diabetes among children aged 2 to 12 equals the number of children aged 2 to 12 years with type 2 diabetes divided by the total number of children within that age range.

Hypertension: A condition in which the force exerted by the blood against the walls of the arteries is excessively high. In general, high blood pressure is defined as having a reading that is

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greater than 140/90, and the condition is considered severe when the reading is more significant than 180/120. There are frequently no symptoms associated with high blood pressure. It is one of the significant risk factors for the development of coronary disease, cerebral infarction, myocardial infarction, vascular disease, and chronic kidney disease.

Women Reproductive Age: The World Health Organization defines reproductive health as "a state of physical, mental and social well-being in all matters relating to the reproductive system at all stages of life." The term reproductive age group refers to the active reproductive years in women, starting with menstruation around 12-14 years and ending with menopause around 45 - 49. For demographic purposes, reproductive age is usually defined as 15 – 49 years or 12 – 49 years for the female gender. For women, the term is imprecise because women can become pregnant and bear children at younger or older ages.

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Endnotes

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Chapter Two

Literature Review

This chapter includes earlier research projects by researchers that are pertinent to this investigation under the guises of a theoretical framework, a theoretical review, an empirical review, a literature assessment, and a conceptual model, the review of the literature.

2.1 Conceptual Review

2.1.1 Epidemiology of HIV

In sub-Saharan Africa, life expectancy has decreased by more than 20 years, economic growth has slowed, and household poverty has increased as a result of the HIV pandemic's increased disease burden on the region since it first emerged in the early 1980s[1].

With a 30-year history of infecting over 70 million people and causing 35 million deaths, HIV continues to be a significant global burden[2]. It is a proven fact that the majority of factors, such as demographic factors, use of alcohol and tobacco, delayed testing for HIV, history of STIs, multiple sexual partners, infrequent use of condoms and knowledge of HIV interact to contribute to the prevalence of HIV in the world. These have severe repercussions for individuals who are at a higher risk of death and for the community in which these individuals reside, most likely leading to the reporting of a large number of new infections. These individuals are also at a higher risk of contracting the infection themselves. The Joint United Nations Programme on HIV/AIDS estimated that 2.1 million individuals around the world became newly infected with HIV in 2015[3]. However, only 70 percent of people who are infected with HIV are aware of their HIV status, and more than 40 percent have not been tested for HIV and are not receiving antiretroviral therapy. According to estimates from the World Health Organization, 36.7 million people worldwide had HIV as of the end of 2016, but a sizable percentage of adults between the

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ages of 15 and 49 are HIV positive[4]. Out of the 36.7 million HIV-positive people in the world, 1.8 million were children under the age of 15, with the majority of them residing in sub-Saharan Africa, according to statistics on HIV and AIDS[5]. An estimated 1.9 million adults aged 15 and older contracted HIV for the first time in 2015, with 47% of them being women. 58% of the new cases that emerged in 2015 involved young girls and women in their adolescent years. The majority of HIV/AIDS cases worldwide are 60% more likely to affect young women and adolescent girls between the ages of 15 and 24.

According to estimates, HIV is the leading cause of DALYs among people aged 30-44 worldwide. HIV is regarded as a significant problem for public health on a global scale and the "single greatest reversal in human development" in the annals of modern history due to the fact that the disease's burden is growing in the majority of countries. It is estimated that 38.1 million people were infected with HIV during the period between the years 2000 and 2014 and that 25.3 million people passed away as a result of AIDS-related illnesses[6]. On the other hand, the number of new infections has decreased by 35%, from 3.1 million in the year 2000 to 2.0 million by the end of 2014, and the prevalence of the disease is estimated to be 36.9 million people as of the end of 2014. Additionally, between the years 2000 and 2014, there was a 24% decrease worldwide in the number of deaths caused by AIDS, going from a peak of 2.0 million deaths in 2004/2005 to 1.2 million deaths in 2014. This decrease was accompanied by a decrease in the incidence of HIV. This has been attributed to a concerted effort made by all countries towards the achievement of the Millennium Development Goals (MDGs) on HIV/AIDS as well as the introduction of ART.

Sub-Saharan Africa (SSA), which is estimated to have 10% of the world's population, bears the heaviest burden of the HIV/AIDS pandemic. This is despite the fact that SSA only has 5% of the

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world's total population. The socio-economic effects of HIV/AIDS include a decrease in life expectancy, a reduction in economic growth, and an increase in the level of household poverty in the majority of the countries in sub-Saharan Africa (SSA), where the disease has a high prevalence. As of the end of 2014, it was estimated that there were 25.8 million people living in SSA who were infected with HIV/AIDS, with women making up 57% of that total[7]. In addition, an estimated 1.4 million new infections were accountable to SSA, but this is a decrease of about 41% between 2000 and 2014. Despite these advancements, sub-Saharan Africa continues to lead the world in terms of the proportion of total new infections. The number of people who died of AIDS-related causes in SSA in 2014 was estimated to be 790,000, which represented 34.2% of the global estimate; however, this number represents a decrease of 48% between 2004 and 2014.

There is a varying prevalence of HIV across countries worldwide; however, the vast majority of reported cases come from low- and middle-income countries, particularly those in Africa. In 2016, the number of people living with HIV in sub-Saharan Africa was 25.5 million, which was significantly higher than the figure of 6.7 million in Asia and of 4.2 million in both Europe and the United States. All ages and sexual orientations are affected by HIV/AIDS[8]. Swaziland had the highest prevalence of HIV/AIDS among adults (27.2%) compared to the ten nations with the highest rates of the disease worldwide. Swaziland was followed by Lesotho (25%), Botswana (21.9%), South Africa (18.9%), Namibia (13.8%), Zimbabwe (13.5%), Zambia (12.4%), Mozambique (12.3%), Malawi (9.2%), and Uganda (6.5%). Figure 1 below displays the percentage of the world's population that is HIV-positive.

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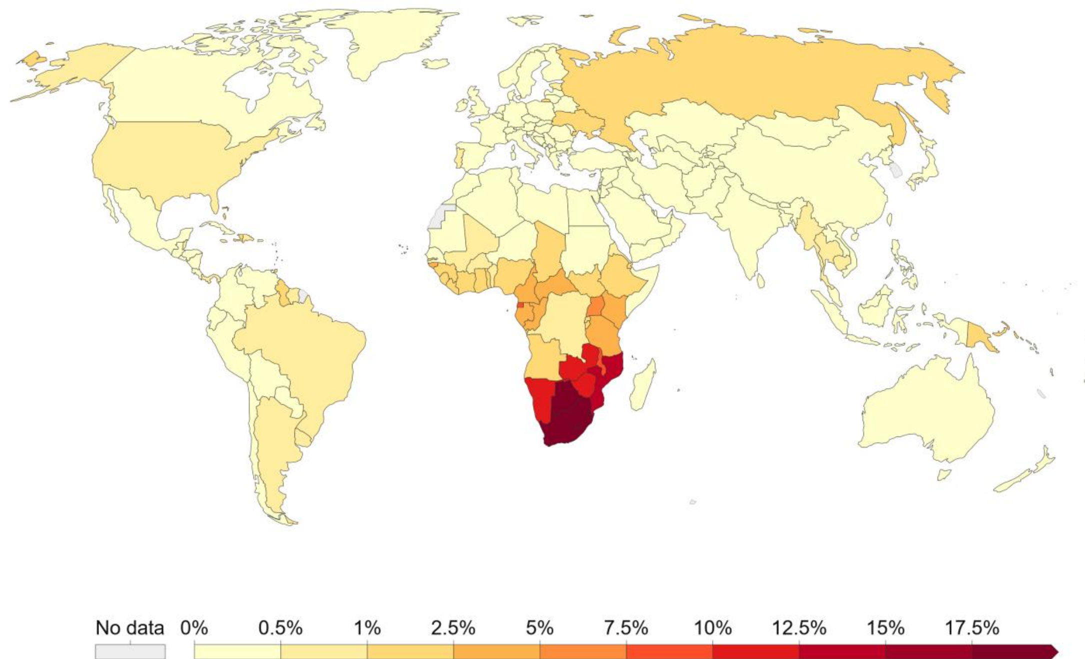

Figure 2.1: Global Share of the Population Infected With HIV

Source[9]

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2.1.2 Transmission and Presentation of HIV

HIV is the virus that causes HIV infection, which advances into AIDS. The most common mode of HIV transmission is from an infected person to a healthy person. Blood, vaginal fluids, pre-seminal fluids, rectal fluids, pre-seminal fluids, vaginal fluids and semen are the most common fluids that can transmit HIV. Breast milk can also transmit HIV. In order for HIV to be passed on from one person to another, these fluids of an infected person must either come into contact with a mucous membrane or damaged tissue, or they must be directly injected into the bloodstream of an uninfected person (using a needle or syringe)[10]. Inside the rectum, vagina, penis, and mouth

are all locations that contain mucous membranes. Sexual contact with HIV-positive individuals and the sharing of injection drug equipment are the two most common ways HIV can be transmitted. As a result of the HIV infection, the infection-fighting CD4 cells of the immune system are subjected to attack, which leads to a loss in the CD4 count and makes it more difficult for the body to fight infections[11]. Without treatment, HIV can gradually destroy the immune systems of those infected and eventually lead to AIDS. The progression of HIV infection can be broken down into three stages: acute HIV infection, chronic HIV infection, and acquired immunodeficiency syndrome (AIDS) [12]. Despite the success of antiretroviral therapy (ARV), which has been shown to prevent HIV infection from progressing to AIDS, there is currently no cure for HIV. HIV medications help people infected with the virus live longer, healthier lives and contribute to the reduction of viral load, which in turn lowers the risk of HIV transmission. Adherence to HIV medications also helps people infected with the virus live longer.

The clinical presentation of symptoms and physical signs is necessary in order to make an HIV diagnosis. People who are HIV positive can exhibit the physical signs and symptoms of any stage of the HIV infection at any time during their infection. Malaise, fever and a rash that spreads all over the body are the symptoms of acute seroconversion, which manifests as a flu-like illness. The signs and symptoms are those of the illness that is presenting itself, which means that an HIV infection should be suspected as an underlying illness whenever unusual infections appear in individuals who appear to be healthy. A person infected with HIV may experience a noticeable loss of weight. If there is evidence of HIV risk factors or the presence of opportunistic infections, this could be a clue that the person is infected with HIV[13].

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Transmission of HIV through Sexual Intercourse

The most common way that HIV is passed on is through unprotected sexual contact, with the vast majority of infections occurring as a result of heterosexual encounters[14]. The risk of infection through anal intercourse is high, estimated to be between 1.4% and 1.7% per act, and it is present in both heterosexual and homosexual contacts[15]. The risk of transmission in heterosexual contacts is estimated to be 0.06% per act in high-income countries, which is significantly lower than the risk of transmission in low-income countries, which is estimated to be 0.34% per act. Even though there have only been a handful of documented cases of sexually transmitted diseases being passed on through oral contact, it is still possible to contract an infection through oral sex. The viral load, the presence of other STDs and genital ulcers, pregnancy, and anal sex are all factors that increase the risk of sexual transmission of HIV[16]. Other factors include the number of partners and ongoing sexual partnerships.

Transmission of HIV through Contaminated Blood/Blood Products

The second most common method of HIV transmission is through the sharing of contaminated blood and blood products, such as blood transfusion and its byproducts, and hypodermic needles while using intravenous drugs[17]. According to estimates, this route of transmission accounts for 15% of all new infections in low-income countries or between 5% and 10% of infections worldwide.

Mother-to-child Transmission of HIV

Transmission from a mother to her child, also known as vertical transmission, can happen at any point during pregnancy, childbirth, or breastfeeding. It is the third most common means of transmission around the world[18]. It is estimated that in the absence of ART, the risk of HIV

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transmission from an infected mother to her child at any point during pregnancy or childbirth is approximately 20%, while the risk of HIV transmission through breastfeeding is approximately 35%. The transmission of HIV from mother to child through this route has dropped dramatically as a result of policies that ensure all pregnant women receive HIV testing as part of their prenatal care.

2.1.3 HIV Life-Cycle and Pathogenesis

HIV, the primary cause of AIDS, is a retrovirus that belongs to the genus Lentivirus and the family Retroviradae[19]. The typical characteristics of lentiviruses include lengthy incubation times and lengthy disease durations. They spread as single-strand positive-sense enveloped viral RNA, and once inside the host cell, this RNA is translated into double-stranded DNA, which then enters the nucleus and fuses with the DNA of the host cell. The HIV envelope with the protein spikes and the capsid containing the HIV nucleic acid and enzymes are depicted schematically in Figure 2. The HIV life cycle has seven stages, including binding, fusion, reverse transcription, integration, replication, assembly, and budding. The various phases of the HIV life cycle are depicted in Figure 3. The single-stranded RNA-HIV (founder virus) docks at the target cell after entering the human body[20]. The CD4+ T lymphocytes and other cells with the beta-chemokine receptor (CCRS) or the alpha-chemokine receptor are the primary target cells (CXCR4), as well as resting CD4+ T cells, monocytes, macrophages, and dendritic cells. An interaction between the virion envelope glycoprotein (gp 120) and the chemokine co-receptors is what causes the virus to bind to the cells it is infecting. The virally encoded reverse transcriptase, which was also transported into the host cell during the process of infiltration, is used to perform the process of reverse transcription, which converts the viral RNA that was infiltrated into a double-stranded DNA molecule. Although the reverse transcriptase that is encoded by the virus possesses multi-

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functional activity, such as RNA-dependent DNA polymerase activity, DNA-dependent DNA polymerase activity, and RNase-H activity, it does not possess proof-reading activity, and as a result, it is prone to transcription errors. The double-stranded DNA of the virus then makes its way into the nucleus of the host cell, where it is joined to the host's cellular DNA by an enzyme that is encoded by the virus and by other co-factors produced by the host. When the virion has successfully integrated itself into the DNA of its host, it takes control of the cell's cellular machinery and directs the replication process. At this point, the virus could travel down either of two possible routes:

a) The virus enters a dormant state, and this gives it the ability to evade detection by the immune system of its host along with the cell that it infects.
b) The virus may also become active and be translated into infectious viral RNA that buds off the surface of infected cells into extracellular fluid or the bloodstream to infect other cells. This process is accomplished by messenger RNA (mRNA), which encodes for viral proteins. Through a hybrid spreading mechanism that uses either cell-free spread or cell-to-cell transmission, HIV spreads between CD4+ T cells[21]. This hybrid HIV transmission method is thought to be the cause of the virus' ongoing replication and resistance to ARVs.

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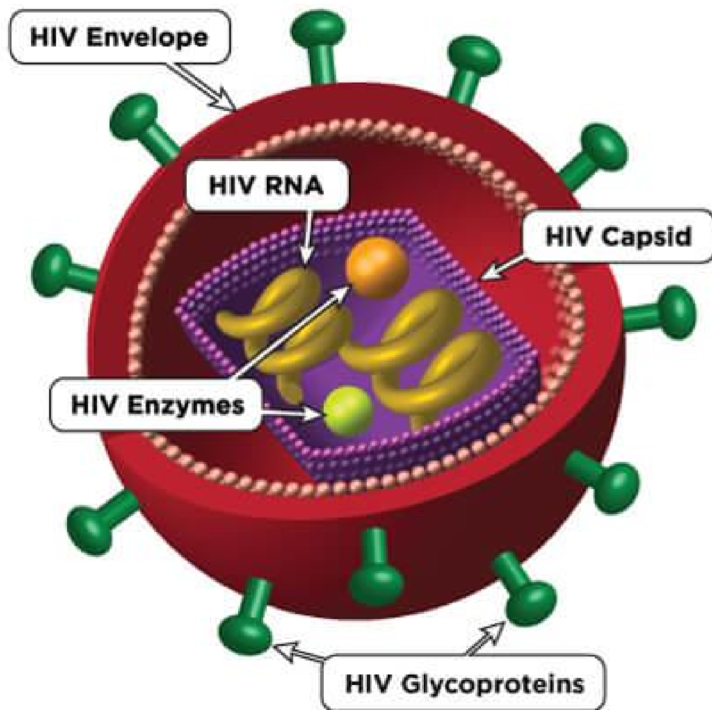

Key to Terms

HIV capsid: HIV's core that contains HIV RNA

HIV envelope: Outer surface of HIV

HIV enzymes: Proteins that carry out steps in the HIV life cycle

HIV glycoproteins: Protein "spikes" embedded in the HIV envelope

HIV RNA: HIV's genetic material

Figure 2.2. Diagram of the Human Immunodeficiency Virus. Source[22]

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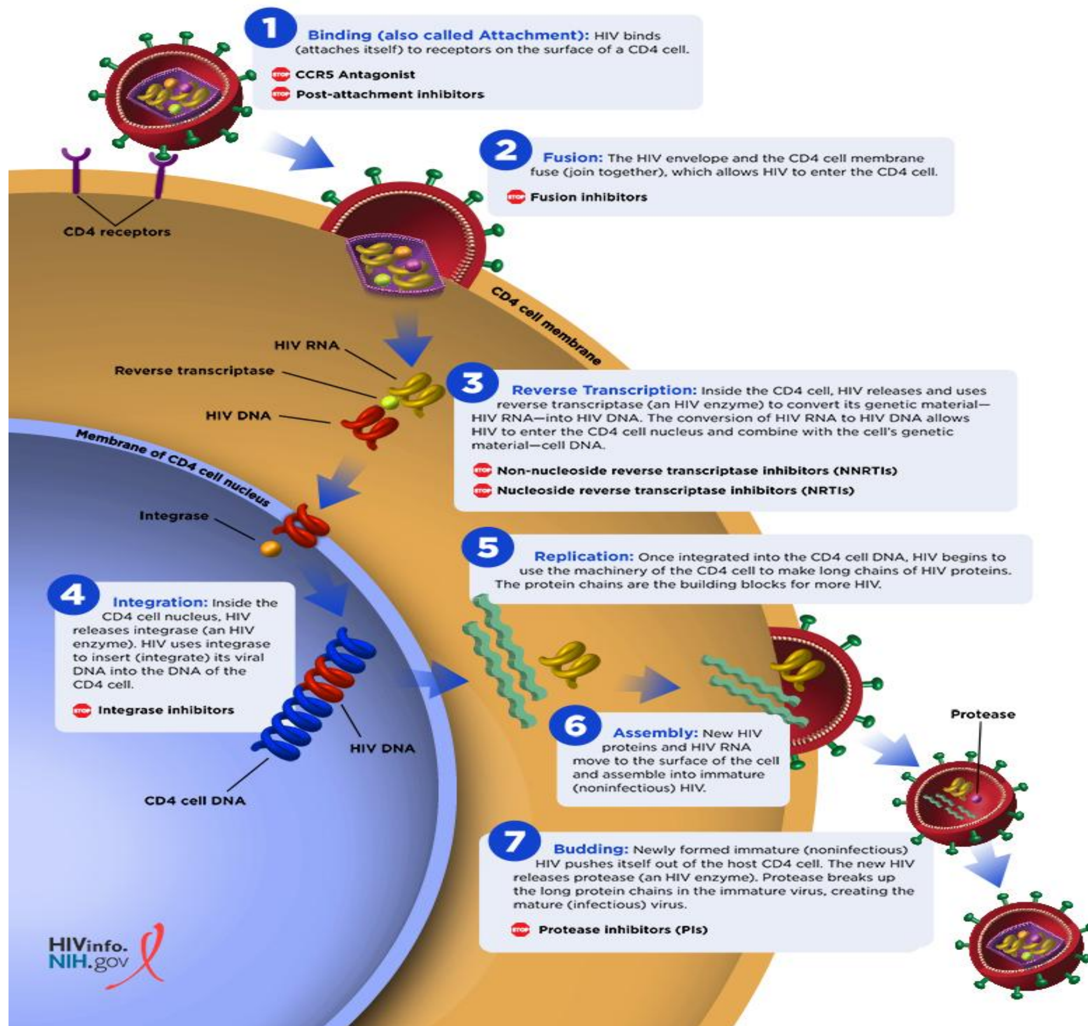

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Figure 2.3. Diagram of the Human Immunodeficiency Virus Life Cycle

Sourrce[23]

Acute viral replication and lymphoid tissue infection occur shortly after infection to create the virus's foundation. In the initial stages following infection, inflammatory cytokines and chemokines are produced in large quantities. This first stage's intense inflammatory processes are telling because they stand in stark contrast to the other viral infections' activity, which displays a more subdued and delayed response. HIV-specific CD8+ cells then kill infected cells in response to the acute infection, resulting in a decrease in viral load but invariably selecting for the

emergence of mutations to avoid the immune system response[24]. Due to the expression of programmed death 1 (PD-L), the acute state in the majority of patients causes profound exhaustion of HIV-specific T-cells, which in turn results in a loss of effector function. Neutralizing antibodies that select for viral escape mutants start to appear three months after the infection. To counteract the effects of these natural killer cells, mutant cells evolve as a result of this innate immune response to control the viral population via killer cells. The combined reduced production of CD4+ T-cells and their ongoing destruction, along with their subtypes like T-helper-17 cells and mucosal-associated invariant T-cells needed for bacterial defence, are the most significant characteristic feature of HIV infection. The T-cells are entirely depleted as a result of these combined effects.

2.1.4. Stages of HIV Infection

When HIV is introduced into a host, the infection progresses through three distinct stages, which are referred to as the acute stage, the chronic stage, and the advanced stage, respectively[25]. The acute stage of HIV disease begins immediately after the infection of the virus, and during this stage, the majority of infected people experience flu-like symptoms that are not virus-specific. These symptoms may include fever, sore throat, headache, nausea, gastrointestinal disturbances, or genital or mouth ulcers.

The second stage of the infection is known as the clinical latency stage, and it can also be referred to as chronic HIV or asymptomatic HIV[26]. During the early part of this stage, the majority of infected people will experience fewer or no symptoms. However, during the latter parts of this second stage, symptoms such as weight loss, myalgia, fever, and persistent generalized lymphadenopathy may appear. In the absence of ART, the second stage can last between 3 and 20 years.

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AIDS is the final stage of HIV disease, and it is defined by specific parameters such as a CD4+ count of 200 cells/uL in addition to other symptomatic features such as pneumocystis pneumonia, cachexia, and respiratory tract infections. In addition to the symptoms that are experienced during the first stage of the infection, there is a possibility of developing cancers such as Kaposi's sarcoma and cervical cancer.

2.1.5. HIV Infection Classification

HIV and diseases related to HIV are clinically classified so that appropriate treatment can be administered. This is necessary because HIV infection is a chronic and progressive disease. The WHO HIV staging system, which is more appropriate for settings with limited resources, and the CDC classification, which is, on the other hand, idle for developed countries, are the two primary classification systems that exist. Both of these systems are related to one another.

The WHO's HIV staging system divides the progression of the infection into five distinct stages, which are as follows:

- Primary HIV infection: An infected person may or may not exhibit symptoms of the acute retroviral syndrome, depending on the severity of their infection.
- Stage I: A person who is infected but has a CD4+ Tcell count of under 500 cells/ul may not show any symptoms.
- Stage II: With a CD4+ T-cell count of fewer than 500 cells/ul, an infected person may exhibit minor mucocutaneous manifestation and recurrent upper respiratory tract infection.
- Stage III: Advanced symptoms of infection include chronic diarrhoea, pulmonary tuberculosis, and a CD4+ T-cell count of less than 350 cells/uL.

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- Stage IV: A person who has the disease and is in WHO stage IV is said to have AIDS. Brain toxoplasmosis, candidiasis of the oesophagus and other organs, and a CD4+ T-cell count of less than 200 cells per uL of blood are all symptoms.

The CDC system classifies HIV infection into 5 stages as follows:

- Stage 0: This stage is the time frame right up to 180 days prior to an infected person testing positive for HIV.
- Stage I: The infected person has a CD4+ T-cell count of 500 cells or less and no symptoms of AIDS.
- Stage 2: The infected person exhibits symptoms of AIDS and has a CD4+ T-cell count between 200 and 500 cells/ul.
- Stage 3: The infected person exhibits symptoms of AIDS and has a CD4+ T-cell count of 200 cells/uL.
- Unknown: An individual who is known to be infected but does not yet have enough clinical data to be categorized into one of the stages above is considered to be in this stage.

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2.1.6. Factors Contributing to HIV Transmission

The virus known as HIV is what causes HIV infection, which progresses to AIDS. HIV primarily spreads from an HIV-positive person to a healthy person. Blood, rectal fluids, semen, vaginal fluids, pre-seminal fluids, and breast milk are the fluids most frequently capable of transmitting HIV. HIV must either be directly injected into the bloodstream (from a needle or syringe) of an uninfected person or come into contact with a mucous membrane or damaged tissue for transmission to occur[27]. The mouth, vagina, penis, and rectum all contain mucous membranes.

HIV is primarily spread through sexual contact and sharing of injection equipment between HIV-positive individuals. HIV infection causes the immune system's infection-fighting CD4 to be attacked, which lowers CD4 counts and makes it harder for the body to fight infections. Without treatment, HIV can gradually weaken immune systems and progress to AIDS[28]. The HIV infection will progress more quickly if medication is not taken. The progression of HIV infection can be broken down into three stages: acute HIV infection, chronic HIV infection, and acquired immunodeficiency syndrome (AIDS). Despite the success of antiretroviral therapy (ARV), which has been shown to prevent HIV infection from progressing to AIDS, there is currently no cure for HIV. HIV medications help people infected with the virus live longer, healthier lives and contribute to the reduction of viral load, which in turn lowers the risk of HIV transmission. Adherence to HIV medications also helps people infected with the virus live longer.

The clinical presentation of symptoms and physical signs is necessary in order to make an HIV diagnosis. People who are HIV positive can exhibit the physical signs and symptoms of any stage of the HIV infection at any time during their infection. Malaise, fever, and a rash that spreads all over the body are the symptoms of acute seroconversion, which manifests as an illness that is similar to the flu. The signs and symptoms are those of the illness that is presenting itself, which means that an HIV infection should be suspected as an underlying illness whenever unusual infections present in individuals who appear to be healthy. A person infected with HIV may experience a noticeable loss of weight[29]. If there is evidence of HIV risk factors or the presence of opportunistic infections, this could be a clue that the person is infected with HIV.

There are many things that can influence HIV transmission. Even though HIV diagnosis and treatment services are provided at no cost in the vast majority of nations around the world, some people who are HIV infected but are unaware that they have the virus may not realize the

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severity of the disease even though HIV testing and treatment are typically provided at no cost. Also, many HIV-positive people may put off going to a health care facility because they are unable to afford the transportation costs to the facility, which is typically located quite a distance from their home. Additionally, many HIV-positive people may put off going to a health care provider because they must take time out of their day to travel to an antiretroviral therapy centre.

There is a statistically significant link between having multiple sexual partners, engaging in sexual activity for financial gain, a history of injection drug use, and the transmission of HIV[30]. According to a study's findings, a number of factors contribute to HIV infection, including advanced age, separation from a spouse (during marriage), being a woman of a lower social class, having both HSV-2 and HIV infection, being a widow or divorcee, and having a lower level of education[31]. This finding is supported by another study, which found that HIV infection is significantly associated with men who have a history of genital ulcers in the previous 12 months [(AOR), 1.91; 95% confidence interval (CI), 1.04–3.49)][32]. In women, HIV infection was associated with a history of unusual vaginal discharge in the previous 12 months. According to the World Health Organization, having a history of tuberculosis is one of the most significant risk factors for people living with HIV (PLWH) [33]. In addition, having a history of sexually transmitted infections is another factor that contributes to an increased risk of HIV transmission. People who are HIV positive (PLWH) had a survival rate free of tuberculosis (TB) of 91%, with an incidence rate of TB of 2.8 per 100 people per year. The prevalence of tuberculosis was significantly higher among HIV patients whose CD count was less than 200[34]. 364 women (60.9%; 95% CI: 56.9%-64.8%) had prior STDs documented. People with prior STDs, those who had sex before the age of 15, those who had multiple sexual partners, and sex workers all have higher HIV prevalence rates. According to a study, having multiple sexual partners, engaging in

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unprotected sex, and having a history of STDs all point to a possible rapid spread of HIV[35]. Similarly, according to another study, drug use and multiple sexual partners are risk factors for HIV[36]. According to a study, related illnesses may play a significant role in the morbidity and mortality from HIV among PLWHA[37].

Numerous measures have been taken around the world to lessen the impact of HIV, but one thing is sure: everyone who is HIV-positive and in need of treatment should receive it. Access to ART has led to lower rates of HIV morbidity and mortality around the world, but many HIV-positive individuals are undiagnosed and, therefore, unaware of their status. As much as 95% and more levels of adherence are needed for all PLWHA to receive effective antiretroviral therapy, but there are many obstacles to adherence. According to a study, there are a number of obstacles to receiving ART services in South Africa, including a lack of financial resources, non-adherence, a lack of HIV treatment supporters, depression, alcohol use, social stigma, and side effects of antiretroviral therapy[38]. In addition, a study conducted in Vietnam found that access to HIV treatment services and shame and stigma experienced by family and friends are both related to HIV treatment adherence[39].

According to a 2014 study, HIV is more prevalent among people with higher socioeconomic status in sub-Saharan Africa, but it is more prevalent among HIV-positive people living in poorer households in Swaziland and Senegal[40].

According to a different study, women who have been married in the past are more likely to contract HIV than women who are currently married or have never been married[41]. In addition, compared to women who put off having sex until later years, women who had their first sexual encounter before turning 15 have a higher risk of contracting HIV. According to a study, the majority of sexually active young women who did not use a condom during their first sexual

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encounter are at a higher risk of contracting HIV[42]. When compared to people who are married, those who are single or never married have a 13 times higher risk of dying from HIV/AIDS. Additionally, those with secondary education or higher and who are between the ages of 25 and 34 have a lower HIV prevalence than those with less education[43].

HIV mortality and prevalence can be significantly decreased by early case detection and antiretroviral therapy initiation. Effective antiretroviral (ARV) therapy can manage HIV and aid in halting its spread, according to research from Elsasser and the World Health Organization. This suggests that following antiretroviral therapy will lessen productivity losses brought on by illness, disability, and death, in addition to lowering the risk of infection in pregnant women and their unborn children. Although people with HIV are typically most contagious in the first few months, about 40% of people worldwide do not find out until much later. Due to immunosuppression, most late testers of AIDS are more likely to pass away quickly after being diagnosed.

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The majority of people in Hawasa, Ethiopia, are aware of HIV, according to a community-based study there. Among Nigerian students in Lagos, Nigeria, tertiary students are more knowledgeable about HIV/AIDS. Nevertheless, when it comes to high-risk sexual behaviours, risk perception is low. The majority of people, according to a study, believe that HIV is transmitted through unprotected sex, from mothers to their infants, and through sharing needles or syringes[44]. The information came from healthcare facilities (26 (10.4%) and the mass media (32). There were multiple sources of information for 181 (72.4%) of the respondents. The majority of people in Ghana said that peers and their schools were their primary sources of information about HIV Voluntary Counselling Testing.

2.1.7. Therapeutic Management of HIV Infection

Since the advent of ART in the middle of the 1990s, HIV infection has evolved into a chronic infectious condition that, with proper management, can be survived. Currently, there are over 25 licensed medications for managing HIV infection that has been approved by the US FDA. At various stages of the HIV replication life cycle, these medications have an impact on their antiretroviral activity (Figure 3). Generally, ARVs are divided into five categories based on the stage of the HIV life cycle that they affect as follows;

1. **Fusion Inhibitors/Entry Inhibitors:** These ARVs prevent the HIV virus from joining together and entering the intended host cell. By adhering to the HIV envelope glycoprotein gp41, the fusion inhibitors stop the formation of the "hairpin" structure necessary for the virion to fuse to the cell membrane of the host cell[45]. The entry inhibitors are CCR5 co-receptor antagonists, and they prevent the virus from entering the target cell by blocking proteins on CD4+ T-cells.
2. **Nucleoside and nucleotide reverse transcriptase inhibitors (NRTIs/NtRTIs):** The reverse transcriptase, which the virus uses to reverse-transcribe the viral RNA genome into genomic RNA, is the target of ARVs in this class. Thus, during the reverse transcription process of the virion, NRTls/NtRTIs function as DNA-chain terminators[46].
3. **Non-Nucleoside Reverse Transcriptase Inhibitors (NNRTIs):** By attaching to an area close to the enzyme's active site (allosteric site) and altering the enzyme's conformation, this class of ARVs also inhibits the reverse transcriptase enzyme in the virion (non-competitive inhibition).

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4. **Integrase Strand Transfer Inhibitors (INSTIs):** Integrase inhibitors work by preventing the viral enzyme integrase from integrating the viral double-stranded DNA into the DNA of the host.
5. **Protease Inhibitors (PIs):** Protease inhibitors prevent viral protease from assembling the viral proteins that make up the imler core (Gag and Gag-Pol multiprotein complexes) before the mature virus buds off the cell surface. This prevents HIV from replicating.

Table 2.1. Shows the various ARVs approved by US Food and Drugs Administration and their therapeutic classes.

Drug Class	Generic Name (Other names and acronyms)	Brand Name
Nucleoside Reverse Transcriptase Inhibitors (NRTIs)		
NRTIs block reverse transcriptase, an enzyme HIV needs to make copies of itself.	abacavir (abacavir sulfate, ABC)	Ziagen
	emtricitabine (FTC)	Emtriva
	lamivudine (3TC)	Epivir
	tenofovir disoproxil fumarate (tenofovir DF, TDF)	Viread
	zidovudine (azidothymidine, AZT, ZDV)	Retrovir

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Non-Nucleoside Reverse Transcriptase Inhibitors (NNRTIs)		
NNRTIs bind to and later alter reverse transcriptase, an enzyme HIV needs to make copies of itself.	doravirine (DOR)	Pifeltro
	efavirenz (EFV)	Sustiva
	etravirine (ETR)	Intelence
	nevirapine (extended-release nevirapine, NVP)	Viramune Viramune XR (extended-release)
	rilpivirine (rilpivirine hydrochloride, RPV)	Edurant
Protease Inhibitors (PIs)		
PIs block HIV protease, an enzyme HIV needs to make copies of itself.	atazanavir (atazanavir sulfate, ATV)	Reyataz
	darunavir (darunavir ethanolate, DRV)	Prezista
	fosamprenavir (fosamprenavir calcium, FOS-APV, FPV)	Lexiva
	ritonavir (RTV)	Norvir

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	*Although ritonavir is a PI, it is generally used as a pharmacokinetic enhancer as recommended in the Guidelines for the Use of Antiretroviral Agents in Adults and Adolescents Living with HIV and the Guidelines for the Use of Antiretroviral Agents in Pediatric HIV Infection.	
	tipranavir (TPV)	Aptivus
Fusion Inhibitors		
Fusion inhibitors block HIV from entering the CD4 T lymphocyte (CD4 cells) of the immune system.	enfuvirtide (T-20)	Fuzeon
Integrase Strand Transfer Inhibitor (INSTIs)		
Integrase inhibitors block HIV integrase, and an enzyme, HIV, needs to make copies of itself.	cabotegravir (cabotegravir sodium, CAB)	Vocabria
	dolutegravir (dolutegravir sodium, DTG)	Tivicay Tivicay PD
	raltegravir (raltegravir potassium, RAL)	Isentress Isentress HD

Source[47]

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The U.S. FDA has also approved the pharmacokinetic enhancer cobicistat, which increases the effectiveness of these classes of ARVs. Combination HIV medications, which include two or more ARVs from one or more drug classes, are also offered.

- Abacavir and Lamivudine
- Abacavir, Dolutegravir, and Lamivudine
- Abacavir, Lamivudine, and Zidovudine
- Bictegravir, Emtricitabine, and Tenofovir Alafenamide
- Cabotegravir and Rilpivirine
- Darunavir, Cobicistat, Emtricitabine, and Tenofovir Alafenamide).

Continuous evaluation of PLWHIV's immunological, virological, and clinical indices is necessary for HIV management. In order to alter the course of HIV infection by halting clinical progression, ART necessitates the use of ARVs. The rapid, widespread clinical adoption of compelling combination ART in developed nations followed its development in the mid-1990s. As a result, from 1995 to 1999, there were two-thirds fewer PLWHIV fatalities. Since then, ART regimens have improved in terms of usability, safety, and efficacy. Additionally, the average life expectancy of an HIV-positive patient receiving appropriate ART treatment rose from 10.5 years in 1996 to 22.5 years in 2005 after receiving an HIV diagnosis. When ART is used to treat HIV infection, viral replication is suppressed, CD4+ T-cell counts rise, and the body's immune system as a whole performs better.

After 2000, the use of ART increased significantly in developing nations, where it has been shown to have clinical advantages comparable to those observed in developed nations. According to current estimates, 5 million PLWHIV in developing nations are receiving ART.

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Despite these notable advances, problems with access, adherence, toxicity, drug-drug interactions, and drug resistance persist, especially in underprivileged populations. According to the most recent WHO recommendations, regardless of WHO clinical stage, ART should be started as soon as possible in all HIV-positive adults and adolescents with CD4 counts between 350 and 500 cells/ul (strong recommendation, moderate-quality evidence)[48].

NRTIINtRTI, NNRTI, and boosted-PI are three different drug classes that are combined in current therapy. The current WHO Guidelines advise using a single NNRTI, efavirenz (EFV), as well as a dual NRTIINtRTI combination of either tenofovir (TDF) and lamivudine (TC) (or emtricitabine-FTC) as the first line therapy for HIV infection (strong recommendation, moderate-quality evidence)[49]. The following alternative is suggested in cases where TDF + 3TC (or FTC) + EFV is contraindicated or unavailable (strong recommendation, moderate-quality evidence).

- Zidovudine (AZT) + Lamivudine (3TC) + Efavirenz (EFV)
- Zidovudine (AZT) + Lamivudine (3TC) + Nevirapine (NVP)
- Tenofovir (TDF) + Lamivudine (3TC) (or Emtricitabine-FTC) + Nevirapine (NVP)

2.1.8. Hypertension Global View

Hypertension, the most prevalent cardiovascular disease, affects about one billion people worldwide[50]. It continues to be the leading cause of 9.4 million annual deaths and the most significant single contributor to the global burden of disease and mortality. A projected 1.5 billion people will have hypertension by 2025, up from an estimated 972 million in 2000, 65% of whom resided in developing nations[51]. By 2025, the WHO predicts that this percentage will reach 29% (representing roughly 1.6 billion), or a prevalence of 60%. By 2025, it is predicted

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that 75% of the world's hypertensive people will live in economically developing nations, contributing to the sharp rise in the prevalence of hypertension worldwide[52]. High blood pressure was the leading modifiable risk factor for disability-adjusted life-years lost globally in 2013 and is a significant contributor to heart disease and stroke, which are the first and third leading causes of death worldwide, respectively. With an estimated 7.1 million deaths per year, this is said to keep hypertension in its position as the world's most significant preventable cause of premature death over the next 20 years. The risk of heart disease and blood vessel damage to the brain and kidneys increases with blood pressure. As a result, about 50% of deaths from heart disease and stroke are brought on by hypertension.

In developing nations, cardiovascular disease (CVD), which includes hypertension, is the leading cause of death, accounting for nearly as many fatalities as HIV, malaria, and tuberculosis combined.

According to the World Health Organization, high blood pressure is the third leading cause of death worldwide, accounting for one in every eight fatalities. Four million people die each year directly related to hypertension worldwide, where there are one million hypertensives[53].

Hypertension has prematurely killed nearly 9.4 million people worldwide, and its death rate is rising quickly. Additionally, it is stated that approximately 1 billion individuals are currently dealing with high blood pressure. Around 40% of people worldwide, who are 25 years of age and older, have high blood pressure[54]. Although the prevalence of hypertension has decreased in developed nations due to effective public health initiatives that included widespread access to diagnosis and treatment, the disease burden has reached its highest level in the majority of developing nations.

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A study stated that, hypertension is a significant public health issue and the leading cause of death and disability in developing nations[55]. The prevalence of hypertension in adults worldwide is currently at 25%, and by 2025, it is expected to reach 29%. By 2025, there will be 1.15 billion hypertensive patients worldwide, according to model predictions. The prevalence of hypertension varies across the world: it affects 35% of people in Latin- America, 20%–30% of people in China and India, and 14% of people in Sub-Saharan Africa.

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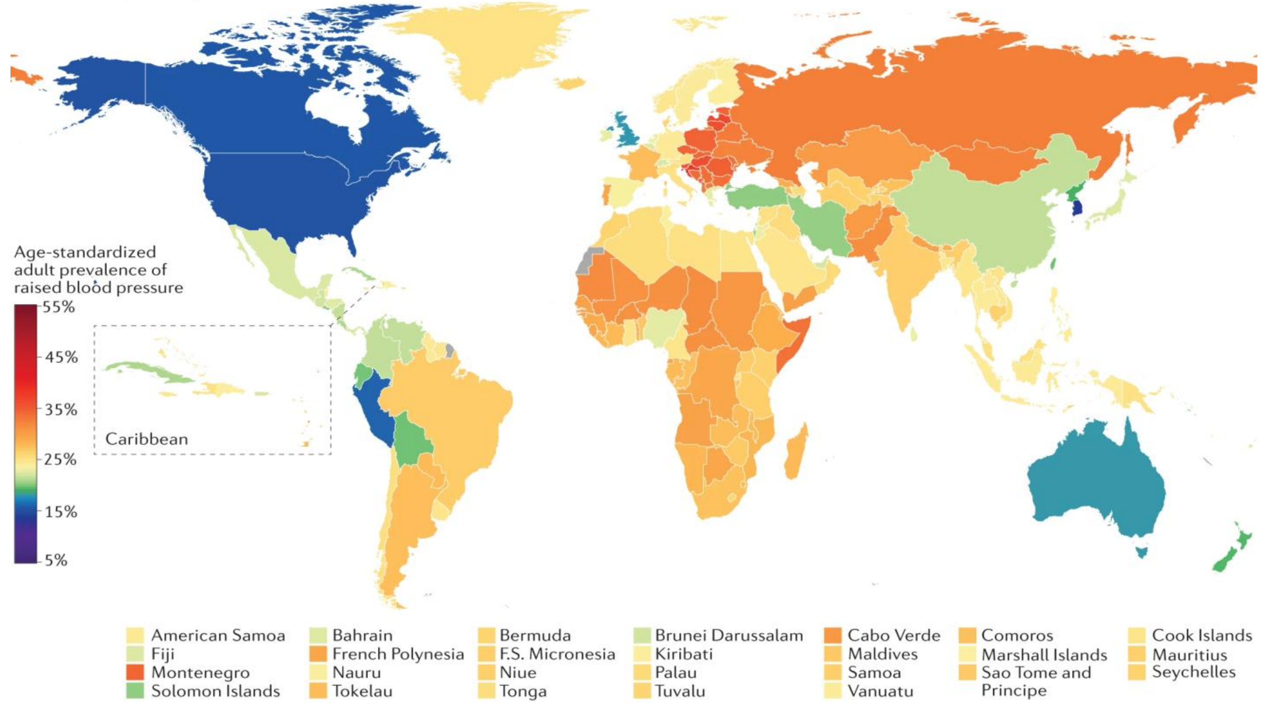

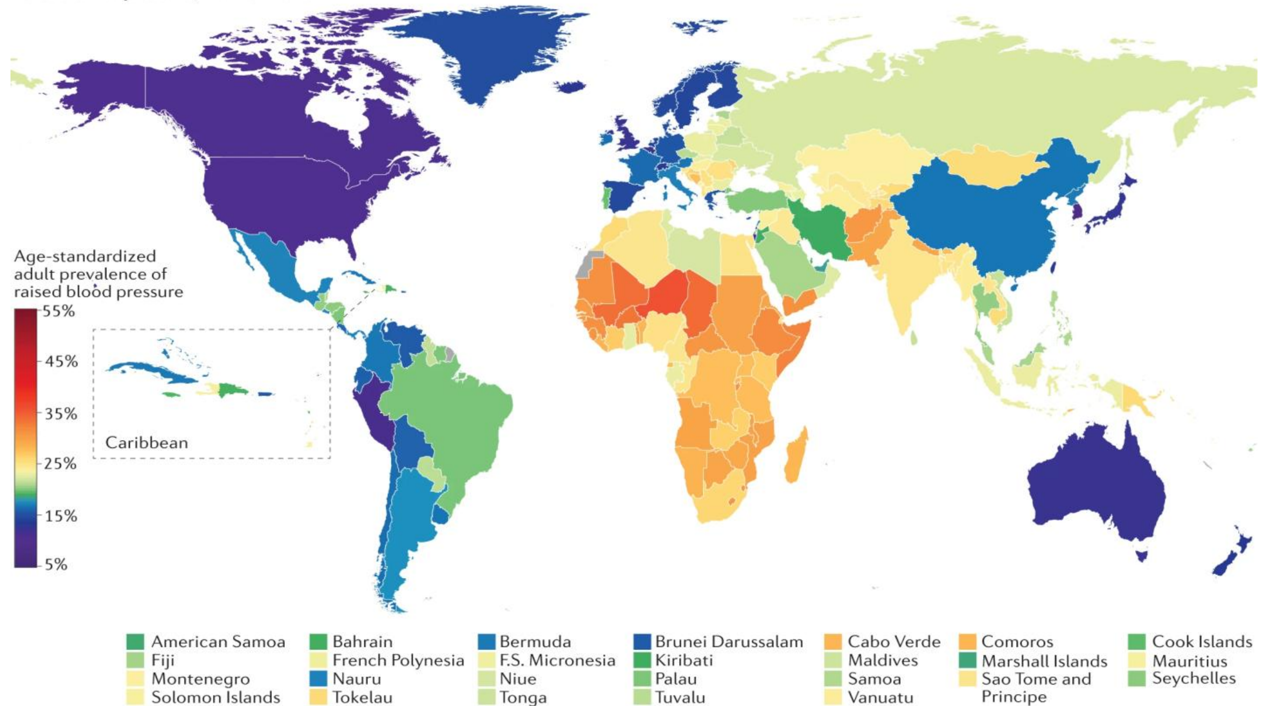

Figure 2.4. Prevalence of Raised Blood Pressure by Country in 2015

Source [56]

In a few studies, the risk ratios from epidemiological studies were combined with information on the population's average blood pressure to estimate the number of deaths related to high blood pressure. Initially concentrating on CVDs, these calculations later expanded to include chronic kidney disease. These studies' findings suggest that elevated blood pressure is a contributing factor in 7.7–10.4 million deaths annually[57].

Figure 4 displays the total number of CVD and chronic kidney disease-related deaths, broken down by region and cause of death. SBP levels above the recommended level of 115 mmHg were blamed for an estimated 4.5 million deaths in men and 4.0 million deaths in women in 2015, 88% of which occurred in low- and middle-income areas. In comparison to 1990, this number represents an increase of 1.6 million men and 0.9 million women, respectively. The increase was brought on by a doubling of high blood pressure-related deaths in East, South, and Southeast Asia, as well as sub-Saharan Africa. Contrarily, despite having a more significant and older population, the number of deaths attributable to high blood pressure decreased by 20–30% in high-income Western and Asia–Pacific regions. In comparison to CVD deaths, deaths from chronic kidney disease caused by high blood pressure increased more.

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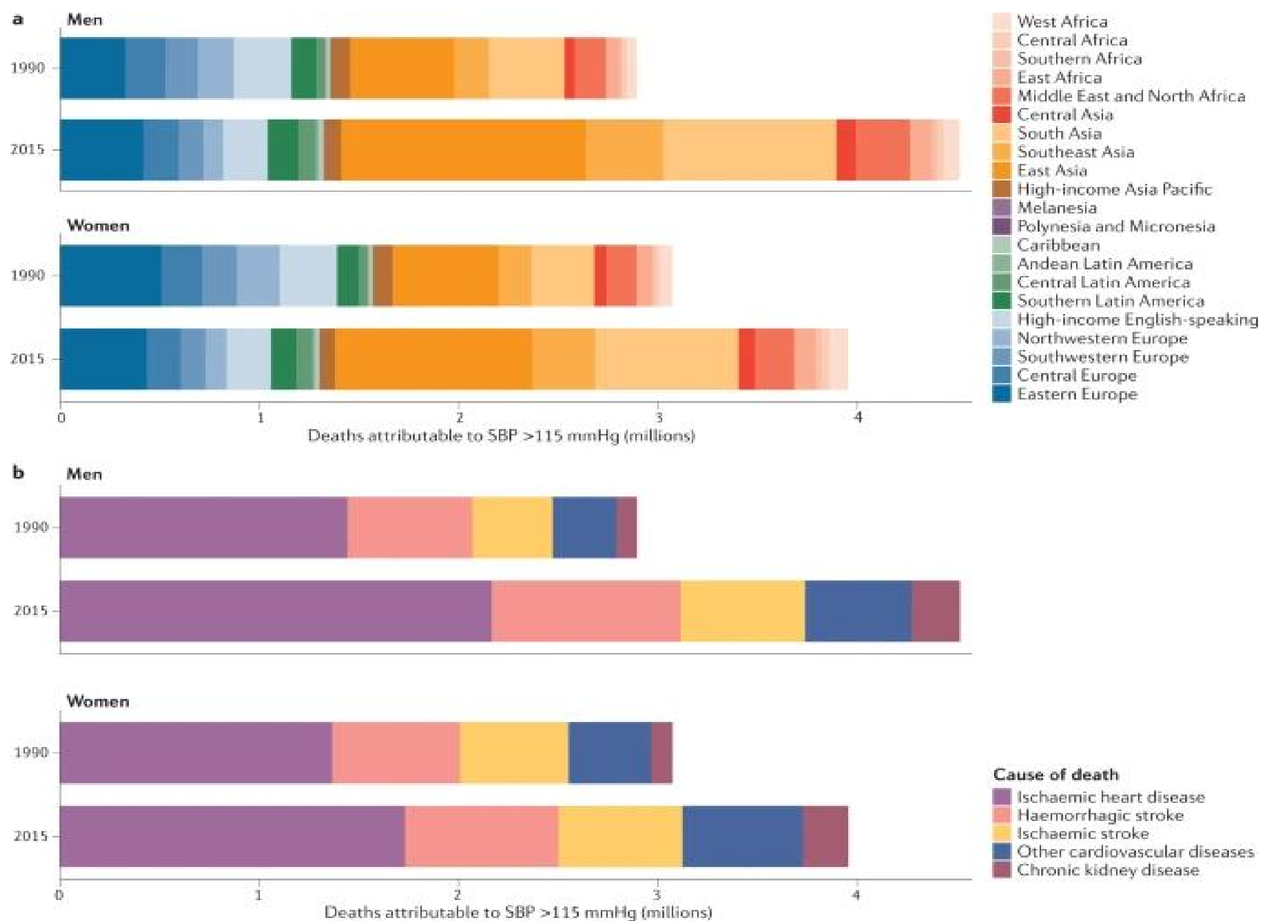

Figure 2.5. Deaths attributable to high systolic blood pressure (SBP) in 1990 and 2015, coloured by region (part a) and cause of death (part b)

Source[58]

2013 saw an agreement among the 194 WHO member states on nine voluntary global targets for reducing preventable non-communicable diseases. Between 2013 and 2030, the sixth of these goals is to cut the prevalence of high blood pressure by 25% worldwide. This declaration and intervention are crucial because high blood pressure is considered to be the leading risk factor for death and disability globally. According to a systematic review of disease burdens, elevated sBP >110-11 5 mmHg is the leading risk factor for morbidity (7% of daily-adjusted life years) and mortality (9.4 million deaths) worldwide. Furthermore, a joint policy statement from the

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World Hypertension League and the International Society of Hypertension issued in 2014 strongly implied that hypertension was to blame for the estimated 9.4 million deaths and 162 million years of life lost in 2010 due to the condition. The statement also implied that heart disease and stroke were more prevalent in economically developing nations than in developed nations and that low and middle-income countries (LMIC) were disproportionately affected by hypertension, with two-thirds of cases occurring there.

Studies have shown a link between low socioeconomic status and high blood pressure[59]. According to a study done on women, having a lower socioeconomic status, less education, and less money is linked to developing hypertension[60]. The WHO Study on Global Ageing and Health (SAGE) and the Prospective Urban Rural Epidemiology (PURE) study are two critical studies in this field. Exciting data from SAGE shows that people over 50 in high- and low-income countries have age-standardized hypertension, which is defined as sBP 2:140 mmHg or dBP 2:90 mmHg. According to the PURE study, only 20% of rural patients in LIC receive anti-hypertensive medication compared to 30% of urban hypertension patients. Additionally, research revealed differences between LMIC and HIC, showing that while in HIC, men experience significantly higher rates of hypertension than women do, this is not the case in LMIC. The PURE study also revealed that 13% of hypertension patients could keep their blood pressure under 140/90 mmHg and that 47% of hypertension patients worldwide were aware of their condition[61]. The PURE study's findings are comparable to those of the SAGE study, which found that rates of blood pressure control in LIC are low and range from 4% in Ghana to 14% in India, despite the fact that 32% of hypertension patients in LIC received treatment for the condition.

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2.1.9. Prevalence of Hypertension in PLWHIV in Sub-Saharan Africa

In addition to the epidemiological shift, the majority of SSA countries are ageing their populations, which has increased the prevalence of hypertension. The burden of diseases among PLWHIV in SSA is anticipated to rise as a result of this increase in hypertension prevalence. A review of the literature from studies conducted in SSA shows that people living with HIV, particularly those who are taking ART (exposed to ART), have higher rates of hypertension than people who are not taking ART (ART-naive) [62]. Different countries have reported varying HIV prevalence among the general population. Two studies in Cameroon both found that 28.5% of PLWHIV had hypertension, and a third study reported a prevalence of 25.5% [63]. Studies in South Africa reported a prevalence of 19.5% in PLWHIV; in Uganda, 27.9%, 8.0% and 11.0% in PLWHIV[64 65].

The leading causes of death and disability in SSA are still considered to be hypertension and other cardiovascular diseases. According to a 2006 African Union report, HIV/AIDS and hypertension together pose the biggest challenge to the healthcare systems in the majority of African nations [66]. According to reports, hypertension is also more prevalent in Africa than in other parts of the world, but it is still unclear how prevalent it is in most nations. The WHO reported that the African region had the highest global prevalence of hypertension in 2000, at 46%. It is generally acknowledged that the prevalence of hypertension in SSA is increasing, even though this prevalence is higher than what has been predicted and reported by the majority of studies. Young and active Africans are more likely to experience this increase, which has been linked to a number of factors, including the ageing of the majority of Africans, rising populations, rapid urbanization, and rising rural-urban migration. A systematic review of 92 carefully chosen studies on hypertension in Africa found that the prevalence of the condition had increased from

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19.7% in 1990 to 27.4% in 2000 to 30.8% in 2010 and that awareness had increased from 16.9% in 1990 to 29.2% in 2000 to 33.3% in 2010 [67]. With the exception of 1990, rates were generally higher among females than males in the remaining years. Using modelling estimates, the study also estimated the number of hypertensive cases to be 54.6 million in 1990 (age-adjusted prevalence of 19.1%), 92.3 million in 2000 (age-adjusted prevalence of 24.3%), 130.2 million in 2010, and 216.8 million by 2030 (age-adjusted prevalence of 25.3%).

These findings point to significant disparities between HIC and LMIC in terms of their awareness of hypertension, use of anti-hypertensive drugs, and subsequent management of high blood pressure.

In Tanzania, a cross-sectional study found that the prevalence of hypertension was 26.2% in PLWHIV and was significantly higher in patients who were receiving ART compared to those who were not [68]. The prevalence of hypertension in ART-naive patients was reported to be 12.5% in a multi-centred cross-sectional study conducted in Tanzania with 12 HIV Care and Treatment Centers and 34,111 PLHIV.

Another study conducted in Kenya found that the prevalence of hypertension was 7.4% in women and 11.2% in men who were HIV positive[69]. Men (10.6%) and women (22.6%), however, were more likely to be overweight or obese. In Ghana, a study found that systolic hypertension was present in 15.2% and diastolic hypertension was present in 23.8% of ART-exposed HIV-positive patients, compared to 3.5% and 6.4%, respectively, in ART-naive HIV-positive patients[70].

According to a study conducted in Nigeria, the prevalence of hypertension was 16.3% in patients who had received ART and 9.0% in patients who had not[71]. A study conducted in Senegal,

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28.1% of people living with HIV have hypertension[72]. A summary of the various SSA-based studies reporting on the prevalence of hypertension in PLHIV can be found in Table 2 below. These studies demonstrate that there is a significant variation in the prevalence reported between countries and even within some countries, despite the fact that the majority of them were cross-sectional studies. A thorough review and meta-analysis of the prevalence of hypertension (and CVDs) in PLHIV in SSA are therefore required.

Table 2.2. Studies Assessing the Prevalence of Hypertension in PLHIV in Sub-Saharan Africa.

Country	Year	Study Design	Sample Size	% Females	Overall	ART Exposed	ART Naive
Botswana	2011	Cross-sectional	179	57.5	14.0	NR	NR
	2012	Cross-sectional	62	100	NR	65.0	28.0
Cameroon	2013	Cross-sectional	143	72.0	NR	27.8	10.7
	2014	Cross-sectional	463	74.7	28.5	31.3	20.3
	2015	Cross-sectional	215	74.9	25.6	29.4	14.5
	2016	Cross-sectional	200	70.0	28.5	38.0	19.0
Ghana	2014	Cross-sectional	305	68.2	25.6	SH:15.2; DH:23.8	SH:3.5; DH:6.4
Kenya	2011	Cross-sectional	4629	33.0	32.0	NR	NR
	2011	Cohort	12,194	64.8	Men:11.2; Women:7.4	NR	NR
	2014	cohort	49,475	74.0	Men:10.2; Women:7.0		

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						NR	NR
Nigeria	2012	Cohort	268	48.9	NR	NR	26.4
	2013	Cross-sectional	265	67.5	NR	12.1	7.8
	2013	Cross-sectional	200	53.0	NR	17.0	2.0
	2014	Cross-sectional	250	62.4	NR	12.3	19.0
	2016	Cross-sectional	406	68.5	NR	16.3	9.0
Senegal	2012	Cross-sectional	242	57.9	NR	28.1	NR
South Africa	2011	Cross-sectional	204	78.0	NR	19.1	NR
	2012	Cross-sectional	2513	71.0	19.5	NR	NR
	2014	Cross-sectional	89	70.8	NR	NR	42.7
	2015	Cross-sectional	214	79.9	NR	26.2	NR
	2015	Cross-sectional	5511	73.3	NR	19.7	NR
Tanzania	2014	Cross-sectional	301	67.8	NR	28.7	5.3
	2014	Cross-sectional	671	70.5	27.2	30.0	21.9
	2016	Cross-sectional	34111	67.2	NR	NR	12.5

SH=Systolic Hypertonic; DH Diastolic Hypertension, PLHIV= Persons living with HIV; NR=Not report

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Source[73]

2.1.10 Signs and Symptoms of Hypertension

While headaches, lightheadedness, vertigo, tinnitus, altered vision, and fainting episodes are frequently reported, symptoms of hypertension are rarely observed. Additionally, hypertension has been linked to hypertension retinopathy, which is characterized by changes in the optic fundus of the eye. The severity of the retinopathy can be used as a proxy for estimating the length of time spent in a hypertensive state as well as the degree of its impact.

2.1.11. Types of Hypertension

There are primary hypertensions and secondary hypertensions, both of which are characterized by an elevation in blood pressure but differ in the underlying cause of the condition. Hypertension can be broken down into two categories: primary or essential hypertension and secondary hypertension.

Primary Hypertension

Primary hypertension, also known as "essential hypertension," is high blood pressure that does not have any clearly defined aetiology that affects the blood pressure regulating mechanism. It accounts for between 97 and 98 percent of all instances of hypertension and is, therefore, the most prevalent form of the condition and the treatment of it practically results in lower blood pressure, which has significant clinical benefits[74]. The majority of people who have essential hypertension do not show any symptoms of the condition, but some cases have been reported of symptoms such as frequent headaches, tiredness, dizziness, and nose bleeding. It is not known what causes essential hypertension; however, factors such as being overweight, smoking,

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abusing alcohol, consuming an excessive amount of salt in the diet, and having a family history of hypertension have all been linked to the condition.

Secondary Hypertension

Secondary hypertension is a form of condition that affects people who have a definite underlying cause for their hypertension, which most frequently involves the renal or endocrine systems. Approximately 2% to 3% of patients with hypertension have secondary hypertension. Glomerulonephritis, diabetic nephropathy, polycystic kidney disease, and renal stenosis are among the renal causes of secondary hypertension. Secondary hypertension can result from certain endocrine system disorders like Cushing's syndrome, Conn's syndrome (hyperaldosteronism), phaeochromocytoma, thyroid dysfunction, and excessive adrenal gland activity. Sleep apnea, pregnancy-related hypertension, alcohol abuse, the use of some herbal remedies, and illicit drug use are additional causes of secondary hypertension. Secondary hypertension has also been connected to arsenic-contaminated drinking water.

2.1.12. Pathogenesis and Pathophysiology of Essential Hypertension

Families with a solid genetic foundation and resulting inherited biochemical abnormalities are more likely to experience essential hypertension[75]. Thus, it appears that a number of factors, including hereditary, environmental, lifestyle, and metabolic, as well as renal mechanisms, contribute to the pathogenesis of essential hypertension. Therefore, the interaction of genetic and environmental factors leads to essential hypertension. An author evaluated the various implicated or suggested mechanisms of the pathogenesis of essential hypertension and identified a number of mechanisms, including increased sympathetic nervous system activity, excess sodium-retaining hormone and vasoconstrictors production, chronic high sodium intake, insufficient

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dietary potassium and calcium intake, and increased renin secretion with increased production of angiotensin II and aldosterone. Diabetes mellitus, insulin resistance, obesity, an increase in the activity of vascular growth factors, modifications to the adrenergic receptors that affect heart rate and vascular tone, elevated levels of oxidative stress, endothelial dysfunction, and vascular remodelling are additional mechanisms that have been suggested.

2.1.13. Measurement of Blood Pressure in Adults

Systolic and diastolic blood pressures are measured in millimetres of mercury (mm Hg). Typically, these two numbers are written one above the other, with the upper number representing the systolic blood pressure reading and the lower number representing the diastolic blood pressure reading. Diastolic blood pressure is the lowest pressure in blood vessels between heartbeats when the heart relaxes, whereas systolic blood pressure is the highest pressure in blood vessels when the heart contracts. The WHO defines normal blood pressure in an adult as having a systolic blood pressure of 120 millimetres of mercury and diastolic blood pressure of 80 millimetres of mercury[76]. According to the WHO, hypertension is characterized by a systolic blood pressure of more than 140 mm Hg or a diastolic blood pressure of more than 90 mm Hg.

Basically, there are three types of blood pressure measuring equipment: electronic, mercury, and aneroid. The World Health Organization advises using reasonably priced, trustworthy, and electronic devices with the option to choose manual readings.

The National Institute for Health and Care Excellence (NICE) recommended in its 2011 guidelines that the diagnosis of hypertension be made on the basis of blood pressure readings taken on three different occasions at intervals of at least one month[77]. The NICE guidelines, which were first published in 2004 and subsequently reviewed in 2006, 2008, 2009, and 2011,

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distinguish between three different blood pressure measurements that can be used to diagnose hypertension as follows

- Clinic blood pressure monitoring (CBPM)
- Ambulatory blood pressure monitoring (ABPM) and
- Home blood pressure monitoring (HBPM)

Health professionals must make sure that all equipment used to measure blood pressure is adequately validated, maintained, and routinely recalibrated in accordance with the manufacturer's instructions. This is in addition to ensuring that the measurements take place in a standardized, unhurried environment and that the subject is still seated, with an arm outstretched and supported.

Both CBPM and ABPM are used in the diagnosis of hypertension, but ABPM has been found to be the most precise and economical method of doing so. Two readings are advised for CBPM, and if the second is significantly different from the first, a third reading is taken. The lower of the three readings is then used as the blood pressure reading. In ABPM, the recommended protocol calls for taking blood pressure readings at least twice an hour during the subject's awake hours (for example, between 8 am and 10 pm each day). Thereafter, the diagnosis of hypertension is made based on the average of 14 readings taken during the period.

HBPM is used in circumstances where ABPM is inappropriate or intolerable. This involves measuring blood pressure twice daily for four to seven days (morning and evening), averaging the readings, and then taking into account only the average readings for the subsequent days.

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2.1.14. Diagnosis and Stages of Hypertension in Adults

The NICE recommendations state that depending on the type of measurements taken, the diagnosis of hypertension is divided into three stages;

Stage I hypertension: CBPM systolic blood pressure ~140 mmHg and diastolic ~90 mmHg and subsequent ABPM or HBPM values of systolic blood pressure ~135 mmHg or diastolic blood pressure ~85 mmHg.

Stage II hypertension: CBPM systolic blood pressure ~160 mmHg or diastolic ~100 mmHg and subsequent ABPM or HBPM values of systolic blood pressure ~150 mmHg or diastolic blood pressure ~95 mmHg.

Stage III hypertension (Severe hypertension): CBPM systolic blood pressure ~180 mmHg or diastolic ~110 mmHg.

American Heart Association guidelines advise having three blood pressure readings taken at least twice during separate hospital visits. Blood pressure readings are categorized as follows in the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure's 7th report (JNC 7);

- Normal: Systolic blood pressure readings of 90-119 mmHg or diastolic blood pressure readings of 60- 79 mmHg
- Pre-hypertension: Systolic blood pressure readings of 120-139 mmHg or diastolic blood pressure readings of 80-89 mmHg
- Stage I hypertension: Systolic blood pressure readings of 140-159 mmHg or diastolic blood pressure readings of 90-99 mmHg.

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- Stage II hypertension: Systolic blood pressure readings of 160-179 mmHg or diastolic blood pressure readings of 100-109 mmHg.
- Isolated systolic hypertension: Systolic blood pressure readings of 2:140 mmHg and diastolic blood pressure readings <90 mmHg.

2.1.15. Prevention of Hypertension

The majority of hypertension prevention strategies are population-based because doing so invariably results in lower antihypertensive medication usage. Programs to lower the prevalence of hypertension typically involve lifestyle changes. An essential factor in the occurrence of hypertension is behavioural factors. The World Hypertension League's policy statement from 2014 listed the following details;

- According to estimates, a poor diet causes about half of all cases of hypertension.
- A 30% increase in salt intake is thought to be a contributing factor in hypertension cases.
- Insufficient dietary potassium intake contributes to about 20% of hypertensive cases.
- About 20% of cases of hypertension are attributed to ineffective exercise.
- Obesity accounts for about 30% of hypertensive cases and
- Excessive consumption of alcohol is also associated with hypertension.[78]

The American National Education Program and the British Hypertensive Society both place a strong emphasis on lifestyle changes because they have the potential to lower blood pressure just as effectively as individual antihypertensive medications. They emphasize the following metrics in their programs:

1. Reduction and subsequent maintenance of body mass index (BMI) to be between 20 and 25 kg/m^2

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2. Reduction of dietary salt intake (6g of salt/day)
3. Participation in regular aerobic physical activity or exercising (~30 minutes/day)
4. Limit to alcohol intake (not more than 3 units/day for men and 2 units/day for women)
5. Ensuring fruit and vegetable become part of the daily dietary intake (at least 5 portions/day)

The WHO recommends population-wide policy interventions to lower the incidence of hypertension, in line with advocacy organizations. These interventions should include measures aimed at reducing alcohol consumption, increasing physical activity through exercises, reducing overweight and obesity, consuming less salt in the diet, quitting smoking, and managing stress.

2.1.16. Management of Hypertension

The management of hypertension entails modifying one's lifestyle (as in the prevention of hypertension) and taking antihypertensive drugs. Different recommendations for the management of hypertension specify target blood pressure values for the general population and patients with comorbidities like diabetes and kidney disease. Other recommendations recommend different target blood pressure readings for patients over 60 and those over 80. Generally speaking, the recommended range for the general population's systolic and diastolic blood pressure is between 120 and 80 mmHg.

For the treatment of hypertension, a number of different classes of antihypertensive drugs are available. These include diuretics, calcium channel blockers (CCBs), angiotensin-converting enzyme (ACE) inhibitors, angiotensin II receptor blockers (ARBs), adrenergic receptor antagonists, vasodilators, benzodiazepines, renin inhibitors and aldosterone receptor antagonists. First-line antihypertensive drugs include thiazide-type diuretics, calcium-channel blockers, ACE

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inhibitors, and angiotensin II receptor blockers (ARBs). While CCBs prevent calcium from entering muscle cells in the walls of arteries, diuretics increase the kidneys' ability to excrete excess salt and water from the body. Angiotensin-converting enzyme activity is inhibited by ACE inhibitors, and angiotensin receptor blockers (ARBs) prevent the activation of angiotensin receptors. In most cases, more than one medication is required for the management of hypertension[79]. Drugs from different classes may be used alone or in combination.

2.1.17. Cardiovascular Manifestation of Hypertension and HIV

The impact of HIV results in a variety of cardiovascular diseases, including pulmonary hypertension associated with HIV, dilated cardiomyopathy, coronary heart disease, and systemic arterial hypertension. The causes of these include HIV-induced endothelial dysfunction, vasculitis in small, medium, and large vessels, atherosclerosis brought on by HAART, insulin resistance brought on by proteins inhibitors with increased sympathetic activity, sodium retention, and aneurysms of large vessels like the carotid, femoral, and abdominal aorta with the reduced flow to the renal arteries. Uncontrolled high blood pressure can cause heart attack, stroke, heart failure, coronary heart diseases, and cardiomyopathies in both PLWHIV and non-HIV individuals. There are distinctive features in the aetiology, presentation, and spectrum of HIV-associated cardiovascular disorders in people living in Africa, despite the fact that the epidemiology of CVD in HIV infection is poorly defined. First, in the early stages of the illness, the pericardial disease may be the first sign of HIV infection. Second, prevalent infectious diseases like tuberculosis often have a similar aetiology to cardiac disease. Third, there have been reports of rare cardiovascular conditions like giant vessel aneurysms occurring in association with HIV infection in several African countries[80]. Symptomatic heart failure in HIV-positive patients can occur in a range of 4 to 28% of cases. Additionally, 25% of HIV-infected

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children die from chronic heart disease, and 28% have severe cardiac events after developing an AIDS-defining illness[81].

People with HIV are living longer thanks to the availability of life-sustaining combination antiretroviral therapy (ART), which may put them at higher risk for age-related diseases like cardiovascular disease. According to a model based on the AIDS Therapy Evaluation in the Netherlands (ATHENA) cohort, the median age of HIV-positive individuals taking antiretroviral therapy will rise from 43.9 years in 2010 to 56.5 years in 2030, by which time 78% of those living with HIV will have been diagnosed with cardiovascular disease[82]. When compared to those without HIV, people with HIV have a relative risk of myocardial infarction that increases by 20% to 100%. Those who have viral suppression are still at an elevated relative risk. Although those with fewer risk factors for this condition have lower absolute rates of acute myocardial infarction, people with HIV continue to have a higher relative risk of this condition, even those with good cardiac health. Ischemic stroke accounts for approximately 80% of all strokes in people with HIV, with the rest, accounted for by hemorrhagic stroke[83].

According to a recent meta-analysis, the risk of cardiovascular disease was more than twice as high for people living with HIV[84]. Geographical location and the prevalence of HIV affect the distribution of risk factors for cardiovascular disease. The highest prevalence of HIV is found in Sub-Saharan Africa, which also has a younger population than Western Europe and North America, a higher prevalence of high blood pressure, lower tobacco use rates, and a lower prevalence of high cholesterol. Additionally, in sub-Saharan Africa, a number of unique exposures, such as indoor air pollution and repeated contact with infectious agents, may exacerbate the impact of HIV on cardiac and pulmonary health, whereas, in high-income environments, their significance may be minimal.

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2.1.18. Impact of HAART on Blood Pressure

Antiretroviral medications have significantly increased the life expectancy of HIV-positive individuals. However, a metabolic condition has been linked to the prolonged use of antiretroviral medications. Research suggested that the type of ART known as protease inhibitors may cause elevated blood pressure[85]. According to research done for the D:A:D study, patients' age, race, higher BMI, and family history of hypertension are cofounders that contribute to the association between antiretrovirals and high blood pressure. In accordance with a different MACS study, HIV patients who take antiretroviral medications for longer than two years may develop hypertension.

The highly active antiretroviral (HAART) medications that were introduced have significantly changed the lives of people with HIV, allowing them to live longer and more normal lives as long as they adhered to the medication regimen. However, patients taking antiretroviral medications have seen an increase in non-communicable diseases like hypertension and other cardiovascular conditions as a result of the better lifestyle and health status of HIV infection. Despite the lack of adequate data on cardiovascular diseases in HIV patients in Africa, a recent study estimated that 12% of HIV patients in Africa had self-reported CVD risk factors[86]. Atherosclerosis, a form of CVD, affects about 18% of HIV-positive individuals in Uganda (PLWHIV) [87].

After 48 weeks of HAART administration, there is a high prevalence of high blood pressure among PLWHIV and AIDS, according to a case series study on the subject conducted in the USA[88]. Furthermore, it was discovered that age, hypercholesterolemia, and CD4 cell count were associated with the rise in blood pressure in PLWHIV and AIDS patients; consequently, patients with lower CD4 cell counts, hypercholesterolemia, and ageing develop hypertension[89].

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According to a 2003 study, analysis of blood pressure in the Multi Center AIDS Cohort Study conducted in the USA, patients who have been on HAART for longer than two years have a 1.5-fold higher risk of developing systolic hypertension than HIV-negative patients[90]. However, among PLWHIV and AIDS on HAART for less than 2 years, the risk of hypertension is comparable to that of HIV-negative patients.

In a case-control study on the elevated blood pressure in people with lipodystrophy caused by HAART on PLWHIV and AIDS, there is an increase in high blood pressure among HIV and AIDS patients with high levels of fasting triglycerides, an increase in waist-to-hip ratio, and lipodystrophy after HAART[91]. However, the authors suggested that PLWHIV and AIDS patients should start receiving treatment for hypertension.

HIV-infected population in Sub-Saharan Africa has a higher prevalence of cardiovascular diseases like hypertension and others. The question of whether HAART can cause certain metabolic complications, such as dyslipidemia, dysglycemia, and hypertension, is still being debated.

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2.1.19. Factors that Affect Hypertension in HIV

In order to determine their correlation with hypertension in PLHIV, a number of socio-demographic and lifestyle factors have been examined. Age, sex, marital status, education level, employment status, use of tobacco and alcohol, regular exercise, intake of fruits and vegetables, and family history of cardiovascular events are a few of these.

Age

Since the introduction of HAART therapy, HIV patients have lived longer and in better health, and the majority of their deaths today are not historically related to HIV infection but instead to

ageing among PLWHIV. CVD is currently a significant health concern for HIV patients. This was confirmed by Sackoff's analysis of New York City death certificates, which revealed that cardiovascular disease, including hypertension, is more prevalent among HIV-infected people of younger ages when compared to the general population. CVD is the leading cause of mortality in HIV patients aged 55 years or older.

One of the known risk factors for hypertension in the general population is advancing age. Over 50% of people between the ages of 60 and 69 and 75% of people over the age of 70 have hypertension, as the risk of the condition rises with age. The systolic blood pressure increase that comes with ageing is linked to the increased risk of hypertension, which is present in all age groups. Most studies have also associated increasing age with the risk of hypertension in PLHIV. Two extensive cohort studies, the Data Collection on Adverse Events of Anti-HIV Drugs (D:A:D) and the Multicentre AIDS Cohort Study (MACS), also showed a favourable relationship between age and hypertension[92].

There is a link between age and hypertension, according to studies done in SSA. A study found an association between ageing and an increased risk of hypertension in both men and women (OR=2.21 [95% CI, 1.95-2.50] and OR=1.61 [95% CI, 1.40-1.87]) [93]. A correlation between ageing and hypertension in PLHIV in SSA has also been reported by other studies. Other studies have found a link between hypertension and PLHIV aged >40 years (adjusted OR=2.29 [95% CI, 1.49-.02], p=0.002).

Hypertension is the most common cause of death among people living with HIV (PLWHIV) as they age. Because of this, policy makers in SSA should focus their attention on the treatment of non-communicable diseases among patients. Sub-Saharan Africa has approximately 46% of the world's adult population with hypertension, making it the region with the highest prevalence of

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the disease worldwide. A literature review found that age and other common risk factors could independently lead to a higher prevalence rate of hypertension among HIV-infected individuals who were taking antiretroviral drugs.

In addition, a study discovered that people who are living with HIV and have an age that is greater than 40 years, as well as other biological factors, could each be independently associated with hypertension[94]. According to the findings of some studies, the probability of developing hypertension is more significant in females and people who are over the age of 45 (PL WIDV) than it is in individuals who do not fall within those margins. Also associated age as a contributing factor to hypertension in their multivariate model.

Alcohol Use

The presence of alcohol use disorder is a common comorbidity associated with the HIV. Research conducted with participants at HIV clinics reports significant alcohol use in upwards of 63% of HIV patients, whereas research conducted on a national probability sample found that only 8% of people living with HIV had a history of heavy alcohol consumption. Alcoholism increases risk behaviours linked to HIV infection, reduces medication compliance, and significantly contributes to comorbidity in HIV-infected patients. Alcohol's harmful effects on HIV include mechanisms that speed up the infection's progression by stifling the immune system, Reduced therapeutic efficacy and amplification retroviral proteins released by the HIV virus during glial infection that are neurotoxic.

Regardless of other risk factors, excessive alcohol consumption is linked to high blood pressure, and alcohol consumption reduction has been linked to a dose-response relationship that lowers both systolic and diastolic blood pressure in the general population. However, findings from the

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"Coronary Artery Risk Development in Young Adults Study" 20-year follow-up show no correlation between baseline alcohol consumption and incident hypertension. In men, heavy alcohol use was associated with an increased risk of hypertension, and in the general population, low and moderate alcohol consumption was associated with an increased risk of hypertension, according to a systematic review and meta-analysis[95].

The majority of PLHIV studies show either no discernible difference in alcohol consumption prevalence rates between hypertensives and non-hypertensives or no association between alcohol consumption and hypertension in PLHIV. However, a study found that drinking alcohol increases the risk of hypertension in PLHIV when compared to those who do not drink alcohol.

Smoking of Tobacco

In the general population, CVDs are known to be significantly influenced by tobacco use. While some observational studies have shown that current smokers have lower systolic and diastolic blood pressure levels and a lower risk of hypertension than non-smokers, others have mentioned a drop in blood pressure after quitting smoking.

Studies on how smoking affects PLHIV hypertension risks have produced conflicting findings. There is a significant difference between smokers with hypertension (11.1%) and non-smokers (2.5%). Smoking was linked to systolic hypertension but not diastolic hypertension. A study shows that smokers of PLHIV have a higher risk of developing hypertension than non-smokers. However, a review of the majority of studies found no link between smoking and hypertension in PLHIV.

A high prevalence of tobacco and illicit drug use is a contributing factor to the emergence of cardiovascular diseases, including hypertension, among HIV-positive individuals. Smoking is a

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significant lifestyle factor that causes hypertension to develop in HIV patients taking HAART, according to research.

Body Mass Index

The body mass index (BMI) is calculated as follows: BMI = body weight (in kg)/square of height (in meters) (height in m). BMI is used as a measure or indicator of general obesity in terms of being underweight (BMI 18.5 kg/m2), average weight (BMI between 18.5 kg/m2 and 24.9 kg/m2), overweight (BMI between 25.0 kg/m2 and 29.9 kg/m2), and obese (BMI 30.0 kg/m2). Obesity is a known risk factor for hypertension in the general population. Observational studies and clinical studies have demonstrated that blood pressure decreases after weight loss.

Similar to this, a correlation between BMI and hypertension has been found in the majority of studies involving PLHIV. Studies have found a strong link between a BMI of 25 kg/m2 and an increased risk of hypertension[96]. Increased odds of hypertension for a BMI of 25 kg/m2). Additionally, according to other studies, there is a higher chance of developing hypertension for every unit with a higher BMI (adjusted OR=1.1, [9S% CI, 1.1-1.2], P.O.OO1). Other studies have reported a similar trend of association.

Studies done in SSA have also revealed a link between PLHIV's BMI and hypertension. According to several other studies, HIV-positive patients who are overweight or obese have higher odds of developing hypertension than those who are underweight or normal weight[97]. In additional studies, patients with HIV experience, as well as those who have received ART naively or after being exposed to it, were found to be overweight or obese and to have hypertension.

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Sub-Saharan Africa, which is home to 69% of all HIV-positive people worldwide, is the most severely affected continent. As of 2010, half of the HIV-positive individuals in SSA who are eligible are receiving antiretroviral therapy (ART). Since life expectancy has increased and infection-related mortality rates have started to decline, it is likely that more cardiovascular disease mortality among HIV-infected adults is already occurring in developed nations. On a population level, in areas with high HIV prevalence, ART-related weight gain among many adult HIV-infected individuals may "unmask" an epidemic of hypertension and raise the prevalence of cardiovascular disease as a whole.

Sex

When compared to their age-matched pre-menopausal female peers in the general population, studies have shown that men have a higher risk of CVDs and have blood pressure levels that are higher[98]. Contradictory findings have been found in the majority of studies that have established the link between sex and hypertension in PLHIV.

Conflicting findings have been found in studies that have been reported by SSA. According to the findings of some studies, the prevalence of hypertension in men among PLHIV is significantly higher than the prevalence of hypertension in women among PLHIV. However, the findings of other studies suggest that there is either no such difference or no association between sex and hypertension in PLHIV. Men have a higher risk of developing hypertension than women.

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Regular Physical Activity

Several epidemiological studies have shown that engaging in regular physical activity is associated with a lower risk of hypertension in the general population[99]. Several different

mechanisms that may reduce the incidence of hypertension if regular physical activity is performed. These include a reduction in oxidative stress, a decrease in RAS, a reduction in inflammation, and a reduction in body weight or body mass. These are accompanied by an increase in endothelial function, renal function, sodium handling, and angiogenesis. Therefore, engaging in regular physical activity is one of the fundamental recommendations that should be made regarding the prevention and management of hypertension.

Research on the link between maintaining a regular exercise routine and lowering hypertension in people living with HIV has yielded conflicting findings. There was no significant difference between hypertensive and non-hypertensive in terms of the proportions of PLHIV who do not engage in regular physical activity. This was true for individuals who had no prior experience with ART, as well as those who had prior experience. Other studies have also come to the same conclusion, reporting that there is no link between regular exercise and hypertension in people living with HIV. People living with HIV who are physically inactive have a greater risk of developing hypertension compared to those who are physically active (pOR=3.16 [95% CI, 1.69-S.85]).

CD4+ T-cell Count

A number of studies have been carried out to investigate the connection between the CD4+ T-cell count and the prevalence of hypertension and cardiovascular diseases (CVDs). It has been shown that persistent inflammation in people living with HIV can destabilize atherosclerotic plaques, which can lead to cardiovascular diseases. Low CD4+ T-cell counts have also been linked to an increased risk of hypertension.

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According to studies, when a person has HIV, microbial translocation from the gut into the systemic circulation triggers a variety of immune responses that cause inflammation and a decline in CD4+ T cells. In PLHIV, microbial translocation has been linked to hypertension. Lipopolysaccharides have also been linked to atherosclerosis and endothelial dysfunction, two factors in the pathogenesis of hypertension. Studies have also linked arterial stiffness to a low CD4+ Tcell count and atherosclerosis, both of which played a role in the pathogenesis of hypertension. Several observational studies have found no correlation between low CD4+ T-cell count and hypertension, despite the mechanisms that have been postulated to be involved.

Low CD4+ T-cell count has also not been linked to hypertension in studies done in SSA. Low CD4+ T-cell counts (200 cells/ul.) have been linked to an increased risk of hypertension, according to a small number of studies (adjusted OR=1.60 [95% CI, 1.05-2.41]). Similar to this, other studies have found a higher risk of hypertension in individuals with a Nadir CD4+ T-cell count of 50 cells/uL (adjusted OR=2.31 [95% CI, 1.17-4.56], p=0.015).

A higher CD4 count is associated with a higher prevalence of hypertension, particularly in young men compared to the study's older age groups.

Antiretroviral Therapy

Multiple studies on the topic of hypertension in people living with HIV have been carried out in various parts of the world. Despite this, the link between antiretroviral therapy (ART) and hypertension in people living with HIV is still hotly debated, with conflicting results. In a study conducted in Norway, the length of time patients was on antiretroviral therapy appeared to be a factor associated with hypertension; however, the roles of the various ARVs were not investigated[100]. According to the findings of a study that was carried out in Spain, patients who

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had been receiving ART for a period of 48 weeks experienced an increase in their blood pressure, indicating no association between ART and hypertension[101].

Despite the sociodemographic differences between the studies, a systematic review and meta-analysis of 39 studies (of which 11 studies were from SSA) involving 44,903 PLHIV found that hypertension is more common in ART-exposed individuals (who have a prevalence of 14.5%) than in ART-naive individuals (who have a prevalence of 10.5%) [102]. In addition, the review found that patients who had received ART had a higher likelihood of developing hypertension (OR=1.68 [95% CI, 1.35-2.10], P=81.5%) than those who had not received ART.

In terms of the connection between ART and hypertension, the results that have been reported in the SSA region have also been reported to be inconsistent. Whilst studies from Ghana, Cameroon and Nigeria indicate that there is a connection between antiretroviral therapy and hypertension in people living with HIV, a study from Nigeria reported the opposite. In terms of prevalence, however, studies from Botswana, Nigeria, and Cameroon indicate a significant difference in the prevalence of hypertension between ART-exposed and ART-naive study participants. Other studies reported that the prevalence of hypertension differed between study participants who had received ART exposure and those who had not. According to a Tanzanian study, patients who have received ART exposure and those who have not (30.0% vs. 21.9%, respectively, p=O.O10) differed in their prevalence of hypertension. It is important to note that a Kenyan retrospective cohort study with a sizable sample size of 12,194 PLHIV did not find a link between the duration of HIV use and hypertension[103].

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Diabetes

Both diabetes and hypertension are indices that are used to categorize people as having metabolic syndrome. Abdominal obesity is a crucial feature of the metabolic syndrome, which is a collection of interrelated cardio-metabolic abnormalities, including hyperglycemia, high blood pressure, dyslipidaemia (elevated triglycerides and low HDL cholesterol), and dyslipidemia. Metabolic syndrome is used as a predictor of CVDs, type 2 diabetes and hypertension and its presence are increasing been seen in PLHIV on ART.

Diabetes is linked to atherosclerosis, which can lead to high blood pressure and other cardiovascular diseases (CVDs). Studies have shown that people with high blood pressure are more likely to get diabetes than people without high blood pressure[104].

Due to how often these two conditions happen together, it has been suggested that they are both caused by obesity, lack of exercise, and metabolic syndrome. The relationship between diabetes and hypertension in PLHIV has received conflicting reports. This may be explained by the fact that various studies have reported on various fasting plasma glucose (FPG) levels that have been used as criteria to assess diabetes. According to a 2013 study, there is no correlation between diabetes and hypertension in HIV-positive patients with FPG 2:6.1 mmol/L or the use of anti-diabetic medication[105]. According to other studies, there is no connection between diabetes and hypertension in people living with HIV.

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Dyslipidaemia

Dyslipidaemia is a significant CVD risk factor , and it refers to a disorder in the metabolism of lipoproteins, which can be either overproduced (hyperlipidemia) or underproduced (lipoproteinemia) (hyperlipidaemia). The majority of dyslipidaemias are characterized by

hyperlipidaemia, which is characterized by increased serum levels of triglycerides, low-density lipoprotein cholesterol (LDL-C), and total cholesterol, with a corresponding decline in HDL-C. Reduced HDL-C concentration is also recognized as a significant independent risk factor for CVD.

Numerous studies have linked hypertension in the general population and dyslipidaemia. An independent and inverse relationship between the occurrence of hypertension and increased HDL-C serum concentration can be seen. Additionally, it has been demonstrated that elevated serum levels of triglycerides, LDL-C, and total cholesterol put people at risk for developing hypertension. Although the pathophysiology of dyslipidaemia in hypertension is not fully understood, important mechanisms postulated include atherosclerosis, alterations in nitric oxide and endothelial functions.

A review of various studies examining the relationship between elements of the lipid profile and hypertension in PLHIV reveals conflicting findings. In PLHIV, a 2015 study found no correlation between dyslipidaemia and hypertension[106]. While some studies have linked high total cholesterol levels to hypertension, others have reported no such association; Similarly, while some studies link elevated triglycerides to a higher risk of developing hypertension, others have found no connection between the two in PLHIV. Elevated triglyceride levels are linked to hypertension in PLHIV who have never received antiretroviral therapy (OR=1.96, 95% CI, 1.22-3.16) but not in PLHIV who have received ART (OR=0.94, 95% CI, 0.49-1.83). In line with other reports, also found no correlation between HDL-C levels and hypertension in PLHIV who had never received ART and those who had.

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2.1.20. Incidence of Hypertension among HIV-infected Individuals

HIV-infected patients who are normotensive at the time of enrollment in care may develop hypertension. These patients may experience incident hypertension as a result of HIV-related factors or established risk factors for hypertension in the general population (such as age and obesity) (HIV infection itself or the side effects of ART). However, there are very few studies describing the incidence of hypertension among PLHIV, in contrast to those documenting the prevalence of hypertension. According to a study, there was no difference in the incidence of hypertension between HIV-infected and HIV-uninfected subjects (20.4% and 20.7%, respectively) [107]. In two additional studies involving HIV-positive individuals, the incidence was 64.1/1000 person-years, according to one of the studies, and in the other study, 24.1% of participants had incident hypertension[108]. Although these studies employed different methodologies and presented their findings in different ways, the prevalence of hypertension among HIV patients appeared to be high, though it is unclear whether this prevalence is greater than that of their HIV-uninfected counterparts.

2.1.21. Pathogenesis of Hypertension among HIV Patients

The prevalence and incidence of hypertension among PLHIV may be influenced by three factors. The life expectancy of PLHIV has increased due to increased access to ART. ART is likely to be a confounding factor in a longer lifespan because hypertension is linked to ageing. By comparing the length of their telomeres to those of HIV-uninfected people, HIV-infected people are shown to age prematurely.

Additionally, it is hypothesized that the endothelial nitric oxide synthase-nitric oxide (eNOS-NO) system, which preserves vascular endothelial integrity, is disrupted by chronic viremia and

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sustained immune activation of HIV infection. This disruption raises the risk of hypertension by damaging the vascular endothelium, stiffening the arteries, and causing early atherosclerosis. While some studies reported both arterial stiffness and subclinical atherosclerosis, studies that measured arterial stiffness by pulse wave velocity and subclinical atherosclerosis (Carotid intima-media thickness) are inconsistent, but others reported similar findings to uninfected individuals. The adverse effects of ART may also contribute to an increase in the risk of incident hypertension. Protease inhibitor (PI) and non-nucleoside reverse transcriptase inhibitor (NNRTI)-based ART regimens have been linked to insulin resistance, dyslipidaemia, hyperglycemia, and lipodystrophy.

Aortic stiffness has reportedly increased in some studies or Carotid intima-media thickness among patients receiving ART in comparison to patients not receiving ART; however, other studies have not found this association with existing.

2.1.22. Knowledge of Hypertension among PLWHIV

The state of being aware of a fact, phenomenon, or occurrence is referred to as knowledge. One can acquire knowledge through their own experiences or through formal education. Knowledge of hypertension encompasses familiarity with the condition itself, as well as its causes, risk factors, and preventative and treatment options. According to the findings carried out in Nigeria, there is a lack of public awareness and widespread misunderstanding regarding the nature, symptoms, risk factors, and complications of hypertension.

On the other hand, a study found in their cross-sectional study conducted in Dar es Salaam, Tanzania, on the knowledge of hypertensive patients with or without HIV/AIDS that some of these patients are not knowledgeable about hypertension and its side effects[109]. As a result, these

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patients do not have adequate control of their blood pressure due to their lack of knowledge. Because of this, there is a need to improve the patient's knowledge of hypertension, and pharmacists should also be up to date on the knowledge of hypertension and HIV comorbidity. In a study, only about 19% of the pharmacists knew about drug interactions between ARVs and antihypertensive drugs. In addition to this, there ought to be appropriate coordination between HIV clinics and hypertension clinics, with the pharmacist being fully integrated into the system. This is consistent with the findings who demonstrated that awareness of hypertension could lead to better control of one's blood pressure. According to the findings of some studies conducted in the past, patients who are aware that having high blood pressure can shorten one's life expectancy have a higher level of compliance with the use of their medications and with their follow-up appointments than patients who are not aware of this connection.

A descriptive, cross-sectional study was carried out on the knowledge, attitudes, and lifestyle practices of hypertensive patients in the state of Edo in Nigeria discovered that even hypertensive patients who have been taking antihypertensive medications still have poor knowledge of hypertension, which was attributed to their negative attitude toward treatment, in addition to non-adherence and poor life style adjustments[110]. This was attributed to their inadequate educational background because some people still think that food poisoning, evil spirits, or remote enemy attacks can cause hypertension. The fact that hypertension has no symptoms was unknown to 89% of both educated and uneducated hypertensive. Contrary to other studies' findings, which showed that up to 90–96% and 89.6% of the educated and uneducated studied hypertensive patients, respectively, had sufficient knowledge, an accurate perception of the situation, and a positive attitude toward the management of their condition, including the adoption of reasonable lifestyle practices, this observation is incongruous. These pieces of evidence suggest that it is

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essential to investigate the factors that are associated with hypertension in PLWHIV and AIDS patients in order to aid in the prevention of cardiovascular accidents and the threat posed by hypertension.

2.2 Theoretical Review

Social-Ecological Model:

The Social-Ecological Model provides a foundational framework for understanding the multifaceted factors influencing health outcomes. This model encompasses individual, interpersonal, community, and societal levels. In the context of women living with HIV in Ibadan, Nigeria, it will be instrumental in examining how individual health behaviors, interpersonal relationships, community dynamics, and societal structures collectively contribute to the risk and prevalence of hypertension.

Health Belief Model:

The Health Belief Model helps elucidate the cognitive processes that influence health-related decisions and behaviors. Applying this model to the study, it is imperative to explore the perceptions and beliefs of women living with HIV in Ibadan regarding hypertension. Understanding their awareness, perceived susceptibility, severity, and perceived benefits of preventive actions will provide insights into potential intervention strategies.

2.3. Review of Empirical Studies

Nigeria is the third country in the world in terms of the highest-burden of Human Immunodeficiency Virus (HIV) infection. According to the findings of the 2019 Nigeria

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National HIV/AIDS Indicator and Impact Survey, there were 1.9 million people in Nigeria living with HIV and AIDS in the year 2018.

Globally, the prevalence of hypertension among those living with HIV presents a significant challenge. A prospective, cross-sectional study comprising two hundred and eighteen HIV-infected patients was conducted in the Antiretroviral Therapy Clinic of General Hospital, Offa, between November 2015 and December 2016. Following established protocols, patients' blood pressure was measured using an Omron automated blood pressure monitor. To gauge the subjects' weights and heights, a dual weight and height balance was used. In patients receiving combined antiretroviral therapy (cART), the incidence of hypertension was 34%, compared to 9.6% in patients who had not yet begun cART. When compared to men (24.5%), hypertension was more common in HIV-infected women receiving cART (75.5%). 75.5% of women and 24.5% of men who were HIV-infected and receiving cART had hypertension. Among patients receiving cART, body mass index (OR: 3.29, 95% CI: 1.21-2.27; p0.050), sedentary behavior (OR: 1.63, 95% CI: 1.20-5.38; p0.043), age (OR: 2.17, 95% CI: 1.22-2.33; p0.004), and gender (OR: 1.63, 95% CI: 0.85-2.41; p0.037) were all Patients on cART were found to have a higher prevalence of hypertension than cART-naive patients. cART, however, was said to be unrelated to the risk of hypertension[111].

A study was conducted to investigate the relationship between two common cardiovascular diseases and HIV in adults living in sub-Saharan Africa using population data provided through the Demographic and Health Survey for four countries of Lesotho, Namibia, Senegal and South Africa. Logistic models were run for each country separately, with self-reported diabetes as the first outcome and self-reported hypertension as the second outcome and HIV status as the primary independent variable. Models were adjusted for age, gender, rural/urban residence and

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BMI. Complex survey design allowed weighting to the population. The prevalence of self-reported diabetes ranged from 3.8% in Namibia to 0.5% in Senegal. The prevalence of self-reported hypertension ranged from 22.9% in Namibia to 0.6% in Senegal. In unadjusted models, individuals with HIV in Lesotho were 2 times more likely to have self-reported diabetes (OR = 2.01, 95% CI 1.08–3.73); however, the relationship lost significance after adjustment. Individuals with HIV were less likely to have self-reported diabetes after adjustment in Namibia (OR = 0.29, 95% CI 0.12–0.72) and less likely to have self-reported hypertension after adjustment in Lesotho (OR = 0.63, 95% CI 0.47–0.83). Relationships were not significant for Senegal or South Africa. The odds of self-reported diabetes in individuals with HIV were high in Lesotho and low in Namibia, while the odds of self-reported hypertension in individuals with HIV were low across all 4 countries included in this study[112].

A field survey to assess the prevalence of specific NCDs, HIV infection, and risk factors for NCDs in southern Uganda and western Tanzania. Households were enrolled in a population-based cross-sectional survey using multistage sampling and five strata per nation (one municipality, two towns, and two rural areas). Consenting adults (18 years) were examined, quizzed, and tested for HIV and diabetes mellitus using the WHO STEPS survey instrument (DM). Estimates of the population prevalence of hypertension, diabetes mellitus (DM), obstructive pulmonary disease, cardiac failure, epilepsy, and HIV were made after accounting for survey design, and factors linked to hypertension were looked into using logistic regression. In the results across strata, the prevalence of hypertension varied between Tanzania and Uganda, from 19% (CI: 14% to 26%) to 26% (CI: 23% to 30%), and was between 16% and 17% (95% confidence interval (CI): 12% to 22% in Tanzania and 17% to 14% to 22% in Uganda. It affected many young participants and was widespread in both urban and rural areas. DM (1% to 4%

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prevalence) and other NCDs were generally rare. In Tanzania, the HIV prevalence ranged from 6% to 10%, and in Uganda, it was 6% to 12%. In various strata, 12% to 23% of men and 1% to 3% of women reported that they were current smokers. 6% to 15% of men and 1% to 6% of women had a problem drinking, as determined by the criteria of the Alcohol Use Disorder Identification Test. Up to 46% of participants were overweight, which was more prevalent in urban than rural areas and among women. The majority of patients with hypertension and other NCDs were not aware of their condition, and the majority of treated patients had hypertension that was not under control. Older age, male sex, being divorced or widowed, having less education, having a higher BMI, and smoking were all associated with hypertension[113].

The incidence and risk factors for hypertension among HIV patients were examined in a prospective longitudinal study conducted in rural Tanzania in 2017 with HIV patients enrolled in the Kilombero and Ulanga Antiretroviral Cohort between 2013 and 2015. Pregnant women during follow-up and non-ART naive subjects at baseline were both excluded from the analysis. Systolic blood pressure of at least 140 mmHg or diastolic blood pressure of at least 90 mmHg on two separate occasions were considered incident hypertension. In order to evaluate the relationship between baseline characteristics and incident hypertension, Cox proportional hazards models were used. 111 (11.6%) of the 955 ART-unaware, qualified subjects had hypertension at recruitment. Pregnancy prevented ten women from participating. The remaining 834 participants contributed 7967 person-months to the follow-up (median 231 days, interquartile range [IQR] 119-421)), and 80 (9.6%) of them experienced the onset of hypertension over the course of a median follow-up of 144 days following cohort enrolment [incidence rate 120.0 cases/1000 person-years, 95% CI (97.2-150.0)]. 630 (75.5%) patients underwent ART, with a median follow-up of 7 months (IQR 4–14). Age, body mass index, and

estimated glomerular filtration rate were all identified by Cox regression models as independent risk factors for the development of hypertension (aHR 60 versus 60 ml/min/1.73 m2 3.79, 95% CI 1.60-8.99, p = 0.003, adjusted hazard ratio (aHR) 60 versus 60 ml/min/1.73 m2). The study found that our cohort had a high prevalence and incidence of hypertension. Conventional cardiovascular risk factors predicted incident hypertension, but neither immunological nor ART status showed any correlation. These findings support the integration of integrated management and routine hypertension screening into HIV programs in rural sub-Saharan Africa[114].

A descriptive cross-sectional study was conducted among HIV-positive, non-pregnant adults on HAART who visited the clinic between July and August 2018 at Parirenyatwa Hospital in Zimbabwe. 56% of the 600 adult patients with HIV who were the subject of the study were female. The prevalence of hypertension was 29.9%. 11.2% of the hypertensive group's participants had never been diagnosed or were not receiving treatment. Advanced age, using HAART for more than 10 years, being overweight, having a family history of hypertension, smoking, and being older were all factors linked to hypertension. All participants had a body mass index that was higher than 25 kg/m2 in 68.8% of cases. The study found a high prevalence of hypertension. Being overweight was very common, but neither gender nor the use of PI regimens was associated with hypertension. The overall management of HIV-positive patients and co-morbidity monitoring calls for increased vigilance and resource integration[115].

Similar to this, a study in Kebbi State, Nigeria, evaluated the prevalence and risk factors for hypertension in people with HIV/AIDS. The study design chosen was descriptive cross-sectional. Using an automated sphygmomanometer, the blood pressure of 301 PLWH was measured. The respondents had a 37-year-old median age. The majority of respondents (55.1%), or 61% of them, were females and married. It was 17% standard to have high blood pressure. The three factors

that were found to be the most predictive of hypertension were getting older, not exercising, and gaining weight[116].

A cross-sectional analysis among HAART naive HIV-infected patients was used in the study to examine the prevalence of hypertension and its associated risk factors in a HAART-naive HIV-infected population in Dar es Salaam, Tanzania. To examine the factors connected to hypertension, relative risks were used. Results showed that 12.5% of people had high blood pressure. Male patients had a 10% higher risk of developing hypertension than female patients after controlling for potential confounders. Compared to patients aged 30-39, patients over the age of 50 had a risk of hypertension that was more than twice as high. Compared to patients who were of average weight, those who were overweight or obese had a 51% and 94% higher risk of developing hypertension. Low CD4+ T-cell counts, advanced WHO clinical disease stages, and prior TB infection were linked to 10%, 42%, and 14% lower risks for hypertension, respectively. The study found a correlation between hypertension and older age, male gender, and overweight/obesity. Lower risk for hypertension was linked to immune suppression and TB history. Even in people who have never used HAART, it was advised that HIV treatment programs should screen for and treat hypertension[117].

A study using a cross-sectional design was carried out among young adults and adolescents living with HIV (AYLHIV) who were patients at the HIV clinic at the Nigerian Institute of Medical Research. Anthropometric measurements were taken, including weight, height, waist circumference, and body mass index. These were then expressed as age- and gender-adjusted z-scores. Readings of the patient's blood pressure were obtained, and blood samples were drawn and analyzed for glucose levels in the fasting state, triglyceride levels, and high-density

lipoprotein cholesterol levels (HDLc). If an individual satisfies at least three of the five criteria that were defined by the National Cholesterol Education Program Adult Treatment Panel III, then they were determined to have the condition known as metabolic syndrome (MetS) (NCEP ATP III). The obtained data were analyzed using version 23.0 of the SPSS program. According to the findings, the average age of the participants was 15.8 years old (standard deviation: 3.1 years), and 63.6% of them had been receiving antiretroviral treatment for at least 5 years and non-Protease Inhibitor treatment, respectively. According to the NCEP ATP III criteria, the prevalence of MetS was 1.3%, and 56.3% of the participants satisfied at least one component of MetS. The most common metabolic disorder was low HDLc, which accounted for 41.6% of all cases, followed by hypertriglyceridemia (19.5%), hypertension (11.7%), and hyperglycemia (5.2%). Nobody who took part in the study was either overweight or obese. These metabolic characteristics might put a person at risk for developing cardiovascular disease at an earlier age. The findings of the study indicated, in conclusion, that it is essential for the routine care of AYLHIV patients to include screening and follow-up for the aforementioned risk factors[118].

In a similar vein, a cross-sectional study was conducted among 400 HIV-positive adults who sought care at nine secondary health facilities in Lagos State, Nigeria, to determine the prevalence of behavioural risk factors for hypertension. This study also examined the participants' attitudes toward these risk factors. Data were collected using a structured, interviewer-administered questionnaire after respondents were chosen through a multistage sampling process. Three blood pressure readings were taken, and a respondent was deemed to have elevated blood pressure if the mean of the last two readings was more significant than 140 mm Hg for systolic blood pressure or 90 mm Hg for diastolic blood pressure or if they were currently taking anti-hypertensive medication. The prevalence of major behavioural risk factors

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for hypertension was found to be high, according to the findings. For example, 82.0% of the respondents were sedentary. The two most well-known causes of hypertension, identified by 87.3% and 70.5% of the respondents, respectively, were stress and physical inactivity. The majority (66.0%) had favourable opinions of the risk factors for hypertension, and 26.7% of them had elevated blood pressure. Lower age, or being 30 years or younger (OR = 2.89, 95% CI = 1.26-6.64), a BMI of less than 25 (OR = 1.87, 95% CI = 1.16-3.01), and having had an HIV diagnosis for no more than five years (OR = 1.62, 95% CI = 1.006-2.62) were all significantly associated with regular blood pressure readings among respondents. In conclusion, a large percentage of HIV/AIDS patients exhibit behaviours that put them at risk for hypertension. It is necessary to take action to address these risk factors, among others[119].

A cross-sectional study was conducted at the Aminu Kano Teaching Hospital in Kano, Nigeria, with the goal of describing the cardiovascular risk profile of HIV/AIDS patients receiving HAART at a healthcare facility in the northern part of the country. Age- and sex-matched HAART-naive subjects and consenting patients who had been receiving HAART were compared. Under standardized circumstances, questionnaires, interviews, electrocardiography, anthropometric, and blood pressure measurements were made. Plasma glucose, uric acid, and lipid levels were measured using blood samples. The study involved 200 participants, of whom 100 were taking HAART (group 1), and 100 were HAART-naive (group 2). The average age of the subjects was 32.5 (7.6) years for all participants. In group 1, the prevalence of hypertension was 17%, while in group 2, it was 2% (P 0.001). In contrast, 2% and 9% of patients in group 2 had metabolic syndrome, while 11% and 21% of subjects in group 1 had it (P 0.05 for both). The study came to the conclusion that HAART treatment was linked to noticeably higher rates of hypertension, obesity, and metabolic syndrome[120].

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2.4. Conceptual Framework

The proposed framework for this study assumes an interaction between the factors associated with hypertension in HIV infection. These factors were the risk factors, antiretroviral factors and infection factors. The risk factors in the conceptual framework include smoking, age of the patient, family history of hypertension, alcoholism and body mass index of the patient, which could independently lead to hypertension in individuals or could have an effect on HIV-infected patients or even have an effect on HIV clients who are on the active antiretroviral drugs. Prolong intake of highly active antiretroviral drugs could independently lead to hypertension, or its tendency to cause hypertension could be a result of smoking behaviour, family history of hypertension or ageing among patients (traditional factors), or CD4 level among patients on the antiretroviral drug could be a factor to cause hypertension among patients. In the same vein, the antiretroviral factors can also influence the other factors.

Finally, the infection factor, which also includes those infected with the disease and their CD4 levels, can independently lead to hypertension among the patients. Moreover, at the same time, it can also have an effect on the prolong intake of antiretroviral and the factors of the traditional risk group.

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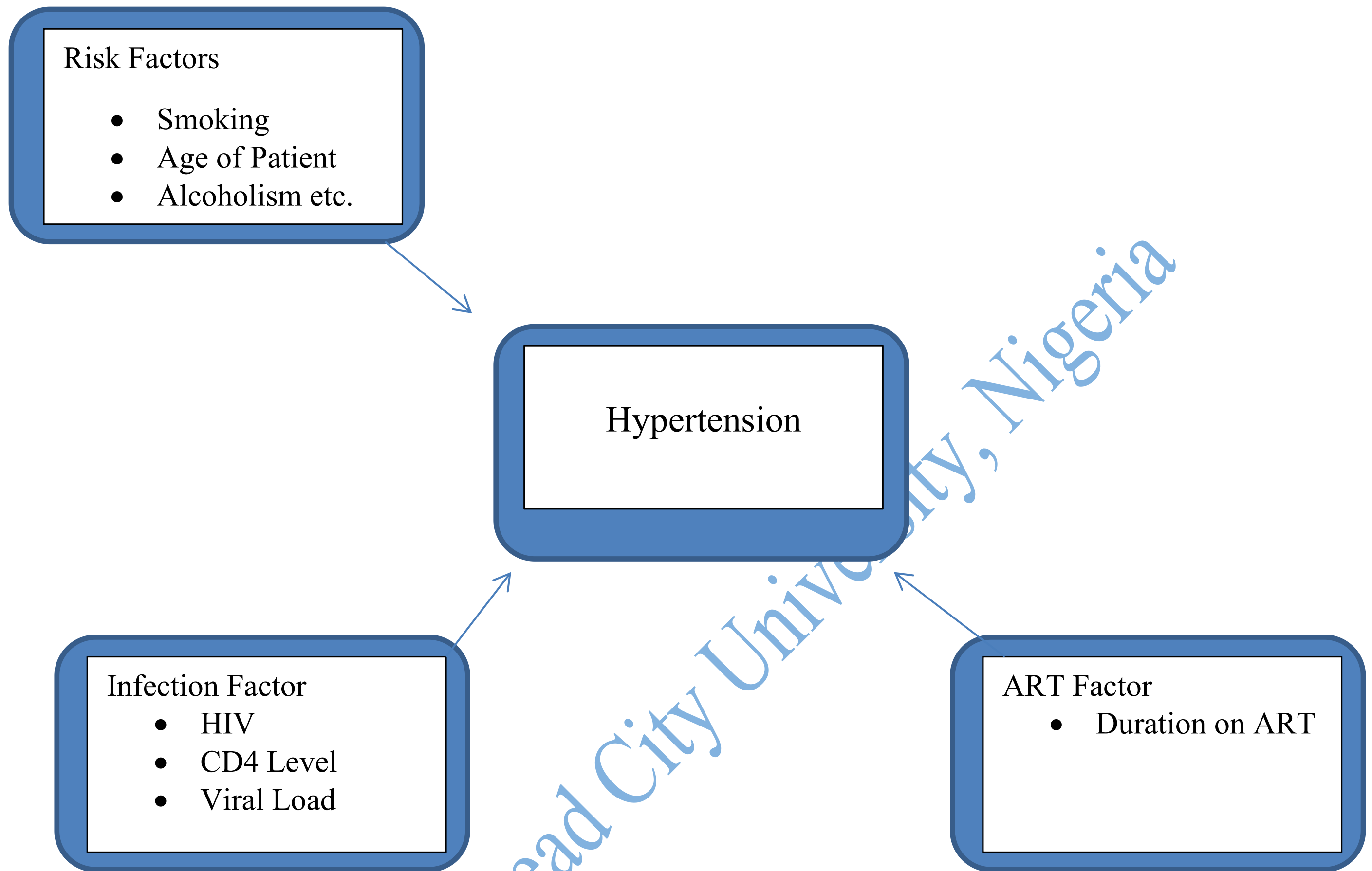

Figure 2.6: Conceptual framework on the factors associated with Hypertension in PLWHIV

Source: Field Work

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2.5 Summary of Gaps in Literature

The literature on hypertension among women living with HIV in Ibadan, Nigeria, reveals critical gaps necessitating further research. Current studies lack specificity, often focusing on general cohorts rather than addressing the unique challenges faced by women living with HIV. Cultural factors influencing health behaviors are inadequately explored, hampering the development of culturally competent interventions. The absence of longitudinal studies limits our understanding

of hypertension trends over time in this population. Additionally, the literature falls short in addressing the intersectionality of identities, neglecting the nuanced influences of gender, HIV status, and socioeconomic factors on hypertension risk. The responsiveness of the healthcare system in Ibadan, particularly in terms of infrastructure and accessibility, remains underexplored. Social support networks, the integration of technological solutions, and the impact of mental health factors are notably absent from current research. Addressing these gaps through targeted initiatives is essential for a comprehensive understanding of hypertension among women living with HIV in Ibadan, informing evidence-based interventions tailored to their specific needs.

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Chapter Three

Methodology

This section provides more information about the research techniques that were applied in this study. It discusses the techniques and methods, such as the research design, sampling frame; the study population; sample size; sampling procedure; study location, research instrument, and the analytical method used for this study.

3.1. Research Design

A facility-based cross-sectional survey was conducted by purposive sampling of available socio-demographics and clinical data of women of reproductive age living with HIV/AIDS receiving Anti-retroviral therapy (ART). The variable outcome will be hypertension status before commencing medication and after the treatment. This will also be backed with a questionnaire for the variable of other non – communicable diseases associated with people living with HIV/AIDS on antiretroviral therapy (ART).

3.2. Study Site

This study will be conducted in four (4) HIV treatment centres situated in the Ibadan metropolis of Oyo State, Nigeria.

Ibadan, the capital of Oyo state, is Nigeria's third-largest city by population, after Lagos and Kano, with a total population of 3,649,000 as of 2021 and a metropolitan area of almost 6 million inhabitants. Geographically, it is the country's largest city. Ibadan was Nigeria's largest and most populated city at the time of its independence in 1960 and Africa's second most populous after

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Cairo. It is a city in western Nigeria, located 128 kilometres (80 miles) inland northeast of Lagos and 530 kilometres (330 miles) southwest of Abuja, the federal capital. It serves as a vital link between the country's coastline region and the country's interior.[1] Ibadan had been the focal point of the erstwhile Western Region's administrative structure since the earliest stages of British colonial rule. Some of the city's old defence walls are still standing today. The Ibadan Metropolitan Area is made up of eleven local governments, including five urban local governments and six semi-urban local governments in the city. Local governments, which were founded by the military administrations but recognized by the constitution of 1999, currently serve as the third tier of government in Nigeria. The Executive Chairman, Vice Chairman, Secretary, and Supervisory Councilors make up the Executive Arm of local government councils. A total of four treatment centres within Ibadan were selected for both phases of this study. The centres are;

- State Hospital, Adeoyo, Ringroad
- Adeoyo Maternity Health Centre
- St. Mary Catholic Hospital, Eleta
- Saint Annes Anglican Hopital, Molete

3.2.2 Population of the Study

The study population comprises women living with HIV/AIDS within the study area of Ibadan Oyo state, Nigeria.

3.2.3 Eligibility Criteria (Inclusion/Exclusion)

a. Inclusion Criteria

- Women between the age of 18-49 living with HIV/AIDS as of the period of the survey were included.

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- Those who give their consent
- Additionally, age 18 years and above and provide written informed consent.

b. Exclusion Criteria

- Those who were HIV-negative or had an unconfirmed HIV-positive result would not be eligible.
- Records of Women of reproductive age living with HIV/AIDS with missing information on the questionnaires administered or any of the outcome or independent variables were removed from the analysis.
- Those who could not give informed consent were excluded from the study.

3.3. Sample and Sampling Technique

A minimum sample size was calculated based on the estimation of a population parameter for cross-sectional studies[2]

The following are the determinants for this cause:

- Estimate population of women living with HIV in Ibadan
- Acceptable sampling error 5%
- A standard deviate of 1.96
- 95% confidence level

$$n = \frac{Z^2 p\,(1 - p)}{d^2}$$

where n= minimum sample size

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- Z^2 = Standard score corresponding to a given confidence level. For example, at a 95% confidence level or 5% of level of Significance
- p= Using pre-estimates of the prevalence of hypertension in PLWHIV of 28.5%[3]
- q=(1-p) or say the percentage of failure which is 100-1=99%
- d= precision limit or proportion of sampling error which is usually a 5% confidence limit.

$$\text{Sample Size} = \frac{1.96^2 \times 0.285(1-0.285)}{0.05^2} = 313$$

To account for potential Non-response, 10% of the sample size was considered. This gives us a total of N= 344

3.3.1. Sampling Technique

A purposive sampling method was adopted in selecting the health facilities because ART treatment is not available in all health facilities. The participants for the study were randomly selected from each of the health facilities.

3.4 Description of the Research Instrument

A questionnaire adapted from the World Health Organization WHO STEPwise approach to chronic disease risk-factor surveillance was modified and used for the collection of study participant's data

3.5. Method of Data Collection

A questionnaire adapted from the World Health Organization WHO STEPwise approach to chronic disease risk-factor surveillance was modified and used for the collection of study participants' data.[4] The instrument was administered in Yoruba, the commonly spoken language

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in Ibadan. This enabled the study participants to engage with the instrument in their mother tongue and also gave them the freedom to choose to answer the English or Yoruba version of the questionnaire. Research assistants were made available for participants who needed extra assistance with answering the questionnaire. This will include those participants who were not able to read or write. An informed consent form was attached to the questionnaire. It explained the research study and guaranteed confidentiality, and required consent from the participant to participate in the research study. The questionnaire took a maximum of 20 minutes to complete.

In addition, other relevant clinical characteristics were obtained from the medical history record (clinical folder) of the study participants. Information obtained from the study participants was classified under the following groupings:

1. Socio-demographic and life-style characteristics
2. Blood pressure, anthropometric and HIV-related and other data extracted from clinical folders

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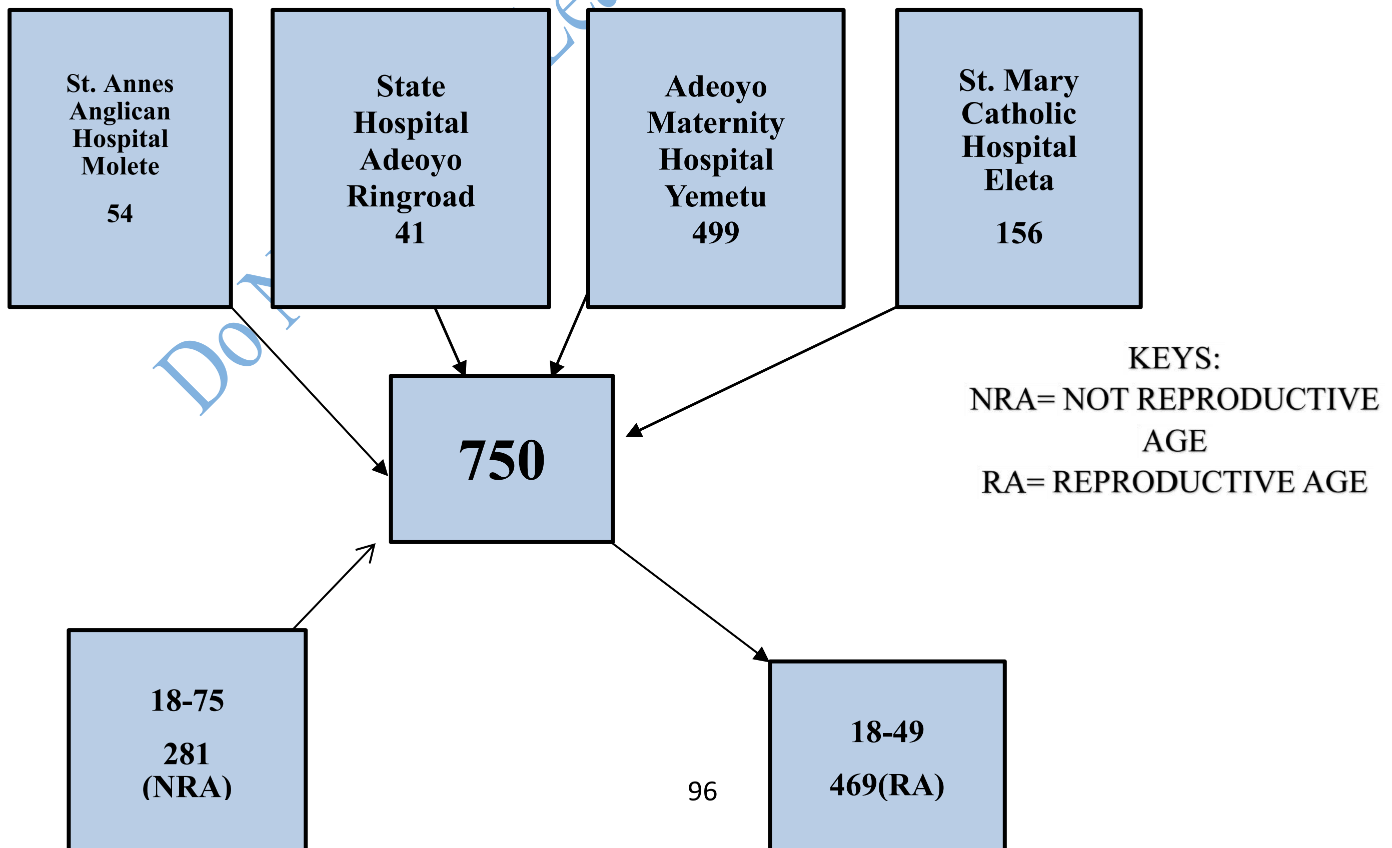

Figure 3.1: Total number of Data Collected

Source: Field Survey 2022

3.6. Data Management (statistical analysis)

Data were analyzed using SPSS Statistics version 28.[5] Data was sorted to avoid inconsistencies before analysis. Descriptive statistics, including frequencies and proportions, were used to summarize the demographic characteristics of the respondents. T-test was deployed to compare the means of clinical and laboratory characteristics of PLWHA before and after commencing ART, while a chi-square test was applied to assess the association between socio-demographic characteristics and hypertensive status before and after commencing ART. Binary logistic regression was used to determine the risk factors for hypertension. Adjusted odds ratios (AORs), with their respective 95% confidence interval (95% CI), were estimated for the factors included in the model. The level of statistical significance will be set at 5%.

3.7. Ethical Approval

Ethical approval for this study was obtained from the Oyo State Ministry of Health Department of Planning Research & Statistics Division (AD 13/479/ 44560[B]). Official permission was obtained from hospitals included in this study. An information statement was provided to all participants prior to obtaining informed verbal consent. To ensure informed verbal consent from participants, the information statement was read in the local language, Yoruba. The Study contained women who had formal education and women with no formal education, so informed verbal consent was more appropriate and was approved by both ethics committees. In addition, it

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was a survey, and the research involved no more than low risk. Participants were given the opportunity to ask questions prior to the interview. The consent procedure took place in a separate private room by trained data collectors after WLHIV had finished their routine clinical care appointment. Participants were informed that their participation was voluntary and that they were free to decline participation or withdraw their consent at any time. It was made clear that participation in this study had no bearing on their receipt of clinical care. The participants were also informed that the survey involved some questions that they might find embarrassing or too personal and some that might cause them to worry about their reproductive health issues. Further, participants were informed that they did not have to answer any question that they did not feel comfortable with, and they could withdraw at any time or simply choose not to answer a particular question. Female nurses were prepared to provide psychological support if the need arose. Anonymized data were stored on password-protected Laptops during data collection. Data were stored on secure and password-protected computers.

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Chapter Four

Results and Discussion of Findings

4.1. Demographic Data Analysis

This section describes the sociodemographic information of the participants, which includes their age, marital status, ethnic group, religion, educational level, employment status, type of partner, and monthly income.

Table 4.1: Socio-demographic Characteristics of Respondents

Variable	Frequency	Percent (%)
Age (n = 469)	469	
		93.8
Mean ± SD	36.87 ± 6.924	
Marital Status (n = 469)		
Married	392	83.6
Divorce	11	2.3
Widowed	27	5.8
Separated	17	3.6
Single	22	4.7
Ethnic Group (n = 469)		
Yoruba	401	85.5
Igbo	42	9.0
Hausa	14	3.0
Others	12	2.6

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Religion (n = 469)		
Christianity	275	58.6
Islam	194	41.4
Others	0	0
Educational Level (n =469)		
Primary level	127	27.1
Secondary level	210	44.8
Tertiary level	88	18.8
None	44	9.4
Employment Status		
Unemployed	98	20.9
Employed	371	79.1
Type of Partner		
Spouse	369	78.7
Steady	42	9.0
Causal	30	6.4
None	28	6.0
What Is Your Monthly Income		
<20,000	228	48.6
20,000 – 30,000	82	17.5
31,000 – 40,000	71	15.1
41,000 – 50,000	52	11.1
>51,000	36	7.7

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Are You Taking Antiretroviral Drugs		
Yes	469	100
No	0	0
Have You Been Diagnosed with Hypertension		
Yes	32	6.8
No	437	93.2

Source: Field Survey 2022

A total of 500 (100%) questionnaire was issued for data collection, and 469 (93.8) of the data was recovered, leaving 31 (6.2) missing. Of the 469 data recovered, all of them were eligible for analysis.

The result of the socio-demographic data, as shown in Table 1 above, reveals that 469 participants were involved in the study, which consists of only females, with the minimum age being 18 and the maximum age being 49. The mean age of the participants was 36.87 ± 6.924. The majority of the participants {210 (44.8%0}, had completed secondary school, with 27.1% completing a primary level and 18.8 completing the tertiary level.

Of the 496 participants, 98 of them were unemployed (20.9%), while the rest, 371(79.1%), had one form of employment. 83.6% of the women stated being married, with 2.3% being divorced, 5.8% being widowed, 3.6% being separated, and 4.7% being single.

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Table 4.2: Clinical Characteristics of the Participants

This section describes the clinical characteristics of the participants, which include their viral load, duration of ART, BMI and blood pressure.

Variable	Frequency	Percent (%)
Viral Load		
Non-Detectable (<70)	427	91
Detectable (>70)	15	3.2
Target not Detected	27	5.8
Duration on ART		
<2 years	179	38.2
>2 years	290	61.8
BMI		
Underweight	15	3.2
Normal (18- <25)	264	56.2
Overweight (25- <30)	143	30.5
Obese (30 & >30)	47	10
Blood Pressure		
Hypertensive	32	6.8
Non-Hypertensive	437	93.2

Source: Field Survey 2022

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A total of 32 study participants (6.8%) were hypertensive, with their median current systolic and diastolic blood pressure values being 148.5 mmHg and 95.0 mmHg, respectively (Table 2). The majority of the participants had good viral suppression {427 (91%)} with only 15 (3.2%) having poor viral suppression.

In terms of BMI, of the 469 participants, 264 (56.2%) of them had a normal BMI, with 30.5 % (143) being overweight and 47(10%) being obese, and only 3.2% (15) being underweight. The result of the duration on ART reveals that 290 participants (61.8) had been on ARV for more than 2 years, with the rest {179 (38.2)} being on ARV for less than 2 years.

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Table 4.3: Lifestyle Characteristics of Participants

This section describes the clinical characteristics of the participants, which include their alcohol drinking status, tobacco smoking status, fruit intake and vegetable intake, engagement in moderate physical activity/exercise, engagement in vigorous physical activity/exercise and salt intake.

Variable	Frequency	Percent (%)
Alcohol Drinking Status		
Yes(currently)	13	2.8
Yes(stopped)	33	7.0
Never	423	90.2
Tobacco Smoking Status		
Yes	17	3.6
No	452	96.4
Fruit Intake		
Most at times	409	87.2
Rarely/Never	60	12.8
Vegetable Intake		
Most at times	453	96.6
Rarely/Never	16	3.4
Engagement in Moderate Physical Activity/Exercise		
Most at times	268	57.1
Rarely/Never	201	42.9
Engagement in Vigorous Physical Activity/Exercise		
Most at times	139	29.6
Rarely/Never	330	70.3
Salt Intake		

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Most at times	305	65
Rarely/Never	164	35

Source: Field Survey 2022

Alcohol and tobacco intake were relatively low in the study sample, with 423 (90.2) and 452 (96.4) of the participants, respectively, reported having not taken alcohol or tobacco. However, 33 (7.0%) of the participants reported prior intake of alcohol but are currently not taking alcohol.

In terms of Fruit, Vegetable, and Salt intake, the majority of the participants consumed each of them most of the time with a percentage of 87.2%, 96.6% and 65%, respectively. The result of the engagement in Moderate and Vigorous physical activity varied, with 57.1% of the participants engaging in moderate physical activity and 29.6% engaging in vigorous physical activity most of the time.

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4.2. Presentation of Data

4.2.1 What Is The Prevalence of Hypertension among Women Living With HIV?

Table 4.4 Prevalence of Hypertension among Study Participants

Variable	Frequency	Percentage
Non-Hypertensive	437	93.2
Hypertensive	32	6.8

Source: Field Survey 2022

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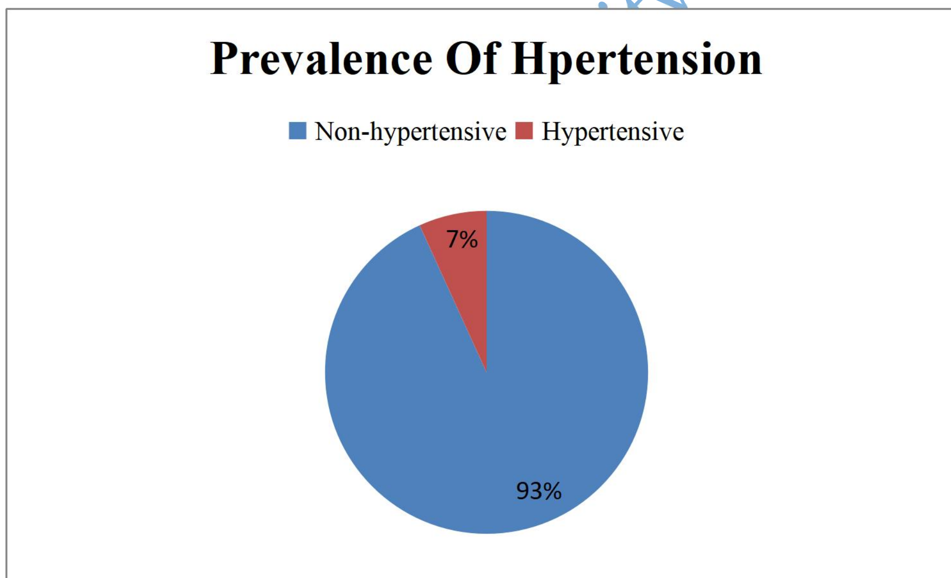
Figure 4.1: Prevalence of Hypertension among Study Participants



Source: Field Survey 2022

The overall prevalence of hypertension in the 469 study participants was 7%, while the rest of the participants were non-hypertensive.

4.2.2 What are the Risk Factors of Hypertension among Women Living with HIV?

Table 4.5: Bivariate analysis of socio-demographic factors associated with hypertension in study participants.

Variable	BP Status		p-value
	Hypertensive (n=32)	**Non-hypertensive(n=437)**	
Religion			
Christianity	14(5.1%)	261(94.9%)	0.071
Islam	18(56.3%)	14(43.7%)	
Tribe			
Yoruba	26(6.5%)	375(93.5%)	0.896
Igbo	4(9.5%)	38(90.5%)	
Hausa	1(7.2%)	13(92.8%)	
Others	1(8.3%)	11(91.7%)	
Educational Level			
Primary Level	10(7.9%)	117(92.1%)	0.527
Secondary Level	15(7.1%)	195(92.9%)	
Tertiary Level	3(3.4%)	85(96.6%)	
Others	4(9.1%)	40(90.9%)	
Marital Status			
Married	24(6.1%)	368(93.9%)	0.344
Divorced	1(9.1%)	10(90.1%)	
Widowed	3(11.1%)	24(88.9%)	
Separated	3(18%)	14(82%)	
Single	1(4.5%)	21(95.5%)	

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Type of Partner			
Spouse	20(5.4%)	349(94.6%)	0.113
Steady	6(14.3%)	36(85.7%)	
Casual	3(10%)	27(90%)	
None	3(11%)	25(89%)	
Employment Status			
Employed	25(7%)	346(93%)	0.888
Unemployed	7(7.1%)	91(92.9%)	

Source: Field Survey 2022

Educational level, employment status, tribe, type of partner and religion were analyzed for association with hypertension in the bivariate analysis. No significant associations were found in the analysis.

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Table 4.6: Bivariate analysis of life-style factors associated with hypertension in study participants.99

Variable	BP Status		p-value
	Hypertensive (n=32)	Non hypertensive(n=437)	
Have you ever consumed any alcohol such as Bear, wine and spirits			
Yes currently	1(8%)	12(92%)	0.667
Yes stopped	1(3%)	32(97%)	
Never	30(7.1%)	393(92.9%)	
Have you ever smoked any tobacco products, such as pipes, cigarettes			
Yes	6(35%)	11(65%)	0.000
No	26(6%)	426(94%)	
In a typical week, how often do you eat fruits			
Always	16(6.6%)	225(93.4%)	0.007
Often	5(5%)	95(95%)	
Sometimes	4(5.9%)	64(94.1)	
Rarely	0	28(100%)	
Never	7(21.9%)	25(78.1%)	
In a typical week, how many days do you eat vegetables			
Always	19(7.9%)	221(92.1%)	0.194
Often	5(4.2%)	114(95.8%)	
Sometimes	7(7.4%)	87(92.6%)	
Rarely	0(0%)	13(100%)	
Never	1(33.3%)	2(66.7%)	
How often do you add salt or salt sauce			

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before or while eating			
Always	5(4.7%)	102(95.3%)	0.000
Often	5(4.3%)	112(95.7%)	
Sometimes	3(3.7%)	78(96.3%)	
Rarely	4(4.3%)	88(95.7%)	
Never	15(20.8%)	57(79.2%)	
In a typical week, how much time do you spend doing vigorous-intensity activities as part of your work, recreational activities, sports, cycling, running or football?			
Always	1(11.1%)	8(88.9%)	0.535
Often	4(13.3%)	26(86.7%)	
Sometimes	5(5%)	95(95%)	
Rarely	13(7.4%)	162(92.6%)	
Never	9(5.8%)	146(94.2%)	
In a typical week, how often do you do moderate-intensity activities as part of your work, recreational activities, sports, fitness, cycling, swimming and volleyball?			
Always	3(8.8%)	31(91.2%)	0.127
Often	6(5.2%)	110(94.8%)	
Sometimes	5(4.2%)	113(95.8%)	
Rarely	2(3.4%)	56(96.6%)	
Never	16(11.2%)	127(88.8%)	

Source: Field Survey 2022

The result of the bivariate analysis of the lifestyle factors associated with hypertension showed a significant association between the smoking of tobacco products, fruit intake and salt intake with a p-value of 0.000, 0.007 and 0.000, respectively.

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Table 4.7: Bivariate analysis of clinical characteristics associated with hypertension in study participants.

Variable	BP Status Hypertensive (n=32)	Non-Hypertensive (n=437)	p-value
BMI			
Underweight	32(7.4%)	398(92.6%)	0.211
Overweight	0	37(100%)	
Obese	0	2(100%)	
Viral Load			
Detectable	1(7%)	14(93%)	0.829
Undetectable	28(7%)	399(93%)	
Target not Detected	3(11%)	24(89%)	

Source: Field Survey 2022

Table 4.7 showed no significant association between the clinical characteristics and hypertension, with results of the BMI and Viral Load giving a p-value of 0.211 and 0.829, respectively

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Table 4.8: Multiple logistic regression analysis of factors associated with hypertension

Variables		Adjusted Odd Ratio	p-value
Alcohol Intake			
	Most times	1.863(1.68,2.059)	0.736
	Rarely/Never		
Tobacco Intake			
	Most times	12.439(0.366,422.926)	0.161
	Rarely/Never		
Fruit Intake			
	Most times	0.138(0.005,3.706)	0.138
	Rarely/Never		
Vegetable Intake			
	Most times	4.520(0.099,205.749)	0.439
	Rarely/Never		
Salt Intake			
	Most times	3.727(0.890,15.606)	0.072
	Rarely/Never		
Vigorous Intense Activity			
	Most times	0.981(0.143,6.730)	0.985
	Rarely/Never		
Moderate Intense Activity			
	Most times	4.418(1.014,19.241)	0.048
	Rarely/Never		

Source: Field Survey 2022

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Table 7 shows the result of the multiple logistic regression of factors associated with hypertension using a purposeful selection of variables method. Among the sociodemographic and lifestyle factors studied, moderately intense activity was significantly associated with hypertension (Table 8). Alcohol intake and Tobacco intake were not significantly associated with hypertension with a p-value of 0.736 (AOR= 1863.311(1.686E-016, 2.059E+22) and 0.161 (AOR= 12.439(0.366, 422.926) respectively.

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4.3. Discussion of Findings

According to the findings of this study, the percentage of women living with HIV in Ibadan had a prevalence of hypertension that was 7%. According to WO, hypertension is the primary risk factor for cardiovascular disease and cerebrovascular mortality. It has also been reported that PLHIV has a high prevalence of hypertension[1]. Several different prevalence figures of hypertension in PLHIV have been reported around the world. These figure range anywhere from 19.9% in Brazil[2 3] to 31.5% in Southern America Cohort[4]. According to research conducted in the majority of developed nations, the percentage of people living with HIV who have hypertension ranges anywhere from 8 to 39 percent[5 6]. Studies conducted in Europe and North America on patients receiving ART report a prevalence of hypertension ranging between 20% and 40% of the total population[7 8 9 10]. According to various reports, the prevalence of hypertension in the general population is significantly higher in sub-Saharan Africa when compared to other sub-regions[11]. According to one calculation of the burden of non-communicable diseases in SSA, the overall prevalence of hypertension in the population was calculated to be 16.2%[12 13]. According to the findings of other studies conducted in sub-Saharan Africa on people living with HIV (both those who have been exposed to ART and those who have never received it), the prevalence of hypertension ranges from a low of 14.0% in Botswana to a high of 32.0% in Kenya[14]. Therefore, the prevalence of hypertension in this study is comparable to other studies that have been conducted on PLHIV in SSA.

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The current study found that hypertension was not connected with any of the socio-demographic factors that were examined, including gender, educational level, religious denomination, marital status, and employment status. According to the findings of previous studies, there is no link between having sexual partners and high blood pressure[15 16]. Observations from other studies

show that there is no correlation between having the most significant educational status reached and having hypertension. This finding is consistent with these reports. In line with the findings of the current study, two studies conducted in 2013 found no correlation between work status and hypertension in their respective studies[17] [18]. Lifestyle factors are among the most important predictors of blood pressure levels and, as a consequence, the treatment of hypertension. The accumulation of excess body fat is the primary contributor to hypertension, which is exacerbated by the additive effects of consuming a high-sodium diet, drinking alcohol, and not getting enough exercise. When it comes to the management of hypertension, Appel et al. (1997) Dietary Approach to Stop Hypertension (DASH) recommends following a diet that is low in salt and high in calcium, as well as one that emphasizes fruits and vegetables. Additionally, exercise is similarly essential, particularly for children and young people who have increased activity in their sympathetic nervous system. The results of this study showed that there was a link between hypertension and the consumption of fruit ($p = 0.007$), smoking habit ($p = 0.000$), physical activity ($p = 0.048$), and the amount of salt consumed ($p = 0.000$) between the patients and the controls. Exercising, a lifestyle factor was established to be associated with hypertension in this study. Several epidemiological studies have shown that engaging in regular physical activity is an essential factor in lowering the prevalence of hypertension in the general population.[19] [20] Although alcohol drinking is considered a significant risk factor in the incidence of hypertension in the general population, the findings of this particular study did not point to such a connection. The findings of other investigations indicated a link that was very comparable to this one[21] [22]. This finding might be a consequence of the counseling sessions that patients have to go through before they can begin receiving ART. These sessions include information on the interactions between drugs and foods, drugs and each other, drugs and alcohol, and drugs and smoking.

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Chapter Five

Conclusion

5.1. Summary of Findings

The key findings of this study involved 469 study participants, of which the prevalence of hypertension among the study participants was 7%. This observed prevalence of hypertension could be a result of the counselling classes the patients undergo before they are started on ART. These sessions include education on drug-food, drug-drug, drug-alcohol, and drug-smoking interactions.

Regression modelling showed that the socio-demographic and lifestyle factors associated with hypertension were smoking (aOR = 0.000), fruit intake (aOR=0.007), salt intake (aOR=0.000) and moderate intense exercising (aOR=0.048). There were no Anthropometric and Metabolic/biochemical factors associated with hypertension in this study.

5.2. Conclusion

This study looked at the risk factors associated with hypertension amongst the Women living with HIV in Ibadan. Factors such as increasing age, fruit intake, alcohol intake and marital status were analysed for association with hypertension. Other factors, such as smoking intake, reveals that those who are smokers have higher chances of developing hypertension. Policies should therefore be put in place to educate people with an emphasis on reasonable lifestyle modification in the control of hypertension, such as low salt intake, physical activities, smoking, as well as alcohol consumption, as these will also help to achieve the WHO 2030 strategic plan on NCD.

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5.3. Recommendations

1. Initiatives should be done by the government to offer free BP, weight and BMI checks for the general public. This would help to curb and control hypertension menace through early detection and intervention
2. A policy framework on CVD risk assessment, prevention and management in patients attending HIV clinics should be formulated.
3. Research into the feasibility of integration of NCD care into HIV -care so that patients need not seek this care from clinics where they may feel uncomfortable in disclosing their HIV status to attending healthcare givers.

5.4. Contribution to Knowledge

1. Contribution to the existing body of knowledge on the prevalence of Hypertension
2. Contribution to the existing body of knowledge on risk factors of Hypertension

5.5. Suggested Area for Further Research

1. A systematic review and meta-analysis on the burden of CVD risk factors in WLHIV, specifically in the SSA region, are recommended.
2. A longitudinal study is recommended to establish a cohort of patients attending HIV clinics in Ibadan to understand better the risk factors of Hypertension in Women Living with HIV

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Appendix

Informed Consent Form

This informed consent form is for women living with HIV aged 18 years and above participating in the research titled Risk factors and prevalence of hypertension among women of reproductive age (18 - 49 years) with HIV in University College Hospital (UCH) Ibadan, Nigeria

Principal Investigator:

Rasheed Abdulaziz Abubakar

Faculty of Public Health

Department of Public Health

Lead City University

Email: **azizifeoluwa@gmail.com**

Mobile: 08145310245

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Good morning/afternoon:

PART 1: Information Sheet

My name is Rasheed Abdulaziz Abubakar and presently, I am a trainee at University College Hospital Ibadan. I am conducting a study which hopes to assess risk factors and prevalence of hypertension among women of reproductive age living with HIV in Nigeria. The research requires us accessing your records to determine hypertension and you will be given a short questionnaire to fill to assess the various risk factors of hypertension in HIV patients. Whenever a study is to be carried out, we ask for the permission of the participants after explaining the procedure to them.

You do not have to decide today whether or not you will participate in the research. Before you decide, you can talk to anyone you feel comfortable with about the research. If there happens to be any word you need clarification on, you can ask me or any researcher around and we will definitely take our time to explain to the best of your understanding.

Purpose of the study: this study aims to investigate the factors that are associated with hypertension among PLHIV and AIDS in PEPFAR Clinic UCH Ibadan. The findings of this study will establish the causes of hypertension among PLWHIV patients to propose ways to ameliorate them and for the optimal blood pressure control to prevent morbidity and mortality

that is associated with high blood pressure. This study is also a part of fulfillment for the award of my master's degree at Lead City University

Procedure: The study is expected to be carried out within one or two months. Those clients who agree to participate in this study will be required to give some information about them and also answer several questions which will be used to estimate the risks that are associated with hypertension, and their awareness on hypertension. Blood pressure will also be measured during the interviews. You will be required to participate only once during the entire period of this study.

Voluntary participation

Your participation in this research is entirely voluntary. It is your choice to choose whether to participate or not. Whether you choose to participate or not, all the services you receive at this clinic will continue and nothing will change. You may change your mind later and stop participating even if you agreed earlier.

Duration

The research work would require you to fill a questionnaire which would take 10 minutes of your time.

Risks

There is no known risk involved in participating in this research

Benefits

There may not be any immediate and direct benefit for you but your participation is will help us find the answer to the research questions.

Confidentiality

We will not be sharing the identity of participants of this research. Any information that we collect from this research project will be kept confidential. Participants information will be coded with numbers which only the researchers will have access to and it won't be shared except with necessary stakeholders.

Sharing The Results

Only what is permitted by law and research ethics will be shared, participants of the research will be notified through meetings in the NIMR Clinic after which results will be published in academic journals for academics.

Contact Information

Who can I contact about this study? If I have questions or concerns about this research study, whom can I call?

You can call us with your questions or concerns. Our telephone numbers are listed below. Ask questions as often as you want

Rasheed Abdulaziz Abubakar
Department of Public Health

Do Not Copy, Lead City University, Nigeria

Lead City University, Ibadan
+2348145310245
azizifeoluwa@gmail.com

If you want to speak with someone not directly involved in this research study, please contact:

Dr Folahanmi Tomiwa Akinsolu
Department of Public Health,
Lead City University, Ibadan
+2347033171050
folahanmi.tomiwa@gmail.com

You can talk to them about:

1. Your rights as a research subject
2. Your concerns about the research
3. A complaint about the research and also, if you feel pressured to take part in this research study, or to continue with it, they want to know and can help.

When you call or write about a concern, please provide as much information as possible, including the name of the researcher, the Ethics Committee number (at the top of this form), and details about the problem. This will help Ethics Committee officials to look into your concern. When reporting a concern, you do not have to give your name unless you want to.

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CERTIFICATE OF CONSENT

I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions that I have asked have been answered to my satisfaction. I consent voluntarily to participate as a participant in this research.

Name of Participant ___________________

Signature of Participant ____________________

Date ____________________________
Day/month/year

If illiterate

A literate witness must sign (if possible, this person should be selected by the participant and should have no connection to the research team). Participants who are illiterate should include their thumb-print as well.

I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

Name of witness______________________ AND Thumb print of participant

Signature of witness _______________________

Date _________________________
Day/month/year

Statement by the Researcher/Person Taking Consent

I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands that the following will be done:

1. Participants will be asked to fill a short questionnaire to assess the various risk factors of hypertension in Women Living with HIV.

2. There will be in-depth interview and group discussion

3. The interview will be recorded for research purpose.

I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

A copy of this Informed Consent Form has been provided to the participant.

Print Name of Researcher/Person taking the consent_________________________

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Signature of Researcher /Person taking the consent___________________________

Date ____________________________

Day/month/year

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Lead City University
Faculty of Public Health

Motto: Redefining Health

QUESTIONNAIRE

RISK FACTORS AND PREVALENCE OF HYPERTENSION AMONG WOMEN LIVING WITH HIV IN IBADAN, NIGERIA

Dear Respondent,

We the researchers are postgraduate students of Lead City University, carrying out research on the above topic

Acceptance to answer the questionnaire will be taken as consent to participate in the study. All information will be treated confidentially and your name is not required on the questionnaire.

Instructions

Please tick (.) the appropriate box option applicable in question below. You tick on or more boxes as appropriate

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SECTION A: SOCIO – DEMOGRAPHIC CHARACTERISTICS.

Kindly tick (√) or fill in the space provided in the statements below;

BP:
Vrl:

1. Age: _________
2. Religion: Christianity ( ) Islam ( ) Other (Specify)__________

3. Tribe: Yoruba( )Igbo ( ) Hausa ( ) Other (Specify)__________

4. Educational level: Primary level ( ) Secondary level ( ) Tertiary level ( ) None ( )

5. Marital status: Married ( ) Divorce ( ) Widowed ( ) Separated ( ) Single ( )

6. Type of partner: Spouse ( ) Steady ( ) Causal ( ) None ( )

7. Employment status: Unemployed ( ) Employed ( )

8. What is your monthly income?
<20,000
20,000 – 30,000
31,000 – 40,000
41,000 – 50,000
>51,000

9. In what year did you first **test positive** for HIV? ………..

---

10. Are you taking antiretroviral drugs? Yes ( ) No ( )
11. How long have you been on ARVS:……………………………………….
12. Have you been diagnosed of hypertension?: ……………………

PREVALENCE OF HYPERTENSION AMONG WOMEN LIVING WITH HIV

13. Have you ever been told by a doctor or health worker that you have raised blood pressure or hypertension? Yes ( ) No ( )
14. Have you ever had your blood pressure measured by a doctor or other health worker
15. Have you ever been told in the past 12 months that you have hypertension? Yes ( ) No ( )
16. In the past two weeks, have you you taken any drugs (medication) for raised blood pressure prescribed by a doctor or other health worker? Yes ( ) No ( )
17. How often do you take them?:……………………………………
18. Have you ever seen a traditional healer for raised blood pressure or hypertension Yes ( ) No ( )
19. Are you currently taking any herbal or traditional remedy for your raised blood pressure Yes ( ) No ( )

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LIFESTYLE/BEHAVIORAL

Alcohol Use

20. Have you ever consumed any alcohol such as Beer, wine and spirits? Yes Currently( ) Yes Stopped ( ) Never ( )
21. Have you consumed any alcohol within the past 12 months
    Yes ( ) No ( )

22. If yes(Currently), indicate how often you consume alcohol
    Always ( ) Often ( ) Sometimes ( ) Rarely ( ) Never ( )

23. If yes but stopped, state how often you consumed alcohol prior.
    Always ( ) Often ( ) Sometimes ( ) Rarely ( ) Never ( )

TOBACCO USE

24. Have you ever smoked any tobacco products, such as Pipes, Cigarettes, and Cigars etc?
    a. Yes(Currently)
        i. Average Number of Sticks:………………………………………

    b. Yes(Stopped)
        i. Average Number of Sticks:………………………………………
25. During the past one month did someone smoke in your home, workplace or surrounding. Yes ( ) No ( )

DIET

26. In a typical week, on how often do you eat fruits?
    Always ( ) Often ( ) Sometimes ( ) Rarely ( ) Never ( )

27. How many servings of fruits do you eat on one of those days?
    One serving ( ) Two servings ( ) Three servings ( ) More than 3 servings ( )

28. In a typical week, on how many days do you eat vegetables?
    Always ( ) Often ( ) Sometimes ( ) Rarely ( ) Never ( )

29. How many servings of vegetables do you eat on one of those days?
    One serving ( ) Two servings ( ) Three servings ( ) More than 3 servings ( )

30. What type of oil or fat is most often used for meal preparation in your home?
    Vegetable Oil ( ) Fat ( ) Others ( ) Don’t Know ( )

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31. How often do you add salt or salt sauce before or while eating?
Always ( )Often ( )Sometimes ( )Rarely ( ) Never ( )

32. How many times are salt or salty seasoning e.g. Maggi, Knorr etc added to your food while cooking?
Always ( ) Often ( ) Sometimes ( ) Rarely ( ) Never ( )

PHYSICAL ACTIVITY

33. Does your work involve vigorous-intensity activity that causes large increase in breathing or heart rate like (carrying or lifting heavy loads, digging or construction work) for at least 10 minutes continuously :Yes ( ) No ( )
34. In a typical week, how much time do you spend doing vigorous-intensity activities as part of your work, recreational activities, sports, cycling, running or football.
Always ( ) Often ( ) Sometimes ( ) Rarely ( ) Never ( )

35. Does your work involve moderate-intensity activity that causes small increases in breathing or heart rate such as brisk walking(or carrying light loads) for at least 10 minutes continually Yes ( ) No ( )

36. In a typical week, how often do you do moderate-intensity activities as part of your work, recreational activities, sports, fitness, cycling, swimming and volleyball.
Always ( ) Often ( ) Sometimes ( ) Rarely ( ) Never ( )

37. How often do you spend sitting or reclining on a typical day?
Always ( ) Often ( ) Sometimes ( ) Rarely ( ) Never ( )

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VOLUNTEER AGREEMENT

The benefits, risks, confidentiality and other procedures for the research title "**RISK FACTORS AND PREVALENCE OF HYPERTENSION AMONG WOMEN LIVING WITH HIV IN IBADAN, NIGERIA**" has been explained to me. I have read or had a witness interpret/explain all of the above, asked questions, received answers regarding participation in this study and am willing to give consent to participate in this study as a volunteer.

…………………………………………………………… ……….

Name and Signature/thumb print of volunteer Date

I certify that the nature and purpose in this research have been duly explained to the above individual.

………………………………………….. ……………

Name and Signature of Researcher/Assistant Date

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Bio-data

A. Personal Data

Full name: Rasheed Abdulaziz Abubakar

Address: Zone 2A Opere, New Garage, Ibadan, Oyo State.

E-mail Address: azizifeoluwa@gmail.com

Phone no: 08145310245

Date of birth: 27th of March, 2001

Place of birth: Yola, Adamawa State

Nationality: Nigeria

Marital Status: Single

Name of Next of Kin: Rasheed Balogun

Address of Next of Kin: Amaokwe Town Hall, Ishiagu Ebonyi State.

B. Educational Background

Educational Institutions Attended with Dates and Qualification:

First leaving School Certificate 2005-20011

Ishiagu Central School

West African Senior School Certificate 2011-2017

School of Arabic and Islamic Studies

Bachelor of Science; (Med. Lab Science) 2017-2020

IRGIB AFRICA University.

Masters of Public Health 2021-current

Lead City University, Ibadan, Ibadan, Oyo State.

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C. Work Experience

D. Publications

Conference Presentations

RASHEED A. Abdulaziz, BANKOLE A. Samuel,LAWALE A. Adedamola,ADEOYE Enitan, ADEGBITE O. Zainab, ADEWOLE E. Ifeoluwa, BULUS-EJOGA Afiniki, AKINSOLU T. Folahanmi. Risk Factor and Prevalence of Hypertension Among Women Living with HIV in Ibadan, Nigeria. Faculty of Natural and Applied Science Abstracts. Poster presentation delivered at the FASCON 3rdinternational conference, Lead City University Ibadan, Ibadan, Oyo State. November 2022.

ADEGBITE O. Zainab, BANKOLE A. Samuel, ADEWOLE E. Ifeoluwa, LAWALE A. Abisola, **RASHEED A. Abdul Aziz**, ADEOYE Enitan, BULUS-EJOGA Afiniki, ADEGBITE B. Saidat, AKINSOLU T. Folahanmi Contraceptive Use among Sexually Active Women living with HIV in Ibadan, Oyo State, Nigeria. Faculty of Natural and Applied Science Abstracts. Poster presentation delivered at the FASCON 3rdinternational conference, Lead City University Ibadan, Ibadan, Oyo State. November 2022.

BANKOLE A. Samuel,LAWALE A. Adedamola,ADEOYE Enitan, ADEGBITE O. Zainab, ADEWOLE E. Ifeoluwa, **RASHEED A. Abdul Aziz**, BULUS-EJOGA Afiniki, AKINSOLU T. Folahanmi Psychological Well-being and Adherence to Antiretroviral Therapy Among Women Living with HIV in Ibadan, Nigeria. Faculty of Natural and Applied Science Abstracts. Poster presentation delivered at the FASCON 3rdinternational conference, Lead City University Ibadan, Ibadan, Oyo State. November 2022.

Certifications

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- **Responsible Conduct of Research**

CITI Program

- **Conduct of Biomedical Research**

CITI Program

________________________ ________________________

Signature Date

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The University Compliance Certification

This is to certify that this thesis by Abdulaziz Abubakar RASHEED, with Matric No. LCU/PG/002280 in the Department of Public Health, Faculty of Allied and Health Sciences, Lead City University, Ibadan is in full compliance with the approved University format.

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_______________________ _______________________

Signature Date

Do Not Copy, Lead City University, Nigeria

TELEGRAMS................ TELEPHONE................

MINISTRY OF HEALTH

DEPARTMENT OF PLANNING, RESEARCH & STATISTICS DIVISION

PRIVATE MAIL BAG NO. 5027, OYO STATE OF NIGERIA

Your Ref. No. ....

All communications should be addressed to the Honorable Commissioner quoting

Our Ref. No.AD 13/479/ 44560[B]

25th August, 2022

The Principal Investigator,
Department of Public Health,
Faculty of Public Health,
Lead City University,
Ibadan, Nigeria.

Attention: Rasheed Abdulaziz

ETHICS APPROVAL FOR THE IMPLEMENTATION
OF YOUR RESEARCH PROPOSAL IN OYO STATE

This is to acknowledge that your Research Proposal titled: "Risk Factors and Prevalence of Hypertension among Women of Reproductive Age with HIV in Ibadan, Nigeria." has been reviewed by the Oyo State Ethics Review Committee.

2. The committee has noted your compliance. In the light of this, I am pleased to convey to you the full approval by the committee for the implementation of the Research Proposal in Oyo State, Nigeria.

3. Please note that the National Code for Health Research Ethics requires you to comply with all institutional guidelines, rules and regulations, in line with this, the Committee will monitor closely and follow up the implementation of the research study. However, the Ministry of Health would like to have a copy of the results and conclusions of findings as this will help in policy making in the health sector.

4. We wish you all the best.

Dr. Abbas Gbolahan
Director, Planning, Research & Statistics
Secretary, Oyo State, Research Ethics Review Committee

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