Survival Pattern, Co-morbidity, and Quality of Life of Adult HIV Patients on Antiretroviral Therapy in Bauchi State, Nigeria

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In Partial Fulfilment of the Requirements for the Award of Doctor of Philosophy Degree (PhD) in Public Health

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Certification

This is to certify that Ekerette Emmanuel UDOH, with Matriculation Number LCU/PG/002555 carried out this research work titled 'Survival pattern, Co-morbidity, Quality of Life of adult HIV patients on Antiretroviral Therapy in Bauchi State, Nigeria' in the Department of Public Health, Faculty of Basic Medical and Health Sciences, Lead City University, Ibadan, Oyo State, for the award of Doctor of Philosophy Degree (PhD) in Public Health (Epidemiology) and that this has not been previously submitted.

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Dedication

This work is dedicated to individuals in our country Nigeria, in local populations, who are facing various health challenges and need interventions to improve their quality of life.

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Acknowledgment

I am sincerely grateful to Lead City University, Ibadan, for providing support and the foundation for this research. I also wish to acknowledge the Society for Family Health and the KP-Care2 Project for granting access to retrospective data and allowing surveys to be conducted with clients at the selected ART treatment facilities.

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To all those who regularly asked about the progress of my PhD and wished me success, I say "Thank you".

Even though the above-mentioned institutions and persons have assisted in the process of this research work, I alone stand responsible for the errors (if any) found in the work.

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Abstract

Background: Antiretroviral therapy (ART) has greatly improved the survival and quality of life (QOL) for individuals living with HIV. However, challenges in the prevention of HIV-related mortality and poor retention of patients in ART treatment pose threats to effective ART interventions. The co-existence of infections and non-infectious diseases also complicate the outcomes of ART, resulting in debilitating health and poor QOL of people living with HIV (PLHIV). This study investigated the survival pattern, comorbidities, and QOL of PLHIV in Bauchi state, Nigeria. **Methods**: A retrospective cohort of 5,608 HIV-positive adults aged 15 years and older, from two Local Government Area (LGA) clinics between January 2020 and December 2022. A cross-sectional survey of 790 adult PLHIV, 18yrs and older, currently undergoing treatment in same facilities was also conducted between May and October 2023. Retrospective data was extracted from electronic medical record (EMR) and analyzed to assess ART outcomes including treatment interruption, lost-to-follow-up, mortality, and viral load suppression, and their incidence was determined. Kaplan-Meier survival analysis modelled probability estimates of treatment outcomes, while Cox proportional hazard was modeled to identify predictors of survival such as Body Mass Index (BMI) and viral load status**.** Survey dependent outcomes included symptoms, comorbidities, adherence to ART, and QOL of PLHIV measured with standardized scales. Analysis described PLHIV outcomes and their predictors. While the Structural Equation Model (SEM) was employed to test the hypothesis of the QOL scale with the domain - physical, psychological, social, environmental, spiritual, and economic - to examine how they interact and contribute to the overall quality of life. **Results**: Mean sample age in retrospective data was 36±8 years. Incidence of treatment interruption decreased over the three years from 33.33 to 27.23 per 100 person years (PY). Incidence of Mortality decreased from 27.78 to 0.81 per 100PY. Having viral load <1000 copies/ml exhibited significantly reduced hazards of lost-to-follow-up (HR = 0.14, 95% CI: 0.06 - 0.33, $p < 0.001$), and mortality (HR = 0.26, 95% CI: 0.10 - 0.64, $p = 0.003$) compared to those with higher viral loads. Being overweight had protective influence on mortality (HR = 0.07, 95% CI: 0.01 - 0.36, $p = 0.001$), while being underweight increased hazard of mortality (HR = 2.64, 95% CI: 1.07 - 6.51, $p = 0.036$), compared to having normal BMI. Significant burden of HIV symptoms (85%), co-infections (35%), and non-infectious comorbidity (37%) was demonstrated. Low ART adherence significantly predicted co-morbidity (OR: 3.29, 95% CI: 1.34, 8.36, $p = 0.010$). High ART adherence exhibited better QOL ($\beta = -12$, 95% CI: -14– -9.5, $p < 0.001$). SEM revealed complexities in QOL factors, indicating that the factors may not align well with the original hypothesis regarding the population. **Conclusion:** The findings show reductions in ART treatment interruption, lost-to-follow-up, and mortality rates, though challenges with infectious and non-infectious comorbidities, and quality of life remain. Integrated interventions should focus on improving the nutrition and health of PLHIV.

Keywords: Antiretroviral treatment outcomes, Quality of life, Comorbidities, ART adherence, PLHIV.

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List of Acronyms

Abbreviation	Meaning
AIDS	Acquired Immunodeficiency Syndrome
AIC	Akaike Information Criterion
ART	Antiretroviral Therapy
AZT	Zidovudine (Antiretroviral Drug)
BASHREC	Bauchi State Health Research Ethics Committee
BMI	Body Mass Index
CD4	Cluster of Differentiation 4
CBO	Community-Based Organization Programs
SCQ	Self-Administered Comorbidity Questionnaire
CAPI	Computer-Assisted Personal Interview
CI	Confidence Interval
CFA	Confirmatory Factor Analysis
CTX	Cotrimoxazole
CTL	Cytotoxic T Lymphocytes
CP	Cumulative Prevalence
CVD	Cardiovascular Disease
EMR	Electronic Medical Record
GDP	Gross Domestic Product
HAART	Highly Active Antiretroviral Therapy
HR	Hazard Ratio
HBV	Hepatitis B Virus

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HCV	Hepatitis C Virus
HSV	Herpes Simplex Virus
HIV	Human Immunodeficiency Virus
HIV-SI Index	HIV Symptom Index
HTS	HIV Testing and Counseling Services
HID	Hospital Identification Number (UHID)
HPV	Human Papillomavirus
NAIIS	Nigeria AIDS Indicator and Impact Survey
IQR	Interquartile Range
IPT	Isoniazid Preventive Therapy
KP-CARE-2	Key Population Community HIV Service for Action and Response
LAMIS	Lafiya Management Information System
LGA	Local Government Area
MMAS-8	Morisky Medication Adherence Scale
MMD	Multi-Month Dispensing
OR	Odds Ratio
OSS	One-Stop-Shop
PY	Person Years
PLHIV	People Living with HIV
QOC	Quality of Care
QUOTE Instrument	Quality of Care through the Patient's Eyes
RNA	Ribonucleic Acid

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RMSEA	Root Mean Square Error of Approximation
SRMEA	Standardized Root Mean Square Error of Approximation
STIs	Sexually Transmitted Infections
SEM	Social Ecological Model
SFH	Society for Family Health
SD	Standard Deviation
STR	Single-Tablet Regimen
TLI	Tucker-Lewis Index
TB	Tuberculosis
UNAIDS	Joint United Nations Programme on HIV/AIDS
VL	Viral Load
WHO	World Health Organization
WHOQOL HIV BREF	WHO Quality of Life HIV BREF

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CHAPTER ONE

1 Introduction

1.1 Background

The Human Immunodeficiency Virus (HIV) is an important infectious disease epidemic contributing to high morbidity and mortality especially in the global south. HIV infection targets the immune system and results in the progressive deterioration of the immune system, breaking down the body's ability to fend off some infections and other diseases. There are two types of HIV: HIV-1 and HIV-2. HIV-1 is responsible for the vast majority of HIV infections globally[1]. As the virus destroys and impairs the function of immune cells, infected individuals gradually become immunodeficient[2]. Immune function is typically measured by cluster of differentiation 4 (CD4) cell count which are the cells responsible to fight infections in the body[3]. The most advanced stage of HIV infection is acquired immunodeficiency syndrome (AIDS), which can take many years to develop if not treated, depending on the individual[4]. AIDS is defined by the development of certain cancers, infections or other severe long-term clinical manifestations[5].

Globally, Nigeria is ranked second among the highest burden of HIV with an estimated 1.9 million people living with the disease[6]. With the high burden of the disease the health sector continues to be strained with combating the disease amidst the generally low budgetary allocation to healthcare in the country, with a current health expenditure per gross domestic product (GDP) of 3.03% as of 2019[7]. Nigeria has maintained steady decrease on the incidence of the disease in the past decades given the national commitments and efforts in development and testing of new interventions, and by adopting recommended pragmatic strategies in the disease control and surveillance. Despite the

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immense contributions of several international efforts through funding to combat HIV in Nigeria, HIV/AIDs remain a significant burden of public health threat in the country.

Antiretroviral therapy (ART) for the treatment of HIV has help immensely in the reduction in the burden of HIV. ART is a treatment for individuals living with HIV that helps to suppress the virus and improve immune function. It is an effective way to manage the disease and can greatly improve the quality of life for those who are able to access it. However, access to ART treatment is not universal, and remains a problem in resource limited settings, and many people with HIV still do not receive the care they need[8]. Despite the impact of ART on HIV treatment, the challenge of HIV treatment is multifaceted and include the issues of survival and ensuring long-term retention, adherence to ART medication, and management of comorbidities to achieve optimal health outcomes and prevent transmission.

Taking ART consistently and correctly is essential for the treatment to be effective, but it can be difficult for some people to maintain the required regimen. Factors such as stigma, social support, and side effects of the medication can also affect a person's ability to adhere to treatment[9]. Improving adherence to ART is essential for the long-term survival of people with HIV. Retaining individuals in HIV treatment is crucial for improving health outcomes and reducing transmission rates. Studies have shown that retention in care is associated with improved survival rates among individuals with HIV[10]. However, challenges to retention in care remain, particularly among vulnerable populations such as those with substance use disorders or unstable housing[11, 12].

Co-morbidities, or the presence of multiple chronic diseases, also impact the health and well-being of people with HIV and are among the major issues in HIV management. Co-morbidities with HIV is a common problem which increases the risk of mortality among people living with HIV.

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Common co-morbidities of HIV include tuberculosis (TB), hepatitis C virus (HCV) infection, cardiovascular disease (CVD), mental health disorders, and certain cancers. These co-morbidities can impact the progression and management of HIV and can negatively affect the overall health of individuals with HIV. Addressing and managing these co-morbidities is critical for improving health outcomes and quality of life among individuals with HIV.

Despite the challenges in HIV management, ART treatment has been shown to greatly improve the quality of life and survival rates of people with HIV. Studies have shown that ART can reduce the risk of death for people with HIV by more than 90%[13]. And people with HIV and on ART can have a normal life expectancy[14]. Adherence to ART is critical for achieving and maintaining viral suppression, as well as preventing the development of drug-resistant strains of HIV. It is a powerful tool for managing the disease and improving the quality of life for those who are able to access it. However, addressing the continued challenges to optimal management of HIV and achieving viral suppression also requires understanding of the complex interplay between co-morbidities, retention in care, adherence, and determinants of survival, including socio-economic factors, mental health, and substance use. Identifying and addressing these factors can help improve the quality of care, reduce health disparities, and improve health outcomes for individuals with HIV. This research aims to analyse the survival patterns, co-morbidities, and quality of life of adult HIV patients on ART in Bauchi State, Nigeria, and to identify the factors associated with mortality, retention in treatment, adherence, and treatment outcomes. The results of this study may also provide useful lessons for other countries in sub-Saharan Africa and increase understanding of the epidemiology of the disease.

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1.2 Statement of the Problem

Despite the availability of antiretroviral therapy, HIV/AIDS remains a significant public health concern, particularly in adults. Patients on ART often face adherence challenges due to side effects, pill burden, and psychosocial factors, risking viral rebound and treatment failure. Co-morbidities add to complicate treatment worsening survival and quality of life. Understanding ART or survival outcomes such as treatment interruptions, lost to follow-up, mortality, and viral load suppression is essential for providing targeted interventions, improving patient retention, and optimizing long-term treatment success in HIV care programs. Furthermore, examining the dynamics of co-morbidities and their effects on the quality of life of adult HIV patients on ART is vital for improving their overall management and health outcomes. Thus, there is a pressing need to address the gaps in knowledge regarding the survival patterns, co-morbidities, and quality of life of adult HIV patients on ART to optimize their health and well-being.

1.3 Rationale of Study

In 2021 Africa contributed about 60% of all people living with HIV in the world[15]. In Nigeria, about 1.9 million people were living with HIV with 130,000 new infections in 2018[16]. Recent reports indicate that many regions of the world with high incidence of HIV including Nigeria did not achieve the 2020 milestone for the control of HIV infections[17]. Globally, an estimated 37.7 million people were receiving HIV treatment in 2020, however, only 73% of the 37.7 million people living with HIV in 2020 were receiving ART[18]. Some of the shortcoming for the control and reduction of HIV burden emanate from lack of adequate infrastructures and funding to meet the demands on the increasing population of these countries, and the disproportionate and poor economic situation of the population[19, 20]. Other factors that contribute to the problem and the

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growing spread of HIV disease include: poor adherence to treatment, poor perception andknowledge about prevention of the diseases, co-morbidities and co-infections with other diseases such as tuberculosis (TB); Hepatitis C Virus; and Hepatitis B (HBV)[21, 22]. Co-morbidities such as mental health problems, diabetes and cardiovascular issues also compound the impact of the disease to patients. Other issues such as lack of clinics available to provide quality treatment service for patients and the in-efficiencies and inadequacies in control programs to deliver on interventions, including prevention and treatment management, and on the surveillance for case identification and proper follow-up continually bedevil the control of HIV disease[23].

According to the Nigeria National Strategic Framework on HIV (2021 - 2025), the goal of the nation is to fast-track the national response towards ending AIDS as a public health threat in Nigeria by 2030[24]. To achieve this goal it is important to gather new evidences and to understand the epidemiologic realities of the people living with HIV (PLHIV) and how to manage the disease and its co-morbidities. It is crucial to conduct research to understand the disease better, improve treatment options, and develop strategies to prevent its spread. In addition, understanding the experiences of HIV/AIDS patients can help healthcare providers better support and care for them. Conducting research among HIV/AIDS patients can help to fill knowledge gaps about HIV/AIDS and lead to new treatments and interventions.

1.4 Research Questions

1. What are the survival patterns on treatment (mortality, viral load suppression, treatment interruption and discontinuation?) of adults HIV patients receiving ART?
2. What are the factors associated with survival in ART treatment?
3. What is the prevalence and determinants of HIV treatment adherence?

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4. How does adherence influence treatment outcome?
5. What is the prevalence and correlates of common HIV co-morbidities among people living with HIV?
6. What are the individual's, social, and behavioural determining factors of the co-morbidities in HIV among people with the infection?
7. How does co-morbidity associate with treatment outcomes?
8. What is the quality of life (QOL) of people living with HIV and the perceived quality of care (QOC) of HIV treatment in public health facilities?
9. How does QOL impact the treatment outcomes of people living with the disease?

1.5 Research Objectives

Main Objective

The objective of this study is to investigate the survival pattern, co-morbidity, and quality of life of Adult HIV Patients on antiretroviral therapy. The information from this study will be useful for developing strategies for improving the overall health and quality of life of PLHIV.

Specific Objectives:

The specific objectives are to:

1. Assess the survival patterns and retention in treatment in a 3-year cohort of adult HIV patients on antiretroviral therapy.
2. Assess the factors associated with survival in ART treatment.
3. Assess the prevalence and determinants of HIV treatment adherence.
4. To assess the levels and risk factors of adherence to HIV treatment and its influence on survival.

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5. To document the specific co-morbidities among HIV patients by the end of a 3-year study period
6. To evaluate the quality of life and perceived quality of HIV care among adult patients, and determine how these factors relate to co-morbidities and survival outcomes.

1.6 Hypotheses

Some key hypotheses for this study are as follows:

Ha1: Patients with higher viral loads, treatment interruptions, or poorer demographic and behavioral characteristics (e.g., lower education, substance abuse history, or co-morbidities) are more likely to experience poor survival patterns, reduced treatment retention, and higher mortality rates.

Ha2: Patients with better clinic characteristics (e.g., normal BMI, higher treatment adherence) and those reporting higher quality of life are more likely to have improved retention in treatment, better viral load suppression, and fewer co-morbidities.

Ha3: Demographic and clinical factors (e.g., age, gender, education, viral load) will moderate the relationship between HIV comorbidities and outcomes, while there may be a significant gap between the perceived importance of health interventions and their actual performance.

1.7 Scope of Work

This study employed a quantitative analysis of retrospectively extracted data for a cohort of adult HIV patients enrolled in ART at selected health facilities to analyze the survival patterns in Bauchi State, Nigeria. In addition, a cross-sectional survey was conducted among HIV patients currently

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undergoing treatment at these facilities to gather comprehensive epidemiological data, including co-morbidities, medication adherence, quality of life outcomes, and the perceived quality of care of PLHIV while receiving ART. The combined approach provides a robust analysis of treatment outcomes and patient well-being.

1.8 Limitations of the Study

- The aspect of the study which was based on secondary data had several incomplete data which affected the sample and caused exclusion of some records from the analysis.
- Part of the information on individuals from the retrospective study were missed because of censored observations.
- In the survey, participants may have faced difficulty accurately recalling past health events, which could introduce recall bias and affect the accuracy of their responses.
- Participants may have been reluctant to report negative experiences or behaviours that they perceived as stigmatizing, which could affect the accuracy of their responses.
- The results of the survey may only be applicable to the population surveyed and may not be generalizable to other populations of PLHIV.
- The survey relied on self-reported data from participants, which may not be consistent with clinical measures.

1.9 Operational Definition of Terms

Survival in Treatment

When a patient is known to be alive as evidenced by their clinical follow up till the end of the study period[25]. In this study survival in the sense of living up till end of the study period refers to PLHIV ART outcomes such as continuous or non-interruption in treatment, retention in treatment,

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or to live follow-up. Additionally, suppression of viral load is also assessed. Contrarily, the event of non-survival in treatment include treatment interruption, lost-to-follow up, non-suppressed viral load, and mortality.

Retention in ART Treatment

Retention in care is defined as a patient's regular engagement with medical care at a health care facility after initial entry into HIV clinical care . This involves patient's continued engagement in health services and captures the whole 'continuum of HIV care': from enrolment in care to discharge/death of the client.

Mortality Rate

A mortality rate is a measure of the frequency of occurrence of death in a defined population during a specified interval[26].

Treatment Interruptions (Ever interrupted treatment)

This is defined as patients not picking up ART drug after 28 days of appointment at any point throughout the repeat visits[27].

Loss-to-Follow-Up

Loss to follow-up' refers to clients who disengaged from care at any stage of the continuum of care[28]. In this study loss-to-follow-up is defined as patients who did not pickup and ART drug after 28 days of their last pickup appointment and never returned to take drugs[29].

Viral Load Suppression

Viral load suppression refers to the reduction of the amount of HIV virus in the blood to very low levels. This indicates that viral load testing result measured by the amount of RNA in the blood plasma is below a threshold of 1000c/ml[30].

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Incidence for Survival on ART

In this study, incidence of the survival outcome is defined as the rate of new cases or events (survival outcomes) over a specified period for the population at risk for the event[31].

Adherence to Treatment

Adherence (to treatment) signifies the extent a client follows a prescribed medication or treatment regimen. Adherence to ART treatment refers to the extent to which a person takes their HIV medications as prescribed by their healthcare provider.

Co-morbidity

Is defined as the is the occurrence or the existence of any distinct additional medical condition to an index disease[32]. In other words it is the existence of a distinct, separate disease or disorder that is present during the course of a primary disorder or disease that is the focus of attention.

Quality-of-Life

Quality of life is defined as 'individuals' perception of their position in life in the context of the culture and value systems in which they live, and in relation to their goals, expectations, standards and concerns[33].

Perceived Quality of Healthcare

Patients perceived quality healthcare refers to patients' view of services received and the results of the treatment and are monitored to assess the delivery and quality of healthcare[34].

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CHAPTER TWO

2 Literature Review

2.1 Epidemiology of HIV

2.1.1 Global epidemiology of HIV/AIDS

Over the past three decades since the start of the HIV epidemic over 84.2 million people have become infected with HIV, and 40.1 million people have died from AIDS-related illnesses[1]. In 2021 alone it was estimated that about 38.4 million people were living with HIV, and the number of new HIV infection was estimated to stand at around 1.5 million. Despite the extensive interventions and research carried out to end the HIV epidemic, the prospect of a cure for the disease remains many years in sight, as no vaccine, which is a key intervention for an infectious disease eradication, is yet to be developed. Recent data on the emerging global trends of HIV shows that the burden of the epidemic continues to vary considerably between countries and regions. However, the global prevalence of HIV among adults (aged 15 – 49 years who are infected) has levelled since 2021 and was 0.8%[2]. The burden of HIV/AID is higher in low- and middle-income countries accounting for 68% of HIV cases globally.

Sub-Saharan Africa has been most severely affected as it accounts for 25 million of the 38 million persons living with HIV (*Table 2-1*)[3]. Of the estimated worldwide deaths due to HIV/AIDS, 2.2 million (75% of the total) are estimated to be in sub-Saharan Africa.2.2 million (or 75% of the total) deaths attributed to HIV/AIDS are thought to have occurred in sub-Saharan Africa.

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Table 2-1 Estimated number of people living with HIV, all ages, 2020−2021 [4]

WHO region	Estimated number of people living with HIV, 2020	Estimated number of people living with HIV, 2021
African Region	25 300 000	25 600 000
	[23 200 000–28 300 000]	[23 400 000–28 600 000]
Region of the Americas	3 700 000	3 800 000
	[2 800 000–4 500 000]	[2 900 000–4 700 000]
South-East Asia Region	3 800 000	3 800 000
	[3 300 000–4 400 000]	[3 300 000–4 400 000]
European Region	2 700 000	2 800 000
	[2 400 000–3 000 000]	[2 500 000–3 100 000]
Eastern Mediterranean Region	410 000	430 000
	[360 000–570 000]	[380 000–600 000]
Western Pacific Region	1 900 000	1 900 000
	[1 300 000–2 300 000]	[1 400 000–2 400 000]
Global	37 800 000	38 400 000
	[33 300 000–43 100 000]	[33 900 000–43 800 000]

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Although there has been a reduction of AIDS-related death by 68% since the peak in 2004 and by 52% since 2010[5]. HIV remains the leading cause of death globally. In 2021, around 650 000 people died from AIDS-related illnesses worldwide, compared to 2.0 million people in 2004 and 1.4 million people in 2010, See *Figure 2-1*. Women are the most affected as they are more vulnerable to HIV infection[6]. Adolescent girls and young women (aged 15 to 24 years) - one of whom becomes infected with HIV every three minutes are three times more likely to acquire HIV than adolescent boys and young men of the same age group in sub-Saharan Africa[7]. Women and girls accounted for 49% of all new infections in 2021, and in sub-Saharan Africa women and girls accounted for the 63% of all new HIV infections in 2021.

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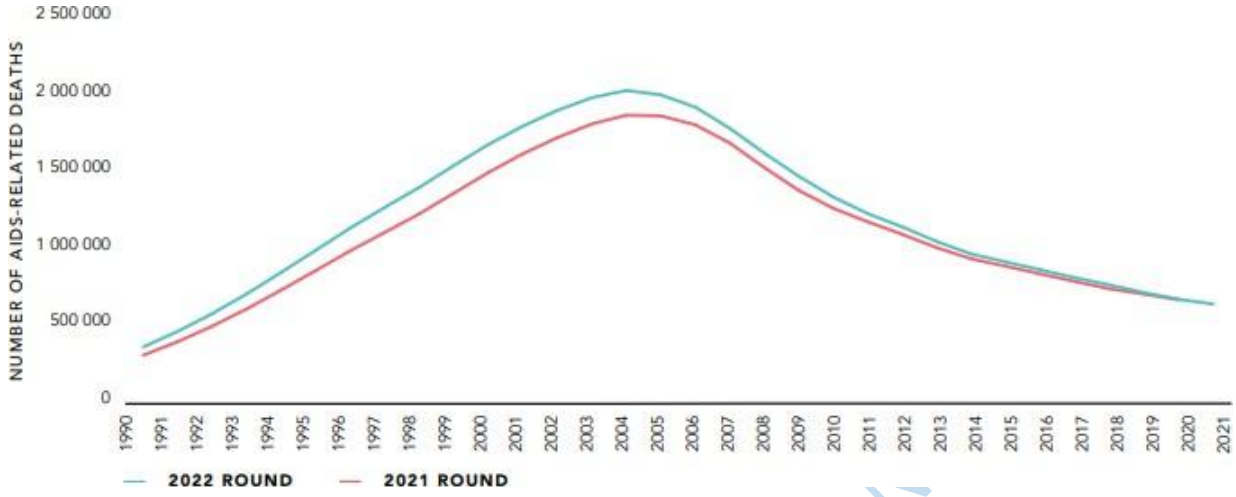


Figure 2-1 Global AIDS-related deaths - comparison of 2022 to 2021 UNAIDS estimates[8]

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2.1.1 HIV Situation in Nigeria

In Nigeria the burden of HIV has been declining. The number of new infections in Nigeria is among the highest of any country in the world. In 2019, Nigeria had an estimated 107,112 total new infections. New infections declined approximately 10% between 2010 and 2019, but progress has stagnated in recent years[9]. *Figure 2-2* shows the trend of the estimated new cases of HIV in the country since 2010 to 2021. The trend shows a significant drop on the burden of HIV since 2010 at around 120,00 total new infections to 74,000 cases in 2021[10]. *Figure 2-3* shows the trend of HIV related mortality since 2010. The trend shows a consistent drop in the number of people who have died from HIV-related cases. Number of deaths dropped from 82,000 in 2010 to 51,000 as of 2021[11].

From epidemiologic surveys and routinely collected programme data in the country, estimates indicated that the HIV prevalence nationally among people aged 15-49 years peaked in 2001 at an estimated 5.8%, and has since declined significantly[12]. The 2019 Nigeria National HIV/AIDS Indicator and Impact Survey which is the most current national HIV survey data, indicates that the national prevalence of HIV among people aged 15-49 years is estimated to be 1.3% (1.2% - 1.4%)[13].

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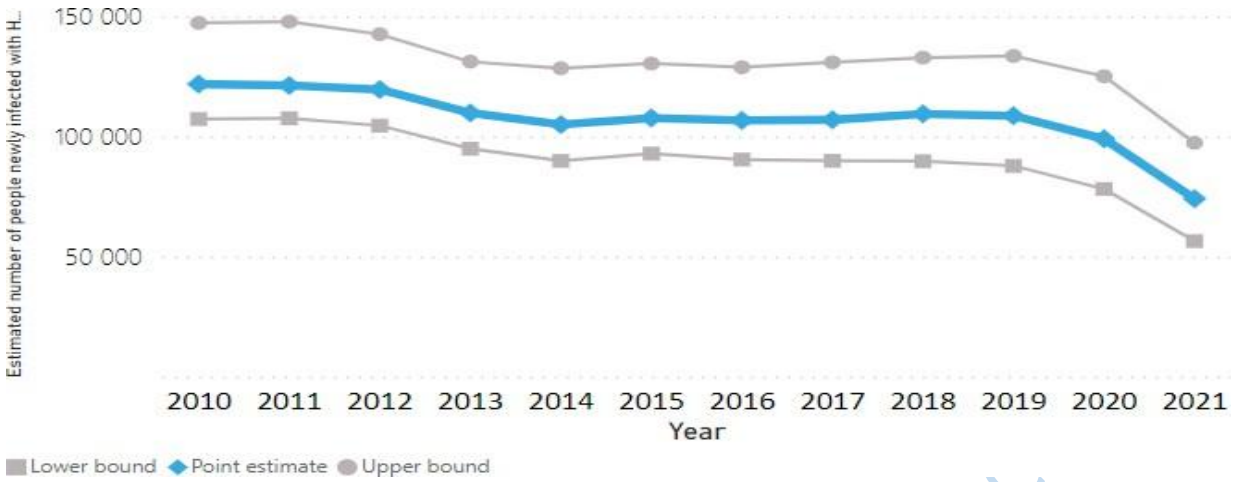


Figure 2-2 Estimated number of people newly infected with HIV in Nigeria[14]

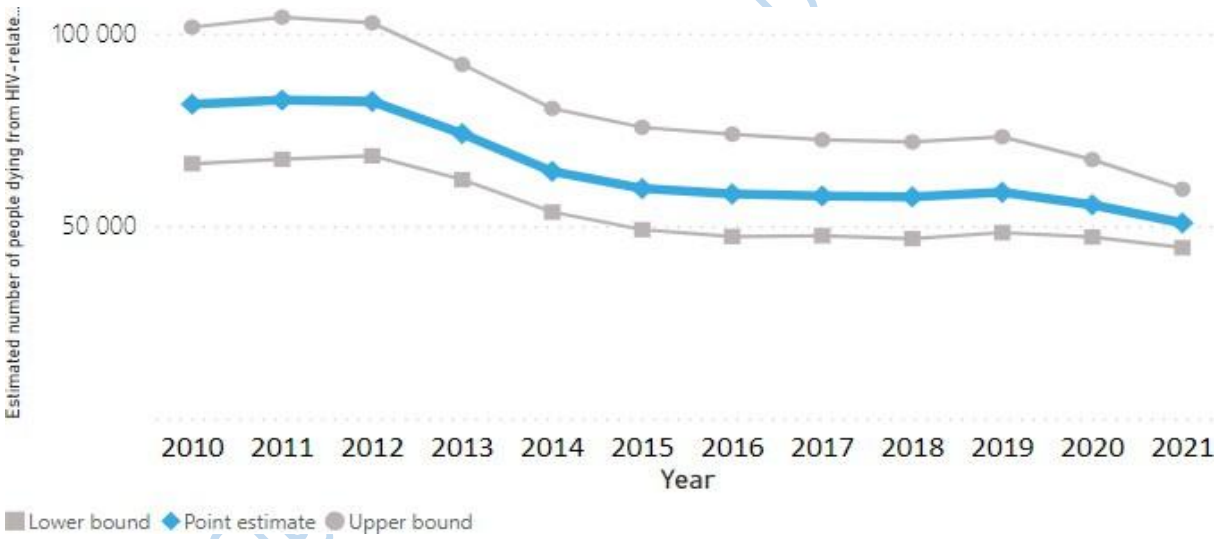


Figure 2-3 Estimated number of people dying from HIV-related causes in Nigeria[15]

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2.2 Clinical Stages and Immunological Dynamics of HIV Infection

HIV infection progresses through several stages, each marked by specific changes in the immune system and viral load[16]. The three clinical stages of HIV infection are:

1. **Acute HIV Infection**: This phase occurs within 2 to 4 weeks after exposure to HIV and lasts for the first 3 to 12 weeks[17]. It is characterized by a rapid spike in viral load (plasma RNA titer) as the virus disseminates widely, seeding lymphoid organs. Individuals may experience flu-like symptoms, known as acute retroviral syndrome. The immune system begins to respond with a sharp decline in CD4+ T cells and an increase in viremia, as depicted by the dotted line in the graph. During this period, seroconversion occurs, marking the development of antibodies to the HIV envelope (env), which also leads to a reduction in the viral load as the immune system fights back.

2. **Clinical Latency (Chronic HIV Infection)**: Following the acute phase, individuals enter a period of clinical latency or asymptomatic infection [18]. During this phase, the viral load stabilizes at a lower level, while CD4+ T cells recover partially but never return to pre-infection levels. This phase can last for years (up to 12 years or longer) with minimal or no symptoms. The body maintains HIV-specific cytotoxic T lymphocytes (CTL) that control viral replication to some extent, but the virus remains active and continues to destroy CD4+ T cells gradually[19].

3. **AIDS (Acquired Immunodeficiency Syndrome)**: When CD4+ T cell levels drop below a critical threshold (usually under 200 cells/mm^3)[20], the immune system becomes severely compromised, leading to AIDS. At this stage, individuals become highly susceptible to opportunistic infections and AIDS-related complex (ARC). Opportunistic diseases such as

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tuberculosis and fungal infections occur due to the weakened immune response. As the graph shows, the viral load increases significantly during this stage, leading to constitutional signs like weight loss, fevers, and ultimately, death if untreated.

The schema in *Figure 2-4* illustrates the natural history of HIV infection, depicting the changes in both CD4+ T cell counts and plasma RNA titers over time[21].

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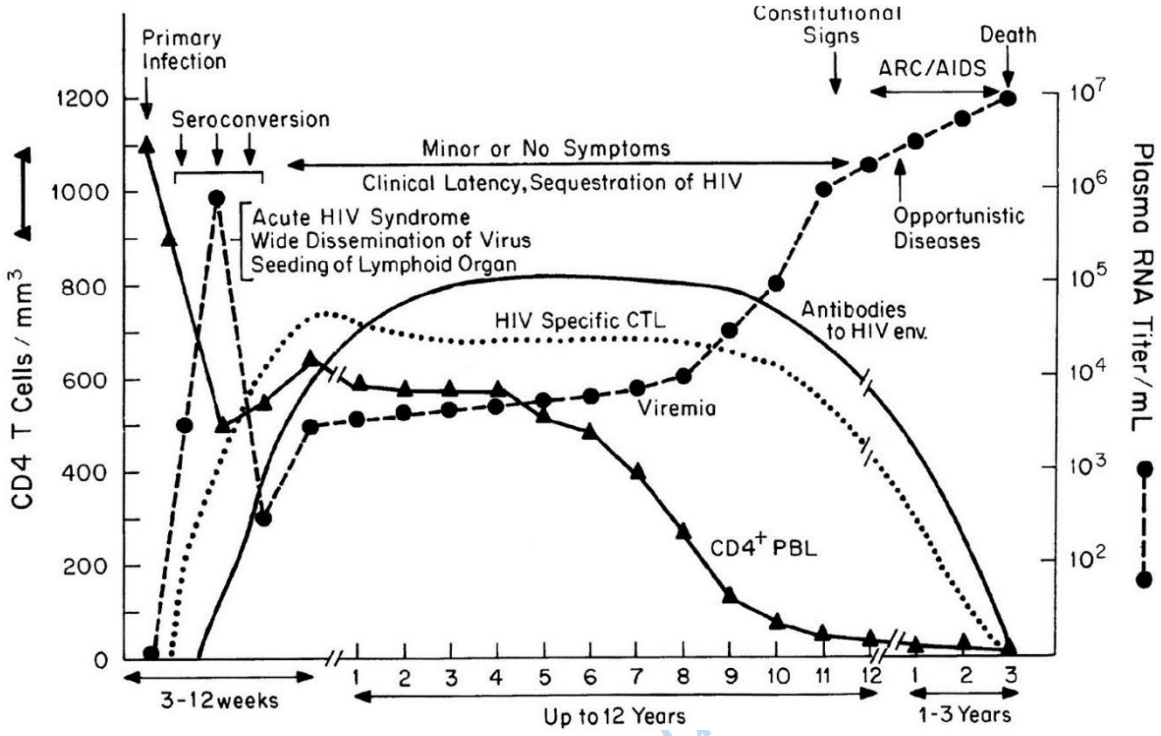


Figure 2-4 Natural history of HIV infection[22]

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2.3 Antiretroviral Therapy and HIV Treatment

The first antiretroviral drug, zidovudine (AZT), was approved in 1987 to treat people infected with HIV/AIDS. Since the introduction of ART the life of people living with HIV has significantly improved. In addition, HIV treatment with ART has undergone significant advancements over the past few decades, leading to improved treatment outcomes for individuals living with HIV. ART is a combination of medications that suppress the replication of the human immunodeficiency virus (HIV) and boost the immune system. One of the key factors affecting survival in HIV treatment is mortality. Studies have found that the mortality rate among people living with HIV who are on ART has significantly declined over the years, thanks to the improved efficacy and tolerability of ART regimens[23] . One study found that the introduction of highly active antiretroviral therapy (HAART) resulted in a significant decrease in AIDS-related mortality and opportunistic infections among HIV-positive individuals[24]. This finding was supported by a meta-analysis study, which showed that the use of HAART was associated with a 75% reduction in mortality among HIV-positive individuals[25]. Despite that ART has significant impact on HIV survival, mortality rates are still higher among people living with HIV compared to the general population. Some of the leading causes of death among people living with HIV include cardiovascular disease, liver disease, and certain types of cancers.

When patients are optimally adherent on ART the health of a patient can be significantly transformed from a potentially fatal condition to a manageable chronic disease [26]. Another important factor influencing treatment outcomes on ART is adherence to medication. A study found that adherence to antiretroviral therapy was associated with improved virologic and immunologic outcomes [27]. This study also found that poor adherence was associated with increased

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risk of disease progression and mortality. In addition to adherence, other factors that can influence HIV treatment outcomes include age, race/ethnicity, socioeconomic status, and comorbidities. In another study, it was found that older age was associated with poorer virologic and immunologic outcomes, while another literature reported that low socioeconomic status were associated with poorer treatment outcomes [28, 29].

Comorbidities, such as hepatitis C co-infection, can also impact treatment outcomes. Some studies found that HIV-positive individuals with hepatitis C co-infection had poorer virologic and immunologic outcomes compared to those without co-infection. However, the use of direct-acting antiviral therapy for hepatitis C has been shown to improve treatment outcomes in this population [30, 31].

Advancements in HIV treatment have led to the development of new drugs and treatment regimens[32]. reported that the use of a single-tablet regimen (STR) was associated with improved adherence and virologic suppression compared to multi-pill regimens. Similarly, the use of long-acting injectable therapy has shown promise in improving adherence and treatment outcomes [33].

2.4 Survival and Retention in HIV Treatment

Survival in HIV treatment refers to the length of time that an individual with HIV is able to live with the virus while on treatment [34]. In the context of HIV, survival is often measured as the length of time from the initiation of ART to death or other clinical outcomes, such as disease progression or the development of opportunistic infections[35]. Survival of HIV patients also refers to the time from the date of initiation of ART to either death, loss to follow-up, transfer to other health institutions or to live follow-up[36]. Comprehensive literature on survival in HIV treatment have shown that early initiation of ART and consistent adherence to treatment significantly improved the survival of people living with HIV[37]. A study showed that survival in ART treatment

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improves as a result of less toxic antiretroviral drugs, improved adherence, prophylactic measures, and management of comorbidity [38].

Retention in HIV treatment is an important issue that affects treatment outcomes. Retention refers to the ability of patients to remain engaged in HIV care and remain on treatment over time. Poor retention in HIV treatment can lead to treatment failure, drug resistance, and higher rates of morbidity and mortality.

Interruptions in treatment, also known as treatment disruptions, have also been shown to negatively impact the survival of people living with HIV [39]. Treatment disruptions occur when people living with HIV miss doses of their ART, discontinue therapy, or switch to a different regimen. These interruptions can lead to the development of drug-resistant strains of the virus, which can reduce the effectiveness of ART and increase the risk of morbidity and mortality[40]. Another factor that can impact survival in HIV treatment is the phenomenon of being "lost to follow-up." This refers to the situation where people living with HIV are no longer receiving medical care or are not in regular contact with their healthcare providers. This can happen for various reasons, such as lack of access to healthcare, stigma, and discrimination, and can have a significant impact on the health and survival of people living with HIV. Interruptions in treatment and being lost to follow-up can have negative impacts on the health and survival of people living with HIV and must be prevented through continued efforts to improve access to care and reduce stigma and discrimination. This will ultimately improve the quality of life of people living with HIV.

Some factors that affect retention in HIV treatment are stigma, substance use, mental health, social and economic factors, and the healthcare system factors. A study found that stigma related to HIV and ART was a significant barrier to retention in care[41]. Patients who experienced stigma were

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more likely to miss appointments, discontinue ART, and have poorer clinical outcomes. Substance use, such as drug or alcohol abuse, can interfere with adherence to treatment and attendance at medical appointments[42].

2.5 Co-morbidity in HIV

Individuals with HIV are more likely to experience other medical conditions, which are referred to as comorbidities. Comorbidities can impact the progression and management of HIV and can affect the overall health of an individual. This literature review will explore the comorbidities associated with HIV. One of the most common comorbidities of HIV is tuberculosis (TB)[43]. TB is an infectious disease caused by the bacterium Mycobacterium tuberculosis. The World Health Organization (WHO) estimates that one-third of individuals with HIV also have TB[44]. The co-occurrence of HIV and TB can complicate the diagnosis and management of both conditions. Treatment of TB in individuals with HIV can also be challenging due to drug interactions and increased risk of adverse reactions[45].

Another common comorbidity of HIV is hepatitis C virus (HCV) infection. HCV is a blood-borne virus that can cause liver damage and lead to cirrhosis and liver cancer. Individuals with HIV are at an increased risk of contracting HCV due to shared risk factors, such as injection drug use [46]. Co-infection with HIV and HCV can accelerate the progression of liver disease and increase the risk of mortality. CVD is also a comorbidity commonly associated with HIV. Individuals with HIV have an increased risk of developing CVD due to chronic inflammation, metabolic changes, and side effects of ART[47]. CVD can lead to heart attacks, strokes, and other complications that can significantly impact the health and quality of life of individuals with HIV[48] .

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Mental health disorders are also prevalent comorbidities of HIV. Depression and anxiety are common in individuals with HIV and can negatively impact adherence to ART and overall health outcomes[49]. Substance use disorders are also common in this population, and can contribute to the development of other comorbidities such as HCV and CVD[50]. Other comorbidities associated with HIV include diabetes, renal disease, and certain cancers, such as Kaposi's sarcoma and lymphoma[51].

HIV is often accompanied by multiple comorbidities that can significantly impact the health outcomes of individuals with the infection. Public health research need to highlight these co-morbidities and healthcare providers need to be aware and work to manage them effectively to improve the overall health and quality of life of individuals living with HIV.

2.6 Quality of Life of people living with HIV

Quality of life is a complex and multi-dimensional concept that is influenced by a range of physical, psychological, and social factors, including the presence of co-morbid conditions[52]. People living with HIV often face challenges related to their physical health, social stigma, and financial hardship, which can negatively impact their quality of life. Studies have shown that people living with HIV often experience decreased quality of life, particularly in the areas of physical and mental health, compared to the general population[53]. This is due in part to the long-term nature of HIV, the toxicities associated with antiretroviral therapy, and the presence of other medical conditions, such as cardiovascular disease, liver disease, and certain cancers, that are more common in people living with HIV[54,55,56].

The presence of co-morbid conditions in people living with HIV, can have a significant impact on quality of life and survival. For example, the presence of cardiovascular disease has been

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associated with increased morbidity and mortality in people living with HIV. Therefore, it is important to monitor and manage co-morbid conditions in people living with HIV to improve their quality of life and survival.

2.7 Dynamics of Continuum of Care in Enhancing ART Outcomes and Well-Being for People Living with HIV: A Socio-Ecological Perspective

The HIV Continuum of Care offers a comprehensive framework for understanding the various stages in managing HIV, from diagnosis to long-term health outcomes. In the context of ART, understanding how each stage of this continuum affects survival in treatment or treatment outcomes, the management of opportunistic infections, and the coexistence of comorbid conditions is Important for improving the overall well-being of PLHIV. Despite significant advances in treatment, challenges persist in ensuring that all individuals successfully navigate through each phase of care.

The review in this section will critically examine existing research on the Continuum of HIV Care, with a specific focus on its role in managing ART outcomes. While addressing the complexities of opportunistic infections and comorbidities, the review will primarily analyze the stages of the continuum that directly influence survival or outcomes of ART, such as diagnosis, linkage to care, retention, and viral suppression. Using the Social Ecological Model (SEM) as a guiding framework, it will explore how various factors - individual, social, and structural factors influence each stage of the continuum (especially as it pertains to ART) and affect patient outcomes[57].

2.7.1 Continuum of Care Model in the Context of ART

The Continuum of Care model, also referred to as the HIV Care Cascade, provides a structured framework for tracking the progression of PLHIV from diagnosis to viral suppression[58]. The

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framework consists of five main stages: diagnosis, linkage to care, retention in care, adherence to ART, and viral suppression. Each stage is essential for the successful management of HIV and achieving long-term health benefits for patients. It plays a fundamental role in understanding how PLHIV engage with healthcare systems to ensure consistent care and better health outcomes[59].

In the context of ART, the Continuum of Care framework is vital for evaluating treatment effectiveness and identifying gaps in care. A research emphasized that the greatest drop-offs in the care continuum occur between the diagnosis and retention stages, a finding corroborated by multiple other studies, highlighting the challenges in maintaining continuous care for PLHIV[60]. According to another study, barriers such as stigma, literacy, healthcare access, and other socioeconomic factors remain significant challenges in ensuring that individuals remain engaged in care long enough to benefit from ART. Comorbidities, such as TB and mental health disorders, add complexity to treatment adherence, often impacting the ability of individuals to maintain ART[62]. Research emphasizes that interventions tailored to address these barriers, including providing psychosocial support and economic support, are effective in enhancing ART adherence and improving overall quality of life for PLHIV[63].

2.7.2 Early Diagnosis in the HIV Continuum of Care

The diagnosis stage of the Continuum of Care is a critical entry point in the management of HIV, influencing subsequent stages such as linkage to care and treatment initiation[64]. Early diagnosis significantly improves ART outcomes, reducing the risk of opportunistic infections and mortality among PLHIV. Research has consistently shown that delays in diagnosis can lead to advanced disease progression, complicating the management of HIV and any coexisting health conditions[65, 66,67]. Individual factors, including health literacy and attitudes toward healthcare, play a significant

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role in influencing diagnosis rates. For instance, a study found that individuals with a better understanding of HIV testing and its importance were more likely to seek testing early. Conversely, fear of stigma and misinformation can deter individuals, particularly within marginalized groups, from getting tested for HIV. This anxiety, often rooted in concerns about receiving a positive result, underscores the persistent social and psychological barriers to diagnosis. Addressing these barriers is crucial for enhancing early diagnosis[68,69].

Social support systems, such as family and peer networks, further impact the likelihood of early HIV testing. Research indicates that those with strong social connections are more inclined to engage with healthcare services, including seeking HIV testing[70]. In contrast, social isolation and concerns about confidentiality can lead to delays in diagnosis, emphasizing the importance of supportive environments in facilitating access to care[71].

At the structural level, the availability and accessibility of healthcare services are necessary. Many low-resource settings face significant challenges, including limited testing facilities and healthcare worker shortages, which can result in delayed diagnosis. Moreover, structural barriers, such as discriminatory practices within healthcare systems and insufficient community outreach programs, hinder access to early diagnosis, particularly for high-risk populations[72, 73].

Recent innovations, such as community-based testing and self-testing initiatives, have shown potential in improving early diagnosis rates[74]. These approaches address some structural barriers while also leveraging social networks to reduce stigma and enhance access to testing[75]. Recently the introduction of HIV rapid diagnostic self-testing has also contributed to increasing uptake to HIV testing. By integrating these methods into the healthcare continuum, it is possible to facilitate timely diagnosis and ultimately improve ART outcomes for PLHIV, enhancing their overall quality of life. According to studies, in order to achieve the priority goal of the early diagnosis of

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HIV-infected individuals, it is essential not to miss opportunities in health services and to increase the availability of rapid tests to reach asymptomatic individuals with CD4+ cell counts above 500 cells/mm3 and without opportunistic diseases[76].

2.7.3 Linkage to care in HIV Continuum of Care

Linkage to care is a pivotal phase in the HIV Continuum of Care, significantly impacting treatment outcomes and overall health for PLHIV[77]. This stage involves ensuring individuals diagnosed with HIV are promptly connected to necessary healthcare services, including ART.

Early ART initiation is linked to improved health outcomes, including sustained viral suppression, reduced transmission risk, and increased longevity[78]. Studies demonstrate that timely linkage enhances ART adherence and retention crucial for optimal treatment outcomes[79]. Various factors influence linkage to care, including individual circumstances, healthcare infrastructure, and social determinants[80]. Research indicates that barriers like stigma, lack of awareness, and socioeconomic challenges can hinder the transition from diagnosis to care[81,82,83]. For instance, financial difficulties may impede access to transportation or affordable care. Social support systems play a crucial role in encouraging healthcare engagement[84]. Individuals with strong social networks are more likely to adhere to ART and attend regular check-ups, emphasizing the importance of community-based interventions fostering support[85]. Tailored interventions are essential for successful linkage to care. Programs offering immediate follow-up appointments, combined with supportive services like counseling and transportation assistance, can effectively increase ART initiation[86]. Outreach efforts targeting underserved populations, such as adolescents and marginalized communities, are crucial for enhancing overall treatment initiation rates[87]. By

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addressing multifaceted barriers to care, healthcare systems can improve linkage and subsequent health outcomes for PLHIV.

Addressing co-morbid conditions during linkage is vital. Many PLHIV present with co-occurring health issues like tuberculosis or mental health disorders, which can complicate care engagement[88]. Integrating treatment for these conditions alongside ART can improve retention in care and enhance overall HIV treatment effectiveness. Studies have reported evidence suggesting that patients receiving comprehensive care for both HIV and related health issues experience better health outcomes, highlighting the need for an integrated approach at this critical stage[89].

2.7.4 Retention in HIV Care Continuum

Retention in care is a fundamental aspect of the HIV Continuum of Care, significantly impacting the effectiveness of ART. Maintaining consistent engagement with healthcare services is crucial for achieving sustained viral suppression and overall health improvements for PLHIV. However, numerous challenges hinder patients' ability to remain in care, often stemming from a combination of individual, social, and structural factors[90]. For instance, socioeconomic status can significantly influence a person's ability to access and continue care, as financial constraints often limit transportation options or the ability to pay for necessary medications[91]. Research has shown that patients facing socioeconomic disadvantages are at a higher risk of dropping out of care, which can lead to poor ART outcomes and increased morbidity[92,93]. Furthermore, structural barriers such as inadequate healthcare infrastructure, long wait times, and limited availability of healthcare providers can dissuade individuals from returning for follow-up appointments[94]. Additionally, stigma associated with HIV can further complicate retention efforts, as individuals may fear discrimination or judgment when seeking care[95]. These barriers can create a vicious

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cycle of disengagement, leading individuals to feel discouraged from returning to care and ultimately impacting their health outcomes.

Effective interventions to improve retention in care must address these multifaceted challenges. For example, community-based approaches that offer support services, financial initiatives, have shown promise in enhancing patient engagement[96]. Several studies have shown that programs that incorporate case management and peer support can foster ongoing communication between patients and healthcare providers, helping to keep individuals motivated and informed about their treatment options[97]. Additionally, integrating mental health services into routine HIV care can address the psychological barriers that many patients face, fostering a more supportive environment for those at risk of dropping out[98]. The interplay of these factors illustrates the need for a comprehensive understanding of the environment in which PLHIV seek care. Tailoring interventions to meet the specific needs of diverse populations can lead to improved retention rates. Targeted outreach to marginalized communities, including youth and individuals with concurrent health issues, can help bridge the gap in care and foster long-term adherence to ART[99].

2.7.5 Adherence to ART in Care Continuum

Successful HIV management relies on individuals living with HIV consistently adhering to ART, which directly influences viral suppression and health outcomes. Social and structural factors significantly affect a patient's ability to take medication regularly[100]. Research has shown that strong social support systems, including family involvement and community engagement, significantly contribute to treatment adherence[101]. For instance, some researchers found that individuals with robust social networks were more likely to adhere to their treatment regimens, underscoring the importance of community ties in fostering positive health behaviors[102].

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Despite these supportive factors, numerous challenges can impede treatment adherence, particularly those stemming from structural barriers within healthcare systems[103]. Additionally, healthcare environments lacking cultural competence can alienate PLHIV, diminishing their motivation to engage with ART[104].

To ensure better ART outcomes, a comprehensive approach addressing challenges faced by PLHIV is crucial. Interventions should not solely focus on individual adherence behaviors but also consider the broader social and structural contexts in which patients live.

2.7.6 Viral Load Suppression in Care Continuum

Achieving viral suppression is the ultimate goal of ART for individuals living with HIV. This critical milestone not only signifies effective treatment but also significantly improves long-term health outcomes, including reduced mortality and enhanced quality of life. Research consistently demonstrates that sustained engagement in the continuum of care is paramount for achieving viral suppression. Studies indicates a strong correlation between consistent care participation and improved viral suppression rates, underscoring the necessity of ongoing patient involvement.

The importance of continuous care cannot be overstated, as treatment interruptions can lead to viral rebound and increased transmission risk. According to the World Health Organization, maintaining an undetectable viral load is essential for both individual health and public health efforts to prevent HIV transmission[105]. HIV Prevention Trials Network 052 study further supports this, demonstrating a 96% reduction in HIV transmission among serodiscordant couples with early ART initiation and consistent adherence[106]. Addressing factors that influence retention in care is therefore crucial for fostering viral suppression. Social determinants significantly impact viral suppression outcomes. Peer-support with routine medical care is superior to routine clinic follow-

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up in improving outcomes for people living with HIV. A study emphasized the role of peer support interventions in fostering adherence, particularly among those experiencing isolation or discrimination. Creating supportive environments that empower individuals to seek and maintain care is essential for facilitating better health outcomes[107,108].

Comorbidities, often accompanying HIV, can hinder viral suppression by complicating patient care[109]. Mental health disorders, substance use, and other chronic diseases can disrupt consistent treatment[110]. Curtailing comorbidities through prophylactic interventions, such as the use of cotrimoxazole or isoniazid preventive therapy, can help reduce the occurrence of opportunistic infections and other health complications[111]. By preventing these additional health burdens, prophylaxis helps stabilize a patient's health, improving ART adherence and ultimately supporting viral load suppression.

2.8 Conceptual Framework of the Study

Based on the study objective to investigate the survival pattern, co-morbidity, and quality of life of Adult HIV Patients on antiretroviral therapy, the conceptual framework of this study, as illustrated in *Figure 2-5*, outlines the interrelationships and dynamics between various factors affecting PLHIV who are receiving ART.

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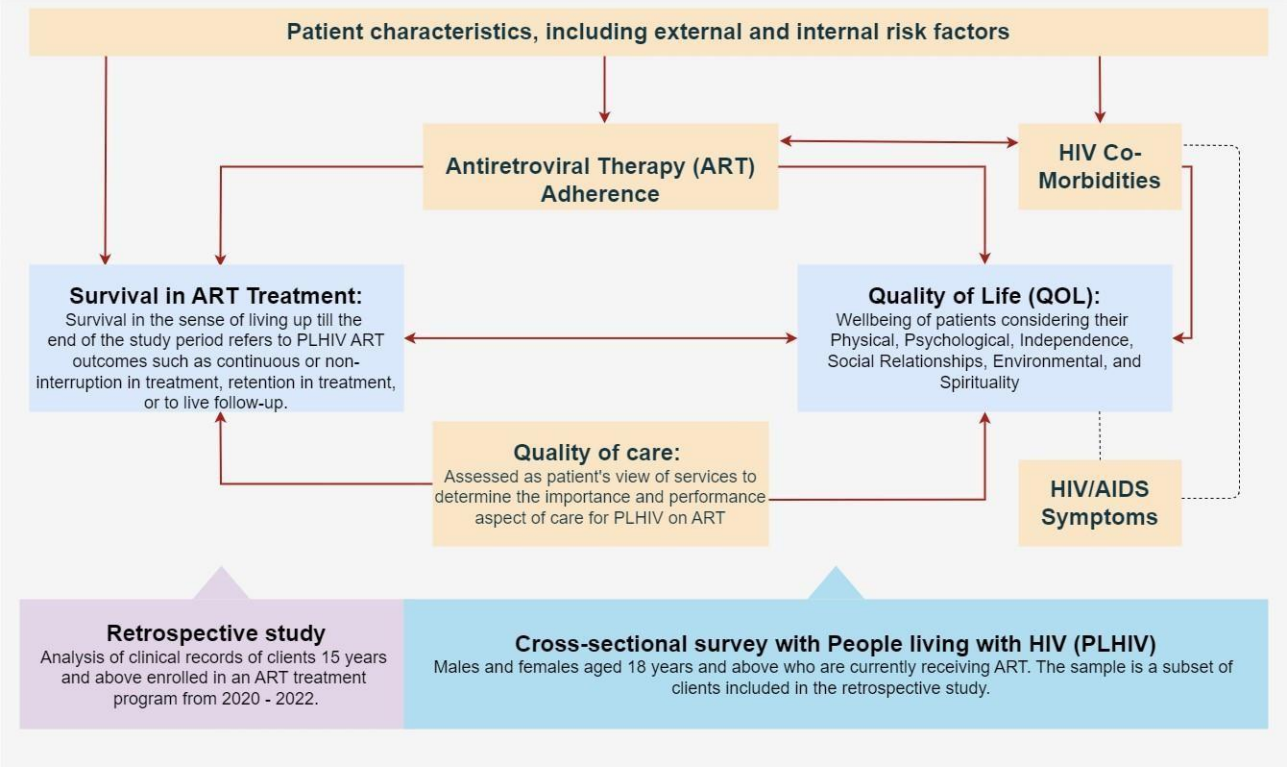


Figure 2-5 Conceptual framework for the study

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Central to the outcome of treatment on ART are the survival outcomes and quality of life of PLHIV. Survival in ART Treatment refers to the patients' ability to continue living up to the end of the study period while undergoing ART. It encompasses outcomes like continuous or non-interruption in treatment, retention in treatment, and to live follow-up. While quality of life examines the overall well-being of the patients considering various domains such as physical, psychological, independence, social relationships, environmental, and spiritual aspects.

ART treatment outcomes are influenced by several factors which encompass ART adherence, HIV-comorbidities, and the quality of care received at the treatment center. The conceptual framework in this study illustrates how patient characteristics, including external and internal risk factors, interact with ART adherence and HIV co-morbidities to influence the key outcomes such as survival in ART treatment and . ART adherence and the presence of co-morbidities are critical factors that determine the effectiveness of HIV treatment, patients' continuous retention in treatment, and their overall well-being across physical, psychological, social, and spiritual dimensions. The quality of care received by patients also significantly impacts their adherence to ART and their perceived quality of life. The presence of symptoms can decrease and complicate the management of HIV, making it more challenging to maintain continuous treatment and positive health outcomes.

In this study a retrospective clinical records provides the historic data of PLHIV survival on ART, while the cross-sectional survey gathers current patient data on , adherence on ART, co-morbidities and symptoms, and QOC. Data from these study methods provide a comprehensive understanding of how the study factors interrelate, and will help to identify areas for improvement in ART programs and patient care.

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CHAPTER THREE

3 Methodology

3.1 Study Design

This study involved quantitative analysis of data of extracted retrospectively for cohort of patients enrolled for ART treatment at selected health facilities, and a cross-sectional survey of adult HIV patients who are currently undergoing treatment at the selected facilities for an enhanced epidemiologic information.

1. Retrospective prospective study of clinical records of clients enrolled in ART in the last three (3) years to investigate the prevalence and incidence of HIV treatment outcomes including rates of defaulting treatment, survival in ART treatment, and their determinants.
2. A cross-sectional survey of adult HIV patients to describe common HIV co-morbidities, adherence to medication, quality of health, quality of care, and risk practices, with linkage to clinical records of participants to explore associations between patient factors and clinical characteristics.

2.2 Study Location and Settings

Bauchi state is in the North-East geopolitical zone of Nigeria. The state is predominantly an agricultural sate with a population of about of 4,653,066 (according to the 2006 national census), with a forecasted population estimate of 6,537,314 as of 2016, and a population density of 95. The state covers an area of 49,119.1 square kilometres. It lies at latitude 10°30’ North and longitude

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10°00’ East. Bauchi State is made up of 20 LGAs[1]. The image in *Figure 3-1* shows the map of Bauchi State showing the 20 LGAs in the state.

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Figure 3-1 Map of Bauchi State[2].

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According to the 2018 Nigeria HIV/AIDS Indicator and Impact Survey (NAIIS), the HIV prevalence among adults aged 15-64 years in Bauchi State is 0.5%, which is lower than the national prevalence of 1.5%. This represents a significant drop from previous years, where the prevalence was as high as 6.8% in 2012[3,4]. The survey found that the a slightly higher prevalence among females (0.6%) compared to males (0.4%).

Bauchi state and the selected study LGAs and facilities were purposefully selected for this study based on the need to evaluate the HIV program in the state and the feasibility in recruiting the potential participants for this academic research. The two LGAs selected for this study for the purpose of confidentiality and anonymity will be referred to as LGA1 and LGA2. Data was collected from two selected facilities which serve as hub for ART treatment for PLHIV receiving referrals from other health facilities in the study location.

In Bauchi state, HIV treatment programs aimed at reducing the prevalence of HIV have involved collaboration between the government and various partner organizations. One initiative is the Key Population Community HIV Service for Action and Response (KP-CARE-2), a project implemented by the Society for Family Health (SFH) under funding by the Global Fund. This project is designed to enhance HIV prevention, treatment, and care services in the state.

The KP-CARE-2 Project of SFH implements a comprehensive HIV continuum of care by providing access to quality HIV prevention, treatment, and care services for key populations and other vulnerable groups. The KP-CARE-2 project operates across six states in Nigeria: Adamawa, Bauchi, Kebbi, Sokoto, and Zamfara, including Bauchi State, which is the focus of this study. The project was launched in the state since 2020. The project operates through private, non-profit out-patient treatment facilities called one-stop-shop (OSS). These facilities while private work closely

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with public health institutions to provide comprehensive care. The program employs a "hub and spoke" strategy where care is centralized at a primary hub facility but extending services to decentralized spoke clinics.

Clinic records from the SFH KP-CARE-2 HIV treatment facilities were used to obtain secondary data for this study. This data was analyzed to investigate the incidence and prevalence of mortality, treatment interruptions, lots-to-follow up, and viral load suppression. The study examined the survival patterns of these treatment outcomes. Clinic records from the past three years were obtained, encompassing data from clients who have enrolled in the treatment program.

A cross-sectional survey of people living with HIV was also conducted in the selected facilities. This involved male and female PLHIV aged 15 years and above who are currently enrolled in ART in the selected treatment centers the study location. The population was selected to elicit information from the participants regarding assessment of comorbidities, sexual and reproductive health, behaviours, and practices. Participants treatment adherence behaviour was also investigated. The quality of life of patients was also investigated. In addition, the quality of HIV treatment services that is provided from the facility was evaluated.

3.2 Sampling and Sample Population

3.2.1 Retrospective Facility Study

Considering that this study entailed a cohort of patients who are undergoing ART treatment, a total sampling of all eligible patients were adopted. Data for the retrospective study was extracted from the two study LGAs. The study recruited adults aged 15 years and older, who have been on treatment for HIV with ART in the last 3 years from 2020 to 2023. Clinic staff supported the

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retrieval of information from records based on the data extraction request by the researcher for all variables and records of PLHIV clients in the facility.

3.2.2 Cross-sectional Survey of Patients:

Sample size for the facility cross-sectional study was calculated using the formular for estimating sample size for estimating proportions using OpenEpi online sample size estimator, with the parameters based on the percentage of adherence to ART in northern Nigeria which is about 62.6% absolute precision of 5% and the confidence level of 95%. This gives a sample size of 359[5,6]. To increase the statistical power for achieving precision in the outcomes a design effect value of 2.0 was adopted. The sample size is multiplied by 2. In addition, a 10 percent non-response rate was considered, this increased the sample size to 790. A total of 790 participants were recruited and interviewed.

The selection of participants for the survey was done by pulling participants currently enrolled in the two HIV clinics. Participants were male and female individuals aged 18 years and older, and active on ART treatment in the facilities. Participants in the survey were proportionately sampled according to the sample population that was retrieved for analysis in the retrospective study. With approximately 70% of the sample drawn from LGA1 and 30% from LGA2. Recruitment was done consecutively as they visit facilities until the required sample size was achieved.

3.3 Inclusion and Exclusion Criteria

Retrospective Facility Study

In the retrospective study, records of ART-naive patients aged 15 years and above initiated on ART between 1st January 2020 and 31st December 2023 for the treatment program was included in the analysis. Patients transferred out of the facility, and cases with invalid record such as records

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of hospital IDs with current date of treatment status earlier than date of registration, and cases of enrolment before or after the cut-off period of 1st January 2020 and 31st December 2023 were excluded in the analysis. Individuals transferred out of a facility were excluded from the study because they could potentially be transferred into another facility included in the study, leading to duplication of participants. The schema in *Figure 3-2* below shows the recruitment process of patients for analysis.

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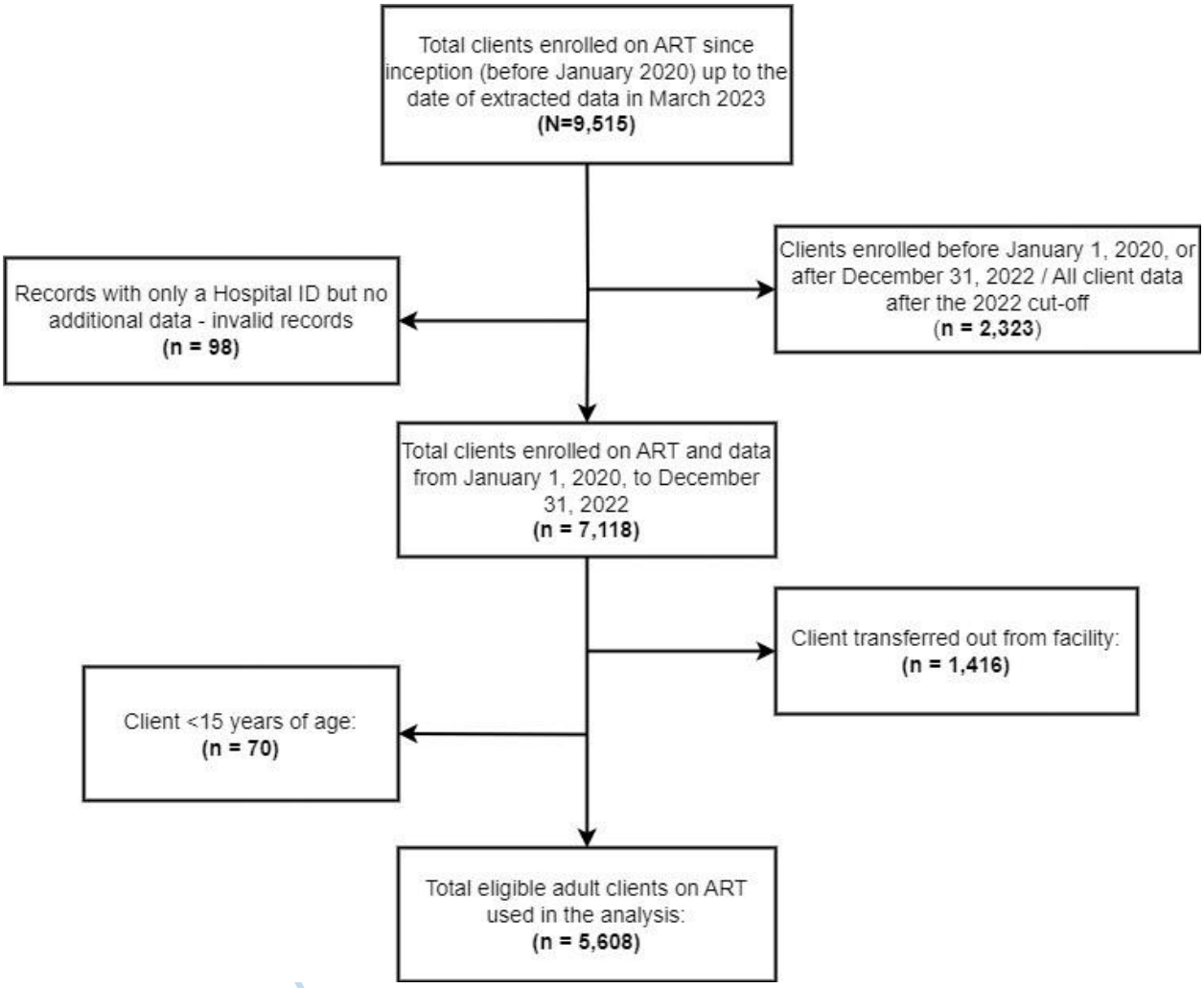


Figure 3-2 Schematic presentation of sampling of population for analysis

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Cross-sectional Survey

In the cross-sectional survey, eligibility for the study included participants who are male and female aged 18 years and above, who are currently receiving ART treatment from any of the two study treatment facilities in Bauchi state, and willingly provided written informed consent to be surveyed. The participants were also required to be subset of participants who have been selected in the retrospective study. A frame list of all clients who were included in the retrospective analysis and currently receiving treatment in the facilities was generated and preloaded on the data collection device, such that only clients who's unique hospital identification number (UHID) were on record could be surveyed. Participants who were physically challenged were also included in the study.

Ineligible participants who were excluded and not surveyed, included clients who are less than 18 years old and recent enrollees to ART treatment as at the time of contact with the research assistant. Participants who did not provide written informed consent were excluded from the survey. Additionally, participants whom the research assistant visibly ascertained or who themselves indicated they would not be able to withstand the interview due to ill health were also excluded from the survey.

3.4 Data Collection Procedure

Retrospective Facility Data Extraction

In the retrospective facility study data was retrieved from electronic record for HIV database called Lafiya Management Information System (LAMIS). The LAMIS is an electronic medical record (EMR) storage and retrieval system suitable for recording patient information for different medical domains[7]. The system supports point of care (POC) services and retrospective data entry along the standard health facility workflow and enables health care providers to track patients across the

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continuum of care, generating data for improving clinical care. The system is used by HIV program implementing partners who have experience implementing HIV program and the use of the health information system[8]. The database for HIV extracted for this study contained information on the baseline records of patients prior to commencement of ART, tracked, and current medical records of patients.

A formal data request for the HIV clinic records on LAMIS was made to the Society for Family Health (SFH), and approval for the retrieval of the data was granted in August 2022. The data on LAMIS for Bauchi State was de-identified by SFH staff with access to the database and then shared with the researcher based on specific requirement. The main requirements for sharing the data included the complete extraction of the database records and all variables collected in the program available on the LAMIS database. The HIV data of the clients in the facility included their clinic records, such as patient baseline data, pharmacy records for information on ART administration/regimen, and laboratory data for available information on viral load tests and CD4 counts. However, in this study, the CD4 counts were not included in the analysis due to the extremely low amount of data for this variable.

Cross-sectional Survey

In the cross-sectional facility survey, permission to conduct the survey among clients currently undergoing ART treatment in the facilities was obtained from the Society for Family Health, following the ethical approval obtained for the study. Potential participants for the study were recruited by the healthcare provider in the facility, who read a recruitment script (see Appendix A: Recruitment Script) providing information about the study during the clients visits to the facility for clinic consultations. Participants willing to learn more about the study were then referred to trained data collectors who were also case managers for the facilities. These case managers were

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recruited as data collectors because they support the facilities in facilitating treatment and care for PLHIV and already have established regular contacts with the PLHIV, thereby fostering trust and easing the recruitment process. The case managers were recruited and trained as research assistants on the ethical principles of conducting human subject research and on the study tools. The training also included confidentiality protocol, informed consent process, and proper data handling. Six data collectors were trained, three for each facility and study LGA. The data collectors carried out eligibility to ascertain whether the participant was eligible for the study. The eligibility process involved confirmation of all eligibility criteria before enrollment in the study. The data collectors also conducted data collection at the facility on a routine basis until the required sample size was achieved. The data collection spanned 6 months from May to October 2023.

Data collection was done by selecting patients aged 18 years and above who were a subset of participants in the retrospective study to allow for linkage of the cross-sectional data with the facility retrospective data. A frame list generated from the retrospective data, including patient information and unique identification numbers, was used to identify the patients to be recruited. Patients were recruited into the survey as they visited the facilities for ART refills or clinical services. A fully structured questionnaire was used for data collection (Appendix C: Survey Questionnaire). Although the questionnaire was not translated, the data collectors were trained to interpret the questionnaire appropriately for participants who needed any questions delivered in the local dialect, mainly Hausa. The questionnaires were administered in both Hausa and English.

Data collection in the survey was done using computer assisted program (CAPI) called Kobocollect, implemented on android mobile devices to ensure data quality. The questionnaire was first pre-tested for its content validity among patients from the same facility employed in the study. This was necessary as it was not possible to pre-test the tool in a different facility, as none

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were accessible in the state. However, the individuals who participated in the pre-test were excluded from the main study.

3.5 Study Variables and Instruments

3.5.1 Retrospective Facility (Extracted Data) Study Variables

Independent Variables from Extracted Data

Demographic variables: Baseline socio-demographic variables from the extracted patients' records included age at registration, gender, educational status, occupation, marital status, and LGA of the treatment facility.

Clinical variables: Clinical related data in the extracted facility data in the study included care entry point at registration, date of ART registration, current treatment status and date of current treatment status, baseline and recurrent systolic and diastolic blood pressure reading which was used to determine the blood pressure of patients, baseline and recurrent patient weight (kg) and height (cm) which was employed to compute body mass index (BMI), baseline and recurrent functional status, baseline and recurrent clinic stage. Other variables included baseline and recurrent ART regimen, offer of prophylaxis at baseline, baseline and recurrent TB status, baseline and recurrent viral load test results. Viral load (VL) status was then categorized into three levels: "suppressed" – clients whose last VL on record is below 1,000 copies per millilitre (c/ml); "unsuppressed" – clients whose last VL record is at least 1,000 (c/ml); and "not recorded" – clients who do not have a viral load reading on record. Additionally, date of appointments for clinic/pharmacy and laboratory visits were extracted. The duration in treatment was computed as difference in date of current status and year of ART initiation.

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Retrospective Facility Study Outcome Variable (ART Survival Outcomes)

In the study, the following were the main outcome variables in the retrospective study and are referred to as the ART survival outcomes.

Treatment Interruptions (Ever Interrupted Treatment): Not picking up ART drug after 28 days of appointment at any point throughout the repeat visits.

Loss-to-follow-up: Patients who did not pickup and ART drug after 28 days and never returned to take drugs.

Mortality: Recorded death at any point throughout the duration of treatment.

Viral Load Suppression: Patients who achieved a viral load status of below 1,000 copies per millilitre (c/ml) at the time of censor or at end of the study duration.

Cross-sectional Survey Variables

In the survey several information was elicited on the demographic characteristics of participants, self-reported co-morbidity of participants, presence of symptoms and mental health of patients, adherence on ART, quality of life of patients and quality of care on treatment was assessed. In addition, information to access risk factors including external and internal risk experiences by participants was also assessed.

Independent Variables

The independent variables in the study were variables selected to examine their effects on the dependent or outcome variable. These variables were not influenced by other factors in the study and investigated to determine their impact on the outcome of interest. The variables are as follows;

Sociodemographic variables: The sociodemographic characteristics variables in the study included information on age (in years), which was disaggregated into various age groupings, educational status,

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and occupation. Occupation was categorized as professional (including professions such as doctor, lawyer, accountant, lecturer), highly skilled (including professions such as nurse, teacher, School of Tech graduate), skilled (including professions such as tailor, beautician, plumber, hairdresser, carpenter, electrician), semi-skilled (including professions such as farmer, fisher, miner, forester), and unskilled (including professions such as laborer, trader, shopkeeper, hawker, vendor). Additionally, the study included variables on marital status, having children, number of children, living together with children, approximate total household income, and approximate total household income (grouped).

External risk factors: External risk factors in the study included smoking, alcohol and drug abuse, risky sexual behaviors, physical activity and other related participant medical factors. Specifically, these factors included:

- Smoking: regular use of tobacco products, including the frequency of cigarette smoking.
- Alcohol use: the frequency of drinking alcohol and whether the participant drank alcohol in the last 12 months.
- Drug abuse: whether the participant had ever used illicit drugs and if they had used such drugs in the past month.
- Risky sexual behaviors: having ever had sex, the number of sexual partners in the past 6 months, condom use during the last sexual intercourse, frequency of condom use, and a history of sexually transmitted infections (STIs) before HIV diagnosis.

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- Physical activity: the frequency of exercising.
- HIV-related factors: whether the participant had ever been hospitalized because of HIV disease, had disclosed their HIV status, and had ever experienced stigma because of their HIV status.
- Healthcare access: whether the clinic where ART is received is far from the participant's current residence.

Internal risk factors (Family history of disease): The internal risk factors in the study assessed whether any family members have been diagnosed with asthma, hypertension, diabetes, cancer, and depression.

Survey dependent or Outcome Variables

The survey dependent or outcome variables were the main focus of the study, as they were the specific characteristics, behaviors, or responses being measured. These included:

Co-morbidity variables: In this study, the comorbidity variable was a composite of non-infectious and infectious co-morbidity.

- Non-infectious co-morbidity: The self-administered co-morbidity Questionnaire (SCQ) was used to assess the presence of non-infectious comorbidity in the participants[9]. The SCQ comprises 13 questions covering both chronic and acute medical issues. Specifically, the SCQ addresses the following health conditions: including heart disease, high blood pressure, lung disease, diabetes, ulcer or stomach disease, kidney disease, anaemia or other blood diseases, cancer, depression, osteoarthritis or degenerative arthritis, back pain, rheumatoid arthritis, and other specified medical problems. Each item within the questionnaire asked respondents to indicate whether they have been diagnosed with or

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experienced the specified condition. Additionally, among those who experienced a co-morbidity the impact and burden of the non-infectious co-morbidities among the study participants was assessed by asking the participants if they received treatment for the disease and if the disease limited their activities.

- Infectious co-morbidity: The co-infection tool employed in this study evaluated the common infectious co-morbidities prevalent among HIV patients. These co-morbidities encompass a spectrum of infectious agents, including hepatitis viruses (irrespective of type), human papillomavirus (HPV) and its associated genital warts, herpes simplex virus (HSV), syphilis, gonorrhoea, and chlamydia. Where participants reported being diagnosed of any co-infection they were also asked if they received any treatment for the infection.

HIV Symptoms: Current symptom experiences of patients were assessed to comprehensively evaluate the health status of the participants. This was to understand the impact of HIV on the participants. The HIV Symptom Index (HIV-SI index) questionnaire, was employed for this purpose. This self-reported questionnaire consists of 20 items designed to capture various symptoms associated with HIV infection[10,11]. The tool captures a range of symptoms experienced by individuals, encompassing physical, cognitive, and emotional aspects. These symptoms include fatigue or loss of energy, fevers, chills, and sweats, feelings of dizziness or lightheadedness, pain, numbness, or tingling in the hands or feet, memory difficulties, nausea, vomiting, diarrhea, and feelings of sadness or depression. Additionally, it assesses symptoms such as anxiety, sleep disturbances, skin problems like rash or itching, respiratory issues such as cough or shortness of breath, headaches, changes in appetite or taste, gastrointestinal discomfort, muscle aches, joint pain, sexual dysfunction, alterations in body appearance or weight, hair loss,

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and changes to hair texture. The tool not only captures the presence of symptoms but also assesses their impact on individuals' daily lives and well-being. Participants were asked to indicate whether they experience each symptom, and for those who did, they were asked to what extent they were bothered by the symptom. A Likert scale was utilized to score for symptoms severity and ranged from 0-4. Response options encompassed "I do not have these symptoms" (scored as 0), "I have symptoms and it doesn't bother me" (scored as 1), "It bothers me a little" (scored as 2), "It bothers me" (scored as 3), and "It bothers me a lot" (scored as 4).

Adherence to ART Medication: The Medication Adherence Scale (MMAS-8) was used to assess adherence to ART. The instrument has 8 items[12]. For items 1 through 6, participants responded with either "Yes" or "No." All "No" responses were coded as 1, and "Yes" responses were coded as 0, except for question 5, where "Yes" was coded as 1 and "No" was coded as 0. Item 7 had a 5-point Likert scale with responses coded 0-5. This was standardized by dividing the result by 5 to calculate the summed score. Similarly, item 8 had a 4-point Likert scale (coded 1-4) and was also standardized by dividing the result by 4. The total score of the MMAS-8 ranged from 0 to 8. An adherence status was created by categorizing a score of 8 as "High adherence," a score of 7 or 6 as "Medium adherence," and a score less than 6 as "Low adherence[13]."

Quality of Life (QOL) of Patients: Quality of life of patients was assessed using the WHO Quality of Life HIV BREF (WHOQOL-HIV BREF) , a 31-item instrument designed to measure the quality of life in individuals with HIV infection. The WHOQOL HIV BREF is derived from the WHO- 100 instrument and focuses specifically on the quality of life of people living with HIV/AIDS[14, 15]. The tool encompasses questions covering various domains, including Physical, Psychological, Level of Independence, Social Relationships, Environmental, and aspects of their life within each domain on a Likert scale. The Likert scale ranges from 1 to 5, with higher scores

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indicating better quality of life. This instrument provides a comprehensive assessment of the different facets of quality of life experienced by individuals living with HIV/AIDS.

Perceived Quality of Care: Perceived quality of care in treatment was assessed using the Quality of care through the patient's eyes (QUOTE Instrument)[16]. This instrument measures the quality of care from the perspective of the HIV-infected patient. The 27-item tool assesses both the importance and performance aspect of care experienced by the patient, providing insights into their perception of the care received. The importance aspect of care relates to the patient's expectations and priorities regarding treatment and support, while the performance aspect of care relates to the actual delivery and effectiveness of those services in meeting the patient's needs and expectations. In this study, only 26 items were included in the survey. The item asking about having an open ear for a conversation about euthanasia was excluded from the survey due to its sensitivity, especially considering that euthanasia is illegal and a highly controversial topic in Nigeria [17]. With the removal of an item from the tool, the scale remains valid because there are no strict guidelines on the number of items that must be included[18].

3.6 Data Management and Analysis

Retrospective Data Management and Analysis

No personal identifiers such as names, phone numbers, or contact information of the of the clients were shared in the data from the facility for the study. The data was password protected before shared with the researcher. Only the researcher had access to the data after it was shared. The shared datasets were password protected in excel spreadsheet files. The data were shared as a

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separate individual patient, clinic, laboratory, and pharmacy dataset, and individuals in each dataset were identified with a unique hospital identification (UHID). The format for the extracted data were either as long or wide data format, which were eventually reformatted, and the different datasets merged using the hospital IDs of the clients, before the data was used for subsequent cleaning and analysis.

Data management and analysis was done using R: A Language and Environment for Statistical Computing (version 3.6.1) employing numerous and relevant packages and functions in its ecosystem for data wrangling, analysis, and visualizations. Data cleaning and wrangling involved exploration of the data and utilization of statistical technique to determine adequacy of the data, with invalid or erroneous entries in the dataset removed. In addition, the eligibility criteria for the study were employed to arrive at the final sample dataset that was utilized for analysis [19]. To validate the final dataset preliminary descriptive analysis output were shared with the program staff of SFH for review and to provide feedback on the data and for clarifications on variables in the dataset. The variables recoded to allow for the types of analysis that was required. To Statistical significance was set at $p<0.05$.

Analysis of retrospective data

Descriptive statistics such as frequencies, percentage, mean, median with the spread of the estimates presented using standard deviation (SD), interquartile range (IRQ) and interquartile range (IRQ) as applicable to present all variables, including socio-demographic characteristics, patients clinic characteristics and other variables such as the ART outcome; treatment interruption, lost-to-follow up, mortality and viral load suppression.

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To estimate incidence of ART survival outcomes over the three-year period in the study, the incidence rate of the ART survival outcomes was determined as the measure of the number of new cases of the ART survival outcome per the total observation time in a group at risk (total person-years at risk)[20]. Person-years at risk is defined as the total time that individuals in the study population are at risk of developing the disease. In this study incidence rates were expressed as rates per 100 person years (PYs) with 95% confidence interval (CI) presented. The formula presents the incidence rate (IR) as follows:

$$\boldsymbol{Incidence\ Rate\ (IR) = \frac{Number\ of\ new\ cases}{Total\ person\ years\ at\ risk} \times 100}$$

- The number of new cases is the count of new events (e.g. treatment interruption, lost-to-follow up, mortality, and viral load suppression) observed during the study period.
- Total person-time at risk is the sum of the time each person in the study was at risk of experiencing the event, measured in person-years.
- The result is then multiplied by 100 to express the rate per 100 person-years.

Cumulative prevalence of ART outcomes over the three-year period were analyzed. This was measured as the proportion of the population who experienced the ART outcomes between 2020 to 2023. This was estimated in percentages with their 95% CI.

$$\boldsymbol{Cummulative\ Prevalence\ (CP) = \frac{Number\ of\ cases}{Total\ sample\ population}}$$

- Where Number of cases refers to the count of individuals in the sample population who have experienced treatment interruption, lost-to-follow up, mortality, and viral load suppression at the end of follow up in 2023 or over the period from 2020 to 202.

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- Total sample population is the total number of individuals in the sample population.

Results of incidence rates of ART outcome variables were further presented according to demographic characteristics and clinical characteristics to show the variation in ART outcomes across different subgroups of the population.

Survival patterns of ART outcomes were investigated employing survival analysis through Kaplan–Meier model using the survfit function in R. Survival analysis refers to a collection of statistical procedures for data analysis where the outcome variable of interest is time until an event occurs[21]. Kaplan–Meier model estimated the survival function probabilities of PLHIV ART survival outcomes over the three-year period of investigation (in months). The Kaplan-Meier method is used to estimate the survival probability function because it is a non-parametric method that does not require the assumption of a specific distribution of the survival time[22]. The resulting Kaplan-Meier probability function were plotted to reveal survival patterns on ART outcomes using survival curves to visualize the step-by-step trend of the probability function of survival according to time to event. In the study censored subjects were not excluded in the study to avoid bias in the estimation of survival probabilities and the overall analysis of survival outcomes. The mathematical formular for the iterative estimation of Kaplan-Meier function applied to the study data is as follows.

$$S_t = S_{t-1} \times \frac{N_t - E_t}{N_t}$$

- S_t is the survival probability at time t.
- S_{t-1} is the survival probability just before time t.
- N_t is the number of individuals at risk before time t.

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- $\boldsymbol{E_t}$ is the number of ART events (including treatment interruption, lost-to-follow up, mortality and viral load suppression) at time t.

Kaplan-Meier survival curves were also plotted for selected explanatory variables such as viral load status, baseline offer of prophylaxis, BMI, and TB status for each ART outcome, and the log-rank test was used to compare survival between the groups. However, there were some limitations in the data as some comparison based on log-rank test were not feasible due to small sample sizes for some subgroups, and insufficient occurrences of event in some categories, thereby affecting the statistical power of the models.

To identify the predictors or independent factors associated with the ART survival outcome variables, multivariate Cox proportional hazards model was used. Mathematically, the Cox model is written as follows[23].

$$\boldsymbol{H(t) = H^{0(t)} \times \exp[b^1 x^1 + b^2 x^2 + \cdots .. b_k x_k]}$$

Where $\boldsymbol{x^1}$ … $\boldsymbol{x_k}$ represents the predictor variables and $\boldsymbol{H^{0(t)}}$ is the expected hazard at time t, which is the hazard of an individual having the predictors set to zero. $\boldsymbol{b^1, b^2 \ldots\ b_k}$ are the coefficients corresponding to covariables.

A model was fitted for all the survival outcome of interest; treatment interruption, lost-to-follow up, mortality, and viral load suppression using *coxph* function in R. The initial model included numerous covariates, however, the calculated Akaike Information Criterion (AIC) values were used to determine the best fit based the model with the smallest AIC.

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3.7 Survey Data Management and Analysis

In the survey, all data materials were kept securely to ensure data privacy and confidentiality. Only the research assistants and the researcher had access to the survey tools used in the process of data collection. The healthcare providers in the facility were not given access to the study data. For the data collection tool on CAPI the chance of error entry and missing data were minimized by ensuring that the tool included validation checks and mandatory fields. A routine monitoring of data entry was also done to ensure accurate data entry.

Similar with the retrospective data, wrangling, analysis, and visualization of the survey data was done using R software. The completed cross-sectional survey data was then linked with the extracted retrospective data by merging the two datasets using the UHIDs of the PLHIV. The final dataset only included the retrospective data of the participants who had been surveyed and their cross-sectional survey data. Therefore, the dataset did not include the retrospective data of clients who were not sampled and surveyed. Data wrangling involved recoding of variables for appropriateness for use in analysis, depending on whether the analysis required grouped or continuous data, and other assumptions of the analysis. Outliers were identified using statistical techniques and visual inspections using box plot, and were addressed by either transformation or exclusion of the data point, to ensure the dataset was clean for analysis.

For some of the survey instruments of the outcome variables, the scales were manipulated and calculated to arrive at the final scores and interpretations of the instrument. In the WHOQOL-HIV BREF the scoring involved calculating domain scores by summing the item scores within each domain[24]. There is no total score for the instrument. These domain scores provide an overall assessment of the individual's quality of life across different dimensions. The total expected score for each domain as applied in this study are as follows; Physical Health – 4 items (range: 4 to 20),

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Psychological Health – 5 items (range: 5 to 25), Level of Independence – 4 items (range: 4 to 20), Social Relationships – 4 items (range: 4 to 20), Environment – 8 items (range: 8 to 40), and Spirituality/Religion/Personal Beliefs – 4 items (range: 4 to 20). A higher score corresponds to better quality of life.

The sensitivity of the WHOQOL-HIV BREF instrument was examined by evaluating the floor and ceiling effects. The floor and ceiling effects were examined to assess the extent to which the responses clustered at the lowest and highest possible scores, respectively. The floor and ceiling effects occur when the tests are relatively easy or difficult to the extent that substantial proportions of individuals obtain either the maximum or minimum score. As such, the true extent of their abilities cannot be determined[25]. The floor and ceiling estimates are used to evaluate the sensitivity of the instrument in detecting changes or differences. The floor effect occurs when a test or scale is relatively easy, leading to many participants scoring at the lowest end. As a result, it becomes challenging to differentiate between individuals with lower abilities. Conversely, the ceiling effect occurs when a test is too easy, causing many respondents to score at the highest end. In this case, the instrument may fail to capture improvements beyond a certain point. It highlights potential limitations in the instrument's ability to capture the full range of variability in the respondents' experiences. In this study, the analysis assumed a floor or ceiling effect present based on the floor and ceiling estimates calculated as follows;

The floor of the mean was computed as: $(mean - 1.96 \times SD)$, where the floor value represents the lower bound of the 95% confidence interval for the data, indicating that a significant portion of respondents scored at the upper extreme of the scale.

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The ceiling of the mean was computed as: $(mean + 1.96 \times SD)$, where the ceiling value represents the upper bound of the 95% confidence interval for the data, indicating that a significant portion of respondents scored at the lower extreme of the scale. By identifying these values, the study assessed whether a significant portion of respondents scored at the extreme ends of the measurement scale, suggesting potential floor or ceiling effects.

Survey Data Analysis

Descriptive statistics such as frequencies, percentages, mean, median, and variability using standard deviation (SD) and interquartile range (IQR) were performed to explore the demographic and HIV/health-related characteristics, including internal and external risk factors, as well as the dependent outcomes of the sample, including estimates for the prevalence and burden of HIV self-reported co-infections, HIV symptoms, and adherence to ART. The distributions were disaggregated by sex, with the significant values presented to indicate the differences in distributions of subgroups.

Bivariate Associations Between Test Variables and Survey Outcome Variables of PLHIV

Bivariate associations between different test variables or between independent PLHIV factors and the survey outcome variables were tested using Pearson's Chi-squared test or Fisher's exact test, as appropriate, when two categorical variables were involved. The non-parametric Wilcoxon rank sum test and Kruskal-Wallis rank sum test were employed as appropriate when the association involved a continuous variable with a categorical variable with two levels, and a continuous variable with more than two levels, respectively. The R software applied the test statistics as defaults for their robustness of the analysis.

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The Fisher's exact test is a non-parametric test statistics used as a replacement for the chi-square test when the expected frequency of one or more cells is less than 5[]. For a typically 2×2 contingency table the formular for calculation is as follow[26]:

$$\boldsymbol{P = \frac{(a+b)!\,(c+d)!\,(a+c)!\,(b+d)!}{(a!\,b!\,c!\,d!\,n!)}}$$

where:

- **(a), (b), (c),** and **(d)** are the individual frequencies in the 2×2 contingency table.
- **(n)** is the total frequency.

The Pearson's Chi-squared test is a nonparametric test used to test hypothesis of no association between two or more groups, population or criteria (i.e. to check independence between two variables); and to test how likely the observed distribution of data fits with the distribution that is expected[27].

The Chi-squared statistic ($\chi 2$) is calculated as:

$$\boldsymbol{\chi 2 = \sum_{i-1}^{n} \frac{(O_i - E_i)^2}{E_i}}$$

Where:

- $\boldsymbol{O_i}$ represents the observed frequency for the *i*-th category.
- $\boldsymbol{E_i}$ represents the expected frequency for the *i*-th category.
- The summation ($\boldsymbol{\Sigma_i}$) is over all categories.

The Wilcoxon Rank Sum Test, also known as the Mann-Whitney U Test, is a non-parametric test used to compare two independent samples to determine whether their population mean ranks differ[28]. The Wilcoxon Rank Sum Test rejects the hypothesis that the two populations have

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identical distributions when the rank sum W is far from its mean[29]. The steps for its calculation is a follows:

- Rank all observations from both groups combined:
- Calculate the sum of ranks for each group:
    - W_1: Sum rank for the first group
    - W_2: Sum rank for the second group
- Determine the Mean:

$$\mu W = \frac{n^1(N-1)}{2}$$

and standard deviation:

$$\sigma W = \sqrt{\frac{n^1 n^2 (N+1)}{12}}$$

Where: n^1 and n^2 are the sample sizes of the two groups.

N is the sum of the total observations($n^1 + n^2$).

The test statistic (Z) is calculated as:

$$Z = \frac{W^1 - \mu W}{\sigma W}$$

Using the Z-value, the p-value from the standard normal distribution was determined.

In this study Kruskal-Wallis rank sum test was employed to determine if there are statistically significant differences between the medians of three or more independent groups[30]. The steps for calculation of Kruskal-Wallis rank sum test is as follows[31]:

- Combine the data from all groups.

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- Rank all observations from smallest to largest. If there are tied values, assign the average rank to the tied values.

- Compute the sum of the ranks for each group (***Ri***):

The Kruskal-Wallis test statistic ***H*** is calculated as:

$$H = \left(\frac{12}{N(N+1)}\right)\sum_{i-1}^{k}\frac{R_i^{\,2}}{n_i} - 3(N+1)$$

Where:

- ***N*** is the total number of observations across all groups.

- ***k*** is the number of groups.

- R_i is the sum of ranks for the *i*-th group.

- n_i is the number of observations in the *i*-th group.

The test statistic ***H*** approximately follows a chi-square distribution with ***k*** −1 degrees of freedom under the null hypothesis.

Determining Predictors of PLHIV outcomes

To identify the predictors or independent factors associated with the PLHIV in the survey outcomes variables, different regression models were employed based on the type of outcome variable. For continuous outcome variables as utilized in the WHOQOL-HIV BREF outcome score, linear regression was used to estimate the Beta (β) co-efficient of the predictors, while for binary outcome variables including co-morbidity, adherence on ART treatment, logistic regression was employed to estimate the odds ratio (OR) of the predictor variables. The models first included bivariate unadjusted estimates to determine the effect of each predictor variable with the outcome

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variable without controlling for other variables, while and adjusted model included multiple predictor variables simultaneously to control for potential confounders. The confidence intervals for all estimates were presented.

Linear regression is a statistical model that estimates the linear relationship between a dependent variable and one or more independent variables. In the analysis the *lm* function in the base R package was used to model linear regressions.

The mathematical equation for linear regression model which includes only one predictor variable (unadjusted models) is as follows[32].

$$\boldsymbol{Y = \beta_0 + \beta_1 X + \epsilon}$$

Where:

- $\boldsymbol{Y}$ is the dependent variable (outcome).
- $\boldsymbol{X}$ is the independent variable (predictor).
- $\boldsymbol{\beta_0}$ is the intercept (the value of $\boldsymbol{Y}$ when $\boldsymbol{X} = 0$).
- $\boldsymbol{\beta_1}$ is the slope coefficient (the change in $\boldsymbol{Y}$ for a one-unit change in $\boldsymbol{X}$).
- $\boldsymbol{\epsilon}$ is the error term (the difference between the observed and predicted values of $\boldsymbol{Y}$).

The adjusted linear regression model includes multiple predictor variables to account for potential confounders. The formula is[33]:

$$\boldsymbol{Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 \ + \cdots + \beta_p X_p + \epsilon}$$

Where:

- $\boldsymbol{Y}$ is the dependent variable (outcome).
- $\boldsymbol{X_1, X_2, \ldots, X_p}$ is the independent variable (predictor).

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- β_0 is the intercept.
- $\beta_1, \beta_2, \ldots, \beta_p$ are the slope coefficients for each predictor variable.
- ϵ is the error term.

In the multivariate (adjusted) linear models, only the relevant predictors that were considered theoretically important and did not exhibit collinearity were retained in the final model. Additionally, the model with the smallest AIC and the highest R-squared (R^2) value was retained as the final models. The overall model fit statistic was also examined based on their F-statistic and p-value, with p-value < 0.05 indicating best fit, as the model explains a significant portion of the variance in the dependent variables.

As for the logistic regression analysis, it is a statistical method used to model the relationship between a binary dependent (outcome) variable and one or more independent (predictor) variables. In this study the *glm* function in R was applied to model the logistic regression. The mathematical formula for unadjusted logistic regression model including only one predictor variable is as follows[34]:

$$og\left(\frac{P(Y-1)}{1-P(Y-1)}\right) = \beta_0 + \beta_1 X$$

Where:

- $P(Y=1)$ is the probability that the outcome variable Y equals 1.
- X is the independent variable (predictor).
- β_0 is the intercept (the log-odds of the outcome when X=0).
- β_1 is the coefficient for the predictor (the change in log-odds for a one-unit change in X). The exponentiated coefficients represent the unadjusted Odds Ratio (OR).

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For the multivariate or adjusted logistic regression model [35]:

$$\boldsymbol{log}\left(\frac{\boldsymbol{P(Y-1)}}{\boldsymbol{1-P(Y-1)}}\right) = \boldsymbol{\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_p X_p}$$

Where:

- ***P(Y=1)*** is the probability that the outcome variable ***Y*** equals 1.
- $\boldsymbol{X_1, X_2, \ldots, X_p}$ is the independent variables (predictors).
- $\boldsymbol{\beta_0}$ is the intercept.
- $\boldsymbol{\beta_1, \beta_2, \ldots, \beta_p}$ are the coefficients for each predictor variable. The exponentiated coefficients represent the adjusted Odds Ratios (ORs).

In the multivariate model analysis, in the initial model variables with collinearity were dropped from the model. Subsequently, the model with best fit was determined by evaluating the models test statistics. This included evaluation of the log-likelihood of the model. Additionally, different model fits were assessed using the AIC, where lower values indicate a better fit.

Testing Hypothesis of the Original Domains of WHOQOL-HIV BREF

Confirmatory factor analysis (CFA) executed through structural equation modelling (SEM) was employed to test the hypothesis of the original 6 domains of the WHOQOL-HIV BREF, examining their structure and measurement model's fit to the data collected from PLHIV respondents. CFA is a model-data fit test based on multivariate regression. The relationships between observed variables and the underlying unobserved latent variables are assumed to be linear [36]. The basic mathematical formular for CFA is as follows[37]:

$$Y = \lambda\xi + \delta x$$

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Where:

- ***Y*** is the observed variable (indicator)
- **λ** refers to factor loadings,
- ξ refers to underlying factors and
- **δx** refers to measurement error of **x**

In modelling the CFA for the study data the *Lavaan* package in R was used by applying *cfa* function. In the analysis, an iterative process was undertaken to refine the model by examining the modification indices of the previously constructed models. Outputs are coefficients of paths and fit indices. If the paths are significant and indices indicate acceptable or high degree of fit, that means the structural model is confirmed by data. During the initial model evaluation, any observed (indicator/ manifest) variables that had factor loadings of less than 0.2 with their respective latent variables were removed from the model. It has been recommended that items with low factor loadings (e.g. below 0.2 or 0.3) be removed from the instrument[38]. This threshold was used to ensure that only variables with a significant and meaningful relationship to the latent constructs were retained, thereby improving the overall model fit and interpretability. The factor loadings between the latent and observed variables indicate the strength of the relationship between each observed variable and its corresponding latent construct. In the analysis the standardized coefficients were computed. Higher factor loadings (> 0.05) suggest that the observed variable is a good indicator of the latent construct.

The model fit of the data were examined using the following fit indices: Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR)[39].

The following thresholds is typically recommended according to as indicative of a good fit:

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CFI > 0.95, TLI > 0.95, RMSEA < 0.06, and SRMR < 0.08[40]. In addition, the error covariances between observed variables were examined by evaluating their modification indices. This evaluation determined the covariances to be added to the model to further improve the fit and explains the error terms for the shared variances among the observed items. The domain correlations were analyzed to evaluate the construct validity of the latent variable, using a correlation threshold of less than 0.85. Correlations exceeding this threshold would indicate significant relationship, implying that the domains might not be distinct from each other. Several model iterations were done with the evaluation of the fit indices until the model with the best indices were arrived at and presented.

A path diagram of the derived structure of the WHOQOL-HIV BREF instrument for the data was presented to visually represent the relationships between the latent constructs and the observed variables, with their resulting observed items error variances and domain correlations to aid in understanding the model.

3.8 Ethical considerations

Ethical approval was sought from the Bauchi State Health Research Ethics Committee (BASHREC), with Approval No: NREC/03/11/19B/2021/018) for the implementation of the study in the state (see Appendix D: Study Approval from Study State IRB). Permission to obtain HIV patient records from treatment facilities was obtained from SFH the organization managing the outpatient (One-Stop-Shop) HIV treatment clinics in the two study LGAs where the retrospective and survey HIV patients' data were obtained for the study. A written informed consent was collected from all participants who voluntarily participated in the surveys given the private health information provided. However, a waiver for consent for the extraction and utilization of patient's data was requested from the Bauchi Ministry of Health ethics review board for the use of the

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retrospective routine patient records extracted from the facilities. Social permission were also sought from the respective clinics that were assessed before the survey was conducted among PLHIV.

All research assistants were carefully trained in human subjects' protection, especially the importance of protecting privacy and confidentiality. Training included practical steps to ensure confidentiality. Some of the key ethical principles that were considered and adhered to in the study are as follows:

Benefits and risk

There was no direct benefit to the participants in this study. However, the study helps to provide new evidence and understanding on the epidemiologic realities of the population about the disease and how to manage the disease and its co-morbidities. This study had minimal risk associated with participation. Although while some participants could have felt obligated to participate in the study given that the interviews were conducted by the case managers, participants were fully informed of their voluntariness to participate in the study and that they can withdraw from the study when they decide to do so, and their withdrawal from the study would not affect their ability to continue to receive service from the facility.

Consent Process

Written informed consent form was used (see Appendix B: Informed consent form), and therefore respondent signed their name on the consent document after appropriate information had been given. Research participants were informed of all risks and protections in the written consent script. Participants were also informed of their right to withdraw from the study and to not answer any questions they do not feel comfortable answering. The written informed consent contained information about the purpose of the study, information about the principal investigator,

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information about potential risk, affirmation on voluntariness and confidentiality of the information.

Confidentiality and Privacy

All respondents' answers were kept strictly confidential. Only deidentified data were retrieved from the facility for analysis. Unique HIDs were used to identify patients enrolled in the study for analysis and used for linkage with the cross-sectional survey data. All documents were stored securely and only accessible by study assistants and the principal personnel. Geographic or personal data that could aid identification of patients or group of patients were removed in analysis. During recruitment of PLHIV for the survey interviews, trained research assistants confirmed that the potential participant was in a conducive environment before the recruitment was initiated and that the participant was conformable and willing to take interviews to avoid any potential risk to clients.

Subject Compensation

Participants in the survey were given a refreshment during the interview as compensation for their time in giving the interview.

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CHAPTER FOUR

4 Results and Discussion of Findings

4.1 Patient Demographic Characteristics from Retrospective Study

From the total eligible population of 5,618 patients drawn from the patient records in the retrospective facility study, the mean age of eligible patients was 36 years (SD = 8), with a 95% CI from 35 to 36 (See *Table 4-1*). The age group distribution shows that the majority of participants fall within the age ranges of 25-34 years (37%, n = 2,094) and 35-44 years (42%, n = 2,375). Most participants were female (74%, n = 4,150) compared with males (26%, n = 1,468). The majority of respondents were married (47%, n = 2,472) or single (33%, n = 1,727), with smaller proportions being widowed (8.6%, n = 453), divorced (8.9%, n = 472), or separated (2.7%, n = 144). Respondents had varied educational status, with significant proportions having completed primary education (31%, n = 1,535) or having no formal education (29%, n = 1,433). Other educational categories included senior secondary (24%, n = 1,192), Quranic (8.1%, n = 403), post-secondary (4.2%, n = 209), and junior secondary (1.4%, n = 67). A large proportion of participants were unemployed (78%, n = 3,972), while others reported being employed (17%, n = 854), students (2.8%, n = 140), retired (0.3%, n = 15), or having occupation status not available (1.7%, n = 88). The data extraction covered two LGAs, with the majority of respondents residing in LGA1 (73%, n = 4,100) compared to LGA2 (27%, n = 1,518).

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Table 4-1 Patient Demographic characteristics from retrospective data

Characteristic	N = 5,618[1]	95% CI[2]
Age	36 (8)	35, 36
Age group		
<15 - 24 years	486 (8.7%)	7.9%, 9.4%
25 - 34 years	2,094 (37%)	36%, 39%
35 - 44 years	2,375 (42%)	41%, 44%
45+ years	663 (12%)	11%, 13%
Gender		
Female	4,150 (74%)	73%, 75%
Male	1,468 (26%)	25%, 27%
Marital status		
Divorced	472 (8.9%)	8.2%, 9.8%
Married	2,472 (47%)	45%, 48%
Not Available	10 (0.2%)	0.10%, 0.36%
Separated	144 (2.7%)	2.3%, 3.2%
Single	1,727 (33%)	31%, 34%
Widowed	453 (8.6%)	7.8%, 9.4%
Education		
Junior secondary	67 (1.4%)	1.1%, 1.7%
None	1,433 (29%)	28%, 30%
Not available	123 (2.5%)	2.1%, 3.0%
Post secondary	209 (4.2%)	3.7%, 4.8%
Primary	1,535 (31%)	30%, 32%
Quranic	403 (8.1%)	7.4%, 8.9%
Senior secondary	1,192 (24%)	23%, 25%
Occupation		
Employed	854 (17%)	16%, 18%
Not available	88 (1.7%)	1.4%, 2.1%
Retired	15 (0.3%)	0.17%, 0.50%
Student	140 (2.8%)	2.3%, 3.3%
Unemployed	3,972 (78%)	77%, 79%
Study LGA		
LGA1	4,100 (73%)	72%, 74%
LGA2	1,518 (27%)	26%, 28%

[1]Median (IQR); n (%)

[2]CI = Confidence Interval

Source: Researcher's Secondary data

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4.2 Patient Clinical Characteristics from Retrospective Study

The commonest care entry point into the ART treatment program was through outreaches (92%, n = 5,081), with other entry points being through HTS program (2.9%, n = 162) and community-based organization programs (CBO) (3.0%, n = 163), *Table 4-2*. A majority of the patients had been on ART treatment in the facility for 18 months and above (63%, n = 3,566), with patients who had been on treatment for less than 6 months being 9.7% (n = 546), for 6-11 months being 12% (n = 693), and for 12-17 months being 14% (n = 813). At the time of registration for ART at the facility, most of the patients were HIV naive cases that had never been on ART (99%, n = 5,558), while 0.9% (n = 49) were cases that transferred-in from a different facility into the study facility.

The analysis showed that the current blood pressure status of the majority of patients was stage 1 high blood pressure (42%, n = 2,245), while those who had normal blood pressure were 40% (n = 2,139). Others had elevated blood pressure (13%, n = 719) and stage 2 high blood pressure (5.2%, n = 282). The distribution of current BMI of patients was shown to be normal for the majority of the patients (68%, n = 3,800), overweight (25%, n = 1,372), and underweight (7.4%, n = 416).

The distribution of the patients based on their baseline functional status showed that nearly all the patients who accessed the facility for ART were working (99%, n = 5,513), while only 1.1% (n = 64) were ambulatory patients. Similarly, nearly all patients (approximately 100%, n = 5,534) in the study as of the time of censor or end of study were categorized at stage I on WHO clinic staging for people with HIV, with a very small number in stage II (0.1%, n = 7). Nearly all the patients (approximately 100%, n = 5,563) in the study were placed on TDF-3TC-DTG as their first ART regimen, with 94% of the patients (n = 5,277) offered Isoniazid Preventive Therapy (IPT) as

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baseline prophylaxis, while the offer of Cotrimoxazole (CTX) Prophylaxis was 4.4% (n = 248). Only 1.7% (n = 93) were found not to have been offered any prophylaxis at the start of treatment.As of the time of censor, nearly the entire patient population in the sample (100%, n = 5,608) were still receiving TDF-3TC-DTG. The viral load of the patients in the sample as of the time of censor in the study was less than 1000 c/ml among the majority of the population (96%, n = 5,399).

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Table 4-2 Patients' clinic characteristics from retrospective data

Characteristic	N = 5,618[1]	95% CI[2]
Care entry point		
CBO	163 (3.0%)	2.5%, 3.4%
HTS	162 (2.9%)	2.5%, 3.4%
HTS(Walk-in)	4 (<0.1%)	0.02%, 0.20%
In-patient	17 (0.3%)	0.19%, 0.50%
OPD	3 (<0.1%)	0.01%, 0.17%
Others	30 (0.5%)	0.37%, 0.79%
Outreach	5,081 (92%)	91%, 93%
PMTCT	4 (<0.1%)	0.02%, 0.20%
STI Clinic	1 (<0.1%)	0.00%, 0.12%
Transfer-in	49 (0.9%)	0.67%, 1.2%
Duration in treatment (Months)		
less than 6 months	546 (9.7%)	9.0%, 11%
6 - 11 months	693 (12%)	11%, 13%
12 - 17 months	813 (14%)	14%, 15%
18+ months	3,566 (63%)	62%, 65%
Current treatment status		
Died	81 (1.4%)	1.2%, 1.8%
On Treatment	5,458 (97%)	97%, 98%
Stopped Treatment	79 (1.4%)	1.1%, 1.8%
Status at registration		
ART Transfer In	54 (1.0%)	0.73%, 1.3%
HIV Exposed Status Unknown	6 (0.1%)	0.04%, 0.24%
HIV+ non ART	5,558 (99%)	99%, 99%
Blood pressure status		
Normal	2,139 (40%)	38%, 41%
Elevated	719 (13%)	12%, 14%
High blood pressure stage 1	2,245 (42%)	40%, 43%
High blood pressure stage 2	282 (5.2%)	4.7%, 5.9%
BMI		
Underweight	416 (7.4%)	6.8%, 8.2%
Normal	3,800 (68%)	67%, 69%
Overweight	1,372 (25%)	23%, 26%
Baseline functional status		
Ambulatory	64 (1.1%)	0.89%, 1.5%
Working	5,513 (99%)	99%, 99%
Baseline clinic stage		
Stage I	5,534 (100%)	100%, 100%
Stage II	7 (0.1%)	0.06%, 0.27%
Clinic stage at censor/end of study		
Stage I	5,610 (100%)	100%, 100%
Stage II	3 (<0.1%)	0.01%, 0.17%
Stage III	1 (<0.1%)	0.00%, 0.12%
Stage IV	1 (<0.1%)	0.00%, 0.12%
First ART Regimen		
ABC-3TC-DTG	1 (<0.1%)	0.00%, 0.12%
AZT-3TC-NVP	2 (<0.1%)	0.01%, 0.14%
TDF-3TC-DTG	5,563 (100%)	100%, 100%
TDF-3TC-EFV	1 (<0.1%)	0.00%, 0.12%
Baseline prophylaxis offered		
Cotrimoxazole (CTX) Prophylaxis	248 (4.4%)	3.9%, 5.0%
Isoniazid Preventive Therapy (IPT)	5,277 (94%)	93%, 95%
Not given	93 (1.7%)	1.3%, 2.0%
Current regimen line		

Characteristic	N = 5,618[1]	95% CI[2]
ART First Line Adult	5,608 (100%)	100%, 100%
ART First Line Children	10 (0.2%)	0.09%, 0.34%
Current regimen		
TDF-3TC-DTG	5,608 (100%)	100%, 100%
Baseline TB status		
No sign or symptoms of TB	4,855 (88%)	87%, 89%
Currently on INH prophylaxis	644 (12%)	11%, 13%
Currently on TB treatment	2 (<0.1%)	0.01%, 0.15%
TB positive not on TB drugs	1 (<0.1%)	0.00%, 0.12%
Current viral load status		
Greater than 1000	98 (1.7%)	1.4%, 2.1%
Less than 1000	5,399 (96%)	96%, 97%
No VL	121 (2.2%)	1.8%, 2.6%
Viral load indication		
Routine	5,449 (99%)	99%, 99%
Targeted - Post EAC	47 (0.9%)	0.64%, 1.1%
DMOC type		
MMD	3,887 (100%)	100%, 100%
Others	2 (<0.1%)	0.01%, 0.21%

[1]n (%)

[2]CI = Confidence Interval

Source: Researcher's Secondary data

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4.3 Incidence and Cumulative Prevalence for Patients' Treatment Outcomes

To visualize the temporal trends in patient treatment outcomes, an incidence rate was plotted (Figure 4-1). The plot illustrates the incidence rate per 100 person-years over successive years for the study cohort.

The study revealed significant rate of incidence of treatment interruption in the study over the period of study. However, the rates of lost-to-follow-up and mortality remained relatively low among the study population throughout the observation period. On the other hand, viral load suppression incidence was shown to be high over the period of observation in study. Incidence of treatment interruption decreased steadily over the three-year period from 0.33 per 100PY in 2020 to 0.27 per 100PY in 2022. Lost to follow-up was shown to be low, decreasing from 0.20 per 100PY in 2020 to 0.01 per 100PY in 2022. Incidence of mortality showed a reducing trend and ranged from 0.28 per 100PY in 2020 to 0.01 per 100PY in 2022. The high incidence observed for viral load suppression reduced slightly over the period of observation.

Further analysis showed that the cumulative prevalence for the treatment interruption 28% (n = 1,492; 95% CI: 26%, 29%), 1.4% (n = 79; 95% CI: 0.54%, 0.95%) for lost-to-follow up, and mortality was 1.4% (n = 81; 95% CI: 0.56%, 0.98%), *Table 4-3 Cumulative treatment outcomes prevalence rates for patients in ART treatment between year 2020 – 2023*. While viral load suppression prevalence was 90% (n = 5,047; 95% CI: 89%, 91%).

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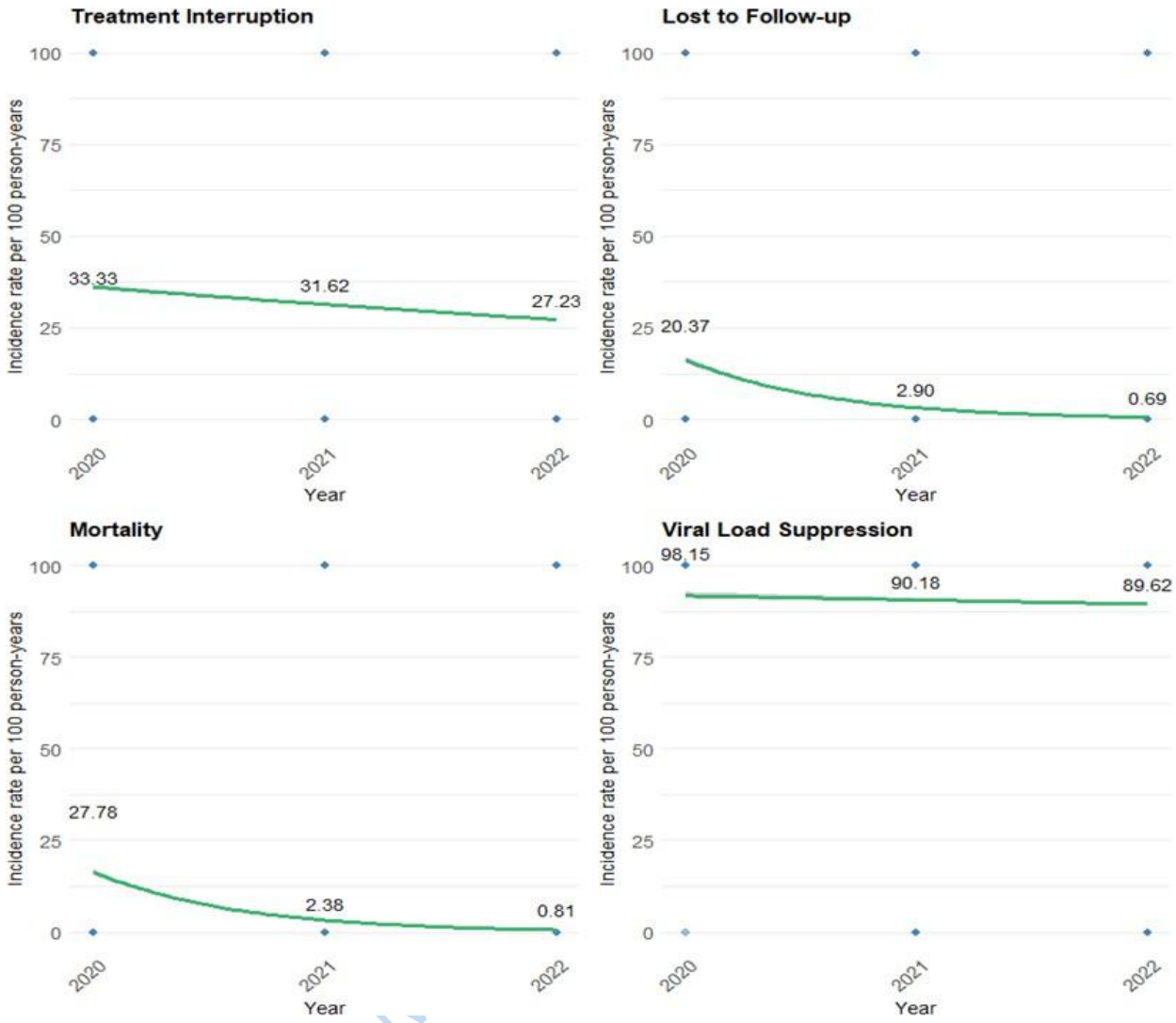


Figure 4-1 Annual incidence rate per 100 person-years trend for ART treatment outcomes.
Source: Researcher's Secondary data

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Table 4-3 Cumulative treatment outcomes prevalence rates for patients in ART treatment between year 2020 – 2023

Characteristic	N = 5,618[1]	95% CI[2]
Treatment interruption	1,592 (28%)	27%, 30%
Lost to follow up	79 (1.4%)	1.1%, 1.8%
Mortality	81 (1.4%)	1.2%, 1.8%
Viral load suppression	5,047 (90%)	89%, 91%

[1]n (%)

[2]CI = Confidence Interval
Source: Researcher's Secondary data

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4.4 Incidences of Treatment Outcomes according to Demographic and Clinical Characteristics

Analysis presented incidence rates of treatment outcomes based total person-years (PYs), according to the demographic characteristics of the participants (*Table 4-4*). According to the age grouping of the participants in the study, the total PYs for treatment interruption ranged from 574 to 3092, corresponding to an incidence rate of 27.87/100 PYs (95% CI: 24.2 - 31.5) among participants aged 15-24 years and 21.51/100 PYs (95% CI: 20 - 23) among those aged 25-34 years. The incidence was 20.89/100 PYs (95% CI: 19.5 - 22.3) for the 35-44 age group and 24.52/100 PYs (95% CI: 21.5 - 27.5) for those aged 45 years and above. The youngest and oldest age groups exhibited a higher incidence of defaulting in treatment compared to the middle age groups in the study. Similarly, a higher incidence of lost-to-follow-up was seen among the youngest age group (1.57/100 PYs, 95% CI: 0.6 - 2.6) with a total person-years of 574 and among the oldest age group (1.67/100 PYs, 95% CI: 0.8 - 2.6) with a total person-years of 779. The incidence of mortality was higher among the younger age group (15-24 years) and the age group of 45 years and above. Furthermore, the incidence of viral load suppression was highest among individuals in the youngest age group (15-24 years) and among the oldest age group (45+ years).

The incidence of treatment interruption was higher among males (23.03/100 PYs) compared to females (21.73/100 PYs), with total person-years of 1906 for males and 5305 for females. Lost-to-follow-up, however, was higher among females (1.19/100 PYs) compared to males (0.84/100 PYs), with total person-years of 5305 for females and 1906 for males. Based on marital status, individuals who were divorced/separated/widowed had the highest rate of treatment interruption (22.88/100 PYs), while married individuals had the lowest rate (20.3/100 PYs). However, mortality rates were comparable across marital statuses. Treatment interruption incidence rate was

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highest among students (36.42/100 PYs) and employed individuals (23.64/100 PYs) compared to retired individuals (14.29/100 PYs) and unemployed individuals (20.61/100 PYs). The lowest incidence of suppressed viral load was also observed among employed and student groups.

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*Table 4-4 Number of cases and incidence of ART treatment outcomes according to patient demographic characteristics (*Source: Researcher's Secondary data*)*

	Treatment Interruption			Lost to Follow-up			Survival			Viral Load Suppression		
Demographic Characteristics	**Number of Defaults**	**Total Person Years**	**Rate of Default (95% CI)**	**Number of Lost to Follow-up**	**Total Person Years**	**Rate of Lost to Follow-up (95% CI)**	**Number of Deaths**	**Total Person Years**	**Mortality Rate (95% CI)**	**Number of Suppressed Viral Load**	**Total Person Years**	**Rate of Suppressed Viral Load (95% CI)**
Age group												
25 - 34 years	595	2766	21.51 (20 - 23)	31	2766	1.12 (0.7 - 1.5)	27	2766	0.98 (0.6 - 1.3)	1833	2550	71.88 (70.1 - 73.6)
35 - 44 years	646	3092	20.89 (19.5 - 22.3)	27	3092	0.87 (0.5 - 1.2)	32	3092	1.03 (0.7 - 1.4)	2106	2865	73.51 (71.9 - 75.1)
45+ years	191	779	24.52 (21.5 - 27.5)	12	779	1.54 (0.7 - 2.4)	13	779	1.67 (0.8 - 2.6)	582	726	80.17 (77.3 - 83.1)
<15 - 24 years	160	574	27.87 (24.2 - 31.5)	9	574	1.57 (0.6 - 2.6)	9	574	1.57 (0.6 - 2.6)	403	499	80.76 (77.3 - 84.2)
Gender												
Female	1153	5305	21.73 (20.6 - 22.8)	63	5305	1.19 (0.9 - 1.5)	52	5305	0.98 (0.7 - 1.2)	3647	4871	74.87 (73.7 - 76.1)
Male	439	1906	23.03 (21.1 - 24.9)	16	1906	0.84 (0.4 - 1.2)	29	1906	1.52 (1 - 2.1)	1277	1769	72.19 (70.1 - 74.3)
Marital status												
Divorced/Separated/Widowed	324	1416	22.88 (20.7 - 25.1)	17	1416	1.2 (0.6 - 1.8)	22	1416	1.55 (0.9 - 2.2)	943	1304	72.32 (69.9 - 74.7)
Married	615	3030	20.3 (18.9 - 21.7)	26	3030	0.86 (0.5 - 1.2)	31	3030	1.02 (0.7 - 1.4)	2183	2814	77.58 (76 - 79.1)
Single	528	2151	24.55 (22.7 - 26.4)	28	2151	1.3 (0.8 - 1.8)	23	2151	1.07 (0.6 - 1.5)	1493	1940	76.96 (75.1 - 78.8)
Education												
None	425	1856	22.9 (21 - 24.8)	12	1856	0.65 (0.3 - 1)	23	1856	1.24 (0.7 - 1.7)	1239	1714	72.29 (70.2 - 74.4)
Primary	392	2017	19.43 (17.7 - 21.2)	14	2017	0.69 (0.3 - 1.1)	15	2017	0.74 (0.4 - 1.1)	1361	1856	73.33 (71.3 - 75.3)
Quranic	73	251	29.08 (23.5 - 34.7)	1	251	0.4 (-0.4 - 1.2)	9	251	3.59 (1.3 - 5.9)	360	229	157.21 (NaN - NaN)
Secondary/post-secondary	406	1851	21.93 (20 - 23.8)	26	1851	1.4 (0.9 - 1.9)	18	1851	0.97 (0.5 - 1.4)	1287	1687	76.29 (74.3 - 78.3)
Occupation												
Employed	274	1159	23.64 (21.2 - 26.1)	19	1159	1.64 (0.9 - 2.4)	18	1159	1.55 (0.8 - 2.3)	737	1068	69.01 (66.2 - 71.8)
Retired	2	14	14.29 (-4 - 32.6)	0	14	0 (0 - 0)	0	14	0 (0 - 0)	14	14	100 (100 - 100)
Student	55	151	36.42 (28.7 - 44.1)	2	151	1.32 (-0.5 - 3.1)	3	151	1.99 (-0.2 - 4.2)	115	125	92 (87.2 - 96.8)
Unemployed	1002	4862	20.61 (19.5 - 21.7)	48	4862	0.99 (0.7 - 1.3)	47	4862	0.97 (0.7 - 1.2)	3510	4482	78.31 (77.1 - 79.5)
Study LGA												
LGA1	1169	6210	18.82 (17.8 - 19.8)	72	6210	1.16 (0.9 - 1.4)	63	6210	1.01 (0.8 - 1.3)	3565	5709	62.45 (61.2 - 63.7)
LGA2	423	1001	42.26 (39.2 - 45.3)	7	1001	0.7 (0.2 - 1.2)	18	1001	1.8 (1 - 2.6)	1359	931	145.97 (NaN - NaN)

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The analysis of treatment outcomes across various clinical characteristics revealed several important findings *Table 4-5*. Treatment interruption rates varied across different entry points into care, with Community-Based Organizations (CBOs) showing a high rate of 28.29% (95% CI: 22.7 - 33.9), followed by HIV Testing and Counseling Services (HTS) at 24.91% (95% CI: 19.7 - 30.1). Conversely, patients entering care through Outreach programs exhibited a lower treatment interruption rate of 21.29% (95% CI: 20.3 - 22.3) over the study period. Regarding the duration of treatment, patients receiving treatment for 6-11 months had the highest treatment interruption rate of 113.68% , while those on treatment for 18+ months had a comparatively lower rate of 18.36% (95% CI: 17.4 - 19.3). Additionally, baseline prophylaxis offered seemed to influence treatment outcomes, with patients not given prophylaxis exhibiting a higher treatment interruption rate of 38% (95% CI: 28.5 - 47.5), compared to those on Cotrimoxazole CTX) Prophylaxis (23.25%, 95% CI: 19.3 - 27.2) or Isoniazid Preventive Therapy (IPT) (21.76%, 95% CI: 20.8 - 22.8).

The results also showed that the incidence of treatment interruption was higher among those who experienced elevated blood pressure (21.7%) and stage 2 high blood pressure (20.38%) with total person-years of 1000 for individuals with elevated blood pressure and 368 for individuals with stage 2 high blood pressure. Patients with elevated blood pressure had a mortality rate of 0.4 (95% CI: 0 - 0.8), while those with high blood pressure stage 1 had a slightly higher rate of 0.54 (95% CI: -0.2 - 1.3). Patients with normal blood pressure exhibited a mortality rate of 0.97 (95% CI: 0.6 - 1).

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Table 4-5 Number of cases and incidence of ART treatment outcomes according to patients clinical characteristics

	Treatment Interruption			Lost to Follow-up			Survival			Viral Load Suppression		
Demographic Characteristics	**Number of Defaults**	**Total Person Years**	**Rate of Default (95% CI)**	**Number of Lost to Follow-up**	**Total Person Years**	**Rate of Lost to Follow-up (95% CI)**	**Number of Deaths**	**Total Person Years**	**Mortality Rate (95% CI)**	**Number of Suppressed Viral Load**	**Total Person Years**	**Rate of Suppressed Viral Load (95% CI)**
Care entry point												
CBO	71	251	28.29 (22.7 - 33.9)	1	251	0.4 (-0.4 - 1.2)	4	251	1.59 (0 - 3.1)	135	251	53.78 (47.6 - 59.9)
HTS	66	265	24.91 (19.7 - 30.1)	5	265	1.89 (0.3 - 3.5)	5	265	1.89 (0.3 - 3.5)	146	265	55.09 (49.1 - 61.1)
Others	36	84	42.86 (32.3 - 53.4)	1	84	1.19 (-1.1 - 3.5)	1	84	1.19 (-1.1 - 3.5)	74	84	88.1 (81.2 - 95)
Outreach	1380	6482	21.29 (20.3 - 22.3)	72	6482	1.11 (0.9 - 1.4)	71	6482	1.1 (0.8 - 1.4)	4577	6482	70.61 (69.5 - 71.7)
Duration in treatment (months)												
less than 6 months	37	9	411.11 (NaN - NaN)	3	9	33.33 (2.5 - 64.1)	27	9	300 (NaN - NaN)	529	9	5877.78 (NaN - NaN)
6 - 11 months	108	95	113.68 (NaN - NaN)	25	95	26.32 (17.5 - 35.2)	14	95	14.74 (7.6 - 21.9)	662	95	696.84 (NaN - NaN)
12 - 17 months	293	822	35.64 (32.4 - 38.9)	20	822	2.43 (1.4 - 3.5)	21	822	2.55 (1.5 - 3.6)	732	822	89.05 (86.9 - 91.2)
18+ months	1154	6285	18.36 (17.4 - 19.3)	31	6285	0.49 (0.3 - 0.7)	19	6285	0.3 (0.2 - 0.4)	3124	6285	49.71 (48.5 - 50.9)
Status at registration												
ART Transfer In	24	21	114.29 (NaN - NaN)	1	21	4.76 (-4.3 - 13.9)	0	21	0 (0 - 0)	50	21	238.1 (NaN - NaN)
HIV Exposed Status Unknown	0	8	0 (0 - 0)	0	8	0 (0 - 0)	0	8	0 (0 - 0)	4	8	50 (15.4 - 84.6)
HIV+ non ART	1568	7182	21.83 (20.9 - 22.8)	78	7182	1.09 (0.8 - 1.3)	81	7182	1.13 (0.9 - 1.4)	4993	7182	69.52 (68.5 - 70.6)
Blood pressure status												
Normal	558	2990	18.66 (17.3 - 20.1)	26	2990	0.87 (0.5 - 1.2)	29	2990	0.97 (0.6 - 1.3)	1903	2990	63.65 (61.9 - 65.4)
Elevated	217	1000	21.7 (19.1 - 24.3)	3	1000	0.3 (0 - 0.6)	4	1000	0.4 (0 - 0.8)	651	1000	65.1 (62.1 - 68.1)
High blood pressure stage 1	671	2617	25.64 (24 - 27.3)	19	2617	0.73 (0.4 - 1.1)	15	2617	0.57 (0.3 - 0.9)	2030	2617	77.57 (76 - 79.2)
High blood pressure stage 2	75	368	20.38 (16.3 - 24.5)	1	368	0.27 (-0.3 - 0.8)	2	368	0.54 (-0.2 - 1.3)	253	368	68.75 (64 - 73.5)
BMI												
Underweight	127	411	30.9 (26.4 - 35.4)	7	411	1.7 (0.5 - 2.9)	11	411	2.68 (1.1 - 4.2)	371	411	90.27 (87.4 - 93.1)
Normal	1058	4937	21.43 (20.3 - 22.6)	39	4937	0.79 (0.5 - 1)	52	4937	1.05 (0.8 - 1.3)	3413	4937	69.13 (67.8 - 70.4)
Overweight	404	1842	21.93 (20 - 23.8)	14	1842	0.76 (0.4 - 1.2)	8	1842	0.43 (0.1 - 0.7)	1234	1842	66.99 (64.8 - 69.1)
Baseline functional status												
Ambulatory	18	111	16.22 (9.4 - 23.1)	1	111	0.9 (-0.9 - 2.7)	1	111	0.9 (-0.9 - 2.7)	59	111	53.15 (43.9 - 62.4)
Working	1560	7039	22.16 (21.2 - 23.1)	78	7039	1.11 (0.9 - 1.4)	80	7039	1.14 (0.9 - 1.4)	4952	7039	70.35 (69.3 - 71.4)
Baseline clinic stage												
Stage I	1560	7081	22.03 (21.1 - 23)	78	7081	1.1 (0.9 - 1.3)	79	7081	1.12 (0.9 - 1.4)	4971	7081	70.2 (69.1 - 71.3)
Stage II	2	10	20 (-4.8 - 44.8)	0	10	0 (0 - 0)	0	10	0 (0 - 0)	7	10	70 (41.6 - 98.4)
Last clinic stage												
Stage I	1589	7207	22.05 (21.1 - 23)	78	7207	1.08 (0.8 - 1.3)	76	7207	1.05 (0.8 - 1.3)	5040	7207	69.93 (68.9 - 71)
Stage II	0	1	0 (0 - 0)	1	1	100 (100 - 100)	1	1	100 (100 - 100)	3	1	300 (NaN - NaN)

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	Treatment Interruption			Lost to Follow-up			Survival			Viral Load Suppression		
Demographic Characteristics	**Number of Defaults**	**Total Person Years**	**Rate of Default (95% CI)**	**Number of Lost to Follow-up**	**Total Person Years**	**Rate of Lost to Follow-up (95% CI)**	**Number of Deaths**	**Total Person Years**	**Mortality Rate (95% CI)**	**Number of Suppressed Viral Load**	**Total Person Years**	**Rate of Suppressed Viral Load (95% CI)**
Stage III	1	1	100 (100 - 100)	0	1	0 (0 - 0)	1	1	100 (100 - 100)	1	1	100 (100 - 100)
Stage IV	1	0	Inf (NaN - NaN)	0	0	NaN (NaN - NaN)	0	0	NaN (NaN - NaN)	1	0	Inf (NaN - NaN)
First ART regimen												
Others	1	3	33.33 (-20 - 86.7)	0	3	0 (0 - 0)	0	3	0 (0 - 0)	4	3	133.33 (NaN - NaN)
TDF-3TC-DTG	1576	7137	22.08 (21.1 - 23)	78	7137	1.09 (0.8 - 1.3)	80	7137	1.12 (0.9 - 1.4)	4997	7137	70.02 (69 - 71.1)
Baseline prophylaxis offered												
Cotrimoxazole (CTX) Prophylaxis	103	443	23.25 (19.3 - 27.2)	5	443	1.13 (0.1 - 2.1)	4	443	0.9 (0 - 1.8)	218	443	49.21 (44.6 - 53.9)
Isoniazid Preventive Therapy (IPT)	1451	6668	21.76 (20.8 - 22.8)	49	6668	0.73 (0.5 - 0.9)	62	6668	0.93 (0.7 - 1.2)	4749	6668	71.22 (70.1 - 72.3)
Not given	38	100	38 (28.5 - 47.5)	25	100	25 (16.5 - 33.5)	15	100	15 (8 - 22)	80	100	80 (72.2 - 87.8)
Current ART regimen												
TDF-3TC-DTG	1589	7197	22.08 (21.1 - 23)	79	7197	1.1 (0.9 - 1.3)	81	7197	1.13 (0.9 - 1.4)	5039	7197	70.02 (69 - 71.1)
Baseline TB status												
No sign or symptoms of TB	1390	6697	20.76 (19.8 - 21.7)	37	6697	0.55 (0.4 - 0.7)	46	6697	0.69 (0.5 - 0.9)	4339	6697	64.79 (63.6 - 65.9)
Currently on INH prophylaxis	171	415	41.2 (36.5 - 45.9)	18	415	4.34 (2.4 - 6.3)	9	415	2.17 (0.8 - 3.6)	597	415	143.86 (NaN - NaN)
Currently on TB treatment	1	2	50 (-19.3 - 119.3)	1	2	50 (-19.3 - 119.3)	0	2	0 (0 - 0)	2	2	100 (100 - 100)
TB positive not on TB drugs	1	1	100 (100 - 100)	0	1	0 (0 - 0)	1	1	100 (100 - 100)	1	1	100 (100 - 100)
Current viral load status												
Greater than 1000	32	133	24.06 (16.8 - 31.3)	6	133	4.51 (1 - 8)	7	133	5.26 (1.5 - 9.1)	0	133	0 (0 - 0)
Less than 1000	1547	7017	22.05 (21.1 - 23)	38	7017	0.54 (0.4 - 0.7)	42	7017	0.6 (0.4 - 0.8)	4926	7017	70.2 (69.1 - 71.3)
No VL	13	61	21.31 (11 - 31.6)	35	61	57.38 (45 - 69.8)	32	61	52.46 (39.9 - 65)	121	61	198.36 (NaN - NaN)
viral load indication												
Routine	1558	7105	21.93 (21 - 22.9)	34	7105	0.48 (0.3 - 0.6)	43	7105	0.61 (0.4 - 0.8)	4908	7105	69.08 (68 - 70.2)
Targeted - Post EAC	21	45	46.67 (32.1 - 61.2)	10	45	22.22 (10.1 - 34.4)	6	45	13.33 (3.4 - 23.3)	17	45	37.78 (23.6 - 51.9)
DMOC type												
MMD	1293	6482	19.95 (19 - 20.9)	72	6482	1.11 (0.9 - 1.4)	69	6482	1.06 (0.8 - 1.3)	3408	6482	52.58 (51.4 - 53.8)
Others	0	4	0 (0 - 0)	0	4	0 (0 - 0)	0	4	0 (0 - 0)	2	4	50 (1 - 99)

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4.5 Survival Function analysis for Treatment Outcomes

Survival function plot employing Kaplan Meier analysis was performed to estimate the survival probability for the treatment outcomes among patients in the study population. In the analysis plot, the y-axis shows the probability of survival on the treatment outcome, this also refers to the probability of a patient not experiencing the outcome of the treatment. The x-axis shows the time in months to the occurrence of treatment outcome. The stepped line graph shows the probability of survival over time. Each step in the graph represents a time point at which one or more patients experienced the treatment outcome. The vertical thick mark in the graph indicates censored observations, where the a patients follow-up ended without experiencing the event of interest. The number of patients still at risk (not experiencing the outcome) at each time point is shown in the table below the graphs.

4.5.1 Survival Function Analysis for Treatment Interruption

Analysis estimating the survival probability for treatment interruption showed a decreasing trend over time. At 10 months, 81% (n = 4555) of participants were at risk of interrupting treatment, at 20 months, 61% (n = 3429) were at risk, and at 30 months, 18% (1008) remained at risk (*Figure 4-2*). Based on viral load status (*Figure 4-3*), the survival probability for treatment interruption indicated an increasing risk of the event over time for different viral load groupings. At 6 months, 94% (n = 92) of clients with a viral load status >1000c/ml and 91% (n = 4921) of clients with a viral load status <1000c/ml were at risk of interrupting treatment. At 30 months, the risk remained higher for clients with a viral load status >1000c/ml (19%, n = 19) compared to those with a viral load status <1000c/ml (18%, n = 987). The survival analysis curves showed a statistically significant difference with a log-rank test $p<0.029$. When considering the offer of prophylaxis at

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baseline, a decreasing probability of continuing treatment was observed over time (*Figure 4-2*). For those offered cotrimoxazole (CTX), the percentage at risk ranged from 98% (n = 242) at 6 months to 74% (n = 183) at 30 months. For those offered IPT prophylaxis, the percentage at risk reduced from 90% (n = 4758) at 6 months to 15% (n = 802) at 30 months. These differences in survival curves were statistically significant (log-rank test $p<0.0001$), indicating that treatment interruption was more common among clients who received cotrimoxazole (CTX).

Survival probability based on the BMI of participants also showed a general decline (*Figure 4-4*). Participants classified as underweight had 14% (n = 59) at risk of treatment interruption at 30 months. For participants with a normal BMI, the percentage at risk was 91% (n = 3449) at 6 months and 17% (n = 648) at 30 months. This difference in survival estimates based on BMI status was statistically significant, indicating higher interruption in treatment among clients with a normal BMI over the study period. Survival probability analysis based on TB status (*Figure 4-4*) showed that at 6 months, the percentage at risk for participants with no signs or symptoms of TB was 91% (n = 3837), which dropped to 23% at 30 months, with 967 individuals remaining at risk of interrupting treatment.

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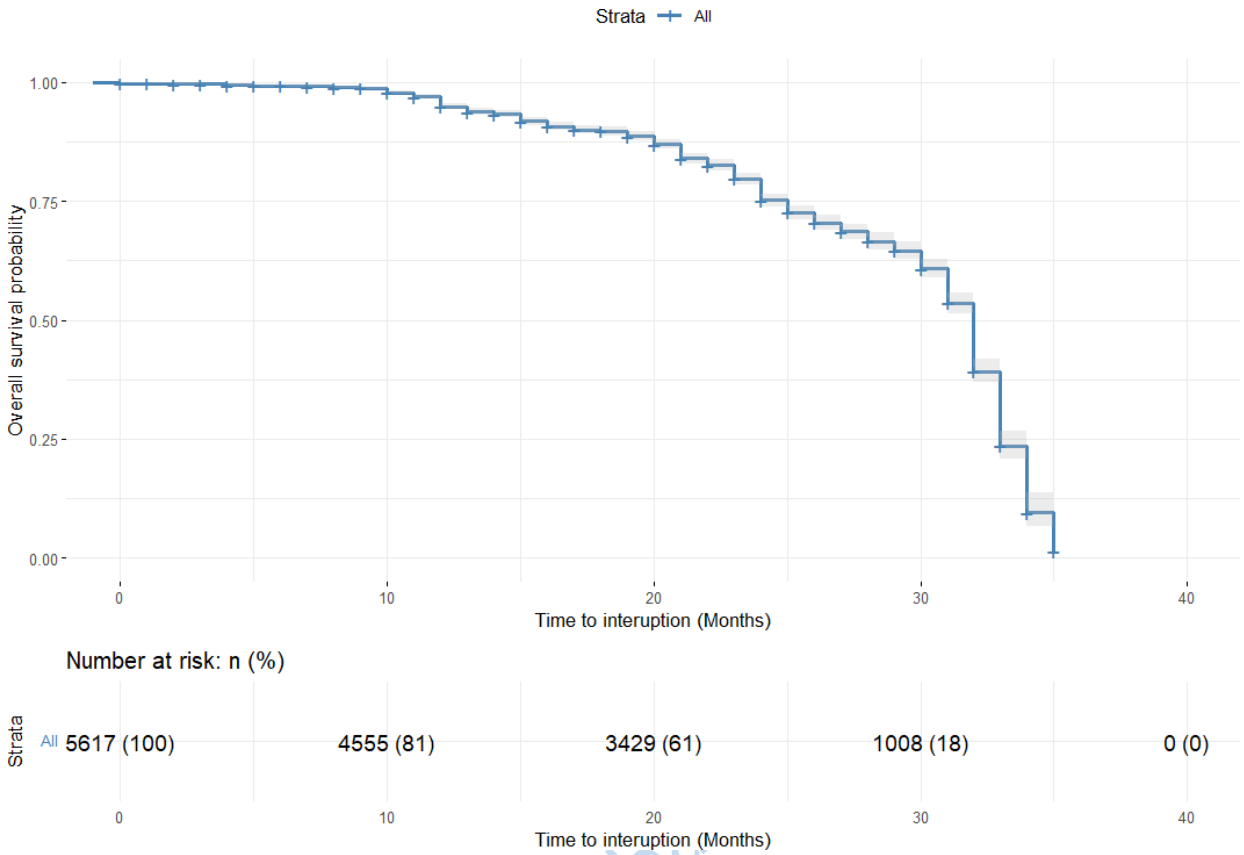


Figure 4-2 Survival function analysis of treatment Interruption
Source: Researcher's Secondary data

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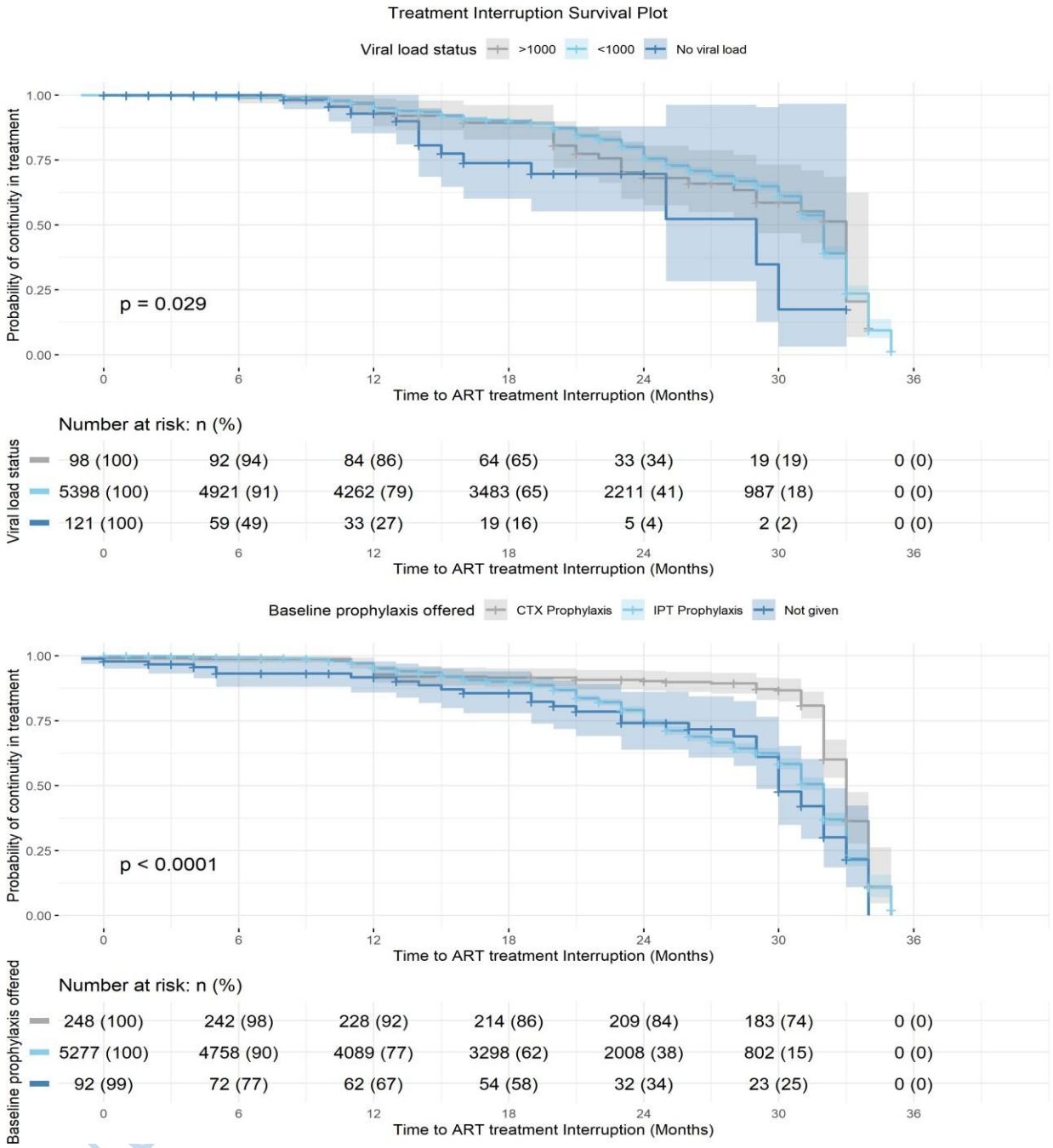


Figure 4-3 Survival function analysis of treatment Interruption for Viral load status and Offer of prophylaxis at baseline

Source: Researcher's Secondary data

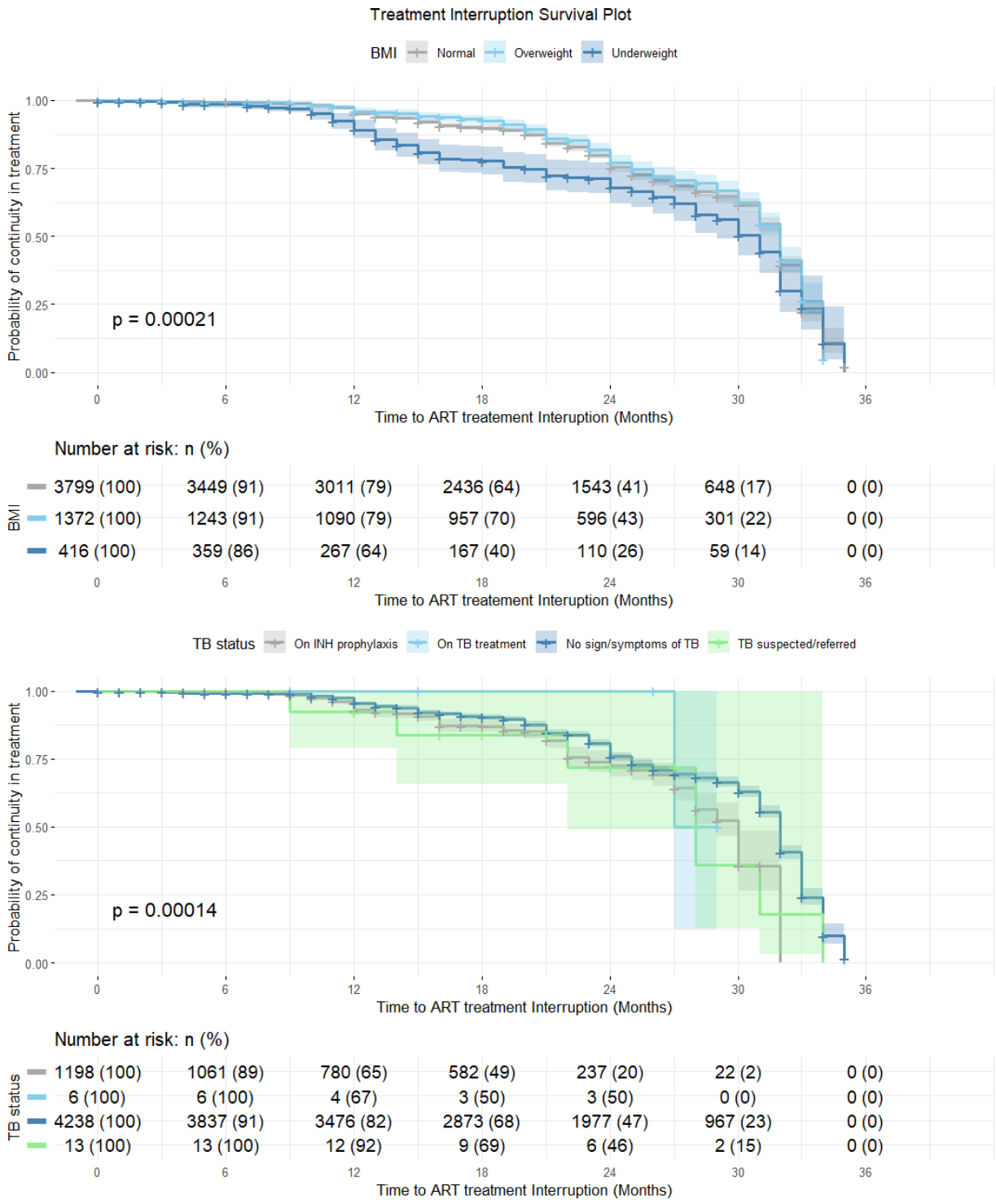


Figure 4-4 Survival function analysis of treatment Interruption for BMI status and TB status

Source: Researcher's Secondary data

4.3.1 Survival Function Analysis for Lost to Follow-up

Survival analysis plots showed estimates of the survival probability for not being lost to follow-up (*Figure 4-5*). Results indicated that the probability of continuing treatment without being lost to follow-up decreased over the study period, suggesting a low risk of being lost to follow-up over time. Initially, there was a 100% (n = 5617) risk of being lost to follow-up. At 10 months, 81% (n = 4555) of participants were at risk of stopping treatment. By 30 months, only 18% (n = 1008) remained at risk of being lost to follow-up.

Based on the viral load status of participants (*Figure 4-6*), the survival curve showed varying drops in the survival functions for being lost to follow-up. At 6 months, 94% (n = 92) of participants with both viral load status >1000c/ml and 91% (n = 4921) with viral load status <1000c/ml were at risk, compared to 49% (n = 59) of those with no viral load status reported. At 30 months, the risk of being lost to follow-up was 18% (n = 987) for those with viral load status <1000c/ml and 19% (n = 19) for those with viral load status >1000c/ml.

Based on offer of prophylaxis at baseline participants who were offered CTX prophylaxis had a lower probability of continuing treatment compared to those offered IPT prophylaxis. This trend was evident throughout the study period (*Figure 4-6*), with the probability of continuation decreasing more rapidly for the CTX group. At 6 months, 98% (n = 242) were at risk of lost to follow-up for those offered CTX prophylaxis, 90% (n = 4758) at risk for lost to follow-up for those offered IPT prophylaxis, and 77% (n = 72) at risk for those not given prophylaxis. By 36 months, the risk of being lost to follow-up was higher for the CTX group compared to the IPT group and those not given prophylaxis. The log-rank test also showed a statistically significant difference ($p < 0.0001$) in the survival curves among the different prophylaxis groups. The survival probability plot for lost to follow-up base on BMI status and TB status is presented in *Figure 4-7*.

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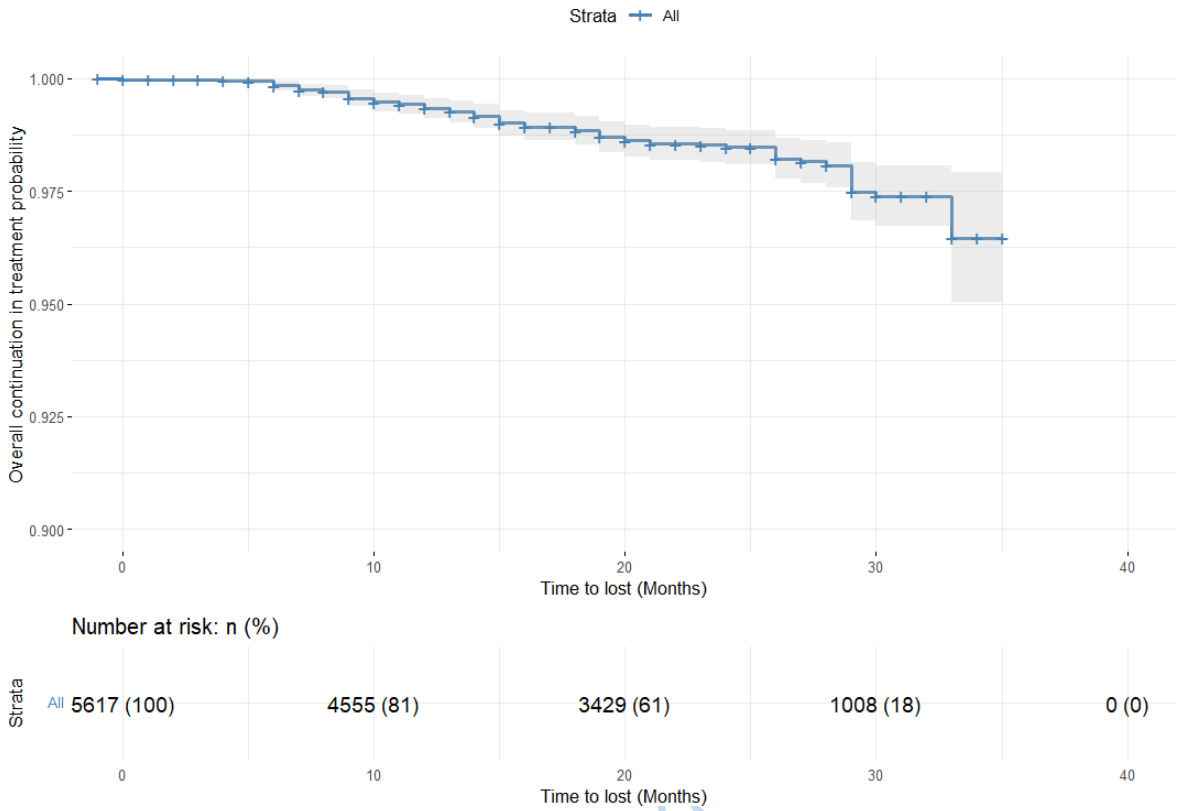


Figure 4-5 Survival function analysis of Lost to follow-up on ART treatment

Source: Researcher's Secondary data

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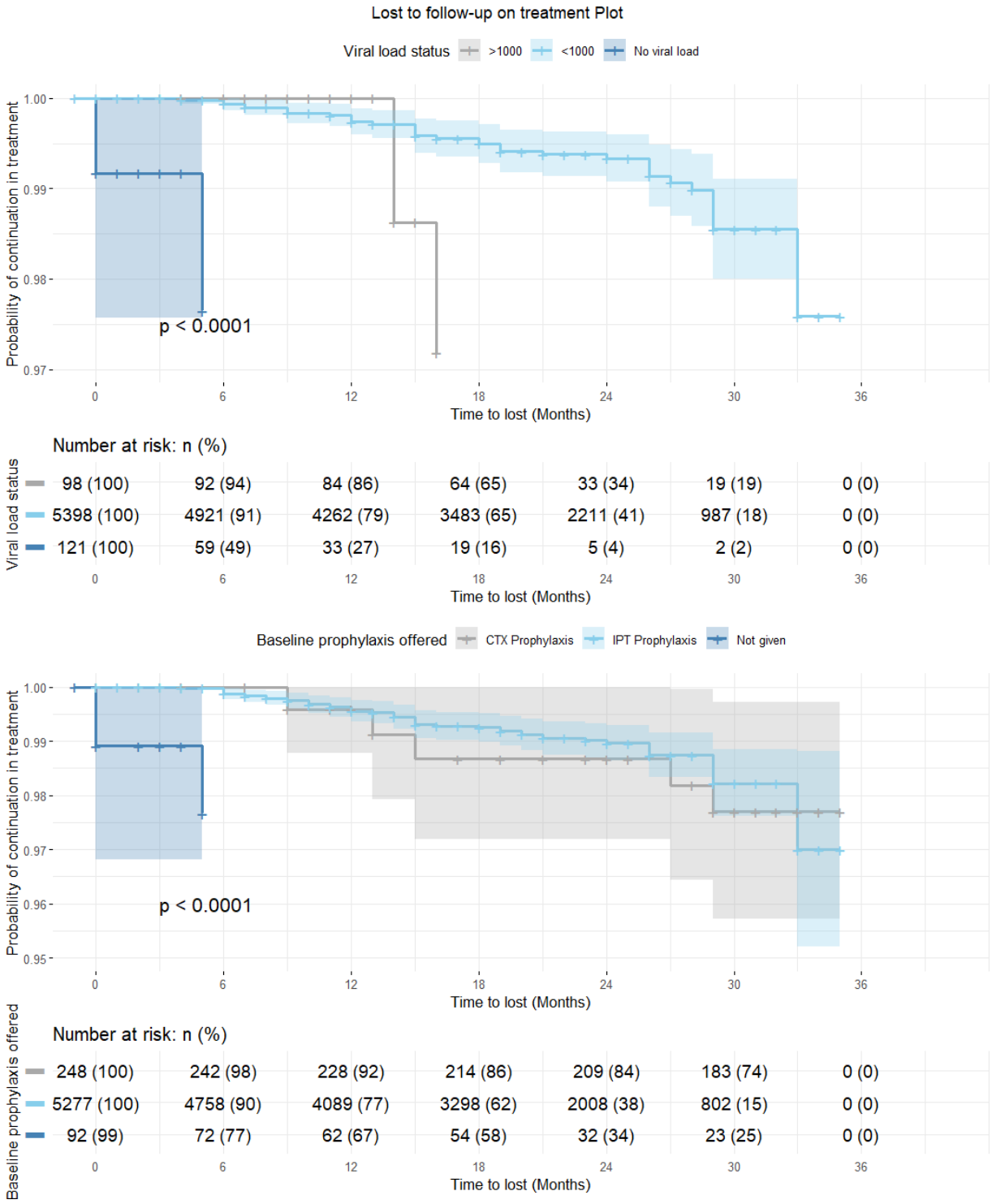


Figure 4-6 Survival function analysis of lost to follow-up for Viral load status and Offer of prophylaxis at baseline

Source: Researcher's Secondary data

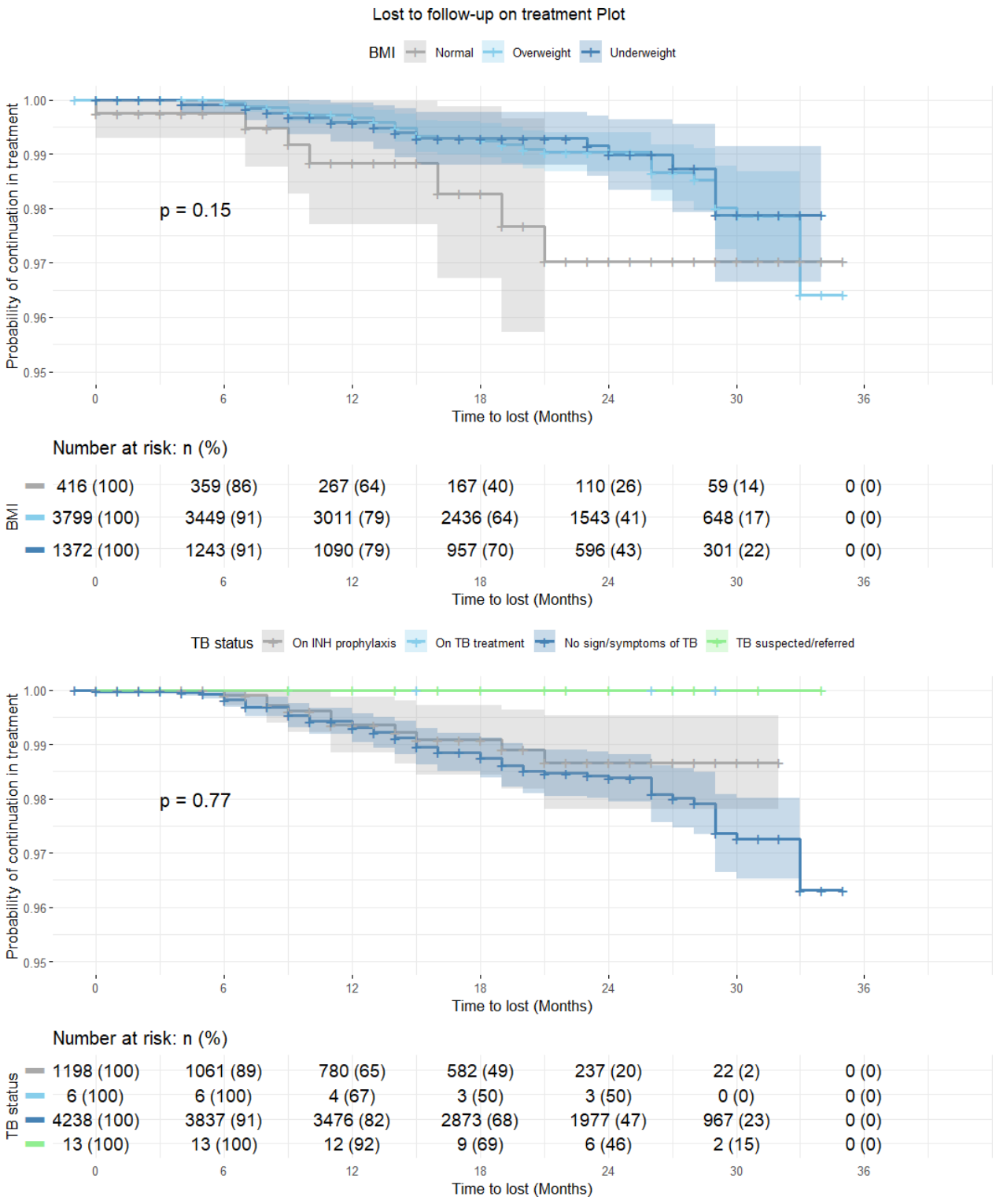


Figure 4-7 Survival function analysis of lost to follow-up for BMI status and TB status

Source: Researcher's Secondary data

4.3.2 Survival Function Analysis for Mortality

Survival function analysis for the probability of surviving treatment and not dying decreased over the period of the study, indicating an increasing risk of dying over time (*Figure 4-8*). Based on viral load status, the probability of survival dropped over time. For those with a viral load status >1000 c/ml, the risk of dying was 94% (n = 92) at 6 months, 34% (n = 33) at 24 months, and 19% (n = 19) at 30 months. For those with a viral load status of <1000 c/ml, the risk of dying decreased from 91% (n = 4921) at 6 months to 18% at 30 months. Based on the offer of prophylaxis (Figure 4-9), the risk of dying decreased from 98% (n = 242) at 6 months for patients offered CTX prophylaxis. For those offered IPT, the risk of dying decreased from 90% (n = 4758) at 6 months to 15% (n = 802) at 30 months. *Figure 4-10* presents the survival plot for BMI and TB status. While Figure 4-11 presents the survival probability curve based on treatment interruption status of participants. The plot showed higher declining probability of survival among participants who did not interrupt treatment, compared with those who interrupted treatment over the period of the study. There was however, not significant difference in their probabilities over the period of observation.

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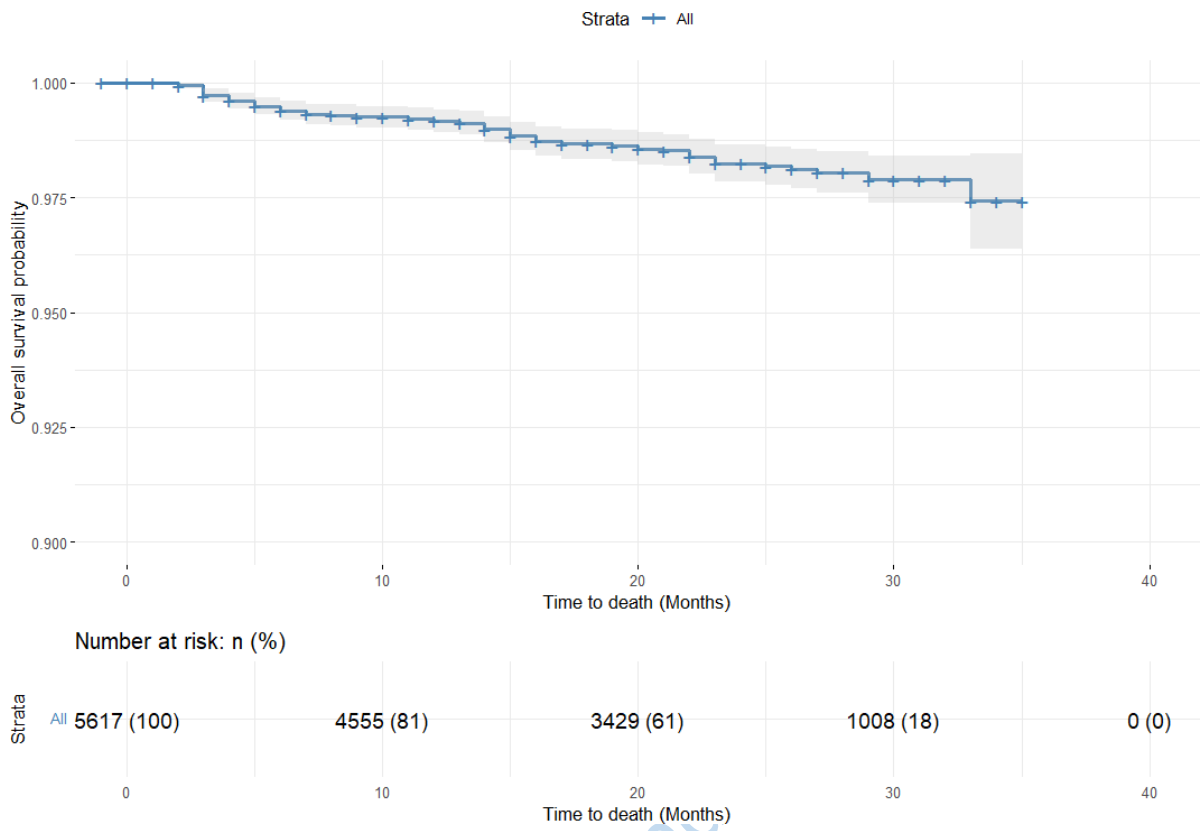


Figure 4-8 Survival function analysis of mortality in ART treatment

Source: Researcher's Secondary data

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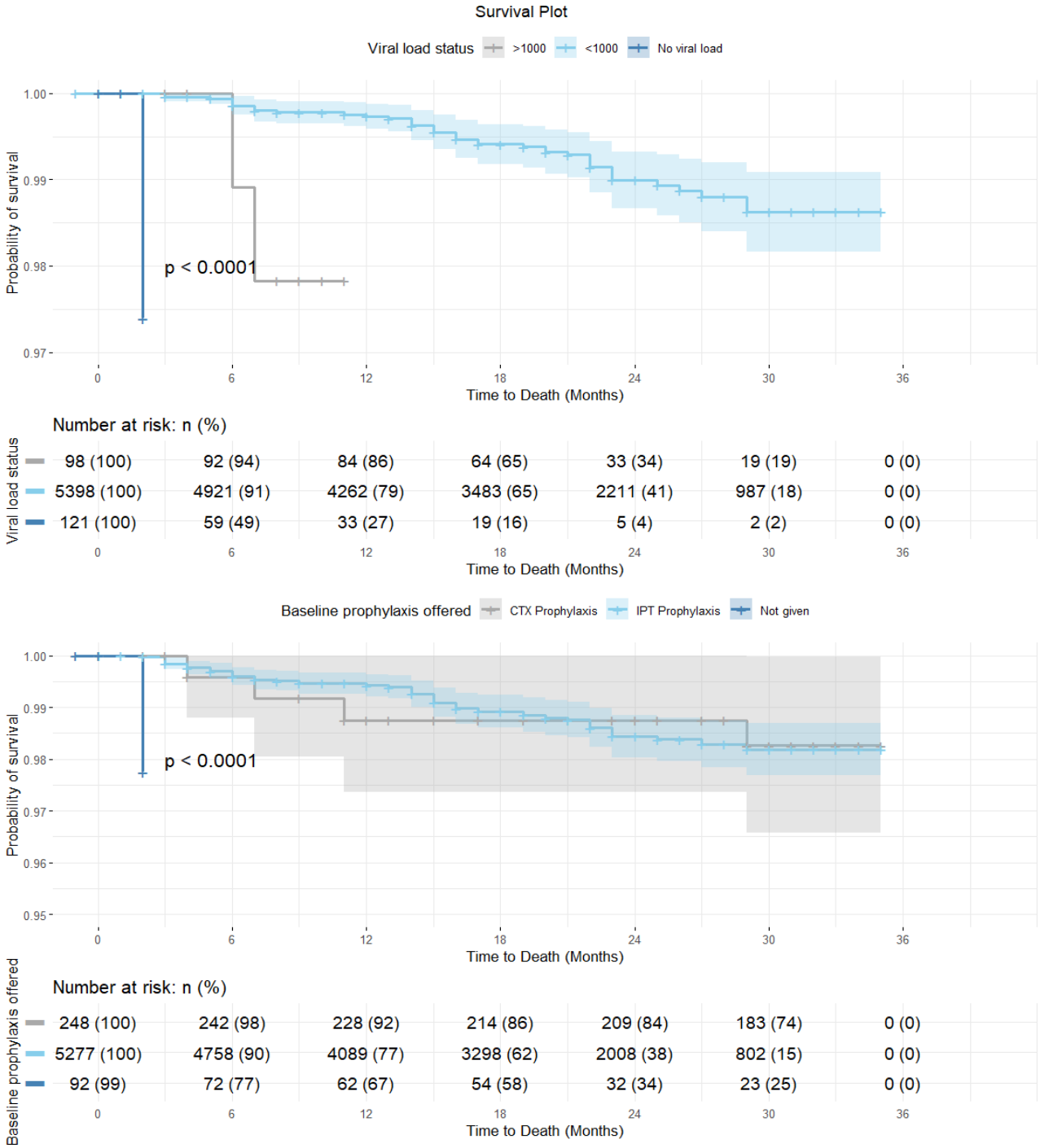


Figure 4-9 Survival function analysis of mortality for Viral load status and Offer of prophylaxis at baseline

Source: Researcher's Secondary data

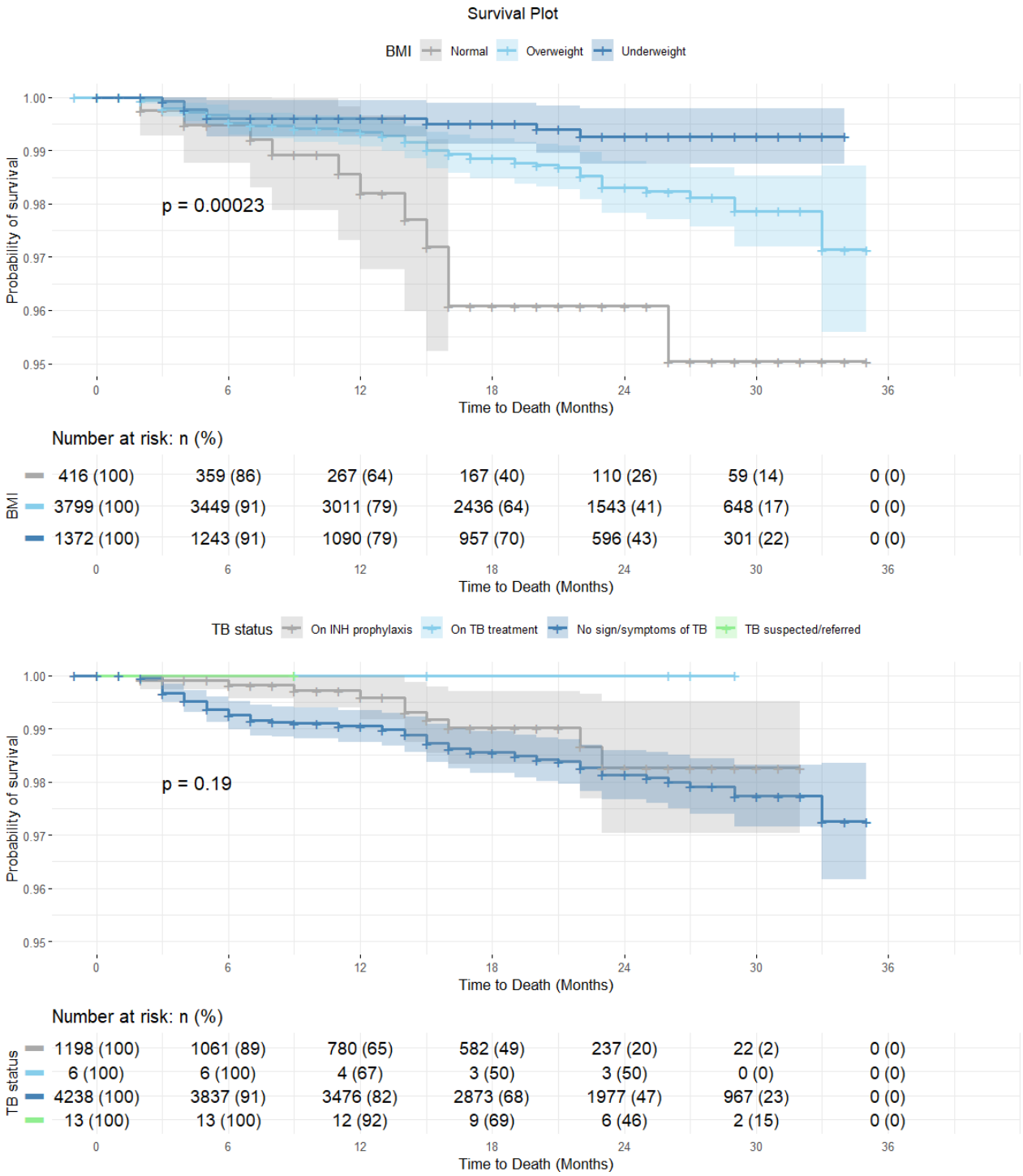


Figure 4-10 Survival function analysis of mortality for BMI status and TB status

Source: Researcher's Secondary data

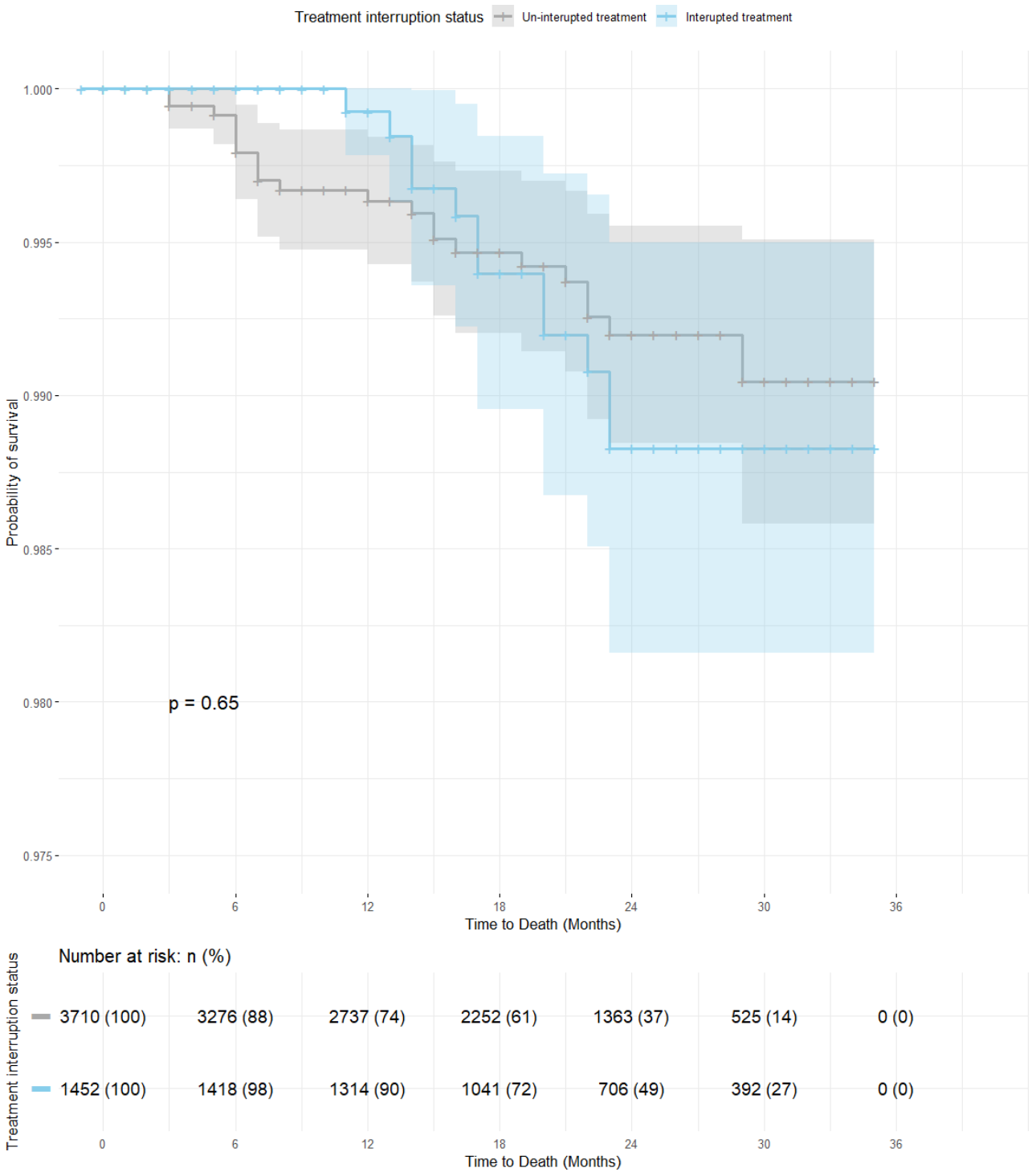


Figure 4-11 Survival function analysis of mortality for treatment interruption status

Source: Researcher's Secondary data

4.3.3 Survival Function Analysis for Viral Load Suppression

Survival probability functions for viral load suppression were computed for participants who had a low viral load at the time of initiation of ART treatment (*Figure 4-12*). Participants included in the analysis were only patients with a viral load status less than 1,000 c/ml at the time of initiation. The hypothesis was that over the period of treatment, the viral load would remain suppressed, otherwise, relapsed occurs. This means that individuals with a low viral load at the start of treatment are expected to remain and maintain viral load suppression while in treatment. The survival probability function, in this context, reflects the anticipated probability of sustaining viral load suppression over time. *Figure 4-12* showed a slightly decreasing probability of viral load suppression, indicating a slightly increasing risk of relapsed in viral load suppression. *Figure 4-13* presents results for survival probability for viral load indication and offer of prophylaxis, while Figure 4-14 shows the survival probability for BMI status and TB status.

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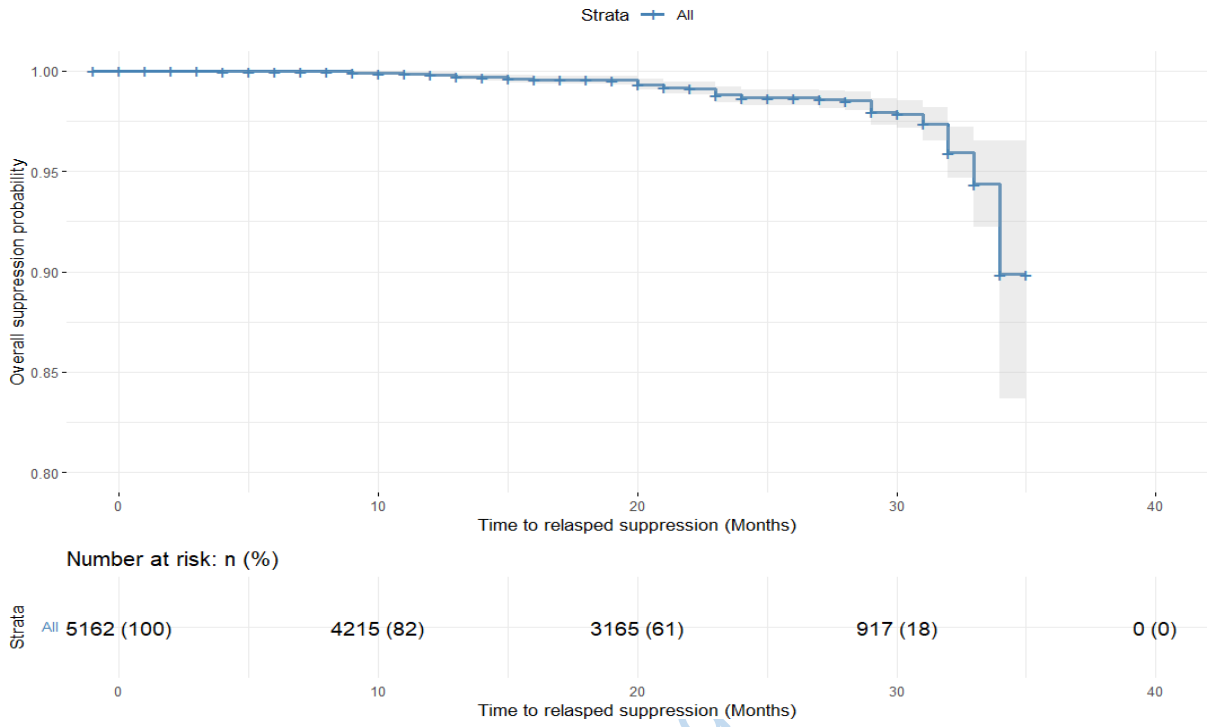


Figure 4-12 Survival function analysis of viral load suppression in ART treatment
Source: Researcher's Secondary data

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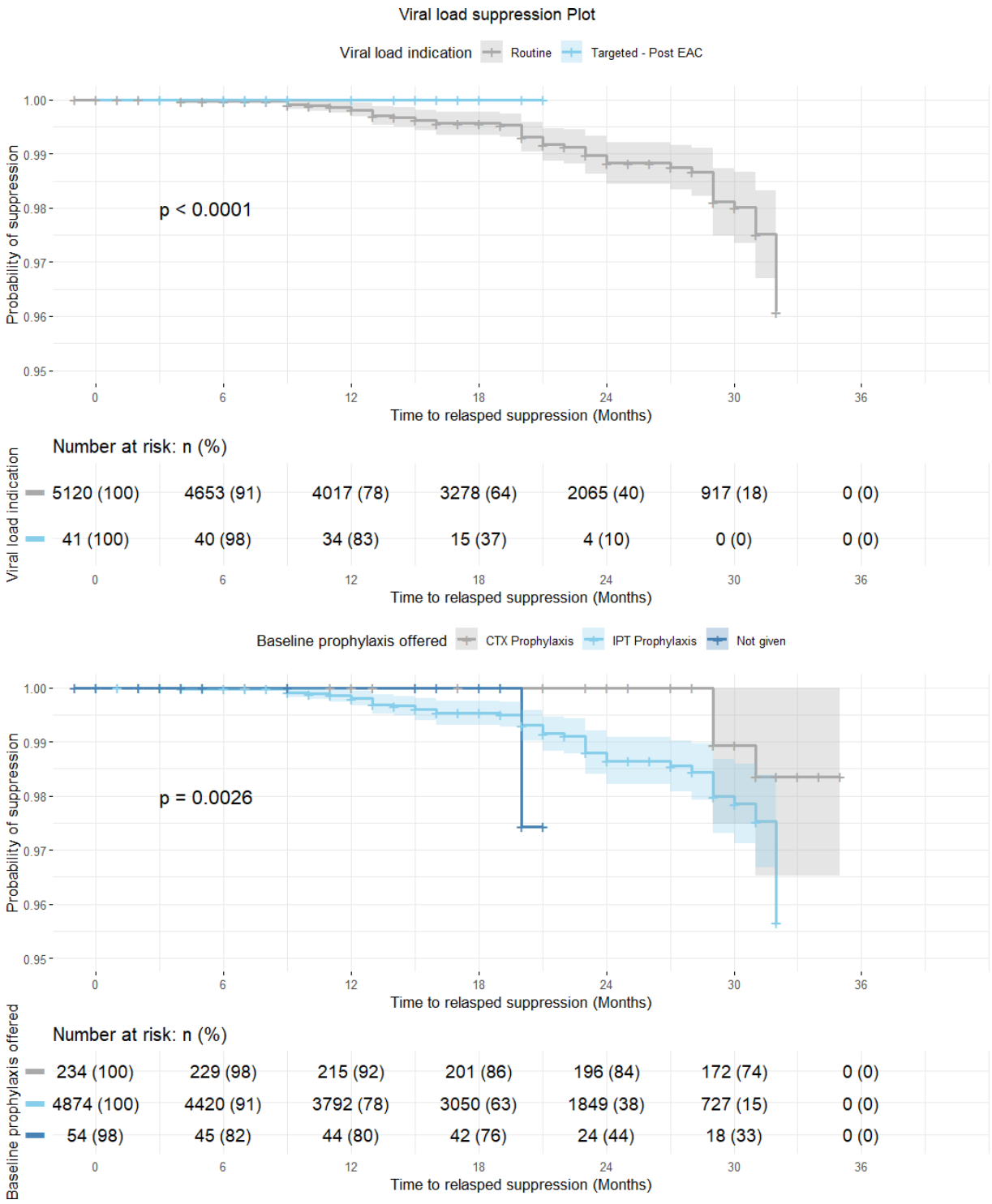


Figure 4-13 Survival function analysis of viral suppression for Viral load indication and Offer of prophylaxis at baseline

Source: Researcher's Secondary data

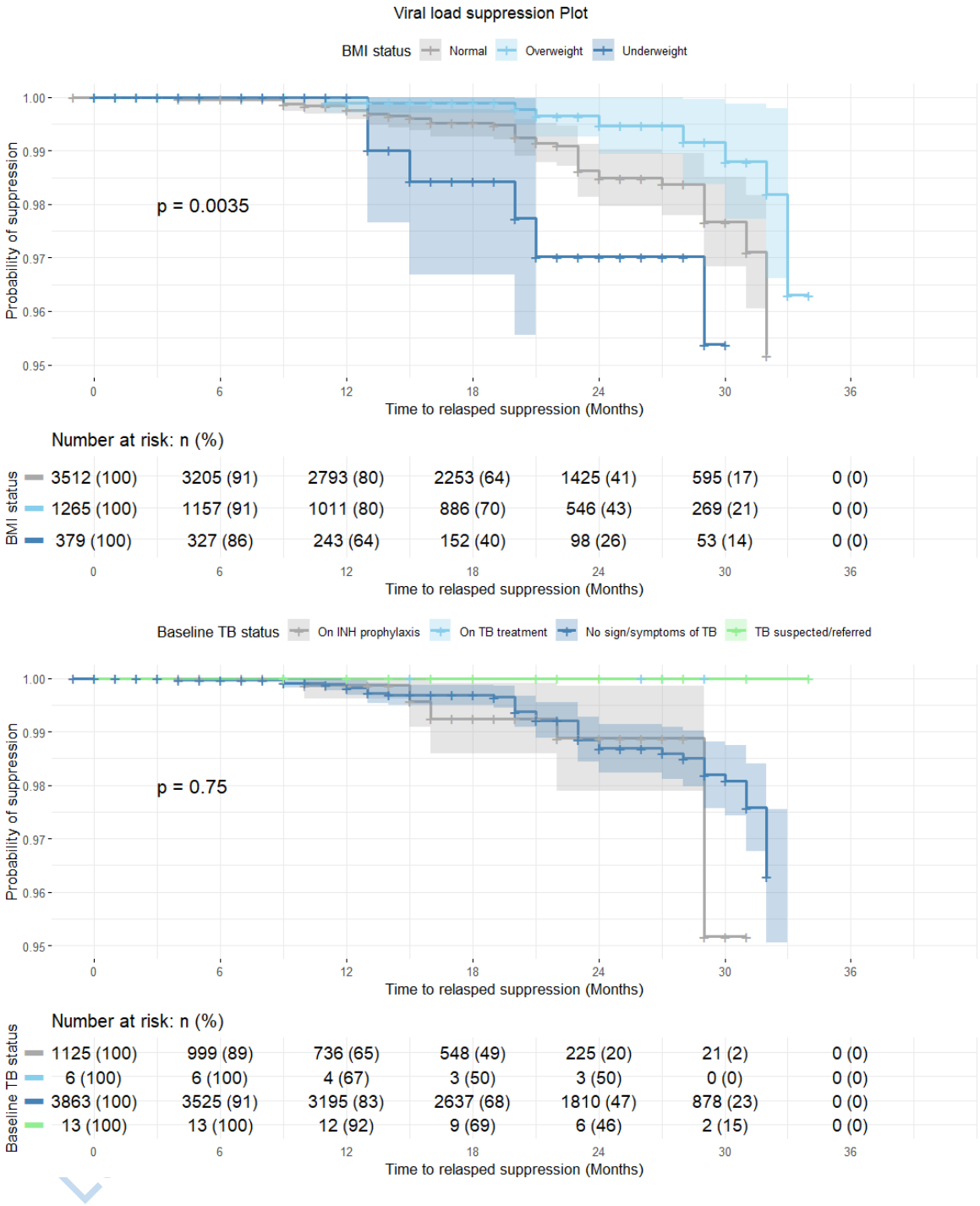


Figure 4-14 Survival function analysis of viral suppression for BMI status and TB status
Source: Researcher's Secondary data

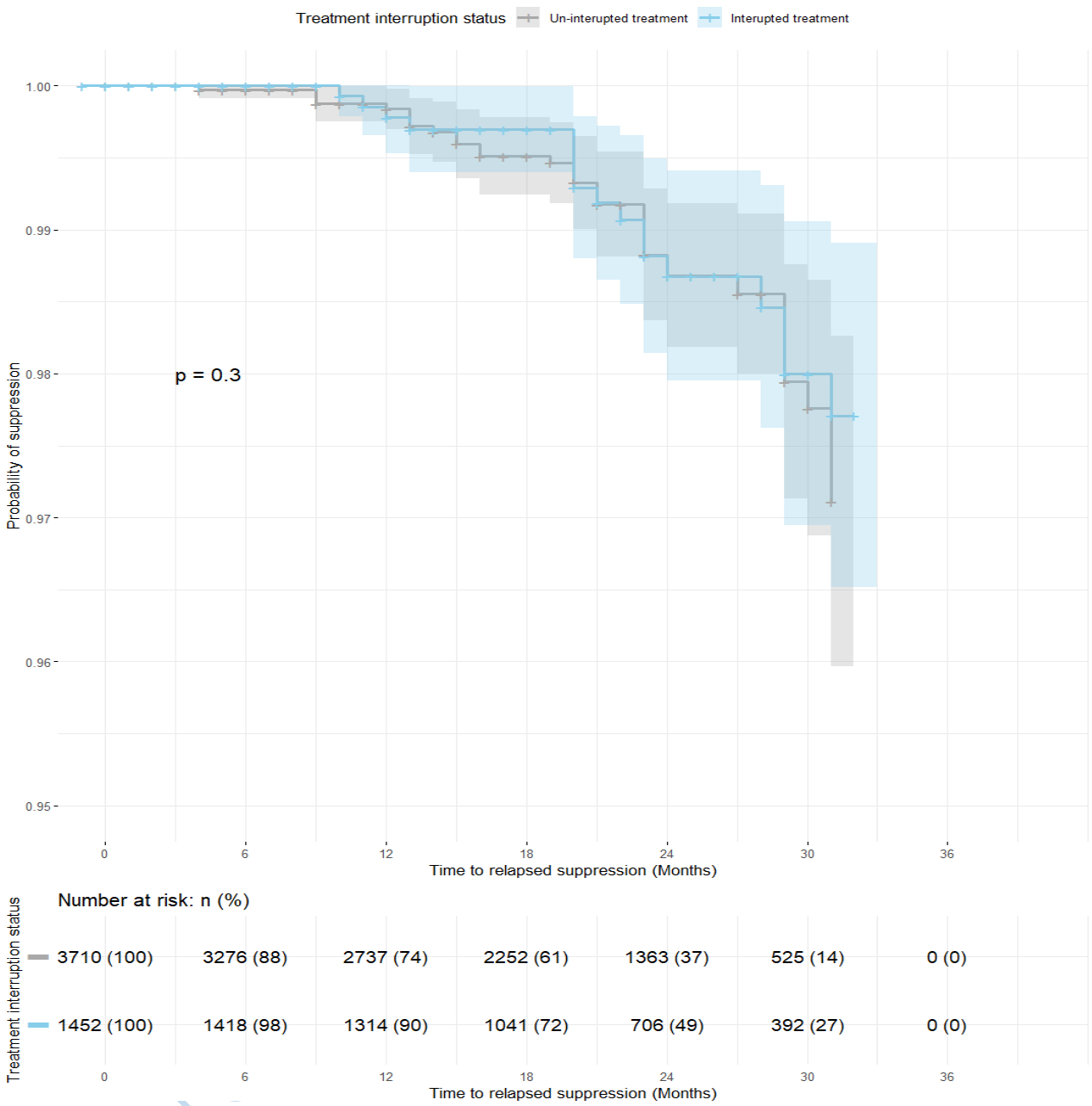


Figure 4-15 Survival function analysis of viral suppression for Treatment Interruption status
Source: Researcher's Secondary data

4.6 Multivariate Analysis of Predictors of Treatment Outcome

Table 4-6 presents the results of a multivariate Cox proportional hazards analysis examining the association between various patient characteristics and treatment outcomes, including treatment interruption, loss to follow-up, mortality, and viral load suppression. Participants aged 35 years and older demonstrated a hazard ratio (HR) of 1.05 (95% CI: 0.93 - 1.19, p = 0.4) for treatment interruption. For lost-to-follow-up, this age group showed a significant HR of 1.08 (95% CI: 0.67 - 1.75, p = 0.7), indicating that individuals in this age group were 1.08 times more likely to be lost to follow-up compared to the reference group (those less than 35 years of age). Conversely, participants aged 35 years and older showed a decreased hazard of death, with an HR of 0.60 (95% CI: 0.31 - 1.16, p = 0.13), although this was not statistically significant. Regarding viral load suppression, participants aged 35 years and older showed a significantly lower hazard, with an HR of 0.52 (95% CI: 0.31 - 0.89, p = 0.017), indicating that individuals in this age group were 0.52 times as likely to achieve viral load suppression compared to the reference group.

Male participants exhibited a significant association with treatment interruption, with an HR of 0.86 (95% CI: 0.74 - 0.99, p = 0.032), indicating that males were less likely to experience treatment interruption compared to females. However, there was no significant association between gender and loss to follow-up, death, or viral load suppression. Marital status did not demonstrate significant associations with any of the treatment outcomes.

Participants with primary education exhibited significantly increased hazards of treatment interruption compared to those with no formal education, with a hazard ratio of 1.39 (95% CI: 1.19 - 1.62, p < 0.001). Similarly, participants with Quranic education (HR = 1.25, 95% CI: 0.95 - 1.64, p = 0.12) and secondary/post-secondary education (HR = 1.46, 95% CI: 1.25 - 1.71, p < 0.001)

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also showed increased hazards of treatment interruption. Among occupation categories, students exhibited a higher hazard ratio for treatment interruption, with an HR of 1.29 (95% CI: 0.93 - 1.78, p = 0.13), compared to those who were employed.

Regarding care entry points, participants entering care through HTS (HIV Testing Services) had a significantly higher hazard of loss to follow-up (HR = 2.55, 95% CI: 1.47 - 4.43, p < 0.001) compared to those entering through CBO (Community Based Organization). Outreach as a care entry point was also associated with a higher hazard of loss to follow-up (HR = 1.51, 95% CI: 1.15 - 1.99, p = 0.003). Offering cotrimoxazole at baseline significantly decreased hazards of treatment interruption (HR = 0.54, 95% CI: 0.33 - 0.89, p = 0.016) and death (HR = 0.14, 95% CI: 0.03 - 0.67, p = 0.013) and increased the hazard of achieving viral load suppression (HR = 0.24, 95% CI: 0.05 - 1.11, p = 0.067). Offering isoniazid at baseline was associated with significantly reduced hazards of treatment interruption (HR = 0.48, 95% CI: 0.16 - 1.43, p = 0.2), death (HR = 0.30, 95% CI: 0.10 - 0.88, p = 0.028), and increased hazard of achieving viral load suppression (HR = 0.30, 95% CI: 0.10 - 0.88, p = 0.028).

Participants with viral loads less than 1000 copies/ml had significantly reduced hazards of loss to follow-up (HR = 0.14, 95% CI: 0.06 - 0.33, p < 0.001) and death (HR = 0.26, 95% CI: 0.10 - 0.64, p = 0.003) compared to those with higher viral loads. Among BMI categories, overweight participants had a significantly reduced hazard of mortality (HR = 0.07, 95% CI: 0.01 - 0.36, p = 0.001), while underweight participants had a significantly increased hazard of mortality (HR = 2.64, 95% CI: 1.07 - 6.51, p = 0.036), compared to participants with normal BMI.

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Table 4-6 Multivariate Cox proportional hazard ratio of patient factors by treatment outcomes

	Treatment interruption			Lost to follow-up			Death			Viral load suppression		
Characteristic	**HR[1]**	**95% CI[1]**	**p-value**	**HR[1]**	**95% CI[1]**	**p-value**	**HR[1]**	**95% CI[1]**	**p-value**	**HR[1]**	**95% CI[1]**	**p-value**
Age group												
< 35 years	—	—		—	—		—	—		—	—	
35+ years	1.05	0.93, 1.19	0.4	1.08	0.67, 1.75	0.7	0.60	0.31, 1.16	0.13	0.52	0.31, 0.89	0.017
Gender												
Female	—	—		—	—		—	—		—	—	
Male	0.86	0.74, 0.99	0.032	0.89	0.50, 1.59	0.7	1.59	0.82, 3.07	0.2	1.24	0.70, 2.21	0.5
Marital status												
Divorced/Separated/Widowed	—	—					—	—		—	—	
Married	0.92	0.79, 1.07	0.3				0.69	0.32, 1.47	0.3	0.80	0.41, 1.57	0.5
Single	1.02	0.86, 1.20	0.8				0.54	0.24, 1.21	0.14	0.71	0.35, 1.45	0.4
Education												
None	—	—										
Primary	1.39	1.19, 1.62	<0.001									
Quranic	1.25	0.95, 1.64	0.12									
Secondary/post secondary	1.46	1.25, 1.71	<0.001									
Occupation												
Employed	—	—										
Retired	0.53	0.13, 2.16	0.4									
Student	1.29	0.93, 1.78	0.13									
Unemployed	1.13	0.96, 1.32	0.13									
Study LGA												

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Characteristic	Treatment interruption			Lost to follow-up			Death			Viral load suppression		
	HR[1]	95% CI[1]	p-value	HR[1]	95% CI[1]	p-value	HR[1]	95% CI[1]	p-value	HR[1]	95% CI[1]	p-value
LGA 1	—	—					—	—				
LGA 2	10.6	8.63, 13.0	<0.001				0.52	0.18, 1.53	0.2			
Care entry point												
CBO	—	—								—	—	
HTS	2.55	1.47, 4.43	<0.001							1.68	0.40, 7.10	0.5
Others	1.75	0.91, 3.37	0.10							0.03	0.00, 143	0.4
Outreach	1.51	1.15, 1.99	0.003							0.46	0.20, 1.10	0.080
Blood pressure status												
Elevated:	—	—										
High blood pressure stage 1: 130-139/80-89	1.02	0.85, 1.23	0.8									
High blood pressure stage 2: 140+/90+	1.28	0.94, 1.73	0.11									
Normal: 120/<80	0.89	0.74, 1.08	0.2									
Unknown	1.48	1.04, 2.10	0.030									
Baseline offer of cotrimoxazole												
Not offered	—	—		—	—		—	—		—	—	
Offered	0.54	0.33, 0.89	0.016	0.48	0.16, 1.43	0.2	0.24	0.05, 1.11	0.067	0.14	0.03, 0.67	0.013
Baseline offer of Isoniazid												
Not offered	—	—		—	—		—	—		—	—	
Offered	0.97	0.63, 1.50	0.9	0.32	0.17, 0.60	<0.001	0.19	0.06, 0.53	0.002	0.30	0.10, 0.88	0.028
TB status												

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Characteristic	Treatment interruption			Lost to follow-up			Death			Viral load suppression		
	HR[1]	95% CI[1]	p-value	HR[1]	95% CI[1]	p-value	HR[1]	95% CI[1]	p-value	HR[1]	95% CI[1]	p-value
No sign or symptoms of TB	—	—										
Currently on INH prophylaxis	1.79	1.42, 2.25	<0.001									
TB positive not on TB drugs	50.1	6.93, 362	<0.001									
Viral load indication												
Routine	—	—					—	—		—	—	
Targeted - Post EAC	1.81	1.04, 3.16	0.035				16.3	5.59, 47.5	<0.001	18.3	6.28, 53.5	<0.001
Viral load status												
Greater than 1000				—	—		—	—				
Less than 1000				0.14	0.06, 0.33	<0.001	0.26	0.10, 0.64	0.003			
No VL				11.8	4.68, 29.8	<0.001						
BMI status												
Underweight							—	—				
Normal							0.42	0.18, 0.98	0.044			
Overweight							0.07	0.01, 0.36	0.001			
Baseline functional status												
Ambulatory							—	—				
Working							0.64	0.09, 4.73	0.7			
Blood pressure status												
Elevated										—	—	
High blood pressure stage 1										1.78	0.77, 4.11	0.2

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	Treatment interruption			Lost to follow-up			Death			Viral load suppression		
Characteristic	**HR[1]**	**95% CI[1]**	**p-value**	**HR[1]**	**95% CI[1]**	**p-value**	**HR[1]**	**95% CI[1]**	**p-value**	**HR[1]**	**95% CI[1]**	**p-value**
High blood pressure stage 2										0.97	0.20, 4.73	>0.9
Normal										1.24	0.53, 2.92	0.6

[1]HR = Hazard Ratio, CI = Confidence Interval

Source: Researcher's Secondary data

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4.7 Demographic Characteristics, Health Behaviours and History of Survey Participants

A total of 790 participants were included in the survey, comprising 576 females and 214 males, as presented in Table 4-7

Table 4-7. The results present the distribution of characteristics of the respondents, including age, educational status, occupation, marital status, family characteristics, and household income of participants, stratified by gender. The median age of the participants was 34 years (IQR: 29-40). Female participants had a slightly lower median age (33 years, IQR: 28-38) compared to males (36 years, IQR: 30-43) ($p < 0.001$). Regarding educational status, significant differences were observed among the genders ($p = 0.001$). The majority of participants in the study had a secondary education (37%, n = 289). A higher proportion of males had tertiary education (15%, n = 33) compared to females (9.7%, n = 56), while females had a higher proportion of individuals with no formal education (30%, n = 172) compared to males (17%, n = 37). A higher proportion of males were engaged in professional occupations (10%, n = 19) compared to females (4.6%, n = 16), while females had a higher proportion of unskilled workers (60%, 207) compared to males (24%, n = 45). There were more single respondents in the study (64%, n = 503) compared with married respondents (41%, n = 325). Marital status varied significantly between genders ($p < 0.001$). A greater proportion of males were married (63%, n = 134) compared to females (33%, n = 191), whereas a higher proportion of females were separated or widowed (28%, n = 162) compared to males (4.7%, n = 10). Males had a higher median number of children (5, IQR: 3-7) compared to females (3, IQR: 2-4). Additionally, a higher proportion of males were living together with children (90%, n =126) compared to females (56%, n = 202).

The approximate total household income varied significantly between genders ($p < 0.001$). The

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median household income for females was 40,000 Naira (IQR: 25,000-50,000), whereas for males, it was slightly higher at 45,000 Naira (IQR: 35,000-60,000). Furthermore, significant differences were observed in the distribution of household income groups between genders ($p < 0.001$). A higher proportion of males belonged to the income group above 30,000 Naira (76%, n = 162) compared to females (63%, n = 362)

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Table 4-7 Demographic characteristics of survey population

Characteristic	**Overall**, N = 790[1]	**Female**, N = 576[1]	**Male**, N = 214[1]	**p-value**[2]
Age in years	34 (29, 40)	33 (28, 38)	36 (30, 43)	<0.001
Educational status				0.001
No formal education	209 (26%)	172 (30%)	37 (17%)	
Primary education	203 (26%)	140 (24%)	63 (29%)	
Secondary education	289 (37%)	208 (36%)	81 (38%)	
Tertiary education	89 (11%)	56 (9.7%)	33 (15%)	
Occupation				<0.001
Professional	35 (6.6%)	16 (4.6%)	19 (10%)	
Skilled	245 (46%)	123 (36%)	122 (66%)	
Unskilled	252 (47%)	207 (60%)	45 (24%)	
Marital status				<0.001
Married	325 (41%)	191 (33%)	134 (63%)	
Separated or Widowed	172 (22%)	162 (28%)	10 (4.7%)	
Single	293 (37%)	223 (39%)	70 (33%)	
Have children	503 (64%)	363 (63%)	140 (65%)	0.5
Number of children	3.00 (2.00, 5.00)	3.00 (2.00, 4.00)	5.00 (3.00, 7.00)	<0.001
Number of children (grouped)				<0.001
1-2 children	173 (34%)	141 (39%)	32 (23%)	
3-4 children	159 (32%)	132 (36%)	27 (19%)	
5 and more	171 (34%)	90 (25%)	81 (58%)	
Living together with children	328 (65%)	202 (56%)	126 (90%)	<0.001
Approximate total household income	40,000 (30,000, 55,000)	40,000 (25,000, 50,000)	45,000 (35,000, 60,000)	<0.001
Approximate total household income (grouped)				<0.001
30,000 Naira and below	266 (34%)	214 (37%)	52 (24%)	
Above 30,000 Naira	524 (66%)	362 (63%)	162 (76%)	

[1]Median (IQR); n (%)
[2]Wilcoxon rank sum test; Pearson's Chi-squared test
Source: Researcher's Field Survey, 2023

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Table 4-8 presents the distribution of health behaviour and medical history of the respondents stratified by gender. There were no significant differences between genders in terms of ever being hospitalized due to HIV disease (6.1% overall [n = 48], 6.4% females [n = 37], 5.1% males [n = 11]; p = 0.5) or disclosing HIV status (75% overall [n = 590], 74% females [n = 424], 78% males [n = 166]; p = 0.3). However, significant differences were observed in sexual behavior. While almost all participants reported ever having sex (99% overall [n = 783], 99% females [n = 573], 98% males [n = 210]), a higher proportion of males reported having more than one sexual partner in the past 6 months compared to females (70% overall [n = 552], 66% females [n = 380], 80% males [n = 172]; p < 0.001). Additionally, males were less likely to use condoms during their last sexual intercourse compared to females, although this difference was not statistically significant (71% overall [n = 561], 73% females [n = 418], 67% males [n = 143]; p = 0.11). About 61% (n = 479) of the total sample reported having had or been diagnosed with a sexually transmitted infection (STI) before their HIV diagnosis. Among these, 60% (n = 347) were female and 62% (n = 132) were male.

Significant differences were observed in smoking cigarette habits between genders (p < 0.001). A higher proportion of males were regular occasional smokers compared to females (21% overall [n = 159], 17% females [n = 91], 33% males [n = 68]). Regarding alcohol consumption, males were more likely to have consumed alcohol in the last 12 months (96% overall [n = 210], 99% females [n = 147], 90% males [n = 63]; p = 0.005) and to report daily or nearly daily alcohol consumption compared to females (16% overall [n = 126], 15% females [n = 87], 18% males [39]; p = 0.035). In addition, a higher proportion of males reported ever using illicit drugs, especially current use

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(84% overall [n = 629], 86% females [n = 465], 80% males [n = 164]; p = 0.019), and recent illicit drug use within the last month (p = 0.003).

There were no significant differences between genders in the distance of the ART clinic from the participants' residences (79% overall [n = 621], 80% females [n = 458], 76% males [n = 163]; p = 0.3). However, significant gender differences were observed in experiencing stigma due to HIV status (29% overall [n = 229], 32% females [n = 185], 21% males [n = 44]; p = 0.001) and frequency of exercising (p < 0.001). Females were more likely to report experiencing HIV-related stigma, while males reported higher levels of exercise frequency.

No significant differences were found between genders in the prevalence of a family history of asthma (16% overall [n = 127], 16% females [n = 35], 16% males [n = 92]; p = 0.9), hypertension (26% overall [n = 206], 26% females [n = 151], 26% males [n = 55]; p = 0.9), or depression (8.6% overall [n = 68], 9.0% females [n = 52], 7.5% males [n = 16]; p = 0.5). However, significant differences were observed in the prevalence of a family history of diabetes (19% overall [n = 152], 18% females [n = 101], 24% males [n = 51]; p = 0.046), with males showing a higher prevalence compared to females.

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Table 4-8 Health behaviour and medical history of the survey population

Characteristic	**Overall**, N = 790[1]	**Female**, N = 576[1]	**Male**, N = 214[1]	**p-value**[2]
Ever hospitalized because of HIV disease	48 (6.1%)	37 (6.4%)	11 (5.1%)	0.5
Disclosed HIV status	590 (75%)	424 (74%)	166 (78%)	0.3
Ever had sex	783 (99%)	573 (99%)	210 (98%)	0.091
Number of sexual partners in past 6 months				<0.001
More than one	552 (70%)	380 (66%)	172 (80%)	
One	238 (30%)	196 (34%)	42 (20%)	
Condom used during last sexual intercourse	561 (71%)	418 (73%)	143 (67%)	0.11
Frequency of condom use				0.081
Always	408 (52%)	308 (53%)	100 (47%)	
Not at all	74 (9.4%)	57 (9.9%)	17 (7.9%)	
Sometimes	308 (39%)	211 (37%)	97 (45%)	
Ever had or been diagnosed of STI before HIV diagnosis	479 (61%)	347 (60%)	132 (62%)	0.7
Smoking cigarette				<0.001
Formerly smoke	155 (21%)	111 (21%)	44 (21%)	
Never smoke	436 (58%)	339 (63%)	97 (46%)	
Regular occasional smoker	159 (21%)	91 (17%)	68 (33%)	
Frequency of drinking alcohol				0.035
Daily or Nearly Daily >4 times/week	126 (16%)	87 (15%)	39 (18%)	
Never	565 (72%)	423 (73%)	142 (66%)	
Some/ Month 1-3 times/ month	40 (5.1%)	22 (3.8%)	18 (8.4%)	
Some/Week 1-4 times/ week	59 (7.5%)	44 (7.6%)	15 (7.0%)	
Drank alcohol in the last 12 months	210 (96%)	147 (99%)	63 (90%)	0.005
Ever used illicit drugs				0.019
Never	629 (84%)	465 (86%)	164 (80%)	
Yes and I currently use it now	55 (7.4%)	31 (5.7%)	24 (12%)	
Yes but I used it in the past	61 (8.2%)	45 (8.3%)	16 (7.8%)	
Illicit drug use in the last month				0.003
Daily or Nearly Daily >4 times/w eek	41 (35%)	18 (24%)	23 (58%)	
Never	35 (30%)	25 (33%)	10 (25%)	
Sometime/ Month 1-3 times/ month	8 (6.9%)	7 (9.2%)	1 (2.5%)	
Sometime/Week 1-4 times/ week	32 (28%)	26 (34%)	6 (15%)	
Clinic where ART is received far from current residence	621 (79%)	458 (80%)	163 (76%)	0.3
Ever experienced stigma because of HIV status	229 (29%)	185 (32%)	44 (21%)	0.001
Frequency of exercising				<0.001
Daily or Nearly Daily >4 times/w eek	23 (2.9%)	13 (2.3%)	10 (4.7%)	
Never	608 (77%)	466 (81%)	142 (66%)	
Sometime/ Month 1-3 times/ month	95 (12%)	65 (11%)	30 (14%)	
Sometime/Week 1-4 times/ week	64 (8.1%)	32 (5.6%)	32 (15%)	
History of Asthma in family	127 (16%)	92 (16%)	35 (16%)	0.9
History of Hypertension in family	206 (26%)	151 (26%)	55 (26%)	0.9
History of diabetes in family	152 (19%)	101 (18%)	51 (24%)	0.046
History of cancer in family	58 (7.3%)	39 (6.8%)	19 (8.9%)	0.3

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Characteristic	**Overall**, N = 790[1]	**Female**, N = 576[1]	**Male**, N = 214[1]	**p-value**[2]
History of depression in family	68 (8.6%)	52 (9.0%)	16 (7.5%)	0.5

[1]n (%)

[2]Pearson's Chi-squared test; Fisher's exact test

Source: Researcher's Field Survey, 2023

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4.8 Patient Experience of HIV symptoms and Comorbidities

Experience of HIV symptoms and the infectious and non-infectious comorbidity of the respondents was assessed. *Figure 4-16* presents the distribution of symptomatic and asymptomatic status, infectious and non-infectious co-morbidity status among participants in the study. A significant portion (85%) of the population reported having symptoms of HIV. Another substantial proportion (35%) reported having a co-infection, while 37% reported having non-infectious co- morbidities.

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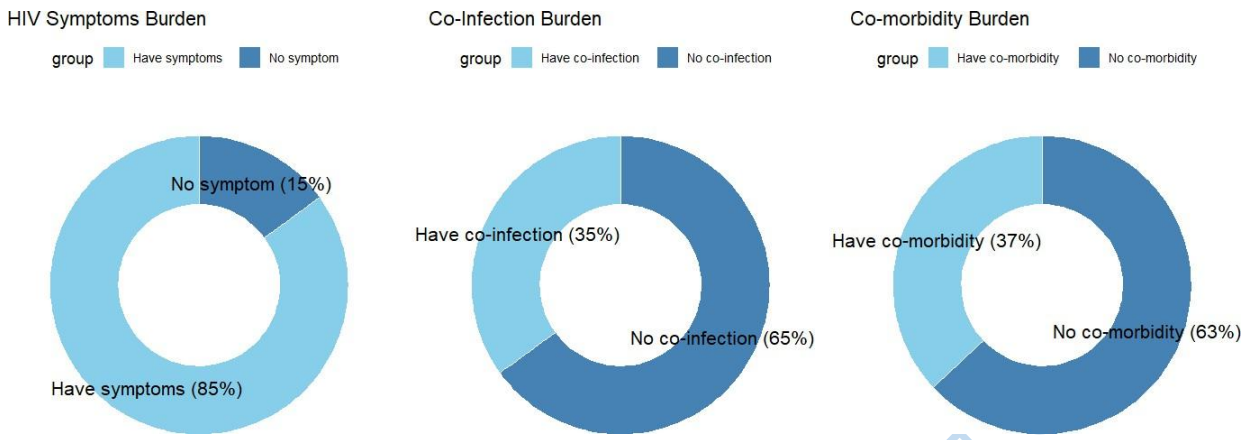


Figure 4-16 Overall prevalence of self-reported HIV symptoms, co-infection and non-infectious comorbidity

Source: Researcher's Field Survey, 2023

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4.9 Burden of symptoms of HIV

Figure 4-17 shows the distribution of the burden of the various reported symptoms of HIV among the respondents stratified by gender. The symptoms exhibiting highest level burden on the respondents included changes in body appearance, headache, pain or tingling in hands and feet appeared commonly in both males and females. Bloating or pain or gas in stomach also exhibited as high burden among the symptoms. Feeling sad or depressed, fatigued and dizziness or lightheadedness were also exhibited as being a high burden symptom.

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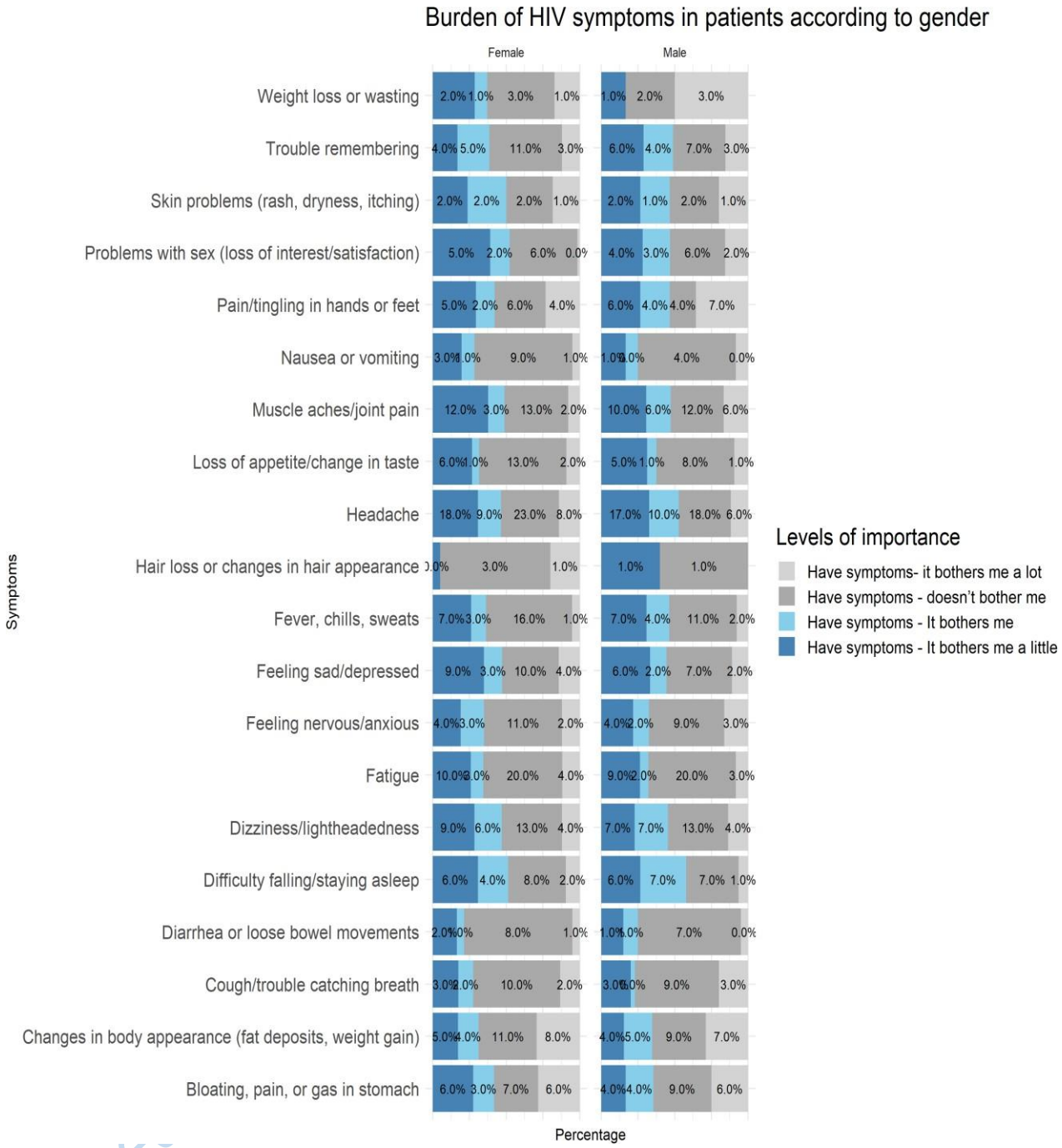


Figure 4-17 Burden of HIV symptoms by gender

Source: Researcher's Field Survey, 2023

4.10 Prevalence and burden of non-infectious co-morbidity

The prevalence of non-infectious co-morbidities which encompassed cardiovascular, respiratory, gastrointestinal conditions, mental health and musculoskeletal conditions were assessed through self-report by the respondents and is detailed in *Table 4-9*, and stratified by gender (*Figure 4-18*).

Peptic ulcers was reported as the most prevalent comorbidity, affecting 22% (n = 174) of the overall sample. This condition was reported more among females (24%, n = 137) compared to males (17%, n = 37). High blood pressure presented as the second most prevalent comorbidity, impacting 12% (n = 91) of the sample, with a relatively even distribution across genders (females: 11%, males: 12%). Heart disease, however, was low in the overall population with 1.6% (n = 13) reporting the condition, with a significant gender disparity, affecting a considerably higher proportion of males (4.2%, n = 9) compared to females (0.7%, n = 4). Similarly, Lung disease was reported by 2% (n = 16) of the sample, with a higher prevalence in males (5.1%, n = 11) compared to females (0.9%, n = 5). Diabetes was reported to affect a smaller proportion of the overall sample (2%, n = 15), with a relatively balanced distribution across genders (females: 1.7%, males: 2.3%). Depression was reported only among females (3.5%, n = 20). Back pain exhibited a higher prevalence in males (14%, n = 30) compared to females (8.7%, n = 50), and the overall prevalence was high at 10% (n = 80). Osteoarthritis and Rheumatoid Arthritis showed a similar trend, although with a lower overall prevalence.

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Table 4-9 Prevalence of Self-reported non-infectious comorbidities according to gender

Characteristic	**Overall**, N = 790[1]	**Female**, N = 576[1]	**Male**, N = 214[1]
Heart Disease	13 (1.6%)	4 (0.7%)	9 (4.2%)
High Blood Pressure	91 (12%)	65 (11%)	26 (12%)
Lung Disease	16 (2.0%)	5 (0.9%)	11 (5.1%)
Diabetes	15 (1.9%)	10 (1.7%)	5 (2.3%)
Ulcer	174 (22%)	137 (24%)	37 (17%)
Cancer	2 (0.3%)	0 (0%)	2 (0.9%)
Depression	20 (2.5%)	20 (3.5%)	0 (0%)
Osteoarthritis	4 (0.5%)	4 (0.7%)	0 (0%)
Back Pain	80 (10%)	50 (8.7%)	30 (14%)
Rheumatoid Arthritis	32 (4.1%)	22 (3.8%)	10 (4.7%)
Other Medical Problems	5 (0.6%)	4 (0.7%)	1 (0.5%)

[1]n (%)
Source: Researcher's Field Survey, 2023

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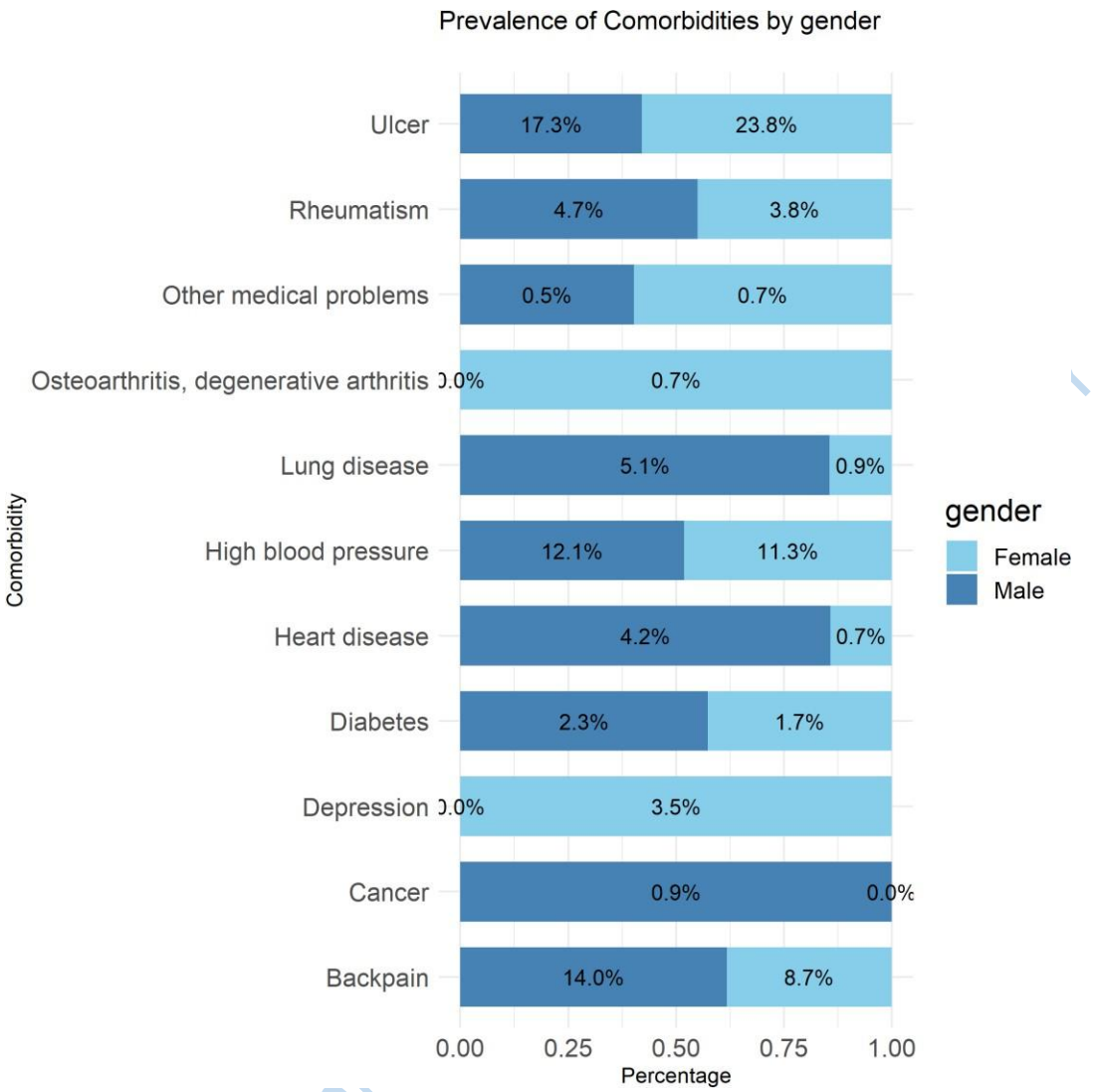


Figure 4-18 Prevalence of co-morbidity by gender

Source: Researcher's Field Survey, 2023

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Table 4-10 presents the receipt of treatment and the impact of various co-morbidity conditions among the participants, disaggregated by gender. All participants (100%, n = 13) with heart disease reported receiving treatment for the condition. Regarding limitations in activities 31% (n = 4) reported the condition limited their activities, however, there was no significant gender difference ($p > 0.9$). A high proportion of participants with high blood pressure received treatment (97% overall, n = 88), with no significant difference between genders ($p > 0.9$). About 30% (n = 26) reported limitations in activities due to high blood pressure. Similarly, there was no significant difference in activity limitations due to high blood pressure across genders ($p = 0.8$).

A high proportion of individuals who reported ulcers received treatment (90%, n = 13), with no significant difference between genders ($p = 0.2$). However, significant gender differences were observed in activity limitations due to ulcers ($p = 0.006$), with a higher proportion of males reporting limitations. The treatment rate for cancer was 50% overall, with no significant gender difference observed. Activity limitations due to cancer were not analyzed due to the small sample size.

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Table 4-10 Burden of non-infectious comorbidities according to gender

Characteristic	**Overall**, N = 790[1]	**Female**, N = 576[1]	**Male**, N = 214[1]	**p-value**[2]
Heart disease (received treatment)				-
Yes	13 (100%)	4 (100%)	9 (100%)	
Heart disease limits activities				>0.9
No	9 (69%)	3 (75%)	6 (67%)	
Yes	4 (31%)	1 (25%)	3 (33%)	
High blood pressure (received treatment)				>0.9
No	3 (3.3%)	2 (3.1%)	1 (3.8%)	
Yes	88 (97%)	63 (97%)	25 (96%)	
High blood pressure limits activities				0.8
No	62 (70%)	44 (70%)	18 (72%)	
Yes	26 (30%)	19 (30%)	7 (28%)	
Lung disease (received treatment)				0.3
No	1 (6.3%)	1 (20%)	0 (0%)	
Yes	15 (94%)	4 (80%)	11 (100%)	
Lung disease limits activities				>0.9
No	10 (67%)	3 (75%)	7 (64%)	
Yes	5 (33%)	1 (25%)	4 (36%)	
Diabetes (received treatment)				0.5
No	2 (13%)	2 (20%)	0 (0%)	
Yes	13 (87%)	8 (80%)	5 (100%)	
Diabetes limits activities				>0.9
No	7 (54%)	4 (50%)	3 (60%)	
Yes	6 (46%)	4 (50%)	2 (40%)	
Ulcer (received treatment)				0.2
No	18 (10%)	12 (8.8%)	6 (16%)	
Yes	156 (90%)	125 (91%)	31 (84%)	
Ulcer limits activities				0.006
No	62 (40%)	43 (34%)	19 (61%)	
Yes	94 (60%)	82 (66%)	12 (39%)	
Cancer (received treatment)				-
No	1 (50%)	0 (NA%)	1 (50%)	
Yes	1 (50%)	0 (NA%)	1 (50%)	
cancer limits activities				-
Yes	1 (100%)	0 (NA%)	1 (100%)	
Depression (received treatment)				-
Yes	20 (100%)	20 (100%)	0 (NA%)	
Depression limits activities				>0.9
No	2 (10%)	2 (10%)	0 (NA%)	
Yes	18 (90%)	18 (90%)	0 (NA%)	
Osteoarthritis (received treatment)				-
Yes	4 (100%)	4 (100%)	0 (NA%)	
Osteoarthritis limits activities				

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Characteristic	**Overall**, N = 790[1]	**Female**, N = 576[1]	**Male**, N = 214[1]	**p-value**[2]
Yes	4 (100%)	4 (100%)	0 (NA%)	
Back Pain (received treatment)				0.3
No	4 (5.0%)	4 (8.0%)	0 (0%)	
Yes	76 (95%)	46 (92%)	30 (100%)	
Back Pain limits activities				0.058
No	19 (25%)	8 (17%)	11 (37%)	
Yes	57 (75%)	38 (83%)	19 (63%)	
Rheumatoid Arthritis (received treatment)				0.5
No	2 (6.3%)	1 (4.5%)	1 (10%)	
Yes	30 (94%)	21 (95%)	9 (90%)	
Rheumatoid Arthritis limits activities				0.7
No	9 (30%)	7 (33%)	2 (22%)	
Yes	21 (70%)	14 (67%)	7 (78%)	

[1]n (%)

[2]Fisher's exact test; Pearson's Chi-squared test

Source: Researcher's Field Survey, 2023

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4.11 Prevalence of co-infections

The result in *Table 4-11Table 4-11* presents the self-reported infectious comorbidities among participants, stratified by gender. A total of 20 participants (2.5%) reported hepatitis viruses, with slightly higher prevalence among females (2.6%) compared to males (2.3%), *Figure 4-19*. The proportion of the sample that reported HPV or genital warts was 4.6% (n = 36). The highest prevalence was observed for gonorrhea, with 26% (n = 202) of participants reporting this condition. Of these, 24% (n = 136) were females, and 31% (n = 66) were males. About 6.3% (n = 50) reported chlamydia (female; 7.6%, males; 2.8%).

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Table 4-11 Self-reported infectious comorbidities according to gender

Characteristic	**Overall**, N = 790[1]	**Female**, N = 576[1]	**Male**, N = 214[1]
Hepatitis viruses (regardless of type)	20 (2.5%)	15 (2.6%)	5 (2.3%)
HPV/Genital warts	36 (4.6%)	36 (6.3%)	0 (0%)
Herpes simplex virus (HSV)	6 (0.8%)	5 (0.9%)	1 (0.5%)
Syphilis	46 (5.8%)	37 (6.4%)	9 (4.2%)
Gonorrhoea	202 (26%)	136 (24%)	66 (31%)
Chlamydia	50 (6.3%)	44 (7.6%)	6 (2.8%)

[1]n (%)
Source: Researcher's Field Survey, 2023

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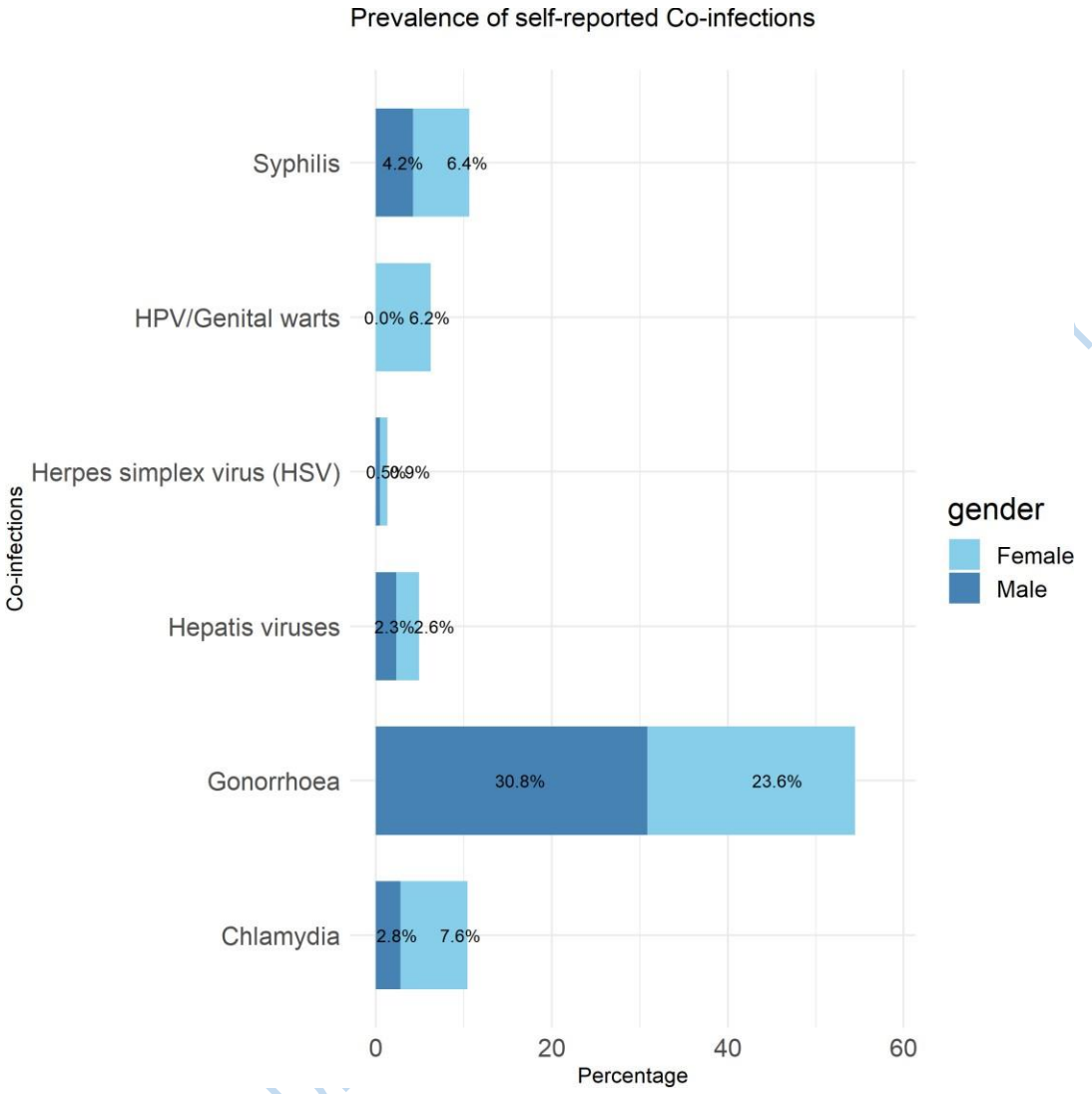


Figure 4-19 Prevalence of self-reported co-infections by gender

Source: Researcher's Field Survey, 2023

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4.12 Bivariate association of HIV Symptoms, Co-infections, and Non-infectious Comorbidities with Sociodemographic and Medical Characteristics

Table 4-12 presents the distribution of the presence of HIV symptoms, co-infections, non-infectious comorbidities, according to various sociodemographic factors. Participants with HIV symptoms had a median age of 34 years (IQR: 29-40), slightly higher than those without symptoms (median age: 33 years, IQR: 29-38). The difference was, however, not statistically significant ($p = 0.11$). Those with co-infections had a lower median age (32 years, IQR: 28-37) compared to those without co-infections (median age: 35 years, IQR: 30-40), showing a significant difference ($p < 0.001$). Similarly, participants with non-infectious comorbidities had a higher median age (36 years, IQR: 30-42) compared to those without comorbidities (median age: 33 years, IQR: 28-38), with a statistically significant difference ($p < 0.001$). Gender distribution did not significantly differ among participants with HIV symptoms, co-infections, or non-infectious comorbidities ($p > 0.05$). Similarly, occupation did not show a significant association with the presence of HIV symptoms, co-infections, or non-infectious comorbidities ($p > 0.05$). Conversely, marital status was significantly associated with the presence of HIV symptoms ($p = 0.007$), co-infections ($p < 0.001$), and non-infectious comorbidities ($p = 0.018$). Participants who were separated or widowed showed higher proportions of HIV symptoms, co-infections, and non-infectious comorbidities compared to those who were married or single.

The number of children was significantly associated with the presence of co-infections ($p < 0.001$) and non-infectious comorbidities ($p < 0.001$), but not with HIV symptoms ($p > 0.05$). Higher household income was associated with a lower prevalence of co-infections ($p < 0.001$) and non-infectious comorbidities ($p = 0.005$), but not with HIV symptoms ($p > 0.05$).

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Regarding the association between HIV symptoms, co-infections, non-infectious comorbidity, and the medical history, the result in *Table 4-13* describe the association. Interestingly, there was a significant association observed between membership in a PLHIV support group and the presence of co-infections ($p < 0.001$). Individuals who were part of such groups showed a higher proportion of co-infections compared to those who were not. However, there was no significant association found between PLHIV support group membership and either HIV symptoms or non-infectious comorbidities. Similarly, the frequency of participation in PLHIV support groups demonstrated a significant association with the presence of co-infections ($p < 0.001$). Participants who engaged in these groups more frequently exhibited a higher proportion of co-infections. However, no significant associations were found between participation frequency and either HIV symptoms or non-infectious comorbidities.

There was a significant association observed between history of TB treatment and the presence of co-infections ($p < 0.001$). Individuals with a history of TB treatment, both current and past, showed a higher proportion of co-infections compared to those who had never been treated for TB. However, no significant associations were found between TB treatment history and either HIV symptoms or non-infectious comorbidities.

Having more than one sexual partner showed higher rate for co-infections compared to having one sexual partner ($p<0.001$). The analysis revealed that while there's no significant association between condom use during last sexual intercourse and the presence of HIV symptoms or non-infectious comorbidities, there is a statistically significant relationship with co-infections ($p = 0.002$), indicating that participants who reported using condoms exhibited a lower proportion of co-infections compared to non-users. I addition, there was an association between smoking cigarette and both the presence of HIV symptoms and co-infections ($p < 0.001$), showing that

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individuals who formerly smoked or who are regular or occasional smokers had a higher prevalence of HIV symptoms and co-infections compared to non-smokers. This association, however, did not show statistically significant with non-infectious co-morbidity.

The frequency of exercising showed association with the presence of HIV symptoms ($p = 0.008$) and non-infectious comorbidity ($p = 0.001$), revealing that individuals who exercised daily or nearly daily exhibited lower proportions of HIV symptoms and non-infectious comorbidities compared to those who never exercised. Additionally, family medical history, including asthma, hypertension, and depression, also showed significant associations with HIV symptoms and non-infectious comorbidities.

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Table 4-12 Distribution of HIV symptoms, co-morbidities according to patient socio-demographic characteristics

Characteristic	HIV Symptoms			Co-infections			Non-infectious comorbidity		
	Have symptoms, N = 672[1]	**No symptoms**, N = 118[1]	**p-value**[2]	**Has Co-infection**, N = 275[1]	**No Co-infection**, N = 515[1]	**p-value**[2]	**Has Comorbidity**, N = 290[1]	**No Comorbidity**, N = 500[1]	**p-value**[2]
Age in years	34 (29, 40)	33 (29, 38)	0.11	32 (28, 37)	35 (30, 40)	<0.001	36 (30, 42)	33 (28, 38)	<0.001
Gender			0.3			0.8			0.8
Female	495 (86%)	81 (14%)		202 (35%)	374 (65%)		213 (37%)	363 (63%)	
Male	177 (83%)	37 (17%)		73 (34%)	141 (66%)		77 (36%)	137 (64%)	
Educational status			0.041			0.050			0.2
No formal education	186 (89%)	23 (11%)		88 (42%)	121 (58%)		86 (41%)	123 (59%)	
Primary education	165 (81%)	38 (19%)		62 (31%)	141 (69%)		79 (39%)	124 (61%)	
Secondary education	240 (83%)	49 (17%)		99 (34%)	190 (66%)		94 (33%)	195 (67%)	
Tertiary education	81 (91%)	8 (9.0%)		26 (29%)	63 (71%)		31 (35%)	58 (65%)	
Occupation			0.5			0.5			0.7
Professional	30 (86%)	5 (14%)		10 (29%)	25 (71%)		10 (29%)	25 (71%)	
Skilled	210 (86%)	35 (14%)		79 (32%)	166 (68%)		88 (36%)	157 (64%)	
Unskilled	207 (82%)	45 (18%)		91 (36%)	161 (64%)		89 (35%)	163 (65%)	
Marital status			0.007			<0.001			0.018
Married	263 (81%)	62 (19%)		81 (25%)	244 (75%)		131 (40%)	194 (60%)	
Separated or Widowed	157 (91%)	15 (8.7%)		60 (35%)	112 (65%)		70 (41%)	102 (59%)	
Single	252 (86%)	41 (14%)		134 (46%)	159 (54%)		89 (30%)	204 (70%)	
Have children			0.9			0.3			<0.001
No	245 (85%)	42 (15%)		107 (37%)	180 (63%)		80 (28%)	207 (72%)	
Yes	427 (85%)	76 (15%)		168 (33%)	335 (67%)		210 (42%)	293 (58%)	
Number of children	3.00 (2.00, 5.00)	3.00 (2.00, 5.00)	0.7	2.00 (2.00, 4.00)	4.00 (2.00, 5.00)	<0.001	4.00 (2.00, 6.00)	3.00 (2.00, 5.00)	<0.001
Number of children (grouped)			0.2			<0.001			<0.001
1-2 children	148 (86%)	25 (14%)		85 (49%)	88 (51%)		57 (33%)	116 (67%)	
3-4 children	129 (81%)	30 (19%)		44 (28%)	115 (72%)		57 (36%)	102 (64%)	
5 and more	150 (88%)	21 (12%)		39 (23%)	132 (77%)		96 (56%)	75 (44%)	
Living together with children			0.2			<0.001			0.8
No	153 (87%)	22 (13%)		88 (50%)	87 (50%)		72 (41%)	103 (59%)	
Yes	274 (84%)	54 (16%)		80 (24%)	248 (76%)		138 (42%)	190 (58%)	
Approximate total household income	45,000 (30,000, 60,000)	30,000 (18,125, 40,000)	<0.001	40,000 (30,000, 50,000)	40,000 (30,000, 60,000)	0.3	45,000 (30,000, 60,000)	40,000 (25,000, 50,000)	0.005
Approximate total household income (grouped)			<0.001			0.2			0.069
30,000 Naira and below	202 (76%)	64 (24%)		100 (38%)	166 (62%)		86 (32%)	180 (68%)	
Above 30,000 Naira	470 (90%)	54 (10%)		175 (33%)	349 (67%)		204 (39%)	320 (61%)	

[1]Median (IQR); n (%)
[2]Wilcoxon rank sum test; Pearson's Chi-squared test
Source: Researcher's Field Survey, 2023

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Table 4-13 Distribution of HIV symptoms, co-morbidities according to patient clinical characteristics

	HIV Symptoms			Co-infections			Non-infectious comorbidity		
Characteristic	**Have symptoms**, N = 672[1]	**No symptoms**, N = 118[1]	**p-value**[2]	**Has Co-infection**, N = 275[1]	**No Co-infection**, N = 515[1]	**p-value**[2]	**Has Comorbidity**, N = 290[1]	**No Comorbidity**, N = 500[1]	**p-value**[2]
Currently belong to any PLHIV support group			>0.9			<0.001			0.4
No	368 (85%)	65 (15%)		178 (41%)	255 (59%)		153 (35%)	280 (65%)	
Yes	304 (85%)	53 (15%)		97 (27%)	260 (73%)		137 (38%)	220 (62%)	
Frequency of participation in PLHIV support group			<0.001			>0.9			0.4
2-4 times/month	47 (100%)	0 (0%)		12 (26%)	35 (74%)		14 (30%)	33 (70%)	
More than 4 times/month	8 (100%)	0 (0%)		2 (25%)	6 (75%)		4 (50%)	4 (50%)	
Once or less/ month	249 (82%)	53 (18%)		83 (27%)	219 (73%)		119 (39%)	183 (61%)	
Ever been on TB treatment			0.3			<0.001			0.022
Never	571 (86%)	94 (14%)		205 (31%)	460 (69%)		231 (35%)	434 (65%)	
Yes and I am currently on TB treatment now	18 (82%)	4 (18%)		11 (50%)	11 (50%)		12 (55%)	10 (45%)	
Yes and I was on TB treatment in the past	83 (81%)	20 (19%)		59 (57%)	44 (43%)		47 (46%)	56 (54%)	
Ever hospitalized because of HIV disease			0.4			0.7			>0.9
No	633 (85%)	109 (15%)		257 (35%)	485 (65%)		272 (37%)	470 (63%)	
Yes	39 (81%)	9 (19%)		18 (38%)	30 (63%)		18 (38%)	30 (63%)	
Disclosed HIV status			0.2			<0.001			0.4
No	165 (83%)	35 (18%)		98 (49%)	102 (51%)		78 (39%)	122 (61%)	
Yes	507 (86%)	83 (14%)		177 (30%)	413 (70%)		212 (36%)	378 (64%)	
Ever had sex			>0.9			0.4			0.4
No	6 (86%)	1 (14%)		1 (14%)	6 (86%)		1 (14%)	6 (86%)	
Yes	666 (85%)	117 (15%)		274 (35%)	509 (65%)		289 (37%)	494 (63%)	
Number of sexual partners in past 6 months			>0.9			<0.001			0.8
More than one	469 (85%)	83 (15%)		231 (42%)	321 (58%)		204 (37%)	348 (63%)	
One	203 (85%)	35 (15%)		44 (18%)	194 (82%)		86 (36%)	152 (64%)	
Condom used during last sexual intercourse			0.4			0.002			0.075
No	191 (83%)	38 (17%)		61 (27%)	168 (73%)		95 (41%)	134 (59%)	
Yes	481 (86%)	80 (14%)		214 (38%)	347 (62%)		195 (35%)	366 (65%)	
Frequency of condom use			0.048			0.001			0.074
Always	357 (88%)	51 (13%)		160 (39%)	248 (61%)		136 (33%)	272 (67%)	
Not at all	57 (77%)	17 (23%)		13 (18%)	61 (82%)		26 (35%)	48 (65%)	
Sometimes	258 (84%)	50 (16%)		102 (33%)	206 (67%)		128 (42%)	180 (58%)	
Ever had or been diagnosed of STI before HIV diagnosis			0.006			<0.001			0.2
No	278 (89%)	33 (11%)		37 (12%)	274 (88%)		122 (39%)	189 (61%)	
Yes	394 (82%)	85 (18%)		238 (50%)	241 (50%)		168 (35%)	311 (65%)	
Smoking cigarette			<0.001			<0.001			0.4
Formerly smoke	149 (96%)	6 (3.9%)		63 (41%)	92 (59%)		64 (41%)	91 (59%)	
Never smoke	349 (80%)	87 (20%)		123 (28%)	313 (72%)		155 (36%)	281 (64%)	

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	HIV Symptoms			Co-infections			Non-infectious comorbidity		
Characteristic	**Have symptoms**, N = 672[1]	**No symptoms**, N = 118[1]	**p-value**[2]	**Has Co-infection**, N = 275[1]	**No Co-infection**, N = 515[1]	**p-value**[2]	**Has Comorbidity**, N = 290[1]	**No Comorbidity**, N = 500[1]	**p-value**[2]
Regular occasional smoker	139 (87%)	20 (13%)		76 (48%)	83 (52%)		61 (38%)	98 (62%)	
Frequency of drinking alcohol			0.002			<0.001			0.3
Daily or Nearly Daily >4 times/week	115 (91%)	11 (8.7%)		75 (60%)	51 (40%)		56 (44%)	70 (56%)	
Never	464 (82%)	101 (18%)		161 (28%)	404 (72%)		201 (36%)	364 (64%)	
Some/ Month 1-3 times/ month	39 (98%)	1 (2.5%)		14 (35%)	26 (65%)		13 (33%)	27 (68%)	
Some/Week 1-4 times/ week	54 (92%)	5 (8.5%)		25 (42%)	34 (58%)		20 (34%)	39 (66%)	
Drank alcohol in the last 12 months			>0.9			0.10			0.3
No	9 (100%)	0 (0%)		2 (22%)	7 (78%)		2 (22%)	7 (78%)	
Yes	193 (92%)	17 (8.1%)		110 (52%)	100 (48%)		85 (40%)	125 (60%)	
Ever used illicit drugs			0.6			0.004			0.2
Never	534 (85%)	95 (15%)		200 (32%)	429 (68%)		237 (38%)	392 (62%)	
Yes and I currently use it now	44 (80%)	11 (20%)		21 (38%)	34 (62%)		14 (25%)	41 (75%)	
Yes but I used it in the past	52 (85%)	9 (15%)		32 (52%)	29 (48%)		23 (38%)	38 (62%)	
Illicit drug use in the last month			0.11			0.8			0.3
Daily or Nearly Daily >4 times/w eek	29 (71%)	12 (29%)		19 (46%)	22 (54%)		9 (22%)	32 (78%)	
Never	31 (89%)	4 (11%)		16 (46%)	19 (54%)		13 (37%)	22 (63%)	
Sometime/ Month 1-3 times/ month	7 (88%)	1 (13%)		5 (63%)	3 (38%)		4 (50%)	4 (50%)	
Sometime/Week 1-4 times/ week	29 (91%)	3 (9.4%)		13 (41%)	19 (59%)		11 (34%)	21 (66%)	
Clinic where ART is received far from current residence			>0.9			0.14			0.007
No	144 (85%)	25 (15%)		67 (40%)	102 (60%)		77 (46%)	92 (54%)	
Yes	528 (85%)	93 (15%)		208 (33%)	413 (67%)		213 (34%)	408 (66%)	
Ever experienced stigma because of HIV status			0.018			<0.001			0.3
No	488 (87%)	73 (13%)		217 (39%)	344 (61%)		199 (35%)	362 (65%)	
Yes	184 (80%)	45 (20%)		58 (25%)	171 (75%)		91 (40%)	138 (60%)	
Frequency of exercising			0.008			0.056			0.001
Daily or Nearly Daily >4 times/w eek	16 (70%)	7 (30%)		11 (48%)	12 (52%)		5 (22%)	18 (78%)	
Never	510 (84%)	98 (16%)		222 (37%)	386 (63%)		244 (40%)	364 (60%)	
Sometime/ Month 1-3 times/ month	89 (94%)	6 (6.3%)		24 (25%)	71 (75%)		29 (31%)	66 (69%)	
Sometime/Week 1-4 times/ week	57 (89%)	7 (11%)		18 (28%)	46 (72%)		12 (19%)	52 (81%)	
History of Asthma in family			0.2			0.8			<0.001
No	559 (84%)	104 (16%)		232 (35%)	431 (65%)		221 (33%)	442 (67%)	
Yes	113 (89%)	14 (11%)		43 (34%)	84 (66%)		69 (54%)	58 (46%)	
History of Hypertension in family			<0.001			0.8			<0.001
No	481 (82%)	103 (18%)		205 (35%)	379 (65%)		180 (31%)	404 (69%)	
Yes	191 (93%)	15 (7.3%)		70 (34%)	136 (66%)		110 (53%)	96 (47%)	
History of diabetes in family			<0.001			0.6			<0.001
No	529 (83%)	109 (17%)		219 (34%)	419 (66%)		210 (33%)	428 (67%)	
Yes	143 (94%)	9 (5.9%)		56 (37%)	96 (63%)		80 (53%)	72 (47%)	

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Characteristic	HIV Symptoms			Co-infections			Non-infectious comorbidity		
	Have symptoms, N = 672[1]	**No symptoms**, N = 118[1]	**p-value**[2]	**Has Co-infection**, N = 275[1]	**No Co-infection**, N = 515[1]	**p-value**[2]	**Has Comorbidity**, N = 290[1]	**No Comorbidity**, N = 500[1]	**p-value**[2]
History of cancer in family			0.6			0.6			0.11
No	624 (85%)	108 (15%)		253 (35%)	479 (65%)		263 (36%)	469 (64%)	
Yes	48 (83%)	10 (17%)		22 (38%)	36 (62%)		27 (47%)	31 (53%)	
History of depression in family			0.14			0.3			<0.001
No	610 (84%)	112 (16%)		255 (35%)	467 (65%)		245 (34%)	477 (66%)	
Yes	62 (91%)	6 (8.8%)		20 (29%)	48 (71%)		45 (66%)	23 (34%)	

[1]n (%)
Source: Researcher's Field Survey, 2023

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4.13 Adherence to ART Treatment

The adherence to ART treatment among the total sample was investigated through various parameters using the MMAS-8. The results in *Table 4-14* presents the distribution of adherence items according to gender. Approximately 40% (n = 313) of participants reported occasionally forgetting to take medication, with no significant difference observed between females (39%) and males (41%) (p = 0.6). On the other hand, the proportion of individuals who missed taking medication in the last two weeks was 16% (n = 124), with no significant difference between females (15%) and males (17%) (p = 0.6). Furthermore, 12% reported cutting back or stopping medication due to side effects without consulting a doctor. A comparable percentage of females (11%) and males (14%) reported this (p = 0.2). The tendency to forget medication when traveling was 17% (n = 135), with 17% of females and 18% of males reporting such incidents (p = 0.6).

Nearly all participants (98%), regardless of gender, reported not missing medication the day preceding the assessment, with 98% adherence rate among females and males (p > 0.9).

Regarding the difficulty in remembering to take medication, the study found no significant gender-based differences. Most participants, irrespective of gender, reported occasional challenges in remembering medication intake. Specifically, approximately 55% of females and 56% of males reported never or rarely experiencing difficulty, while 25% of females and 23% of males reported experiencing it once in a while. Furthermore, around 19% of females and 20% of males reported sometimes facing this issue, with a minimal percentage reporting it usually.

However, differences emerged regarding adherence to dietary advice, with a higher proportion of males consistently following dietary recommendations compared to females. Specifically, 59% of females and 66% of males reported always adhering to dietary advice (p = 0.023). Conversely,

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only 1.4% of females and none of the males reported adhering to dietary advice rarely. Additionally, 42% of females and 34% of males reported following it some of the time.

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Table 4-14 Adherence assessment on ART treatment according to gender

Characteristic	**Overall**, N = 790[1]	**Female**, N = 576[1]	**Male**, N = 214[1]	**p-value**[2]
Sometimes forget to take medication	313 (40%)	225 (39%)	88 (41%)	0.6
Missed taking medication in the last 2 weeks	124 (16%)	88 (15%)	36 (17%)	0.6
Cut-back or stopped taking medication without telling doctor due to side effects	95 (12%)	64 (11%)	31 (14%)	0.2
Forgot to bring medication when traveling	135 (17%)	96 (17%)	39 (18%)	0.6
Missed taking medication yesterday	775 (98%)	565 (98%)	210 (98%)	>0.9
Stopped taking medication sometimes because symptoms are under control	82 (10%)	60 (10%)	22 (10%)	>0.9
Difficulty remembering to take medication				0.4
Never/rarely	433 (55%)	314 (55%)	119 (56%)	
Once in a while	198 (25%)	149 (26%)	49 (23%)	
Sometimes	151 (19%)	109 (19%)	42 (20%)	
Usually	8 (1.0%)	4 (0.7%)	4 (1.9%)	
Followed dietary advice in the last month				0.023
Always	468 (59%)	326 (57%)	142 (66%)	
Never	1 (0.1%)	1 (0.2%)	0 (0%)	
Rarely	8 (1.0%)	8 (1.4%)	0 (0%)	
Some of the time	313 (40%)	241 (42%)	72 (34%)	

[1]n (%)

[2]Pearson's Chi-squared test; Fisher's exact test

Source: Researcher's Field Survey, 2023

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The distribution of adherence status according to the different co-morbidity status and disaggregated by gender is presented in *Figure 4-20Figure 4-20*. Exhibiting low adherence to ART was more among participants who had commodity than those without comorbidity. More females than males exhibited high to moderate adherence to ART despite their co-morbidity status.

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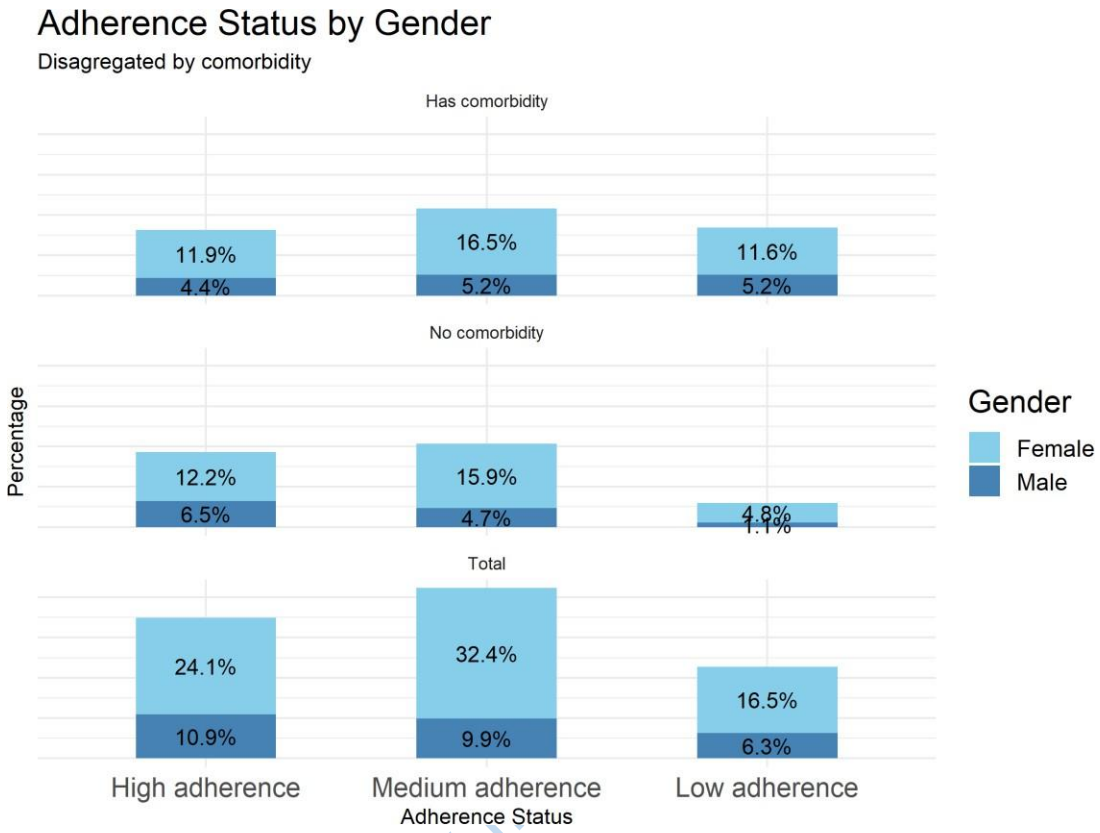


Figure 4-20 Adherence status by gender and disaggregated for group with co-morbidity, without co-morbidity and both groups

Source: Researcher's Field Survey, 2023

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4.14 Bivariate and multivariate Logistic Regression associations of Predictors of HIV Co-morbidities

The predictors of co-morbidity were analyzed using unadjusted and adjusted logistic regression models (*Table 4-15*). In the unadjusted model, individuals with no symptoms have a significantly lower beta coefficient of -0.41 (95% CI: -0.50, -0.31, $p < 0.001$), while those with low adherence to treatment have a higher OR of 0.27 (95% CI: 0.18, 0.36, $p < 0.001$). Educational status shows significant negative associations, with primary, secondary, and tertiary education having beta coefficients of -0.13 (95% CI: -0.22, -0.03, $p = 0.009$), -0.13 (95% CI: -0.22, -0.05, $p = 0.003$), and -0.14 (95% CI: -0.26, -0.02, $p = 0.026$), respectively. Other important predictors include a positive beta coefficient for individuals ever diagnosed with an STI before HIV (0.17, 95% CI: 0.10, 0.24, $p < 0.001$) and a negative coefficient for never smoking (-0.17, 95% CI: -0.26, -0.08, $p < 0.001$).

In the adjusted model, individuals without symptoms have an odds ratio (OR) of 0.14 (95% CI: 0.04, 0.38, $p < 0.001$), indicating a strong protective effect against co-morbidity. Low adherence to treatment remains a significant predictor with an OR of 3.29 (95% CI: 1.34, 8.36, $p = 0.010$), and medium adherence also shows a significant association (OR: 2.40, 95% CI: 1.23, 4.74, $p = 0.011$). A significant association is also observed for individuals currently or previously on TB treatment (OR: 4.40, 95% CI: 1.65, 12.9, $p = 0.004$). Condom use during the last sexual intercourse shows a protective effect with an OR of 0.38 (95% CI: 0.16, 0.89, $p = 0.028$). Additionally, a history of hypertension and diabetes in the family shows elevated, albeit non-significant, odds ratios (OR: 2.47, 95% CI: 0.87, 7.39, $p = 0.095$, and OR: 1.18, 95% CI: 0.45, 3.06, $p = 0.7$, respectively). These results highlight the multifaceted nature of co-morbidity predictors in the

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context of HIV and underline the importance of adherence to treatment and the influence of family medical history.

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Table 4-15 Unadjusted and Adjusted Model for Predictors of co-morbidity

	Unadjusted model			Adjusted model		
Characteristic	OR	**95% CI**[1]	**p-value**	**OR**[1]	**95% CI**[1]	**p-value**
Symptoms						
Have symptoms	—	—		—	—	
No symptoms	-0.41	-0.50, -0.31	<0.001	0.14	0.04, 0.38	<0.001
Adherence status						
High adherence	—	—		—	—	
Low adherence	0.27	0.18, 0.36	<0.001	3.29	1.34, 8.36	0.010
Medium adherence	0.04	-0.03, 0.12	0.3	2.40	1.23, 4.74	0.011
Age in years	0.00	0.00, 0.01	0.10	1.01	0.96, 1.06	0.6
Gender						
Female	—	—				
Male	0.00	-0.08, 0.08	>0.9			
Educational status						
No formal education	—	—				
Primary education	-0.13	-0.22, -0.03	0.009			
Secondary education	-0.13	-0.22, -0.05	0.003			
Tertiary education	-0.14	-0.26, -0.02	0.026			
Occupation						
Professional	—	—				
Skilled	0.10	-0.08, 0.28	0.3			
Unskilled	0.11	-0.07, 0.29	0.2			
Marital status						
Married	—	—				
Separated or Widowed	0.07	-0.02, 0.17	0.12			
Single	0.07	-0.01, 0.14	0.10			
Have children						
No	—	—		—	—	
Yes	0.07	0.00, 0.14	0.048	1.08	0.40, 3.05	0.9
Number of children	0.01	-0.01, 0.03	0.2			
Number of children (grouped)						
1-2 children	—	—				
3-4 children	-0.10	-0.20, 0.01	0.069			
5 and more	0.03	-0.07, 0.13	0.6			
Living with Children						
No	—	—				
Yes	-0.14	-0.23, -0.05	0.003			
Approximate total household income	0.00	0.00, 0.00	0.13	1.00	1.00, 1.00	0.027
Approximate total household income (grouped)						
30,000 Naira and below	—	—				
Above 30,000 Naira	0.06	-0.01, 0.13	0.10			
Currently belong to any PLHIV support group						
No	—	—				

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Characteristic	Unadjusted model			Adjusted model		
	OR	95% CI[1]	p-value	OR[1]	95% CI[1]	p-value
Yes	-0.06	-0.13, 0.01	0.094			
Frequency of participation in PLHIV support group						
2-4 times/month	—	—		—	—	
More than 4 times/month	0.32	-0.05, 0.70	0.090	3.74	0.59, 32.4	0.2
Once or less/ month	0.10	-0.06, 0.25	0.2	0.57	0.22, 1.40	0.2
Ever been on TB treatment						
Never	—	—		—	—	
Yes and I am currently on TB treatment now	0.12	-0.09, 0.33	0.3	1.12	0.23, 5.21	0.9
Yes and I was on TB treatment in the past	0.22	0.12, 0.32	<0.001	4.40	1.65, 12.9	0.004
Ever hospitalized because of HIV disease						
No	—	—				
Yes	-0.01	-0.15, 0.14	>0.9			
Disclosed HIV status						
No	—	—				
Yes	-0.11	-0.19, -0.03	0.007			
Ever had sex						
No	—	—				
Yes	0.41	0.04, 0.78	0.030			
Number of sexual partners in past 6 months						
More than one	—	—		—	—	
One	-0.14	-0.22, -0.07	<0.001	1.80	0.88, 3.77	0.11
Condom used during last sexual intercourse						
No	—	—		—	—	
Yes	-0.02	-0.10, 0.06	0.6	0.38	0.16, 0.89	0.028
Frequency of condom use						
Always	—	—				
Not at all	-0.09	-0.21, 0.03	0.15			
Sometimes	0.05	-0.02, 0.12	0.2			
Ever had or been diagnosed of STI before HIV diagnosis						
No	—	—				
Yes	0.17	0.10, 0.24	<0.001			
Smoking cigarette						
Formerly smoke	—	—		—	—	
Never smoke	-0.17	-0.26, -0.08	<0.001	0.43	0.20, 0.89	0.025
Regular occasional smoker	-0.03	-0.14, 0.08	0.6	1.90	0.59, 6.64	0.3
Frequency of drinking alcohol						

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Characteristic	Unadjusted model			Adjusted model		
	OR	95% CI[1]	p-value	OR[1]	95% CI[1]	p-value
Daily or Nearly Daily >4 times/week	—	—		—	—	
Never	-0.20	-0.30, -0.11	<0.001	2.46	0.73, 8.52	0.15
Some/ Month 1-3 times/ month	-0.19	-0.36, -0.01	0.035	2.22	0.47, 10.7	0.3
Some/Week 1-4 times/ week	-0.14	-0.29, 0.01	0.077	1.76	0.38, 8.55	0.5
Drank alcohol in the last 12 months						
No	—	—				
Yes	0.44	0.13, 0.76	0.006			
Ever used illicit drugs						
Never	—	—				
Yes and I currently use it now	-0.04	-0.18, 0.09	0.5			
Yes but I used it in the past	0.15	0.02, 0.28	0.021			
Illicit drug use in the last month						
Daily or Nearly Daily >4 times/w eek	—	—				
Never	0.14	-0.08, 0.37	0.2			
Sometime/ Month 1-3 times/ month	0.24	-0.14, 0.61	0.2			
Sometime/Week 1-4 times/ week	0.08	-0.15, 0.31	0.5			
Clinic where ART is received far from current residence						
No	—	—		—	—	
Yes	-0.12	-0.21, -0.04	0.004	0.78	0.31, 1.97	0.6
Ever experienced stigma because of HIV status						
No	—	—				
Yes	-0.04	-0.12, 0.04	0.3			
Frequency of exercising						
Daily or Nearly Daily >4 times/w eek	—	—				
Never	0.06	-0.15, 0.27	0.6			
Sometime/ Month 1-3 times/ month	-0.06	-0.28, 0.17	0.6			
Sometime/Week 1-4 times/ week	-0.16	-0.40, 0.07	0.2			
History of Asthma in family						
No	—	—				
Yes	0.19	0.10, 0.28	<0.001			

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Characteristic	Unadjusted model			Adjusted model		
	OR	95% CI[1]	p-value	OR[1]	95% CI[1]	p-value
History of Hypertension in family						
No	—	—		—	—	
Yes	0.21	0.13, 0.29	<0.001	2.47	0.87, 7.39	0.095
History of diabetes in family						
No	—	—		—	—	
Yes	0.22	0.13, 0.30	<0.001	1.18	0.45, 3.06	0.7
History of cancer in family						
No	—	—		—	—	
Yes	0.13	0.00, 0.27	0.048	0.88	0.16, 4.63	0.9
History of depression in family						
No	—	—		—	—	
Yes	0.25	0.13, 0.38	<0.001	4.10	0.77, 27.0	0.12
Marital status						
Married				—	—	
Separated or Widowed				1.49	0.67, 3.38	0.3
Single				1.59	0.57, 4.61	0.4
Ever hospitalized because of HIV disease						
No				—	—	
Yes				0.66	0.19, 2.51	0.5
Ever had or been diagnosed with STI before HIV diagnosis						
No				—	—	
Yes				4.53	2.16, 9.88	<0.001
History of Asthma in family						
No				—	—	
Yes				2.26	0.79, 6.99	0.14

[1]CI = Confidence Interval, OR = Odds Ratio

Source: Researcher's Field Survey, 2023

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4.15 Bivariate and Multivariate Logistic Regression associations of Predictors of ART adherence

Analysis to examine the predictors of adherence to ART (*Table 4-16*). The unadjusted and adjusted models for predictors of adherence to ART treatment reveal several significant factors. In the unadjusted model, individuals without symptoms show a positive beta coefficient of 0.15 (95% CI: 0.05, 0.24, p = 0.002), indicating better adherence. This association remains significant in the adjusted model, with an OR of 3.43 (95% CI: 1.41, 8.65, p = 0.007). Similarly, individuals without co-morbidities have a positive beta coefficient of 0.11 (95% CI: 0.05, 0.18, p < 0.001) in the unadjusted model, and an OR of 2.48 (95% CI: 1.27, 4.93, p = 0.008) in the adjusted model, indicating better adherence.

Educational status significantly influences adherence, with primary, secondary, and tertiary education showing positive beta coefficients in the unadjusted model (0.14, 0.24, and 0.43 respectively). These remain significant in the adjusted model, with tertiary education having the highest OR of 8.28 (95% CI: 2.24, 32.6, p = 0.002). Occupational status reveals that both skilled and unskilled labor are negatively associated with adherence in the unadjusted model, with beta coefficients of -0.23 (p = 0.008) and -0.25 (p = 0.004), respectively. Marital status shows that being separated or widowed is negatively associated with adherence (beta = -0.15, p < 0.001), although this association is not significant in the adjusted model (OR = 0.67, p = 0.4). Additionally, living with children shows a positive beta coefficient of 0.12 (p = 0.007) in the unadjusted model, reflecting better adherence. Higher household income also positively correlates with adherence, with the highest income group showing a beta coefficient of 0.23 (p < 0.001). Belonging to a PLHIV support group shows a trend towards better adherence, but this is not statistically significant in the adjusted model. These findings highlight the multifaceted predictors of ART

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adherence, emphasizing the importance of symptom management, educational attainment, and socio-economic factors.

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Table 4-16 Unadjusted and Adjusted Model for Predictors of adherence on ART treatment

	Unadjusted model			Adjusted model		
Characteristic	**Beta**	**95% CI[1]**	**p-value**	**OR[1]**	**95% CI[1]**	**p-value**
Symptoms						
Have symptoms	—	—		—	—	
No symptoms	0.15	0.05, 0.24	0.002	3.43	1.41, 8.65	0.007
Comorbidity status						
Has comorbidity	—	—		—	—	
No comorbidity	0.11	0.05, 0.18	<0.001	2.48	1.27, 4.93	0.008
Age in years	-0.01	-0.01, 0.00	0.007	0.98	0.93, 1.03	0.3
Gender						
Female	—	—		—	—	
Male	0.07	0.00, 0.15	0.059	1.97	0.96, 4.15	0.068
Educational status						
No formal education	—	—		—	—	
Primary education	0.14	0.05, 0.23	0.002	1.13	0.40, 3.27	0.8
Secondary education	0.24	0.16, 0.32	<0.001	3.86	1.52, 10.7	0.006
Tertiary education	0.43	0.32, 0.54	<0.001	8.28	2.24, 32.6	0.002
Occupation						
Professional	—	—		—	—	
Skilled	-0.23	-0.40, -0.06	0.008	0.60	0.13, 2.61	0.5
Unskilled	-0.25	-0.42, -0.08	0.004	1.50	0.31, 7.24	0.6
Marital status						
Married	—	—		—	—	
Separated or Widowed	-0.15	-0.24, -0.07	<0.001	0.67	0.26, 1.72	0.4
Single	0.05	-0.02, 0.13	0.2	0.75	0.25, 2.18	0.6
Have children						
No	—	—		—	—	
Yes	-0.12	-0.19, -0.06	<0.001	1.46	0.52, 4.06	0.5
Number of children (grouped)						
1-2 children	—	—				
3-4 children	-0.07	-0.17, 0.03	0.2			
5 and more	0.01	-0.09, 0.11	0.8			
Living with Children						
No	—	—				
Yes	0.12	0.03, 0.20	0.007			
Approximate total household income (grouped)						
30,000 - 79,999 Naira	—	—				
80,000 Naira and above	0.23	0.12, 0.35	<0.001			
Less than 30,000 Naira	0.20	0.13, 0.28	<0.001			
Currently belong to any PLHIV support group						

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Characteristic	Unadjusted model			Adjusted model		
	Beta	**95% CI[1]**	**p-value**	**OR[1]**	**95% CI[1]**	**p-value**
No	—	—				
Yes	0.04	-0.02, 0.11	0.2			
Frequency of participation in PLHIV support group						
2-4 times/month	—	—		—	—	
More than 4 times/month	0.01	-0.35, 0.37	>0.9	1.42	0.16, 12.1	0.7
Once or less/ month	-0.14	-0.29, 0.01	0.068	0.38	0.17, 0.87	0.022
Ever been on TB treatment						
Never	—	—		—	—	
Yes and I am currently on TB treatment now	0.15	-0.05, 0.35	0.14	1.73	0.26, 11.5	0.6
Yes and I was on TB treatment in the past	-0.03	-0.13, 0.07	0.6	0.37	0.12, 1.05	0.075
Approximate total household income (grouped)						
30,000 Naira and below				—	—	
Above 30,000 Naira				0.80	0.36, 1.79	0.6

[1]CI = Confidence Interval, OR = Odds Ratio

[2]Model Summary Statistics: R-squared = 0.495 , Adjusted R-squared = 0.448 , AIC = 2420.23, F-statistic: 10.44, p-value: < 0.000

Source: Researcher's Field Survey, 2023

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4.16 Quality of Life of Patients Living with HIV

The result in *Table 4-17* provides descriptive statistics for each domain of quality of life measured by the WHOQOL-HIV BREF. The domains include General Quality of Life, General Health Perception, Physical Health, Psychological Health, Level of Independence, Social Relationships, Environment, and Spirituality. The mean scores for all items ranged from 2.44 to 4.06, indicating moderate to high levels of quality of life across the different aspects measured. The standard deviations varied from 0.66 to 3.71, suggesting some degree of variability in responses within each domain.

High scores for both general quality of life (Mean = 3.86, SD = 0.69) and general health perception (Mean = 3.65, SD = 0.87) were observed, indicating a favorable overall assessment of their well-being. The domain of physical health showed moderate scores (Mean = 13.99, SD = 3.29), with significant variability in responses. Items related to Pain and discomfort (Mean = 3.48, SD = 1.65) and Energy and fatigue (Mean = 3.37, SD = 1.61) showed considerable variability.

Additionally, high scores for psychological health (Mean = 13.95, SD = 2.84), indicating positive mental well-being was observed, with items such as positive feelings (Mean = 3.39, SD = 1.48) exhibiting significant variability. Similarly, high levels of independence (Mean = 14.84, SD = 2.35), particularly in Mobility (Mean = 3.97, SD = 0.66) and Activities of daily living (Mean = 3.83, SD = 0.82) were also observed. High positive social relationships (Mean = 14.93, SD = 2.52), indicating satisfaction with personal and social interactions were also observed. The environment domain demonstrated moderate scores (Mean = 12.74, SD = 2.61), with notable variability in items such as Financial resources (Mean = 2.44, SD = 1.16) and Recreation and leisure (Mean = 2.99, SD = 1.06). Moderate levels of spirituality (Mean = 13.77, SD = 3.71), with significant variability in items such as Forgiveness (Mean = 4.06, SD = 1.35) and Concerns about the Future (Mean =

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2.95, SD = 1.67) were observed.

4.16.1 Floor and Ceiling Effects of the WHOQOL-HIV-BREF items and domains

Floor and ceiling effects were also examined to assess whether respondents consistently rated items at the lowest or highest ends of the scale (see *Table 4-17*), indicating potential limitations in the instrument's sensitivity. The analysis assumed a floor or ceiling effect if the upper and lower bound of the 95% of confidence interval of responses were in extreme categories. The presence of floor or ceiling effects was observed in some domains, particularly in items related to Pain and discomfort, Energy and fatigue, and certain items within the Spirituality domain. However, none of the domains or the overall global score of quality of life demonstrated a floor or ceiling effect indicating good sensitivity of the tool in the population.

4.3.4 Reliability Analysis of the WHOQOL-HIV BREF domains

Reliability analysis was conducted using Cronbach's alpha coefficient to assess the internal consistency of the WHOQOL-HIV BREF, *Table 4-17*. The overall reliability coefficient for the instrument, described as the Global score of QOL was found to be 0.884, indicating high internal consistency. Subscale reliability coefficients ranged from 0.304 to 0.775, with the lowest reliability observed in the Spirituality domain and the highest in the Environment domain. Despite some variations in reliability across domains, all coefficients exceeded the generally accepted threshold of 0.7, suggesting satisfactory internal consistency for each subscale.

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Table 4-17 Descriptive statistics and reliability of WHOQOL-HIV BREFof Patients

Quality of Life Domains	Mean	SD	Floor	Ceiling	Floor Effect	Ceiling Effect	Floor/Ceiling Effect	Reliability (Cronbach's Alpha)
General QOL	3.86	0.69	2.51	5.21	No	Yes	No	
General health perception	3.65	0.87	1.94	5.36	No	Yes	No	
Physical Health	**13.99**	**3.29**	**7.54**	**20.44**	**No**	**Yes**	**No**	**0.386**
Q10. Pain and discomfort	3.48	1.65	0.25	6.71	Yes	Yes	Yes	
Q11. Energy and fatigue	3.37	1.61	0.21	6.53	Yes	Yes	Yes	
Q21. Sleep and rest	3.45	0.99	1.51	5.39	No	Yes	No	
Q28. Symptoms of PLWHAs	3.69	0.87	1.98	5.40	No	Yes	No	
Psychological Health	**13.95**	**2.84**	**8.38**	**19.52**	**No**	**Yes**	**No**	**0.722**
Q13. Positive feelings	3.39	1.48	0.49	6.29	Yes	Yes	Yes	
Q18. Cognitions	3.09	0.77	1.58	4.60	No	No	No	
Q22. Body image and appearance	3.76	0.94	1.92	5.60	No	Yes	No	
Q31. Self-esteem	4.05	0.87	2.34	5.76	No	Yes	No	
Q38. Negative feelings	3.14	1.09	1.00	5.28	No	Yes	No	
Level of Independence	**14.84**	**2.35**	**10.23**	**19.45**	**No**	**Yes**	**No**	**0.531**
Q12. Dependence on medication or treatment	3.08	1.71	-0.27	6.43	Yes	Yes	Yes	
Q27. Mobility	3.97	0.66	2.68	5.26	No	Yes	No	
Q29. Activities of daily living	3.83	0.82	2.22	5.44	No	Yes	No	
Q30. Work capacity	3.95	0.75	2.48	5.42	No	Yes	No	
Social Relationships	**14.93**	**2.52**	**9.99**	**19.87**	**No**	**Yes**	**No**	**0.693**
Q24. Social inclusion	3.54	0.85	1.87	5.21	No	Yes	No	
Q32. Personal relationships	3.84	0.85	2.17	5.51	No	Yes	No	

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Quality of Life Domains	Mean	SD	Floor	Ceiling	Floor Effect	Ceiling Effect	Floor/Ceiling Effect	Reliability (Cronbach's Alpha)
Q33. Sexual activity	3.93	0.98	2.01	5.85	No	Yes	No	
Q34. Social support	3.62	0.78	2.09	5.15	No	Yes	No	
Environment	**12.74**	**2.61**	**7.62**	**17.86**	**No**	**Yes**	**No**	**0.775**
Q19. Physical safety and security	3.47	0.79	1.92	5.02	No	Yes	No	
Q20. Physical environments	3.37	0.79	1.82	4.92	No	No	No	
Q23. Financial resources	2.44	1.16	0.17	4.71	Yes	No	No	
Q25. New information or skills	3.38	0.80	1.81	4.95	No	No	No	
Q26. Recreation and leisure	2.99	1.06	0.91	5.07	Yes	Yes	Yes	
Q35. Home environment	3.71	0.91	1.93	5.49	No	Yes	No	
Q36. Health and social care	3.47	1.30	0.92	6.02	Yes	Yes	Yes	
Q37. Transport	2.66	1.38	-0.04	5.36	Yes	Yes	Yes	
Spirituality	**13.77**	**3.71**	**6.50**	**21.04**	**No**	**Yes**	**No**	**0.304**
Q14. Spirituality, Religion, Personal belief	3.68	1.59	0.56	6.80	Yes	Yes	Yes	
Q15. Forgiveness	4.06	1.35	1.41	6.71	No	Yes	No	
Q16. Concerns about the Future	2.95	1.67	-0.32	6.22	Yes	Yes	Yes	
Q17. Death and dying	3.08	1.79	-0.43	6.59	Yes	Yes	Yes	
Global score of Quality of Life	**84.18**	**12.60**	**59.48**	**108.88**	**No**	**Yes**	**No**	

Source: Researcher's Field Survey, 2023

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4.16.2 Correlation and distribution of WHOQOL-HIV BREF domains

The WHOQOL-HIV BREF's concurrent validity was examined using Pearson's correlations between domains and general quality of life and health perception Figure 4-21. Results showed that Physical and Psychological domain had a weak to moderate correlation (r = 0.478). Similarly, the Physical and Social Relationships domains showed a weak to moderate positive correlation of 0.496. The correlation between the Physical and Environment domains was also weak to moderate and was r = 0.478. In contrast, the correlation between the Physical and Spirituality domains was weak, at 0.217. However, a moderate positive correlation of 0.660 was observed between the Physical domain and General Quality of Life. *Figure 4-21* also shows the distribution of the domains of WHOQOL-HIV BREF within the sample, utilizing histograms and scatter plots to represent the range of scores for each domain.

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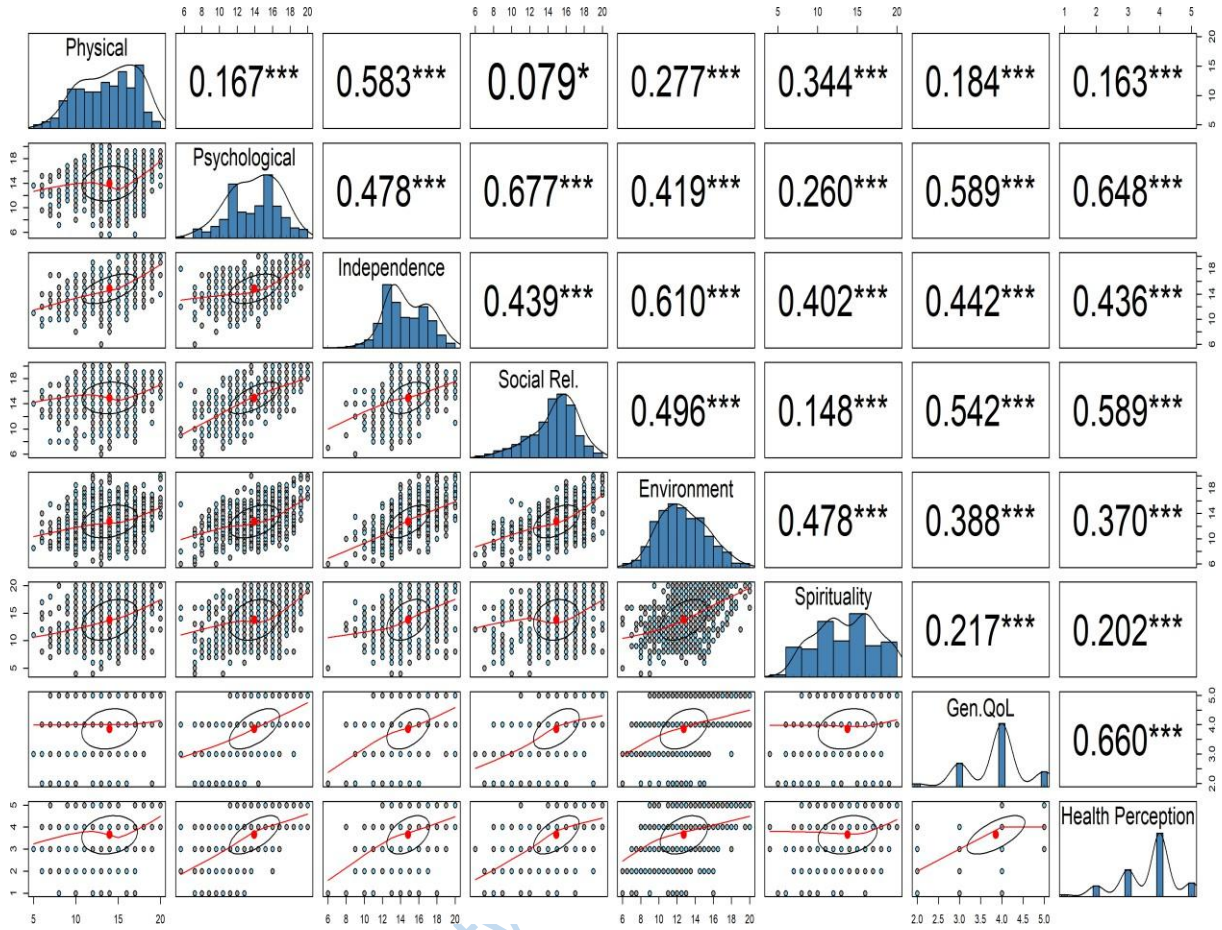


*Figure 4-21 Correlation and distribution of `WHOQOL-HIV BREF domain scores of patients: The pairs-panel diagram shows the distribution of scores for each domain using histograms, correlation matrix, and scatterplot of the relationships. The histogram represents the score range for that domain: The transformed score for the 6 domains ranges from 4 – 20, while Gen. and Health Perception ranges from 1-5. For the correlation matrix, Pearson's correlation coefficients (r) are typically categorized as follows: weak ($r < 0.3$), moderate ($r \geq 0.3$ and < 0.7), or strong ($r \geq 0.7$). Statistical significance of the correlation is indicated with asterisks: no asterisk ($p \geq 0.05$), * = $p < 0.01$, ** = $p < 0.001$, *** = $p < 0.0001$, **** = $p < 0.00001$. The scatterplot shows the distribution of the association with the central tendency.* Source: Researcher's Field Survey, 2023

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4.8.5 Confirmatory Factor Analysis of the WHOQOL-HIV BREF

In the Structural Equation Model based on confirmatory factor analysis the result presented in path diagram (*Figure 4-22*) illustrates the relationship between the latent domain variables and their manifest (observed) variables. For the latent Physical (Phy) domain, the indicator variables Pain and discomfort (Q10) and Energy and fatigue (Q11) exhibited high factor loading ($\beta = 0.95$) and ($\beta = 0.84$), respectively, indicating that respondents' perceptions of Pain and discomfort, and Energy and fatigue correlated positively with their physical well-being. The other two items Sleep and rest (Q21) and Symptoms of PLHIV (Q28) originally hypothesized as being among the Physical domain were not shown as contribution in the model for the sample. For the Psychological domain, the model showed that all the 5 indicator variables hypothesized to make up this domain were exhibited in the model. This relationship exhibited medium to high positive factor loading coefficients ranging from $\beta = 0.42$ for Cognitions (Q18) to $\beta = 0.81$ for Self-esteem (Q31). Indicating positive correlation with the Psychological domain.

For the Independence (Ind) domain, three out of the 4 hypothesized indicators were exhibited in the relationship. The factor loading ranged from 0.59 to 0.78, representing Mobility (Q27) and Work capacity (Q30), respectively. Activities of daily living (Q29) exhibited a factor loading of 0.75. The result indicated that all three variables positively influenced the independence of the patient in the sample. For social (Scl) well-being domain, all the four hypothesized indicators were exhibited in the model with Social inclusion (Q24), Personal relationships (Q32), Sexual activity (Q33), and Social support (Q34) positively influenced scores, with coefficients of ranging from 0.37 to 0.77. 0.75, indicating that these factors contributed positively to respondents' social well-being.

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In the Environment (Env) domain, Financial resources (Q23), Recreation and leisure (Q26), Health and social care (Q36) and Transport (Q37) showed high positive influence, with coefficients of 0.63, 0.57, 0.69 and 0.83, respectively, indicating a positive impact on environmental domain scores. Lastly, in the Spiritual (Spr) domain, three out of the four indicators were represented. Concerns about the Future (Q16) and Death and dying (Q17) demonstrated weak negative influences, with coefficients ranging from -0.43 and -0.43, respectively, indicating that respondents' perceptions of these questions weakly influenced their spirituality. The SEM results also exhibited the correlation between the different domains, with some high correlations between some of the factors.

The fit indices for the structural equation model obtained showed a suboptimal model with the following indices: CFI = 0.807, TLI = 0.767, RMSEA (TLI) = 0.110, and SRMR = 0.136. Given these results, it is important to note a limitation of this SEM model as the model fit fell below commonly accepted thresholds for good fit. Additionally, this poor model could be a result of an issue in the data.

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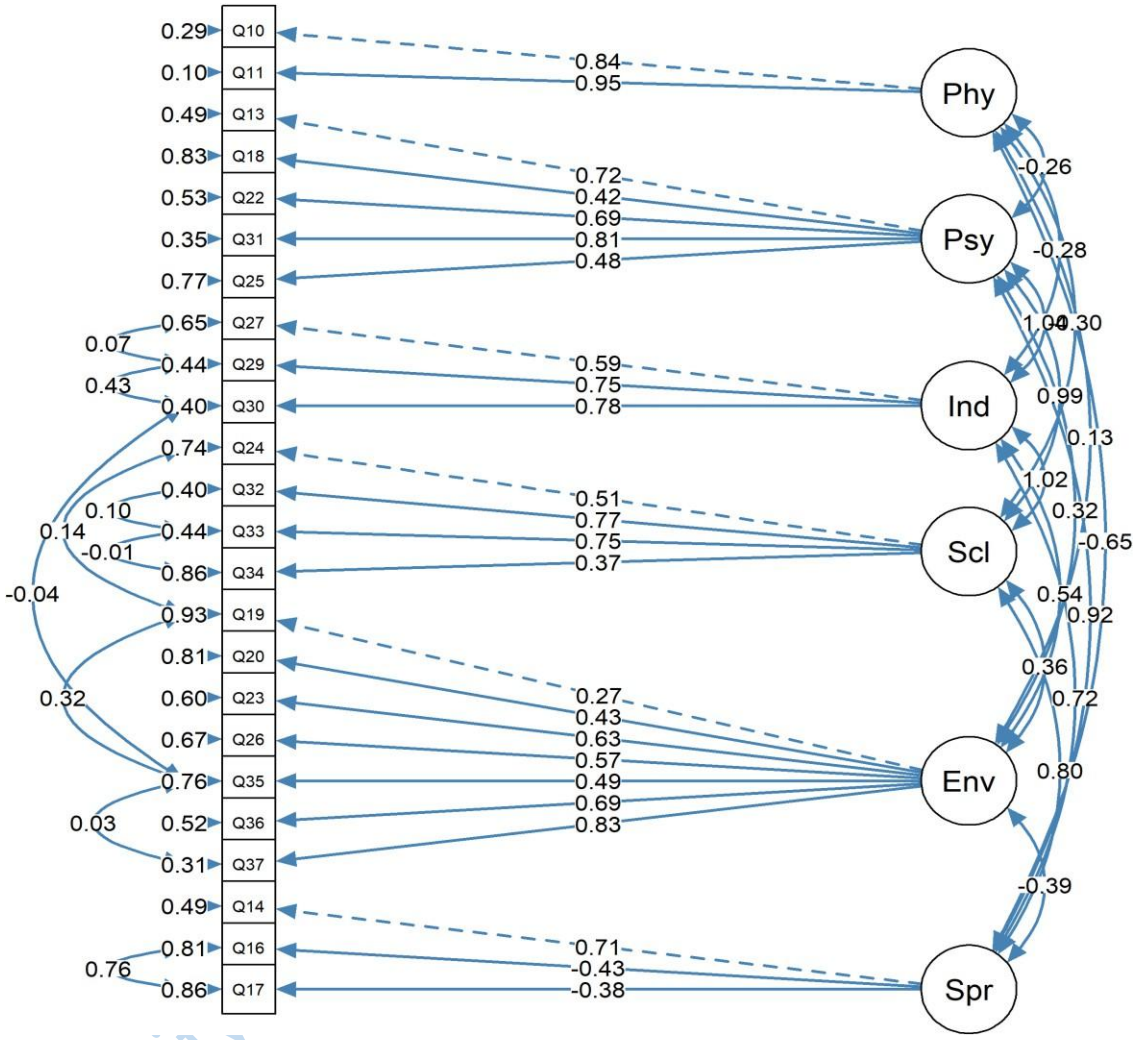


Figure 4-22 Path diagram of the structure of the WHOQOL-HIV BREF Instrument for the sample based on CFA: Comparative Fit Index (CFI) = 0.807, Tucker-Lewis Index (TLI) = 0.767, RMSEA (TLI) = 0.110 , and Standardized Root Mean Square Residual (SRMR) = 0.136. These values are below the generally accepted thresholds for good fit (CFI > 0.95, TLI > 0.95, SRMR < 0.08). The factor loadings between the latent variables (domains) and the observed variables are standardized coefficients.

Source: Researcher's Field Survey, 2023

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4.8.6 Bivariate and Multivariate Linear associations of Predictors of Quality of Life of PLHIV

The results from the linear model for predictors of quality of life among PLHIV are presented in *Table 4-18*. Both unadjusted and adjusted models were utilized to examine the impact of various characteristics on quality of life. Factors such as comorbidity status, adherence to ART, household income, disclosure of HIV status, and certain aspects of sexual behavior and substance use significantly impact the quality of life among PLHIV.

In the unadjusted model, patients without comorbidities had significantly higher quality of life scores compared to those with comorbidities (β = 5.3, 95% CI: 3.6–7.1, p < 0.001). However, co-morbidity was dropped in the multivariate model due to collinearity. Having symptoms did not significantly affect the quality of life of PLHIV in both unadjusted and adjusted models. Low adherence was negatively associated with quality of life in both unadjusted (β = -12, 95% CI: -14– -9.5, p < 0.001) and adjusted (β = -7.1, 95% CI: -10.0– -3.8, p < 0.001) models. Medium adherence also showed a negative impact on quality of life in the unadjusted model. According to age, older age was associated with a slightly lower quality of life (β = -0.18, 95% CI: -0.29, -0.06, p < 0.002), although this association was only statistically significant in the unadjusted model. The demographic factors Gender, Educational Status, Occupation, Number of children, and Approximate total household income where dropped in the adjusted model. PLHIV who reported having children had significantly lower quality of life compared to those without children, even after adjusting for other factors. Based on household Income, Higher household income was associated with a significantly higher quality of life only in the unadjusted model. Participation in

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PLHIV Support Groups and TB Treatment History did not show significant associations with quality of life in the adjusted model.

Various factors related to sexual behavior and substance use showed significant associations with quality of life, including number of sexual partners, condom use, history of STIs, smoking, and alcohol consumption. Other Health History and Lifestyle Factors: Family history of certain diseases, including asthma, cancer, and depression, showed significant associations with quality of life in the adjusted model.

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Table 4-18 Linear model for predictor of quality of life of PLHIV

	Unadjusted model			Adjusted model[2]		
Characteristic	**Beta**	**95% CI[1]**	**p-value**	**Beta**	**95% CI[1]**	**p-value**
Combined comorbidity status						
Has comorbidity	—	—				
No comorbidity	5.3	3.6, 7.1	<0.001			
Symptoms						
Have symptoms	—	—		—	—	
No symptoms	1.1	-1.4, 3.6	0.4	0.96	-2.4, 4.3	0.6
Adherence status						
High adherence	—	—		—	—	
Low adherence	-12	-14, -9.5	<0.001	-7.1	-10, -3.8	<0.001
Medium adherence	-3.8	-5.7, -1.9	<0.001	-0.50	-3.0, 2.0	0.7
Age in years	-0.18	-0.29, -0.06	0.002	-0.17	-0.35, 0.01	0.065
Gender						
Female	—	—				
Male	1.6	-0.33, 3.6	0.10			
Educational status						
No formal education	—	—				
Primary education	0.74	-1.6, 3.0	0.5			
Secondary education	4.9	2.8, 7.1	<0.001			
Tertiary education	14	11, 17	<0.001			
Occupation						
Professional	—	—				
Skilled	-11	-16, -7.0	<0.001			
Unskilled	-14	-19, -10	<0.001			
Marital status						
Married	—	—		—	—	
Separated or Widowed	-0.38	-2.7, 1.9	0.7	0.30	-2.6, 3.2	0.8
Single	2.6	0.63, 4.6	0.010	-2.4	-6.3, 1.5	0.2
Have children						
No	—	—		—	—	
Yes	-5.5	-7.3, -3.7	<0.001	-5.6	-9.4, -1.7	0.004
Number of children (grouped)						
1-2 children	—	—				
3-4 children	1.8	-0.75, 4.3	0.2			
5 and more	1.7	-0.82, 4.2	0.2			
Living with Children						
No	—	—				
Yes	5.6	3.5, 7.7	<0.001			
Approximate total household income (grouped)						

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Characteristic	Unadjusted model			Adjusted model[2]		
	Beta	95% CI[1]	p-value	Beta	95% CI[1]	p-value
30,000 Naira and below	—	—				
Above 30,000 Naira	4.9	3.1, 6.7	<0.001			
Currently belong to any PLHIV support group						
No	—	—				
Yes	1.1	-0.69, 2.8	0.2			
Frequency of participation in PLHIV support group						
2-4 times/month	—	—		—	—	
More than 4 times/month	0.99	-8.4, 10	0.8	5.7	-2.0, 13	0.15
Once or less/ month	-6.0	-9.9, -2.1	0.002	0.88	-2.7, 4.5	0.6
Ever been on TB treatment						
Never	—	—		—	—	
Yes and I am currently on TB treatment now	-6.5	-12, -1.1	0.018	-1.4	-6.9, 4.1	0.6
Yes and I was on TB treatment in the past	-3.4	-6.0, -0.78	0.011	-0.96	-4.2, 2.3	0.6
Current viral load status						
Greater than 1000	—	—				
Less than 1000	3.1	-4.8, 11	0.4			
No VL	4.7	-5.6, 15	0.4			
Ever hospitalized because of HIV disease						
No	—	—				
Yes	-8.3	-12, -4.7	<0.001			
Disclosed HIV status						
No	—	—				
Yes	-2.9	-4.9, -0.84	0.006			
Ever had sex						
No	—	—				
Yes	-8.2	-18, 1.2	0.087			
Number of sexual partners in past 6 months						
More than one	—	—		—	—	
One	4.3	2.4, 6.2	<0.001	2.7	0.14, 5.4	0.039

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	Unadjusted model			Adjusted model[2]		
Characteristic	**Beta**	**95% CI[1]**	**p-value**	**Beta**	**95% CI[1]**	**p-value**
Condom used during last sexual intercourse						
No	—	—		—	—	
Yes	2.3	0.33, 4.2	0.022	-1.3	-4.3, 1.8	0.4
Frequency of condom use						
Always	—	—				
Not at all	-2.2	-5.3, 0.90	0.2			
Sometimes	-2.1	-4.0, -0.26	0.025			
Ever had or been diagnosed of STI before HIV diagnosis						
No	—	—		—	—	
Yes	-11	-12, -9.2	<0.001	-8.9	-12, -6.2	<0.001
Smoking cigarette						
Formerly smoke	—	—		—	—	
Never smoke	-1.6	-3.9, 0.69	0.2	-3.2	-6.0, -0.46	0.022
Regular occasional smoker	3.2	0.46, 6.0	0.022	3.6	-0.72, 7.9	0.10
Frequency of drinking alcohol						
Daily or Nearly Daily >4 times/week	—	—		—	—	
Never	-0.24	-2.7, 2.2	0.8	4.5	-0.09, 9.1	0.054
Some/ Month 1-3 times/ month	7.6	3.1, 12	<0.001	8.2	2.6, 14	0.004
Some/Week 1-4 times/ week	-0.61	-4.5, 3.3	0.8	0.43	-5.2, 6.1	0.9
Drank alcohol in the last 12 months						
No	—	—				
Yes	6.4	-3.7, 16	0.2			
Ever used illicit drugs						
Never	—	—				
Yes and I currently use it now	10	6.9, 14	<0.001			
Yes but I used it in the past	1.4	-1.8, 4.6	0.4			
Illicit drug use in the last month						
Daily or Nearly Daily >4 times/w eek	—	—				
Never	-7.6	-14, -1.7	0.013			

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	Unadjusted model			Adjusted model[2]		
Characteristic	**Beta**	**95% CI[1]**	**p-value**	**Beta**	**95% CI[1]**	**p-value**
Sometime/ Month 1-3 times/ month	-4.6	-15, 5.4	0.4			
Sometime/Week 1-4 times/ week	-5.3	-11, 0.81	0.088			
Clinic where ART is received far from current residence						
No	—	—		—	—	
Yes	-2.6	-4.7, -0.41	0.019	-1.3	-4.5, 1.9	0.4
Ever experienced stigma because of HIV status						
No	—	—				
Yes	-2.9	-4.8, -0.93	0.004			
Frequency of exercising						
Daily or Nearly Daily >4 times/w eek	—	—				
Never	-8.0	-13, -3.1	0.001			
Sometime/ Month 1-3 times/ month	4.8	-0.53, 10	0.078			
Sometime/Week 1-4 times/ week	0.09	-5.5, 5.7	>0.9			
History of Asthsma in family						
No	—	—		—	—	
Yes	3.9	1.5, 6.3	0.001	1.6	-1.9, 5.0	0.4
History of Hypertension in family						
No	—	—		—	—	
Yes	1.2	-0.80, 3.2	0.2	-2.5	-6.3, 1.2	0.2
History of diabetes in family						
No	—	—		—	—	
Yes	0.41	-1.8, 2.6	0.7	-0.58	-3.9, 2.7	0.7
History of cancer in family						
No	—	—		—	—	
Yes	4.8	1.5, 8.2	0.005	0.32	-5.0, 5.7	>0.9
History of depression in family						
No	—	—		—	—	

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	Unadjusted model			Adjusted model[2]		
Characteristic	**Beta**	**95% CI[1]**	**p-value**	**Beta**	**95% CI[1]**	**p-value**
Yes	4.5	1.4, 7.7	0.005	1.7	-3.7, 7.0	0.5
Ever hospitalized because of HIV disease						
No				—	—	
Yes				-1.0	-5.3, 3.3	0.6

[1]CI = Confidence Interval

[2]Model Summary Statistics: R-squared = 0.495 , Adjusted R-squared = 0.448 , AIC = 2420.23, F-statistic: 10.44, p-value: < 0.000

Source: Researcher's Field Survey, 2023

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4.8.7 Domain scores based on specific patient clinical characteristics.

Quality of life scores of patients was examined according to selected patients clinical characteristics. According to the treatment interruption status of the patients Quality of life score was observed to vary based on the different quality of life domain scores (*Table 4-19*). There was a higher mean score of 83 (SD = 12) among patient who did not interrupt treatment compared with those who interrupted treatment, with mean of 85 (SD = 13). This association was significant based on Kruskal-Wallis rank sum test. Conversely, on the Physical domain, patients who interrupted treatment demonstrated higher quality of life with mean of 14.82 (SD = 3.10) compared with those who did not interrupt treatment, having mean of 13.54 (SD = 3.29). Meanwhile, the result demonstrated that for the Psychological domain of quality of life, patients who interrupted treatment showed a statistically lower mean score of 13.54 (2.97) compared with patients who did not interrupt treatment, with mean of 14.16 (2.75) (p=0.006).

Additionally, according to adherence to ART status (*Table 4-20*), it was demonstrated that there was generally a significantly higher quality of life scores across all domains among those patients who exhibited higher, and medium adherence on ART compared with those who exhibited low adherence to ART. Results showed that higher mean score on the Global score for quality of life, 88 (SD = 13) for high adherence, and 85 (SD = 11) for medium adherence compared to those who exhibited low adherence to ART (77 [SD = 11]) (p<0.001).

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Table 4-19 Quality of life mean scores according to patients' treatment interruption status

Characteristic	**Interrupted**, N = 275[1]	**Non interrupted**, N = 501[1]	**p-value**[2]
Global score of Quality of Life	83 (12)	85 (13)	0.045
Domain 1 – Physical	14.82 (3.10)	13.54 (3.29)	<0.001
Domain 2 – Psychological	13.54 (2.97)	14.16 (2.75)	0.006
Domain 3 – Level of Independence	15.07 (2.37)	14.69 (2.34)	0.064
Domain 4 – Social Relationships	14.77 (2.24)	14.99 (2.67)	0.10
Domain 5 – Environment	12.52 (2.21)	12.83 (2.79)	0.3
Domain 6 – Spirituality	13.5 (3.5)	13.9 (3.8)	0.11

[1]Mean (SD)
[2]Wilcoxon rank sum test
Source: Researcher's Field Survey, 2023

Table 4-20 Quality of life mean scores according to patients' ART adherence status

Characteristic	**High adherence**, N = 276[1]	**Medium adherence**, N = 334[1]	**Low adherence**, N = 180[1]	**p-value**[2]
Global score of Quality of Life	88 (13)	85 (11)	77 (11)	<0.001
Domain 1 – Physical	14.92 (2.93)	13.81 (3.38)	12.91 (3.24)	<0.001
Domain 2 – Psychological	14.22 (2.92)	14.52 (2.55)	12.47 (2.75)	<0.001
Domain 3 – Level of Independence	15.69 (2.22)	14.65 (2.24)	13.87 (2.32)	<0.001
Domain 4 – Social Relationships	14.99 (2.61)	15.24 (2.29)	14.27 (2.68)	<0.001
Domain 5 – Environment	14.03 (2.43)	12.27 (2.33)	11.65 (2.58)	<0.001
Domain 6 – Spirituality	15.3 (3.4)	13.5 (3.7)	12.0 (3.4)	<0.001

[1]Mean (SD)
[2]Kruskal-Wallis rank sum test
Source: Researcher's Field Survey, 2023

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According to the patients' current viral load status, variations in quality of life scores were observed across different domains (*Table 4-21*). Patients with a viral load greater than 1000 demonstrated a mean global quality of life score of 81 (SD = 14), while those with a viral load less than 1000 had a mean score of 84 (SD = 13), and patients with no viral load scored an average of 86 (SD = 11). However, statistical analysis using the Kruskal-Wallis rank sum test did not show a significant difference in global quality of life scores among these groups (p=0.4). When examining specific quality of life domains, no significant differences were found between patients with different viral load statuses in the Physical (p=0.3), Psychological (p=0.5), Level of Independence (p=0.9), Social Relationships (p=0.3), Environment (p=0.6), and Spirituality (p>0.9) domains.

Regarding patient hospitalization status, differences in quality of life scores were observed across different domains (*Table 4-22*). Patients who were not hospitalized exhibited a higher mean global quality of life score of 85 (SD = 13) compared to those who were hospitalized, who had a lower mean score of 76 (SD = 10) (p<0.001), as determined by the Wilcoxon rank sum test. Additionally, analysis of specific quality of life domains revealed significant differences between patients with different hospitalization statuses. In the Psychological domain, patients who were not hospitalized had a higher mean score of 14.01 (SD = 2.83) compared to those who were hospitalized, who had a mean score of 13.02 (SD = 2.86) (p=0.020). Furthermore, in the Level of Independence and Social Relationships domains, patients who were not hospitalized also demonstrated significantly higher mean scores compared to those who were hospitalized (p<0.001 and p=0.003, respectively). Similarly, in the Environment domain, patients who were not hospitalized had a higher mean score compared to hospitalized patients, this difference was statistically significant (p<0.001).

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Table 4-21 Quality of life mean scores according to patients' current viral load status

Characteristic	**Greater than 1000**, N = 10[1]	**Less than 1000**, N = 752[1]	**No VL**, N = 14[1]	**p-value**[2]
Global score of Quality Of Life	81 (14)	84 (13)	86 (11)	0.4
Domain 1 – Physical	14.60 (2.84)	14.01 (3.28)	12.71 (3.36)	0.3
Domain 2 – Psychological	12.96 (3.45)	13.95 (2.84)	14.29 (2.43)	0.5
Domain 3 – Level of Independence	14.80 (1.81)	14.82 (2.36)	14.64 (2.50)	0.9
Domain 4 – Social Relationships	14.40 (3.44)	14.91 (2.51)	15.50 (2.85)	0.3
Domain 5 – Environment	12.50 (1.94)	12.71 (2.61)	13.32 (2.45)	0.6
Domain 6 – Spirituality	13.4 (3.9)	13.8 (3.7)	13.6 (4.4)	>0.9

[1]Mean (SD)
[2]Kruskal-Wallis rank sum test
Source: Researcher's Field Survey, 2023

Table 4-22 Quality of life mean scores according to patient hospitalization status

Characteristic	**No**, N = 742[1]	**Yes**, N = 48[1]	**p-value**[2]
Global score of Quality of Life	85 (13)	76 (10)	<0.001
Domain 1 – Physical	14.02 (3.30)	13.56 (3.09)	0.3
Domain 2 – Psychological	14.01 (2.83)	13.02 (2.86)	0.020
Domain 3 – Level of Independence	14.94 (2.33)	13.19 (2.13)	<0.001
Domain 4 – Social Relationships	15.01 (2.47)	13.75 (3.04)	0.003
Domain 5 – Environment	12.88 (2.59)	10.65 (2.03)	<0.001
Domain 6 – Spirituality	13.8 (3.7)	12.8 (3.3)	0.058

[1]Mean (SD)
[2]Wilcoxon rank sum test
Source: Researcher's Field Survey, 2023

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When considering patients' duration in treatment, significant variations in quality of life scores were observed across different domains (*Table 4-23*). Patients treated for 12 months demonstrated a higher mean global quality of life score of 87 (SD = 13) compared to those treated for more than 12 months, who had a lower mean score of 82 (SD = 12) ($p<0.001$), as determined by the Wilcoxon rank sum test. Furthermore, analysis of specific quality of life domains revealed significant differences between patients with different treatment durations. In the Physical domain, patients treated for 12 months had a lower mean score of 13.69 (SD = 3.11) compared to those treated for more than 12 months, who had a higher mean score of 14.25 (SD = 3.40) ($p=0.005$). Conversely, in the Psychological domain, patients treated for 12 months demonstrated a higher mean score of 14.33 (SD = 2.73) compared to those treated for more than 12 months, who had a lower mean score of 13.61 (SD = 2.90) ($p<0.001$). Additionally, in the Level of Independence and Social Relationships domains, patients treated for 12 months also exhibited significantly higher mean scores compared to those treated for more than 12 months ($p=0.046$ and $p=0.042$, respectively). Similarly, in the Environment domain, patients treated for 12 months had a higher mean score compared to those treated for more than 12 months, although the difference was not statistically significant ($p<0.001$).

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Table 4-23 Quality of life mean scores according patients' duration in treatment

Characteristic	**12 months**, N = 359[1]	**More than 12 months**, N = 417[1]	**p-value**[2]
Global score of Quality Of Life	87 (13)	82 (12)	<0.001
Domain 1 – Physical	13.69 (3.11)	14.25 (3.40)	0.005
Domain 2 – Psychological	14.33 (2.73)	13.61 (2.90)	<0.001
Domain 3 – Level of Independence	14.95 (2.19)	14.71 (2.48)	0.046
Domain 4 – Social Relationships	15.05 (2.76)	14.79 (2.30)	0.042
Domain 5 – Environment	13.59 (2.69)	11.97 (2.27)	<0.001
Domain 6 – Spirituality	14.6 (4.0)	13.0 (3.3)	<0.001

[1]Mean (SD)
[2]Wilcoxon rank sum test
Source: Researcher's Field Survey, 2023

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4.17 Perception of Quality of Care of PLHIV

4.17.1 Prevalence of Quality of Healthcare of PLHIV: Importance and Performance of Care aspect

Importance of care aspect

The result in *Figure 4-23* presents the perception of quality of care of PLHIV disaggregated by gender. The chart illustrates the importance of various aspects of care as perceived by male and female patients. The data is divided into different levels of importance: extremely important, fairly important, important, and not important. Females prioritize work efficiency more than males. The results indicate significant gender differences in several aspects of care. For instance, 52.0% of female respondents rated the ability to check their personal file as extremely important, compared to 40.0% of male respondents. Similarly, 26.0% of females versus 23.0% of males considered it extremely important that healthcare providers take their opinions into account. Additionally, the need for uninterrupted consultations was rated as extremely important by 21.0% of females and 19.0% of males.

Other care aspects showed more minor differences. The importance of having a healthcare provider who is always the same person was rated as extremely important by 27.0% of females and 25.0% of males. The clarity of medication explanations was highly valued by 25.0% of females and 21.0% of males. Maintaining confidentiality about HIV status was extremely important to 21.0% of females and 19.0% of males. Some aspects showed near parity between genders. For example, 23.0% of females and 21.0% of males emphasized the importance of healthcare providers breaking bad news gently. Informing patients about the pros and cons of a treatment was rated as

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extremely important by 25.0% of females and 24.0% of males. These results highlight both the commonalities and the divergences in care priorities between genders.

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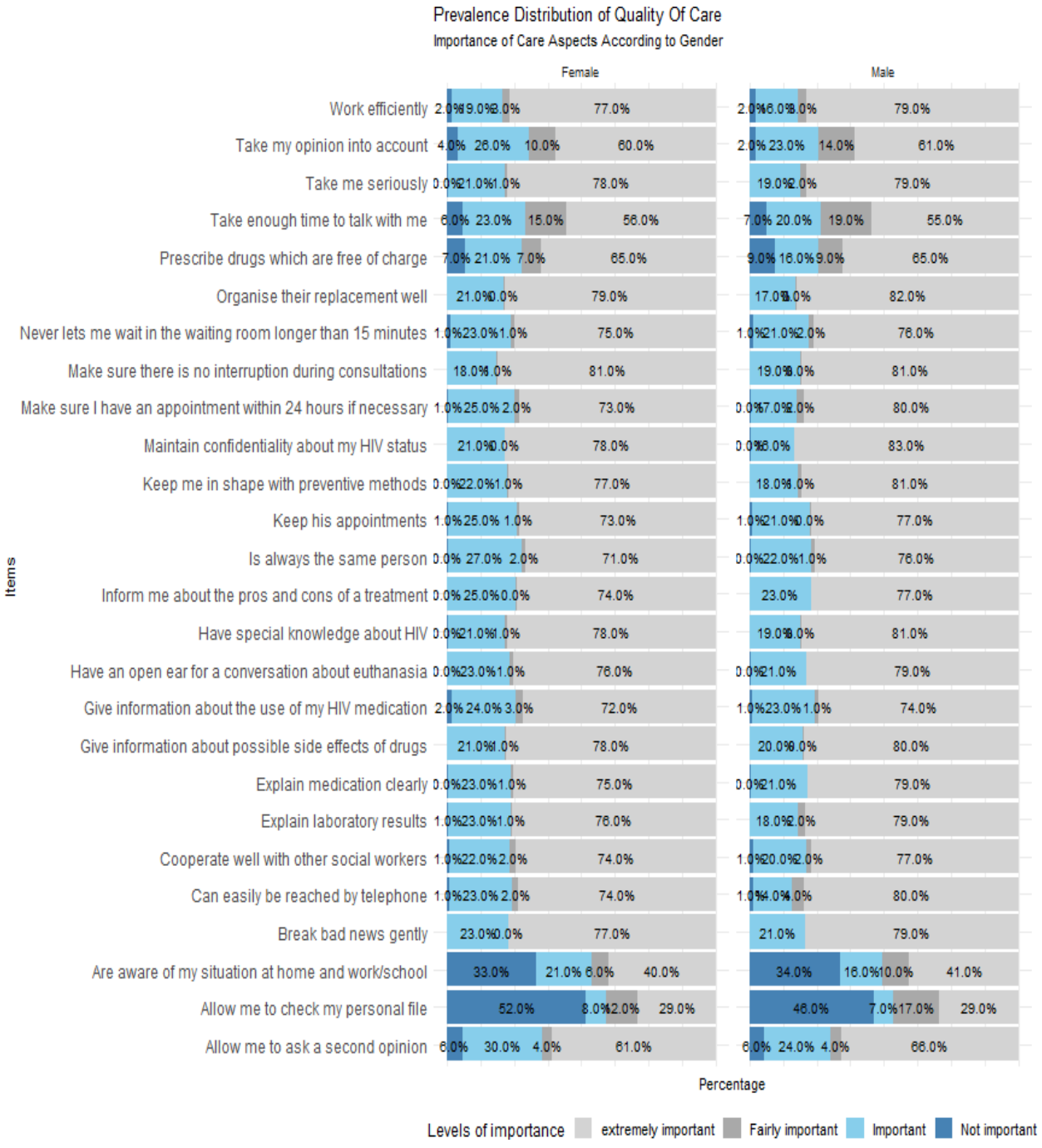


Figure 4-23 Prevalence distribution for importance aspect of quality of care items by gender

Source: Researcher's Field Survey, 2023

Performance of care aspect

The result in *Figure 4-24* presents the performance of various healthcare aspects as perceived by male and female patients. For the aspect of working efficiently, 91.0% of males and 85.0% of females responded positively. When asked if their opinions are taken into account, 52.0% of males and 51.0% of females responded affirmatively. Regarding being taken seriously, 84.0% of males and 81.0% of females felt this was true. The availability of free prescription drugs was positively rated by 50.0% of males and 48.0% of females. For organizing replacement well, 78.0% of males and 77.0% of females responded positively. The aspect of never waiting longer than 15 minutes in the waiting room was rated positively by 75.0% of both genders. Ensuring no interruption during consultations was affirmed by 82.0% of females and 81.0% of males.

Maintaining confidentiality about HIV status was considered well-performed by 74.0% of males and 73.0% of females. Preventive methods to keep patients in shape were positively rated by 80.0% of males and females. Having the same person as their healthcare provider consistently was positively noted by 69.0% of males and 66.0% of females. Special knowledge about HIV was affirmed by 85.0% of females and 84.0% of males. The aspect of breaking bad news gently was positively rated by 83.0% of males and 78.0% of females.

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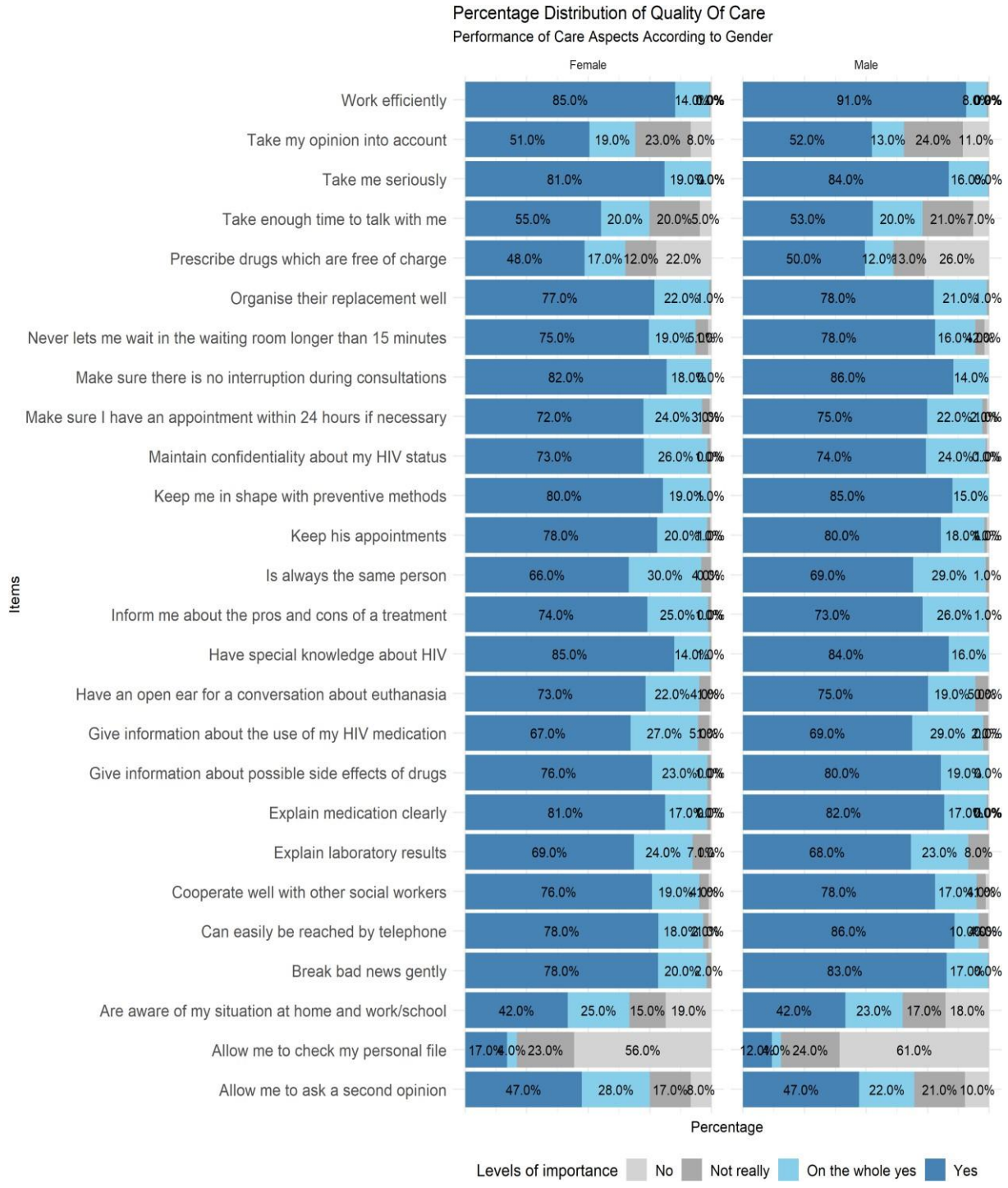


Figure 4-24 Prevalence distribution for performance aspect of care of quality of care by gender

Source: Researcher's Field Survey, 2023

The scatter plot in *Figure 4-25* presents the relationship between the importance and performance of quality of care aspect of PLHIV. The result suggests many aspects of healthcare are not only considered crucial by patients but also meet their performance expectations. However, there is high need for healthcare providers to focus on increasing their services.

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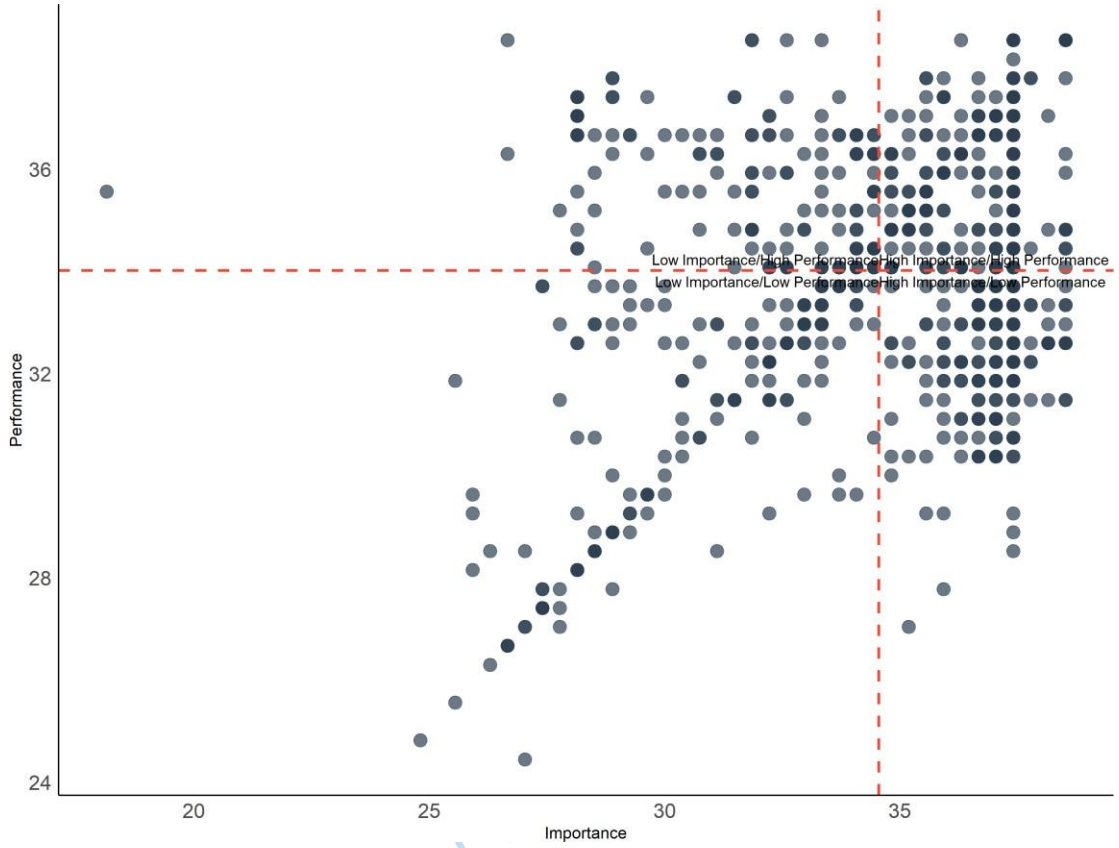


Figure 4-25 Scatter Plot of Importance vs Performance aspect of quality of care on ART: Each dot represents a specific aspect of healthcare, plotted according to its perceived importance (x-axis) and performance (y-axis). The plot is divided into four quadrants by red dashed lines that represent the median values of importance and performance. The quadrant are labeled as follows; High Importance/High Performance (Top Right Quadrant), High Importance/Low Performance (Bottom Right Quadrant), Low Importance/High Performance (Top Left Quadrant) and Low Importance/Low Performance (Bottom Left Quadrant).

Source: Researcher's Field Survey, 2023

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4.18 Gap in Importance and Performance of Care aspect

The result in *Table 4-24* presents a comparison of mean importance, mean performance, and the importance-performance gap for various aspects of healthcare. The aspect of "Prescribe drugs which are free of charge" shows a significant gap, with a mean importance of 3.42 and a mean performance of 2.89, resulting in a gap of 0.53. Similarly, "Allow me to check my personal file" has a mean importance of 2.15 and a performance of 1.78, with a gap of 0.37. "Allow me to ask a second opinion" and "Take my opinion into account" also exhibit notable gaps of 0.35 and 0.32, respectively, indicating areas where patient expectations significantly exceed their experiences.

On the contrary, several aspects demonstrate very small or negative gaps, suggesting that performance meets or exceeds importance. For example, "Break bad news gently" has a mean importance of 3.77 and a performance of 3.78, resulting in a gap of -0.01. "Make sure there is no interruption during consultations" has a mean importance of 3.81 and a performance of 3.83, showing a gap of -0.02. Other aspects such as "Keep me in shape with preventive methods," "Explain medication clearly," and "Take me seriously" all have negative gaps of -0.04 and -0.05, respectively, indicating that these aspects are well-managed according to patient expectations.

Additionally, the aspect "Work efficiently" shows a mean importance of 3.71 and a higher performance rating of 3.85, resulting in a negative gap of -0.14. This suggests a strong alignment between importance and performance in this area. On the other hand, "Are aware of my situation at home and work/school" shows a negative gap of -0.22, with a mean importance of 2.67 and a performance of 2.89, indicating an area where performance slightly exceeds the perceived importance.

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Table 4-24 Comparison between importance and performance mean

Aspect of Care	Mean Importance	Mean Performance	Importance-Performance Gap
Prescribe drugs which are free of charge	3.42	2.89	0.53
Allow me to check my personal file	2.15	1.78	0.37
Allow me to ask a second opinion	3.47	3.12	0.35
Take my opinion into account	3.42	3.10	0.32
Explain laboratory results	3.75	3.60	0.15
Maintain confidentiality about my HIV status	3.79	3.71	0.08
Have an open ear for a conversation about euthanasia	3.75	3.68	0.07
Is always the same person	3.70	3.64	0.06
Give information about the use of my HIV medication	3.67	3.62	0.05
Make sure I have an appointment within 24 hours if necessary	3.72	3.69	0.03
Organize their replacement well	3.79	3.76	0.03
Never lets me wait in the waiting room longer than 15 minutes	3.71	3.68	0.03
Take enough time to talk with me	3.27	3.24	0.03
Inform me about the pros and cons of a treatment	3.74	3.72	0.02
Give information about possible side effects of drugs	3.78	3.76	0.02
Cooperate well with other social workers	3.71	3.70	0.01
Break bad news gently	3.77	3.78	-0.01
Make sure there is no interruption during consultations	3.81	3.83	-0.02
Keep his appointments	3.72	3.76	-0.04
Keep me in shape with preventive methods	3.77	3.81	-0.04
Explain medication clearly	3.75	3.79	-0.04
Take me seriously	3.76	3.81	-0.05
Can easily be reached by telephone	3.70	3.76	-0.06
Have special knowledge about HIV	3.78	3.84	-0.06
Work efficiently	3.71	3.85	-0.14
Are aware of my situation at home and work/school	2.67	2.89	-0.22

Source: Researcher's Field Survey, 2023

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4.19 Discussion of Findings

This study investigated survival pattern, co-morbidity, and quality of life of Adult HIV Patients on antiretroviral therapy.

4.19.1 Incidence of Antiretroviral Treatment Outcomes and Survival Pattern of People living with HIV

In the retrospective study, the incidence rates and the survival on antiretroviral treatment outcomes including treatment interruption, lost-to-follow-up, mortality, and viral load suppression among individuals receiving HIV care over a three-year period was investigated. The findings revealed a significant reduction in treatment interruption, lost-to-follow-up, and mortality rates over the study period. However, viral load suppression, while high, showed a slight decline. The results further showed that survival on treatment such as non-disruptions, retention in treatment, and not dying in treatment can be significantly influenced by patients clinical status such as having suppressed viral load and normal BMI.

The incidence of treatment interruption decreased from 33.33 per 100 PY in 2020 to 27.23 per 100 PY in 2022, indicative of improved adherence to HIV treatment and retention strategies in the treatment facilities. Although, the cumulative prevalence of treatment interruption was observed at 28%. This result is consistent with findings from another lager study in Nigeria, where prevalence of treatment interruption was reported at 32% across 16 states[1]. The significant reduction in treatment interruption may reflect the impact of enhanced patient tracking and follow-up mechanisms. However, the overall high prevalence can be explained by the significant need for patients to consistently attend to and manage complex treatment regimens as other studies of documented[2]

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The higher incidence of treatment interruption among males (23.03/100 PY) compared to females (21.73/100 PY) aligns with existing research, which highlights that men are generally less likely to adhere to HIV treatment due to socio-cultural and economic factors[3]. Although there are varying literatures suggesting that women are more likely than men to interrupt or be non-adherent to treatment[4]. Additionally, the elevated incidence rates among the youngest (15-24 years) and oldest (45+ years) age groups suggests the need for targeted, age-specific interventions to address the unique challenges these populations face in maintaining treatment continuity. Additionally, the higher incidence rates among the youngest (15-24 years) and oldest (45+ years) age groups highlight the need for age-specific interventions to address the unique challenges faced by these populations.

The incidence of lost-to-follow-up showed a significant reduction from 20.37 per 100 PY in 2020 to 0.69 per 100 PY in 2022, indicating effective patient retention strategies. The cumulative prevalence of lost-to-follow-up was 1.4%, which is relatively low compared to other studies reporting rates of 8-26% in similar settings where barriers to consistent treatment adherence remain common despite interventions[5, 6]. Meanwhile, the significant reduction on the incidence of lost-to-follow-up may reflect the impact of enhanced patient tracking and follow-up mechanisms. Studies have documented the impact of use of community health workers and digital health interventions to improve retention in care[7]. The higher incidence of lost-to-follow-up among females (1.19/100 PY) compared to males (0.84/100 PY) highlights the need for gender-sensitive strategies to further mitigate these rates.

The higher incidence of mortality early in the study, with a significant drop over the study period from 27.78 per 100 PY in 2020 to 0.81 per 100 PY in 2022, indicates the effectiveness of interventions and HIV care, likely due to better access to antiretroviral therapy and enhanced

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management of comorbidities[8]. This results corroborates findings on the decreased mortality rates after the first 12 months on ART treatment and the established findings that early treatment initiation significantly impacts on survival rates[9, 10]. In this study the cumulative prevalence of mortality over the study period was 1.4%, which is lower compared to other studies in Nigeria that have reported mortality rates among PLHIV as high as 15%[11]. Additionally, a study in Uganda reported an in-hospital mortality rate of 26% during the study period [12]. The higher mortality rates observed among the youngest and oldest age groups, as well as among individuals with comorbid conditions like elevated blood pressure which aligns with other studies underscore the necessity of an integrated care approaches that will address both HIV and non-communicable diseases[13].

Viral load suppression remained high throughout the study period, although with a slight decrease from 98.15 per 100 PY to 89.62 per 100 PY. The cumulative prevalence of viral load suppression was 90%, which falls short of the UNAIDS 95-95-95 targets for 2030 and indicates potential challenges in sustaining long-term viral suppression. The observed decline may be attributed to factors such as drug resistance or ongoing challenges in treatment adherence[14,15]. The higher incidence of viral load suppression among the youngest and oldest age groups suggests that these populations may have better access to care or adhere better to treatment protocols, though previous a study demonstrated that older people were more adherent to ART[16]. Further investigation is required to fully understand these trends.

The results demonstrated a generally decreasing trend in survival probability among patients on ART treatment, suggesting a reduced risk of adverse events over time. The survival curve for treatment interruptions indicated a significantly higher risk in the early phases of treatment, but this risk diminished as patients continued their ART regimen. This finding is consistent with a previous study in Nigeria that reported a substantial proportion of patients experiencing early

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treatment interruptions. Another study in Nigeria identified factors such as regimen type, facility level, and geographic region as significant contributors to the likelihood of treatment interruption, with higher risks observed in the South-West and North-East zones[17].

The trends in the survival curves for mortality and viral load suppression show a slight decrease over the study period, with only a minimal reduction in survival probability. This slight decrease in probability suggests a small increase in the risk of death and relapsed on viral load suppression. Programs should maintain effective monitoring and support strategies to ensure that even minimal risks are managed proactively, thereby sustaining long-term health outcomes and preventing potential declines in viral load suppression and mortality rates.

The multivariate Cox proportional hazards analysis provided several important evidence on how patient characteristics influenced treatment outcomes. Participants aged 35 years and older were found to have a slightly increased risk of treatment interruption and loss to follow-up, although these associations were not statistically significant. However, this age group demonstrated a reduced hazard for achieving viral load suppression (HR = 0.52, p = 0.017), this aligns with previous studies suggesting that older individuals may face challenges in sustaining viral suppression, potentially due to factors such as comorbidities, medication side effects, or reduced adherence over time[18]. Conversely, the lower hazard of mortality in this age group, though not significant, suggests that older patients may benefit from more stable health conditions or better access to care, highlighting the complexity of age-related outcomes in HIV treatment[19, 20].

Gender-specific differences were also observed, with males showing a lower hazard of treatment interruption (HR = 0.86, p = 0.032) compared to females, possibly reflecting the impact of gender-sensitive interventions. This finding contrasts with previous research indicating that men are typically at higher risk of poor adherence, suggesting that targeted interventions to support female

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patients in maintaining consistent treatment could be beneficial[21]. Conflicting evidence are documented regarding gender as a predictor for ART treatment interruption[22]. Education level emerged as a significant predictor of treatment interruption, with participants possessing primary, Quranic, or secondary/post-secondary education exhibiting higher hazards compared to those with no formal education. Previous studies have also reported higher likelihood of treatment interruption with increasing educational status[23]. This unexpected result could be due to different social and economic challenges faced by people with various education levels, which may affect how well they stick to their treatment. However, engagement due to schooling can impact treatment adherence and lead to treatment interruptions, especially among students who may face conflicting time commitments.

Regarding care entry points, the analysis revealed that participants entering care through HIV Testing Services (HTS) or Outreach programs were at significantly higher risk of being lost to follow-up compared to those entering through Community-Based Organizations (CBOs). This suggests that the initial point of care may play a role in patient retention, possibly due to the mobility of outreach programs, where eventually patients may need to travel long distances to continue to access care in facilities, and differences in the level of support provided[24]. Additionally, the provision of cotrimoxazole and isoniazid prophylaxis at baseline was associated with reduced hazards of treatment interruption and death, and an increased likelihood of achieving viral load suppression. These findings shows the importance of integrating prophylactic treatments into HIV care protocols to enhance patient outcomes[25]. Importantly, participants with lower viral loads (<1000 copies/ml) and those with normal or overweight BMI were less likely to experience adverse outcomes, reinforcing the need for comprehensive management of both viral and physical health in HIV care.

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4.10.1 Self-reported Infectious and Non-Infectious Co-morbidities of HIV among Adults Living with the Disease

The study highlights the various health challenges faced by PLHIV, particularly the coexistence of infectious and non-infectious comorbidities. The high proportion of participants (85%) experiencing HIV symptoms is consistent with other research indicating that despite advances in ART, many patients continue to experience symptomatic HIV[26]. Symptoms such as fatigue, gastrointestinal issues, and frequent infections remain common. Some studies have shown that these symptoms are common with patients with low CD4 counts or low adherence to ART regimens[27, 28]. A substantial portion of participants (35%) reported co-infections, reflecting the continued burden of opportunistic infections in HIV populations. Co-infections such as tuberculosis, hepatitis, and STIs are common among PLHIV and contribute to higher morbidity and mortality rates (World Health Organization, 2021). The high prevalence of viral hepatitis (2.5%) and STIs like gonorrhea (26%), syphilis (5.8%), and chlamydia (6.3%) aligns with previous studies[29]. This underscores the need for integrated care models that address both HIV and co-infection.

Additionally, the study showed significant presence of non-infectious comorbidities like peptic ulcers and hypertension (22% and 12%, respectively). Recent studies have shown that PLHIV are at an increased risk of developing non-infectious comorbidities such as cardiovascular and gastrointestinal disorders due to factors including chronic immune activation and ART toxicity[30]. For instance, studies found that PLHIV are more likely to develop hypertension and other cardiovascular diseases compared to the general population, and this risk increases with age and duration of HIV infection [31].

The observed gender differences in the prevalence of conditions such as peptic ulcers and

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depression among women, compared to heart disease and lung disease in men, are worth attention. Factors such as stress, unequal healthcare access, and societal roles likely contribute to the higher burden of certain conditions in females, as highlighted by some studies[32]. Conversely, higher rates of heart and lung diseases among males may reflect lifestyle factors like smoking and alcohol use, which are known to exacerbate these conditions[33]. Regarding STIs, the high prevalence of gonorrhea emphasizes the need for targeted sexual health interventions, particularly for men, who may have less access to healthcare despite higher rates of reported STIs[34]. Addressing sexual health and HIV care is essential for reducing morbidity and preventing further HIV transmission. The analysis also explored the influence of adherence, age, education, and lifestyle factors on comorbidities. Low adherence to ART (OR 3.29, p=0.010) was a strong predictor of comorbidity, a finding that aligns with prior research showing that poor ART adherence is linked to worsened health outcomes in HIV patients[35]. Higher education, especially at the tertiary level, was shown to have a protective effect, highlighting the importance of health knowledge in managing chronic illnesses. Additionally, lifestyle factors such as smoking and prior diagnosis of STIs before HIV diagnosis emerged as significant predictors. Former smokers had a lower likelihood of developing comorbid conditions (OR 0.43, p=0.025), while those with prior STIs were at increased risk (OR 4.53, p<0.001), which is consistent with existing literature highlighting the role of behavioral risk factors in chronic disease progression in PLHIV[36].

4.10.2 Adherence on ART

Regarding adherence behaviors among PLHIV the findings indicate a relatively high level of forgetfulness and medication non-compliance, with no significant differences between men and women. For instance, 40% of participants reported sometimes forgetting to take their medication,

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and 16% had missed taking medication in the last two weeks, regardless of gender. Previous research show that adherence challenges persist across genders in PLHIV, often due to barriers such as side effects, financial difficulty, shift to alternate therapy, lifestyle factors, or cognitive difficulties[37]. However, the non-significant gender difference with male being more likely to adhere to treatment, align with some studies that suggest women might face more adherence challenges due to caregiving responsibilities or stigma, highlighting the importance of addressing adherence barriers universally in HIV care programs[38].

In the adjusted model, participants without symptoms were significantly more likely to adhere to ART, with an odds ratio (OR) of 3.43 (p=0.007). This supports prior studies demonstrating that symptomatic individuals are often less adherent, possibly due to the discomfort from ART side effects or the perception that the medication is ineffective[39]. Furthermore, the lack of comorbidities was also associated with higher adherence (OR 2.48, p=0.008), which is consistent with findings that coexisting conditions complicate medication regimens and reduce the likelihood of strict adherence[40]. These findings suggest that managing comorbidities and minimizing ART side effects could improve treatment adherence in PLHIV.

Educational status emerged as a strong predictor of adherence, with tertiary education significantly associated with higher odds of adherence (OR 8.28, p=0.002). This finding aligns with the broader literature that associates higher health literacy with better treatment outcomes and adherence to ART[41]. The protective effect of education likely reflects a better understanding of HIV treatment and improved health-seeking habits. In contrast, lower adherence among those with primary or secondary education suggests the need for targeted efforts to boost health literacy and support ART adherence in less-educated individuals.

Finally, socioeconomic and lifestyle factors such as household income and participation in PLHIV

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support groups were important predictors of adherence. Higher household income was associated with better adherence, which is in line with evidence that financial stability enables consistent access to healthcare and ART[42]. Moreover, participants who engaged in PLHIV support groups more frequently (once or more per month) exhibited better adherence, emphasizing the role of social support in promoting health behaviors[43]. These findings indicates the importance of comprehensive care approaches that address both socioeconomic and psychosocial factors to improve ART adherence among PLHIV.

4.10.3 Quality of Life of PLHIV

The results of the study provide insights on the quality of life of PLHIV, as measured by the WHO-BREF. These findings highlight key factors affecting their QOL and suggest the need for better healthcare, psychosocial support, and policies to improve their well-being. The high scores for both general quality of life (Mean = 3.86) and general health perception (Mean = 3.65) suggest a relatively positive outlook on overall health among the study population. These findings align with existing literature, which shows that PLHIV, particularly those on ART, report improved quality of life due to better symptom management and viral load reduction[44]. Access to consistent healthcare, a critical factor in enhancing the well-being of PLHIV likely reinforces this positive perception. However, the possibility for social desirability bias should be considered, as respondents might overreport well-being due to stigma or fear of judgment[45, 46]. Moderate scores in the physical health domain (Mean = 13.99) reflect the physical challenges PLHIV face, with moderate scores in areas like pain (Mean = 3.48) and fatigue (Mean = 3.37), indicating that while ART improves physical symptoms, many patients still experience side effects or related conditions[47].

Psychological health scores (Mean = 13.95) reveal a generally moderate mental state, indicating

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that some participants may still experience psychological distress. Different studies have exhibited varying psychological health scores of PLHIV ranging from as low as 9.2 to 16.5, indicating that PLHIV experience different levels of mental health challenges[48]. These scores suggest significant disparities in psychological well-being. High independence scores (Mean = 14.84), given the high mobility (Mean = 3.97) and activities of daily living (Mean = 3.83) suggest that most participants can function independently, which is associated with enhanced quality of life. However, challenges in work capacity highlight ongoing struggles related to stigma or health complications[49]. The strong social relationships observed (Mean = 14.93) reflect the critical role of social support in improving both mental and physical health outcomes in PLHIV, aligning with research linking social connections to better ART adherence and overall quality of life[50]. Despite moderate environmental domain scores (Mean = 12.74), financial challenges (Mean = 2.44) remain a barrier to optimal quality of life, as financial hardship often hinders treatment adherence[51]. Spirituality (Mean = 13.77) emerged as moderate, with some participants finding comfort while others experienced distress related to concern about the future (Mean = 2.95).

Further analysis, based on the concurrent validity results of the WHOQOL-HIV BREF show that physical health is moderately correlated with both psychological well-being (r = 0.478) and social relationships (r = 0.496), indicating that improvements in physical health may positively influence emotional and social aspects of life for PLHIV. The moderate correlation between the Physical and Environment domains (r = 0.478) also highlights the role of external factors like living conditions in shaping physical well-being. However, the weaker correlation between the Physical and Spirituality domains (r = 0.217) suggests that spiritual health is less directly influenced by physical status. Importantly, the strong correlation between the Physical domain and General Quality of

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Life (r = 0.660) presents the important role of physical health in determining overall well-being, emphasizing the need to prioritize physical health interventions in HIV care. The variability in domain scores further suggests that personalized care approaches may be necessary to address the diverse experiences of quality of life in this population[52].

The Structural Equation Model (SEM) results highlighted the positive correlation between the latent domains and their respective observed variables, with strong loadings for indicators such as Pain and Energy in the Physical domain and Self-esteem in the Psychological domain. However, certain hypothesized indicators, such as Sleep and PLHIV symptoms in the Physical domain, were not present, suggesting a gap between expected and actual data relationships. This could be due to cultural or contextual differences in how respondents prioritize or perceive certain health aspects. Previous studies using exploratory factor analysis have shown mismatch in hypothesized domain factors in the WHOQOL-HIV BREF suggesting peculiarities in the dynamics of the population and location of study[53]. The notably high positive factor loadings for the indicators in the independence domain indicate the strong ability of PLHIV to have reasonably independent lives while on ART[54]. The SEM model revealed positive influences across domains like Independence, Social well-being, and Environment, but negative impacts were seen in the Spiritual domain. The model's poor fit indices (CFI = 0.807, TLI = 0.767, RMSEA = 0.110, SRMR = 0.136), despite refinements in the analysis, suggest limitations in accurately capturing the data structure, possibly due to data-related issues. This highlights the need for further studies investigating the construct of quality of life among PLHIV to test the original hypothesis, and various factors that may significantly contribute to the different domains of quality of life in a similar sample population in the country.

The linear model results provide provided insights on predictors of quality of life among PLHIV.

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The findings suggests that while adherence is a strong predictor, other confounders also influence QOL. Educational attainment, particularly tertiary education, continued to show a positive association with QOL, highlighting the role of education in fostering health literacy and better self-management of HIV[55]. Living with children maintained a significant positive association with QOL in the adjusted model (5.6, 95% CI: 3.5, 7.7), implying that family support plays a crucial role in enhancing well-being[56]. Interestingly, being on TB treatment or having a history of TB was not significant in the adjusted model, unlike in the unadjusted model where a history of TB showed a negative impact on QOL. This suggests that other factors, such as general health status, individual's health behaviors, or access to care, may mediate the relationship between TB and QOL[57]. Other factors such as income also remained a significant predictor of QOL, with higher income linked to better outcomes in both the adjusted and unadjusted models, reinforcing the notion that economic stability enhances the quality of life for PLHIV[58]. Conversely, HIV-related stigma and the experience of being hospitalized for HIV continued to negatively impact QOL, with similar magnitudes across both models, underscoring the persistent effect of stigma on well-being.

4.10.4 Perceived Quality of care on ART

The findings of this study reveal important gaps between the perceived importance and performance of various aspects of care, particularly in providing free medications, access to personal files, and allowing second opinions, with gaps of 0.53, 0.37, and 0.35, respectively. These gaps highlight areas where patients' expectations are not being met, potentially affecting their satisfaction and adherence to treatment, as limited involvement in decision-making can hinder the success of antiretroviral therapy[59]. In contrast, aspects such as confidentiality, timely appointments, and clear medication explanations had minimal gaps, reflecting strong performance and

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reinforcing the importance of trust in HIV care[60]. Interestingly, the negative gap in "breaking bad news gently" suggests that providers are exceeding patient expectations in this area, which is vital for maintaining strong communication.

The results suggests that most perception of quality of care fall into the High Importance/High Performance, indicating that key services or aspects are performing well in line with user expectations. However, attention is needed for areas in the High Importance/Low Performance quadrant, where the gap between user expectations and actual service delivery is the widest. These present opportunities for improvement to enhance overall satisfaction and address unmet needs. Therefore, there is need to prioritize resources and interventions in areas where there is a clear mismatch between the expectations and the actual experience of users.

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Endnotes

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CHAPTER FIVE

5 Conclusion and Recommendations

5.1 Summary of Findings

The study highlighted a notable improvement in key outcomes for adult HIV patients on ART in Bauchi State, Nigeria. The study revealed a steady decline in the incidence of treatment interruption and lost to follow-up over the three-year period, alongside a marked reduction in mortality. Viral load suppression rates, though initially high, showed a slight decline over time. Survival analysis indicated a general trend of improved survival probabilities for patients on ART, with a reduced risk of adverse events as time progressed. Additionally, patients with lower viral loads experienced significantly lower risks of loss to follow-up and death compared to those with higher viral loads. Body Mass Index (BMI) also played a role in survival outcomes, with overweight patients showing a significantly lower risk of mortality, while underweight patients had a notably increased risk compared to those with normal BMI. Age appeared to play a role in treatment adherence, with the youngest and oldest age groups showing a higher tendency to default on treatment. Additionally, patients with elevated and high blood pressure were more likely to interrupt treatment and had higher mortality rates than those with normal blood pressure.

In terms of co-morbidities, a large portion of the study population reported experiencing HIV-related symptoms, and a significant proportion had either co-infections or non-infectious co-morbidities. Peptic ulcers and high blood pressure were the most commonly reported non-infectious conditions, with high blood pressure affecting both males and females equally. Co-

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infections like gonorrhea and hepatitis viruses were also prevalent, with higher income groups showing lower rates of co-morbidities.

The study further found that females generally adhered better to ART than males, and individuals without symptoms or co-morbidities showed better adherence. Regarding quality of life, most patients reported a relatively positive perception of their health. However, those who interrupted treatment had better scores in physical health domains, while their psychological well-being was lower compared to those who did not interrupt treatment.

5.2 Conclusion

In conclusion, this study provides important insights into the treatment outcomes, burden of co-morbidities, and quality of life among individuals receiving HIV care over a three-year period. The findings demonstrate reductions in treatment interruption, lost-to-follow-up, and mortality rates, although the viral load suppression rate, while high, declined slightly, remaining below the UNAIDS 95-95-95 targets. Survival on treatment, characterized by uninterrupted care and retention, was significantly impacted by clinical factors, including viral load suppression and a normal BMI. The protective role of prophylactic treatments like cotrimoxazole and isoniazid in reducing treatment interruption and mortality further emphasizes the need for integrating these interventions into HIV care protocols.

The study highlights the complex health challenges faced by people living with HIV, particularly the high prevalence of both infectious and non-infectious comorbidities. However, this can be ameliorated through comprehensive care approaches that address both medical and social factors affecting their health outcomes. Socioeconomic factors, such as household income and education, emerged as key predictors of adherence, highlighting the role financial stability and health literacy

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play in ensuring consistent access to care. The analysis of quality of life revealed generally positive perceptions of health, but also showed challenges related to physical health, psychological distress, and financial barriers.

Overall, the findings supports the importance of addressing both clinical and social determinants of health in enhancing the outcomes and quality of life of PLHIV. There is a continued need for comprehensive care strategies that integrate medical, psychological, and socioeconomic support to improve the well-being of individuals on antiretroviral therapy, while addressing persistent challenges such as stigma, financial hardship, and long-term treatment adherence.

5.3 Recommendations

A comprehensive approach is essential to address the health challenges faced by people living with HIV, as these challenges extend beyond the healthcare system. Collaboration among various sectors is necessary. Other recommendations include:

- Enhancing access to care by improving transportation options for patients to reach healthcare facilities easily.
- Incorporating routine screenings and preventive health services, such as vaccinations and regular health check-ups, alongside prophylactic treatments like cotrimoxazole and isoniazid, to further enhance the overall health and resilience of individuals living with HIV.
- Strengthening community support networks to help individuals living with HIV connect and share experiences.
- Promoting health education programs focused on HIV treatment, adherence, and overall health to improve health literacy.

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- Addressing financial barriers by developing assistance programs that help patients manage healthcare costs and maintain adherence.
- Focusing on mental health by implementing support services to address psychological distress among individuals living with HIV.
- Encouraging healthy lifestyles by promoting balanced nutrition and physical activity to improve overall health and well-being.

5.4 Contribution to Knowledge

This study enhances the existing body of knowledge on the health outcomes of individuals living with HIV by providing a comprehensive analysis of treatment survival outcomes and well-being over a three-year period in Bauchi State. Globally, it contributes to understanding the factors influencing treatment adherence, mortality, viral load suppression, and quality of life, which are critical for achieving UNAIDS targets. In Bauchi State specifically, the findings highlight local challenges and opportunities, emphasizing the need for tailored interventions to improve HIV care and support systems in the region.

5.5 Suggested Areas for Further Research

- Conducting long-term studies to track the health outcomes of individuals living with HIV over extended periods, focusing on the impact of comorbidities and treatment adherence.
- Conduct studies that explore deeper with larger sample size the specific constructs of quality of life among PLHIV, focusing on how these constructs vary across different demographics and settings.

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- Conduct cohort studies to assess the impact of comorbidities on treatment adherence and viral load suppression across different age demographics, particularly among older individuals.
- Identifying and addressing barriers that hinder access to care, especially for marginalized groups or those living in remote areas.

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Appendices

Appendix A: Recruitment Script

Recruitment script for Facility Survey

Survival Pattern, Co-morbidity, and Quality of Life of Adult HIV Patients on Antiretroviral Therapy in Bauchi State, Nigeria

Protocol Approval Number: Approval No: NREC/03/11/19B/2021/018

Principal Investigators:
Ekerette Emmanuel Udoh
Co- Investigators:
Dr. Zaidat Musa
Dr Olowolafe Tubosun

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IMPORTANT: Please only read this script to clients who are receiving antiretroviral treatment (ART) in the facility and are 18 years or older. Research assistants will handle the informed consent process and confirm if the client meets the study eligibility after you refer them.

While I am your healthcare provider today, I'll step into a research role for a moment to support a study being done among clients receiving care at this facility. I'd like to tell you a bit about the study. The results will help improve the care and treatment that clients on ART receive.

The researchers are studying the co-morbidities of HIV, quality of life, quality of care, and adherence to ART among adults receiving treatment from two clinics in Bauchi, and this clinic is one of them. The information gathered will help address barriers to ART services, improve treatment outcomes, and better understand the quality of life of patients. You've been selected because you're currently receiving ART treatment here.

The study includes people who:

- Are 18 years or older (male or female),
- Are receiving ART at one of the two clinics in Bauchi State,
- Are willing to give written consent to participate in the survey,

If you are interested in taking part in this study I will refer you to a research assistants who will further explain details about the study and will seek your consent to take part in the study. They will also answer any questions.

The decision to learn more about the study is voluntary and will not affect the care you receive from me or the facility. If you decide to join, what you share with the research assistant will be private, and I won't know what you say during the survey.

Are you interested in learning more about the study?

If no → *Thank participant does not agree than them their time. Let them know you will now resume your role as their healthcare provider and will no longer be in a research capacity.*

If yes → Thank participant for agreeing to participate in the research and introduce the participant to the research assistant.

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Appendix B: Informed consent form

Patient Information and consent statement for facility Survey
Survival Pattern, Co-morbidity, and Quality of Life of Adult HIV Patients on Antiretroviral Therapy in Bauchi State, Nigeria

Protocol Approval Number: Approval No: NREC/03/11/19B/2021/018

Principal Investigators:
Ekerette Emmanuel Udoh
Co- Investigators:
Dr. Zaidat Musa
Dr Olowolafe Tubosun
Participant ID number: ____

Interviewer's Name: _____ Date: _____

Hello, my name is _____(name of Interviewer/researcher) I am representing Ekerette Udoh, who is a PhD Candidate from Lead City University, Ibadan, Nigeria.

Purpose of the research

We are conducting a research study about the co-morbidities of HIV, quality of life, quality of care, and adherence in antiretroviral therapy (ART) care among adults receiving ART treatment from clinics. The information gathered will be used to address ART services barriers, treatment outcomes and understand the quality of life of patients. You have been selected to participate in this study because you are eligible as a person receiving ART treatment in this facility. If you decide to participate, you will be one of the study participants and will be asked to complete a survey on the study.

Voluntary participation

Participation in this research study is voluntary. You can stop participating at any time without any consequences. You can also skip any questions that you wish. Your decision to participate will not affect your ability to receive health services in this facility.

Confidentiality and data protection

We will interview you in a private place where no one can hear what is said. The research team will keep what you say in this interview private to the best of our ability. Only members of our

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study team will be able to access the information that you have provided. In order to maintain confidentiality, no identifying information will be collected about you. We will use your hospital number as a unique identifier.

Risk and benefits

Possible risk associated with participation in this study is breach of confidentiality, however this risk has been reduced by creation of unique codes per participant. This code will serve as identifiers for the response you provide in this survey.

There will be no direct benefits from this study, but the data generated from this survey will help the researcher understand the health issues of people receiving ART treatment in this facility.

Contact information

If you have any questions or feel you have been harmed in any way by participating in this study, please contact principal investigator Mr Ekerette Emmanuel Udoh on 08163366955 or via email: *ekerette01@gmail.com*, or contact the academic supervisor Dr Adesola Zaidat Musa via email on *zaidatmusa@lcu.edu.ng*.

This research has been reviewed and approved by Bauchi State Health Research Ethics Committee (BASHREC): Approval No: NREC/03/11/19B/2021/018. If you have any questions about how you are being treated or your rights as a study participant, you can contact the review board who approved this study at: *anasahmedbauchi@gmail.com*

Questions and durations of interview

Before you give consent, please ask any questions on any aspect of this study that is unclear to you. You may take as much time as necessary to think it over. This interview will last for about 45 minutes to 1 hour.

Authorization

You are making a decision whether or not to participate in this study. Your signed consent indicates that you understand the information provided and have had all your questions answered and have decided to participate. A copy of this consent form will be given to you on your request.

Researcher obtained consent from the subject via signed consent: **Yes**____or **No** _____

_____ _____

Participants name and signature Date

_____ _____

Interviewers name and signature Date

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Appendix C: Survey Questionnaire

Questionnaire for Facility Survey

Survival Pattern, Co-morbidity, and Quality of Life of Adult HIV Patients on Antiretroviral Therapy in Bauchi State, Nigeria

	General Information	
1	Patient Unique Hospital Identification number	No: _ Pre-loaded from retrospective study
2	Name of interviewer	Interviewer name 1 Interviewer name 2 Interviewer name 3 Interviewer name 4 Interviewer name 5 Interviewer name 6 Interviewer name 7 Interviewer name 8
3	Facility name	(1) Facility 1 (2) Facility 2

A	**DEMOGRAPHIC AND HEALTH CHARACTERISTICS**					
	INFORMED CONSENT Identify the eligible female or male respondent. Administer the consent procedures.	(1) Y (0) N				
A1	How old were you in your last birthday?	_____ (In years)				
A2	What is your gender?	(1) Male	(2) Female	(99) Others (Please specify)	(98) Prefer not to say	

A3	What is your educational status?	(1) None	(2) Primary	(3) Secondary	(4) Higher	(5) Quranic

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A4	What is your occupation?	1 Professional (doctor, lawyer, accountant, lecturer) 2 Highly skilled (nurse, teacher, School of Tech graduate) 3 Skilled (tailor, beautician, plumbing, hairdresser, carpentry, electrician) 4 Semi-skilled (farming, fishing, mining, forestry) 5 Unskilled (laborer, trader, shopkeeper, hawker, vendor etc.) 6 Other, specify: _____ 7 No response				
A5	What is your current marital status?	(1) Married	(2) Never married	(3) Widowed/widower	(4) Living with partner but not married	(5) Divorced/ Separated
A6	Do you have children?	(1) Yes (0) No				
A7	How many children do you have					
A8	Are your children living with you?	(1) Yes (0) No SKIP IF AQ7 and A7b=0				
A9	Do you currently belong to any PLHIV support group?	(1) Yes (0) No				
A10	How often have you participated in these groups/clubs during last month (count in total)?	(1) Once or less/ month	(1) 2-4 times/month	(3) More than 4 times/month		
A11	Have you ever been on tuberculosis (TB) treatment? (Select one response)	(1) Yes and I am currently on TB treatment now	(2) Yes and I was on TB treatment in the past	(3) Never		
	What is the most likely way that you became infected with HIV? (Select one response)	1. Get infected from husband or wife or long-term partners 2. Sex with a man who was HIV+ 3. Sex with a woman who was HIV+ 4. Share needles with a person who was HIV+ 5. Blood transfusion or other medical procedure 6. Don't know				
A12	What is the approximate total income of your household, per month?	Amount: ____, ____in _____***(indicate the currency)***				

B	**NON-INFECTIOUS AND INFECTIOUS CO-MORBIDITY ASSESSMENT**

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Please indicate if you currently have the following condition. If you have the condition please indicate if you have received medication or some other type of treatment for the problem.		**B1** **Do you have any of the following conditions?**	**B1.2** **Do you receive treatment for it?**	**B1.3** **Does it limit your activities?**
a	Heart Disease	Y/N *[If No, skip to b]*	Y/N *[If No, skip to b]*	Y/N
b	High Blood Pressure	Y/N *[If No, skip to c]*	Y/N *[If No, skip to c]*	Y/N
c	Lung Disease	Y/N *[If No, skip d]*	Y/N *[If No, skip d]*	Y/N
d	Diabetes	Y/N *[If No, skip to e]*	Y/N *[If No, skip to e]*	Y/N
e	Ulcer or stomach disease	Y/N *[If No, skip to f]*	Y/N *[If No, skip to f]*	Y/N
f	Kidney disease	Y/N *[If No, skip to g]*	Y/N *[If No, skip to g]*	Y/N
g	Anaemia or other blood disease	Y/N *[If No, skip to h]*	Y/N *[If No, skip to h]*	Y/N
h	Cancer	Y/N *[If No, skip to i]*	Y/N *[If No, skip to i]*	Y/N
i	Depression	Y/N *[If No, skip to j]*	Y/N *[If No, skip to j]*	Y/N
j	Osteoarthritis, degenerative arthritis	Y/N *[If No, skip to k]*	Y/N *[If No, skip to k]*	Y/N
k	Back pain	Y/N *[If No, skip to l]*	Y/N *[If No, skip to l]*	Y/N
l	Rheumatoid arthritis	Y/N *[If No, skip to m]*	Y/N *[If No, skip to m]*	Y/N
m	Other medical problems (please Specify)	Y/N *[If No, skip to B2]*	Y/N *[If No, skip to B2]*	Y/N

		B2 **Have you ever been diagnosed with the following conditions?**	**B2.2** **Do you receive treatment for it?**
	Conditions	Y/N *[If No, skip to b]*	Y/N
a	hepatitis viruses (regardless of type)	Y/N *[If No, skip to c]*	Y/N
b	human papillomavirus (HPV)/genital warts	Y/N *[If No, skip d]*	Y/N
c	herpes simplex virus (HSV)	Y/N *[If No, skip to e]*	Y/N
d	syphilis	Y/N *[If No, skip to f]*	Y/N
e	gonorrhoea	Y/N *[If No, skip to g]*	Y/N
f	chlamydia	Y/N *[If No, skip to B3]*	Y/N

C	**ADHERENCE ASSESSMENT ON ART**	
C1	Do you sometimes forget to take your medications?	Y/N

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C2	People sometimes miss taking their medications for reasons other than forgetting. Over the past 2 weeks, were there any days when you did not take your medication?	Y/N				
C3	Have you ever cut back or stopped taking your medication without telling your doctor because you felt worse when you took it?	Y/N				
C4	When you travel or leave home, do you sometimes forget to bring your medication?	Y/N				
C5	Did you take your medication yesterday	Y/N				
C6	When you feel like your symptoms are under control, do you sometimes stop taking your medication?	Y/N				
C7	How often do you have difficulty remembering to take all your medication?	(1) Never/ rarely	(2) Once in a while	(3) Some times	(4) Usually	(5) All the tim e
C8	ARVs are u11sually prescribed with some specific requests (e.g. with meals, on empty stomach, before going to bed, drink with much water, etc …). How often did you follow these dietary instructions in last month?	1. Always 2. Some of the time 3. Rarely 4. Never				

D	**HIV SYMPTOM INDEX (HIV-SI INDEX) QUESTIONNAIRE**					
	The following questions ask about symptoms you might have had in the past 4 weeks.	**I do not have these symptoms**	**I have symptoms and…**			
	Please thick the box that describes how much you have been bothered each symptom.		**It doesn't bother me**	**It bothers me a little**	**It bothers me**	**It bothers me a lot**
D1	Fatigue or loss of energy	0	1	2	3	4
D2	Fevers, chills, sweats	0	1	2	3	4
D3	Feeling dizzy or lightheaded	0	1	2	3	4
D4	Pain numbness or tingling in the hands or feet	0	1	2	3	4
D5	Trouble remembering	0	1	2	3	4
D6	Nausea or vomiting	0	1	2	3	4
D7	Diarrhea or loose bowel movements	0	1	2	3	4

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D8	Felt sad, down, or depressed	0	1	2	3	4
D9	Felt nervous or anxious	0	1	2	3	4
D10	Difficulty falling or staying asleep	0	1	2	3	4
D11	Skin problems, such as rash, dryness, or itching	0	1	2	3	4
D12	Cough or trouble catching your breath	0	1	2	3	4
D13	Headache	0	1	2	3	4
D14	Loss of appetite or a change in the taste of food	0	1	2	3	4
D15	Bloating, pain or gas in your stomach	0	1	2	3	4
D16	Muscle aches or joint pain	0	1	2	3	4
D17	Problems with having sex, such as loss of interest or lack of satisfaction	0	1	2	3	4
D18	Changes in the way your body looks such as fat deposits or weight gain	0	1	2	3	4
D19	Weight loss Problems with weight loss or wasting	0	1	2	3	4
D20	Hair loss or changes in the way your hair looks	0	1	2	3	4

E	**WHOQOL-HIV BREF**					
E1	How is your health?	(1) Very Poor	(2) Poor	(3) Neither Poor nor Good	(4) Good	(5) Very Good
E2	Do you consider yourself currently ill?	(1) Yes (0) No				
E3	What is your HIV serostatus?	(1) Asymptomatic	(2) Symptomatic	(3) AIDS converted		
E4	In what year did you first test positive for HIV?	_____				

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E5	In what year do you think you were infected?	_____				
E6	How do you believe you were infected with HIV? (circle one only):	(1) Sex with a man (2) Sex with a woman (3) Injecting drugs (4) Blood products (5) Other (specify)				
Instructions This assessment asks how you feel about your quality of life, health, or other areas of your life. Please answer all the questions. If you are unsure about which response to give to a question, please choose the one that appears most appropriate. This can often be your first response. Please keep in mind your standards, hopes, pleasures and concerns. We ask that you think about your life in the last two weeks. For example, thinking about the last two weeks, a question might ask:						
		Not at all	A little	A moderate amount	Very much	Extremely
E7	How well are you able to concentrate?	1	2	3	4	5
Please read each question, assess your feelings, and circle the number on the scale for each question that gives the best answer for you						
E8	How would you rate your quality of life?	Very poor	Poor	Neither poor nor good	Good	Very good
		1	2	3	4	5
E9	How satisfied are you with your health?	Very dissatisfied	Dissatisfied	neither satisfied nor dissatisfied	Satisfied	Very satisfied
		1	2	3	4	5
The following questions ask about how much you have experienced certain things in the last two weeks						
		Not at all	A little	A moderate amount	Very much	An extreme amount
E10	To what extent do you feel that physical pain prevents you from doing what you need to do?	1	2	3	4	5
E11	How much are you bothered by any physical problems related to your HIV infection?	1	2	3	4	5

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E12	How much do you need any medical treatment to function in your daily life?	1	2	3	4	5
E13	How much do you enjoy life?	1	2	3	4	5
E14	To what extent do you feel your life to be meaningful?	1	2	3	4	5
E15	To what extent are you bothered by people blaming you for your HIV status	1	2	3	4	5
E16	How much do you fear the future?	1	2	3	4	5
E17	How much do you worry about death?	1	2	3	4	5
		Not at all	A little	A moderate amount	Very much	Extremely
E18	How well are you able to concentrate?	1	2	3	4	5
E19	How safe do you feel in your daily life?	1	2	3	4	5
E20	How healthy is your physical environment?	1	2	3	4	5
The following questions ask about how completely you experience or were able to do certain things in the last two weeks.						
		Not at all	A little	Moderately	Mostly	Completely
E21	Do you have enough energy for everyday life?	1	2	3	4	5
E22	Are you able to accept your bodily appearance?	1	2	3	4	5
E23	Have you enough money to meet your needs?	1	2	3	4	5
E24	To what extent do you feel accepted by the people you know?	1	2	3	4	5
E25	How available to you is the information that you need in your day-to-day life?	1	2	3	4	5

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E26	To what extent do you have the opportunity for leisure activities?	1	2	3	4	5
		Very poor	Poor	Neither poor nor good	Good	Very good
E27	How well are you able to get around?	1	2	3	4	5
The following questions ask you how good or satisfied you have felt about various aspects of your life over the last two weeks.						
		Very dissatisfied	Dissatisfied	Neither satisfied nor dissatisfied	Satisfied	Very satisfied
E28	How satisfied are you with your sleep?	1	2	3	4	5
E29	How satisfied are you with your ability to perform your daily living activities?	1	2	3	4	5
E30	How satisfied are you with your capacity for work?	1	2	3	4	5
E31	How satisfied are you with yourself?	1	2	3	4	5
E32	How satisfied are you with your personal relationships?	1	2	3	4	5
E33	How satisfied are you with your sex life?	1	2	3	4	5
E34	How satisfied are you with the support you get from your friends?	1	2	3	4	5
E35	How satisfied are you with the conditions of your living place?	1	2	3	4	5
E36	How satisfied are you with your access to health services?	1	2	3	4	5
E37	How satisfied are you with your transport?	1	2	3	4	5
The following question refers to how often you have felt or experienced certain things in the last two weeks						

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		Never	Seldom	Quite often	Very often	Always
E38	How often do you have negative feelings such as blue mood, despair, anxiety, depression?	1	2	3	4	5

F	**QUALITY OF CARE THROUGH THE PATIENT'S EYES (QUOTE INSTRUMENT)**								
		Importance aspects				**Performance aspect**			
	The doctors and nurses	**Not important**	**Fairly important**	**Important**	**extremely important**	**No**	**Not really**	**On the whole yes**	**Yes**
F1	... work efficiently	1	2	3	4	1	2	3	4
F2	… explain my medication clearly	1	2	3	4	1	2	3	4
F3	... take me seriously	1	2	3	4	1	2	3	4
F4	… take my opinion in account	1	2	3	4	1	2	3	4
F5	… allow me to ask a second opinion	1	2	3	4	1	2	3	4
F6	… allow me to check my personal file	1	2	3	4	1	2	3	4
F7	… cooperate well with other social workers	1	2	3	4	1	2	3	4
F8	… are aware of my situation at home and work/school	1	2	3	4	1	2	3	4
F9	… can easily be reached by telephone	1	2	3	4	1	2	3	4
F10	… never lets me wait in the waiting room longer than 15min	1	2	3	4	1	2	3	4
F11	… prescribe drugs which are free of charge	1	2	3	4	1	2	3	4
F12	… keep his appointments	1	2	3	4	1	2	3	4

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F13	… make sure I have an appointment within 24 hours if necessary	1	2	3	4		1	2	3	4
F14	… inform me about the pros and cons of a treatment	1	2	3	4		1	2	3	4
F15	… explains laboratory results	1	2	3	4		1	2	3	4
F16	… have special knowledge about HIV	1	2	3	4		1	2	3	4
F17	… keep me in shape with preventive methods	1	2	3	4		1	2	3	4
F18	… have an open ear for a conversation about euthanasia	1	2	3	4		1	2	3	4
F19	… give information about possible side effects of drugs	1	2	3	4		1	2	3	4
F20	… gives information about the use of my HIV medication	1	2	3	4		1	2	3	4
F21	… break bad news gently	1	2	3	4		1	2	3	4
F22	… take enough time to talk with me	1	2	3	4		1	2	3	4
F23	… is always the same person	1	2	3	4		1	2	3	4
F24	… organise thier replacement well	1	2	3	4		1	2	3	4
F25	… makes sure there is no interruption during consultations	1	2	3	4		1	2	3	4
F26	… maintains confidentiality about my HIV status	1	2	3	4		1	2	3	4
F27	… is organised in such a way I cannot hear conversations at the desk or in the consulting room	1	2	3	4		1	2	3	4

G	**Risk factors**	
G1	Have you ever been hospitalized because of the HIV disease	Y/N

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G2	Have you disclosed your HIV status to your spouse or any member of your family or friends?	Y/N				
	Have you had sex before?	Y/N				
	How many sexual partners do you have in the past six months?	One More than one				
	Did you use condom during your last sexual intercourse?	Y/N				
	How regularly do you use condom during sexual intercourse?	Sometimes Always Not at all				
	Have you ever had a sexually transmitted infection (STI) or been diagnosed with an STI before your HIV diagnosis?	Y/N				
I would like to ask you questions about alcohol and drug use. Your answer will be kept confidential since they will be used for the study purpose only.						
	Do you smoke cigarette	Never smoke	Formerly smoke	Regular occasional smoker	Don't know/ prefer not to answer	
G4	How often have you had a drink containing alcohol – a glass of beer, wine, a mixed drink, or any kind of alcoholic beverage – in the last month?	Daily or Nearly Daily >4 times/week	Some/Week 1-4 times/ week	Some/ Month 1-3 times/ month	Never	
	Have you drank alcohol in the last 12 months?	Y/N/PNA				
G5	Have you ever used illicit drug?	Yes and I currently use it now	Yes but I used it in the past	Never	Prefer not to answer	
G6	In the last month, how often have you used drug?	Daily or Nearly Daily >4 times/w eek	Sometime/ Week 1-4 times/ week	Sometime/ Month 1-3 times/ month	Never	
G10	Is the clinic where you receive ART treatment far from your current residence?	Y/N				
G11	Have you experienced stigma because of your HIV status?	Y/N				

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G12	How often do you do exercise?	Daily or Nearly Daily >4 times/week	Some/Week 1-4 times/ week	Some/ Month 1-3 times/ month	Never	
Now I would like to ask you about history of family disease						
	Does any member of your family that you know of have the following disease in the past or currently					
G13	Asthnma	Y/N				
G14	Hypertension	Y/N				
G15	Diabetes	Y/N				
G16	Cancer	Y/N				
G17	Depression	Y/N				

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Appendix D: Study Approval from Study State IRB



GOVERNMENT OF BAUCHI STATE
MINISTRY OF HEALTH

Bello Kirfi Road, Off Murtala Mohammed Way,
P.M.B. 065, Bauchi

E-mail: bauchismoh@gmail.com

MOH/GEN/S/1409/II

Reference.....

24th March, 2023

Date.....

PROTOCOL REG. N0: BSMOH/REC/18/2023
PROTOCOL APPROVAL N0: NREC/03/11/19B/2021/018
PROTOCOL APPROVAL DATE N0: March 2023 TO February 2024

Ekerette Emmanuel Udoh
Department of Public Health,
Faculty of Basic Medical and Health Sciences,
LEAD CITY University,
Ibadan, Oyo State.

ETHICAL CLEARANCE FOR SUBMITTED PROTOCOL:
"Survival Pattern, Co-morbidity, and Quality of Life of Adult HIV Patients on Antiretroviral Therapy in Bauchi State, Nigeria"

The Bauchi State Health Research Ethics Committee (HREC) under the State Ministry of Health has received the above named protocol for Ethical Clearance and approval in line with the guidelines set by the Committee. The protocol was reviewed and the Committee noted that the research falls under the Low Risk Category which does not entails clinical trials or any invasive procedures.

2. Consequently, the Committee has granted expedited approval for the research to be conducted within the stipulated timeframe above. However, you should share with us your workplan clearly indicating the start date, where and when to visit the *research* site(s) and **also the final results of your findings**

3. The Committee requires you to comply with all Institutional Guidelines, Rules and Regulations and with the Tenets and Code of the National Health Research Ethics Committee including that all adverse events are reported promptly to the Committee. **No changes are permitted in the research without prior approval by the Committee** except in circumstances outlined in the Code. The Committee reserves the right to conduct compliance visit to your research site at short notice.

(Nuru Yakubu Umar)
For: Hon. Commissioner

Lead

Appendix E: Principal Investigator Biodata

A. PERSONAL DATA

Name : Ekerette Emmanuel UDOH
Email: ekerette01@gmail.com
Phone: 08163366955
Nationality: Nigeria
Place of Birth: Calabar

B. EDUCATIONAL BACKGROUND

UNIVERSITY OF IBADAN — Oyo State, Nigeria.
Master of Public Health (MPH) — Feb. 2012 - August 2015

UNIVERSITY OF CALABAR — Cross River State, Nigeria
Bachelor of Science (B.Sc.). Genetics and Biotechnology — Sept. 2004 - June 2009

HOPE WADDEL TRAINING INSTITUTION — Cross River State, Nigeria
Secondary School Certificate

ANGELIC INTERNATIONAL NURSERY SCHOOL
Primary School

C. WORK EXPERIENCE

- SOCIETY FOR FAMILY HEALTH (SFH) — Abuja HQ Office, Nigeria
Research Coordinator/ MEAL Specialist/ Technical Learning Advisor 1 Jan 2022 - Till Present

- SOCIETY FOR FAMILY HEALTH (SFH) — Abuja HQ Office, Nigeria
Senior Research, Measure and Evaluation Officer — 12 Jul 2018 - 31 Dec 2021

- SOCIETY FOR FAMILY HEALTH (SFH) — Uyo, Nigeria.
Research Survey Consultant — 7 Jun 2018 - 30 Jun 2018

- INSTITUTE OF PUBLIC HEALTH, OBAFEMI AWOLOWO UNIVERSITY — Uyo, Nigeria.
State Program Officer (SFH Global Fund NFM Action Research) — 1Sept 2016 - 31 Dec 2017

- SOCIETY FOR FAMILY HEALTH (SFH) — Ibadan, Nigeria.
Research Survey Consultant — 3 July – 31 Aug 2016

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- SOCIETY FOR FAMILY HEALTH (SFH) Ibadan, Nigeria.

Data Quality Improvement Consultant - Global Fund HIV program15 Jan 2016 - 30 June 2016

- SOCIETY FOR FAMILY HEALTH (SFH) Ibadan, Nigeria.

Management Information System (MIS) Consultant - USIAD ESMPIN May 2015 - Oct. 2015

- SOCIETY FOR FAMILY HEALTH (SFH) Ibadan, Nigeria.

Monitoring and Evaluation Support (Intern) - USIAD ESMPIN 1 Apr 2014 - Sep 2014

- FANSUAM FOUNDATION Kafanchan, Nigeria

Program Volunteer Jan 2010 - Sep 2010

- COLLEGE OF NURSING AND MIDWIFERY Kafanchan, Nigeria

Lecturer Assistant (National Youth Service Corps), 1 Nov 2009 - 31 Oct 2010

D. PEER-REVIEWED SCIENTIFIC PUBLICATIONS

1 Differences in contraceptive prices between and within family planning outlets in urban and semi-urban Nigeria: a prospective cohort study. (2022). Rothschild, C. W., Hu, B., Archer, J., **Udoh, E. E**., Onyezobi, C., & Nwala, A. (2022). AJOG Global Reports, 100131. *https://www.sciencedirect.com/science/article/pii/S266657782200079X*

2 Continuation and user satisfaction of the levonorgestrel intrauterine system (LNG IUS) contraceptive in Nigeria. (2022). Nwala, A., **Udoh, E.**, Anyanti, J., & Fajemisin, A. Gates Open Research, 6(4), 4. *https://gatesopenresearch.org/articles/6-4*

3 Knowledge, attitude, and practice towards lymphatic filariasis among inhabitants of an endemic town in Oyo State, Nigeria. (2022). Jaiyeola, T. M., **Udoh, E. E.**, & Adebambo, A. B. medRxiv.

4 Psychological distress and burden of care among family caregivers of patients with mental illness in a neuropsychiatric outpatient clinic in Nigeria. (2021). **Udoh, E. E.,** Omorere, D. E., Sunday, O., Osasu, O. S., & Amoo, B. A. Plos one, 16(5), e0250309. *https://journals.plos.org/plosone/article/comments?id=10.1371/journal.pone.0250309*

5 Combination prevention package of interventions for reducing vulnerability to HIV among adolescent girls and young women in Nigeria: An action research (2023). Arije, O., **Udoh, E.**, Ijadunola, K., Afolabi, O., Aransiola, J., Omoregie, G., ... & Onayade, A. (2023). PloS one, 18(1), e0279077. *https://doi.org/10.1371/journal.pone.0279077*

6 Faecal antibiotic resistome of Nigerian chimpanzees from a wildlife sanctuary in Cross-River State, Nigeria. (2021). Veterinary Sciences: George, U.E., Arowolo, O.A., Olayinka, O.A., Ifeorah, I.M., Faleye, T.O.C., Oluremi, B., Oragwa, A.O., Omoruyi, E.C., **Udoh, E.E**., Osasona, O.G. and Donbraye, E.. Research and Reviews, 7(1), pp.35-41.

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7 Vulnerability to HIV infection among adolescent girls and young women in Nigeria. Arije, O. O., **Udoh, E. E**., Ijadunola, K. T., Afolabi, O. T., Aransiola, J. O., Omoregie, G., ... & Onayade, A. A. (2021). *Vulnerable Children and Youth Studies*, 1-12. *https://www.tandfonline.com/doi/abs/10.1080/17450128.2021.1876964?journalCode=rvch20*

8 Complementary feeding practices among mothers and nutritional status of infants in Akpabuyo Area, Cross River State Nigeria. **Udoh, E. E**., & Amodu, O. K. *SpringerPlus*, 5(1), 2073. (2016) *https://springerplus.springeropen.com/articles/10.1186/s40064-016-3751-7*

9 Association of maternal nutrition knowledge and child feeding practices with nutritional status of children in Calabar South Local Government Area, Cross River State. Nigeria. Jemide, J. O., Ene-Obong, H. N., Edet, E. E., & **Udoh, E. E**. *Int J Home Sci*, 2(1), 293-298. (2016) *https://www.homesciencejournal.com/archives/2016/vol2issue1/PartE/2-1-36-887.pdf*

10 Knowledge and perception of community health volunteers of family planning services towards COVID-19 Disease. (2020). Anyanti, J., Nwala, A., Onyezobi, C. E., **Udoh, E. E**., Ahmadu, H., & Songo, R. (2020). International Journal of Sexual and Reproductive Health Care, 3(1), 075-079.

11 Determinants of antenatal HIV testing in the opt-out approach in Nigeria: findings from the Nigerian Demographic and Health Survey. **Udoh, E. E**. and Ushie. B. A. (2019) *Journal of Biosocial Science. Journal of biosocial science*, 1-18. *https://doi.org/10.1017/S0021932019000555*

12 Examining inequalities in access to delivery by caesarean section in Nigeria.. Ushie, B. A., **Udoh, E. E.,** & Ajayi, A. I. (2019). *PloS one*, *14*(8), e0221778. *https://doi.org/10.1371/journal.pone.0221778*

13 Clients' Perception of Quality of Multidrug-Resistant Tuberculosis Treatment and Care in Resource-Limited Setting: Experience from Nigeria. O. Oladimeji …**E. E. Udoh**, B. Ushie *et al*. June 20th 2018. *Mycobacterium - Research and Development, Wellman Ribón, IntechOpen, DOI: 10.5772/intechopen.76001. Available from:* https://www.intechopen.com/books/mycobacterium-research-and-development/clients-perception-of-quality-of-multidrug-resistant-tuberculosis-treatment-and-care-in-resource-lim

14 Knowledge, attitude and perception of tuberculosis management among tuberculosis infected patients in resource constraint setting: field experience from Oyo state, South-West, Nigeria. Oladimeji O, Tsoka-Gwegweni JM,…, **Udoh E E**, et al. *Int J. Community Med Public Health*;5(5) 1694-1706. (2018).

15 Barriers and Strategies to Improve Tuberculosis Care Services in Resource-Constrained Setting: A Qualitative Analysis of Opinions from Stakeholders in Oyo State South West Nigeria. Oladimeji O, Tsoka-Gwegweni J. and **Udoh, E. E** (2017) SMG Books.com http://www.smgebooks.com/tuberculosis/chapters/TB-17-18.pdf

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18 Where are We with Young People's Wellbeing? Evidence from Nigerian Demographic and Health Surveys 2003–2013. Ushie, B. A., & **Udoh, E. E**. *Social Indicators Research*, 129(2), 803-833. doi:10.1007/s11205-015-1113-4 (2015).

19 Psychosocial wellbeing of patients with multidrug resistant tuberculosis voluntarily confined to long-term hospitalisation in Nigeria. Oladimeji, O., Ushie, B. A., **Udoh, E. E**., Oladimeji, K. E., Ige, O. M., Obasanya, O., ... & Gidado, M. *BMJ Global Health*, 1(3). (2016) *http://dx.doi.org/10.1136/bmjgh-2015-000006*

20 Culturally sensitive child placement: key findings from a survey of looked after children in foster and residential care in Ibadan, Nigeria. Ushie, B. A., Osamor, P. E., Obieje, A. C., & **Udoh, E. E**. *Adoption & Fostering*, 40(4), 352-361. (2016) *https://journals.sagepub.com/doi/abs/10.1177/0308575916667672*

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E. MAJOR CONFERENCE PAPER PRESENTATIONS

1. *Community-based Healthcare Provider Experiences delivering COVID-19 Antigen Rapid Diagnostic Testing in Federal Capital Territory (FCT), Nigeria.* - **E. Udoh**, et al, INDEED 2023 conference
2. *Determinants of Survival in Treatment Among Adults Living With HIV on Antiretroviral Therapy in Bauchi State, Nigeria.* - **E. Udoh**, et al, INDEED 2023 conference
3. *Service Quality in Decentralized Community-based COVID-19 Antigen Rapid Diagnostic Testing Programmes in the Federal Capital Territory, Nigeria.* - - **E. Udoh**, et al, INDEED 2023 conference
4. Levonorgestrel (LNG)-Intra-uterine system (IUS) User Study in Nigeria. A. Nwala, **E. Udoh**, O Fajemisin *et al. Abstract presented in the 5th Nigeria Family Planning Conference, Abuja, Nigeria, December 2018.*
5. Action research to reduce the vulnerability to HIV infection among adolescent girls and young women in selected states in Nigeria: A community-based intervention. O. Arije1, **E. Udoh**, K. Ijadunola1, O. Afolabi1 *et al. Abstract presented at the SAYPHIN National Conference on the Health and Development of Adolescents in Nigeria. Ibadan, Nigeria April 2019.*
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F. CONTRIBUTION TO POLICY DOCUMENTS

1. Akwa Ibom State Strategic Plan on HIV/AIDS 2018-2022. November 2017.

G. PAPERS AND WORKS IN PROGRESS

1. Service Quality in Decentralized Community-based COVID-19 Antigen Rapid Diagnostic Testing Programmes in the Federal Capital Territory, Nigeria. Accepted in PLOS ONE
2. Community-based Healthcare Provider Experiences delivering COVID-19 Antigen Rapid Diagnostic Testing in Federal Capital Territory (FCT), Nigeria - in press in PLOS ONE.
3. Incidence of antiretroviral treatment outcomes and survival pattern of people living with HIV (PLHIV) in Bauchi State, Nigeria – in Press in BMC

H. SELECT TRAININGS, WORKSHOPS, AND CERTIFICATIONS

- Going deeper with R. *R for the Rest of Us. December, 2022.*
- Fundamentals of R. *R for the Rest of Us. October 10, 2021.*
- Getting Started with R. *R for the Rest of Us. September 2, 2021.*
- All About Reviewing certificate. *Elsevier - Social Sciences & Humanities Open, 28 April, 2021*
- Scientific writing and publishing. *Certificate course through African Population and Health Research Center. April 4- 8, 2022.*
- GIS Techniques for M&E of HIV_AIDS and Related Programs - Certificate course through USAID Global Health e-learning Centre -, 2019
- Certificate course on Research Ethics – *Certification, West African Bioethics/ Collaborative IRB training (CITI) program -17th January, 2013*
- *Human Research Investigators - Collaborative IRB training (CITI), Sep-2023*
- *Nigerian National Code For Health Research Ethics - Collaborative IRB training (CITI), 25th Oct, 2023*
- West and Central Africa Regional Evidence Workshop. Cotonou, Republic of Benin, *Organized by Population Service International.* 10th – 14th December, 2018.

I: REFERENCES

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The University Compliance Certification

This is to certify that the thesis 'Survival Pattern, Co-morbidity, and Quality of Life of Adult HIV Patients on Antiretroviral Therapy in Bauchi State, Nigeria' by **Ekerette Emmanuel UDOH** with Matric no LCU/PG/002555 in the department of **Public Health**, Faculty of Basic Medical and Health Sciences, Lead City University, is in full compliance with the approved university format and style.

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Signature **Date**