COLLEGE OF MEDICINE AND HEALTH

SCIENCE SCHOOL OF PUBLIC HEALTH

INCIDENCE AND PREDICTORS OF NON-COMMUNICABLE DISEASE AMONG ADULT HIV-POSITIVE PATIENTS AT HAWASSA UNIVERSITY COMPREHENSIVE SPECIALIZED HOSPITAL

BY

TSION TESFAYE

JUNE 2024

Hawassa, Ethiopia

INCIDENCE AND PREDICTORS OF NON-COMMUNICABLE DISEASE AMONG ADULT HIV-POSITIVE PATIENTS AT HAWASSA UNIVERSITY COMPREHENSIVE SPECIALIZED HOSPITAL IN HAWASSA, SIDAMA, ETHIOPIA, 2024

BY TSION TESFAYE (BSc)

A THESIS SUBMITTED TO THE SCHOOL OF PUBLIC HEALTH, COLLEGE OF MEDICINE, AND HEALTH SCIENCE, HAWASSA UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR A MASTER OF PUBLIC HEALTH IN GENERAL PUBLIC HEALTH

ADVISORS: Dr. ENDRIASE MARKOS (PhD, Associate. Prof. of Epid)

Mr. YILKAL SIMACHEW (MPH/RH)

JUNE 2024

Hawassa, Ethiopia

Hawassa University

School of Graduate Studies

Approval sheet from advisors

This is to certify that the thesis entitled "Incidence and Predictors of Non-Communicable Disease among Adult HIV Positive Patients at Hawassa University Comprehensive Specialized Hospital" submitted in partial fulfillment of the requirements for the degree of master's with specialization in General Master of Public Health, the graduate program of the school of public health, under our supervision. Therefore, we recommend that the student fulfill the requirements and, hence, submit the thesis to the department.

Name of major advisor	Signature	Date
Name of co-advisor	Signature	Date

Hawassa University

School of Graduate Studies

Examiner's Approval Sheet

We the undersigned, members of the board of examiners of the final open defense by Tsion Tesfaye have read and evaluated her thesis entitled " Incidence and Predictors of Non-Communicable Disease among Adult HIV Positive Patients at Hawassa University Comprehensive Specialized Hospital ", and examined the candidate. Therefore, to certify that the thesis has been accepted in partial fulfillment of the thesis requirements for the degree of Master of Public Health in General Public health.

Main advisor: Dr.Endriase Markos (PhD, Associate. Prof. of Epid)

Internal examiner _____ Signature _____ Date _____

Chairman _____ Signature _____ Date _____

External examiner _____ Signature _____ Date _____

SGS Approval _____ Signature _____ Date _____

Final acceptance of the thesis is contingent upon the submission of the final copy of the thesis to the School of Graduate Studies (SGS) through the Department/School of Graduate Committee DGC/SGC of the candidate's school.

DECLARATION

I hereby declare that this MPH/GMPH thesis is my original work and has not been presented for a degree in any other University and all sources of materials used for this thesis have been duly acknowledged

Name: _____Signature: _____

ACKNOWLEDGEMENT

I am deeply grateful to the Almighty God for guiding me through life's challenges and triumphs. I extend my sincere appreciation to Hawassa University, College of Medicine and Health Sciences, School of Public Health, for granting me the opportunity to pursue my graduate studies. Special thanks to my esteemed advisors, Dr. Endriase Markos and Mr. Yilkal Simachew, for their unwavering support and invaluable guidance. I also acknowledge the cooperation of Hawassa University, College of Medicine and Health Sciences ART clinic for providing necessary information during the preparation of my research thesis. Lastly, I want to express my gratitude to my family and friends for their love and support, without which none of this would have been possible.

TABLE OF CONTENT

LIST OF TABLE

LIST OF FIGURE

ACRONYMS AND ABBREVIATION

ART	Antiretroviral Therapy
AIDS	Acquired Immunodeficiency Syndrome.
AZT	Zidovudine
CD4 +	Cluster of Differentiation 4
COPD	Chronic Obstructive Pulmonary Disease.
CVD	Cardiovascular disease
DM	Diabetic Mellitus
D4 T	Stavudine
HAART	Highly Active Anti Retro Viral Treatment
HIV	Human Immunodeficiency Virus
HTN	Hypertension
NCD	Non Communicable Diseases
PLHIV	People Living With HIV
PYs	Person Years
SPSS	Statistical Package for Social Studies
WHO	World Health Organization

ABSTRACT

Background: Due to the extended life expectancy of HIV/AIDS patients with the availability of antiretroviral therapy, concerns have risen regarding the co-occurrence of HIV and non-communicable diseases (NCDs). Thus, this study aims to contribute to scientific knowledge on NCDs among people living with HIV (PLHIV) aged 18 and above at Hawassa Comprehensive and Specialized Hospital.

Objective: To determine the incidence and predictors of non-communicable diseases among adult HIV-positive patients at Hawassa University Comprehensive Specialized Hospital 2024.
Methods: A retrospective cohort study was conducted from April 1–30, 2024. All HIV-positive patients who fulfilled the eligible criteria and had been followed up at Hawassa University Comprehensive Specialized Hospital from 2003-2022 were considered the total sample size for this particular study. Data was collected from medical records using a standardized checklist using the Kobo toolbox. Statistical Package for Social Studies version 26.0 was used for data analysis. Kaplan-Meier survival function was used to estimate NCDs' free survival time and to compare NCDs' free survival time with a log-rank test. Both bi-variable and multivariable Cox proportional hazard models were fitted to identify the predictors of NCDs. Adjusted hazard ratio (AHR), P-value <0.05, and 95% confidence interval (CI) were used to report the result.

Result: The incidence rate was 8.5 per 100 PYs. Those with a family size >=4 (AHR = 0.6, 95% CI0.4-0.9) Other occupational status (student, prisoner, commercial sex worker)(AHR = 0.4, 95% CI: (0.3-0.7), BMI >=25 (AHR = 2.2, CI: 1.3-3.7), and poor ART adherence (AHR = 3.3, CI: (2-5.5) were predictors for time to any one of the non-communicable disease development.

Conclusion and Recommendation: Given the overall incidence of any one of the NCDs, was high, policymakers need to focus on screening and treatment strategies for PLHIV, while healthcare providers need to offer counseling on drug adherence, lifestyle, and diet.

Keywords: non-communicable disease, HIV-positive patients, incidence

1 INTRODUCTION

1.1Background of study

According to a UNAIDS report for 2022, 39 million individuals worldwide were HIV positive. In 2022, 1.3 million individuals contracted HIV for the first time. In 2022, AIDS-related illnesses claimed the lives of 630,000 individuals(1). When we see the epidemic, HIV-positive individuals account for 2.3 million in North America, Western and Central Europe, 6.5 million in Asia and the Pacific, 20.8 million in eastern and southern Africa, and 4.8 million in western and central Africa (2).In Ethiopia in 2022, there were 610, 000 people living with HIV, 6300 newly infected, and 11,000 deaths due to AIDS (3).

Non-communicable diseases (NCDs) are a broad category of complex and diverse illnesses that include but are not limited to, cancer, diabetes mellitus (DM), renal disease, mental illness, chronic respiratory diseases, and cardiovascular disease (stroke and hypertension). The most common NCDs, which cause at least 80% of deaths worldwide, are chronic obstructive lung disease, diabetes, cancer, and cardiovascular disorders(4).

NCDs are becoming more prevalent quickly in developing nations, which presents a serious threat to public health. According to WHO estimates, deaths from NCDs will rise by 15% globally, especially in Africa, and will surpass deaths from communicable diseases by 2030 (5). The four risk factors for these NCDs include age, socioeconomic position, and inherited and environmental variables, and they can have serious consequences for people living with HIV. There is a complex relationship between risk factors for NCDs, ART, and HIV infection, according to research on the underlying causative pathways. Chronic immunological activation, pharmacological side effects, coinfections, and aging are the main causes of noncommunicable diseases (NCDs) in HIV-positive individuals. HIV and some antiretroviral medications can exacerbate these conditions(6).

ART development in the mid-1990s has led to a dramatic rise in the life expectancy of people living with HIV/AIDS (PLWHA). As long as they follow their ART regimen, PLWHA receiving treatment can now anticipate living into their seventies. With the advancement of antiretroviral therapy (ART), people living with HIV now have longer life expectancies. However, this

positive development has brought about a new challenge(7). NCDs that are frequent in older populations are becoming more significant than ever in the management of people living with HIV's (PLWHA's) health care as their population ages. Furthermore, individuals living with HIV/AIDS have a higher prevalence of various NCDs than those without the virus, such as diabetes, hypertension, stroke, lung diseases, cancer, cardiovascular diseases, and neurocognitive problems(8) (9).

1.2 Statement of Problem

Non-communicable diseases (NCDs) are the primary cause of death worldwide, accounting for 71% of deaths in 2016 and 62% of disability-adjusted life-years (DALYs) between 2007 and 2017(10). In the case of individuals with HIV/AIDS, NCDs remain the leading cause of death, with cardiovascular diseases accounting for 46% of all fatalities. (11). Sub-Saharan Africa, home to 66% of the global population living with HIV/AIDS in 2017, has the highest prevalence of the disease in the region (12), Consequently, HIV/AIDS and NCDs are two epidemics that are significantly burdening the region and are poised to collide. (13).

A systematic review conducted in Sub-Saharan Africa found that 20.1% of people living with HIV (PLHIV) have hypertension, 5.4% have diabetes, 1.5% have cervical cancer, and 7.1% have chronic respiratory disease (19). Studies in Ethiopia show that PLHIV-related NCDs range from 12.7% to 14.1% for hypertension and 7.1% to 8.6% for diabetes. (14),(15). A study in the Sidama region revealed a 26.3% NCD comorbidity among HIV clients on ART, highlighting the significant burden in the region (16). NCDs impact PLHIV patients, causing decreased productivity, increased costs , and longer hospital stays, with an average of 11 missed days and 52% higher transportation expenses. (17).

Many factors have been associated with the occurrence of NCDs among PLHIV like socio-demographic factors like old age(18-20), sex (15), monthly income and occupational status(21), Clinical characteristics like BMI(15, 19), a specific ART regimen(15, 19, 22),duration of ART(18, 20, 22), CD4 count (23) (18).and behavioral and lifestyle factors like lack of physical activity (24) and alcohol use (16, 20) (22)were associated with the occurrence of NCDs among PLHIV in Ethiopia

The United Nations and WHO are working to combat the pandemic of chronic diseases, including PLHIV, by implementing various strategies, including the Global Action Plan and 16 essential interventions (25) (26) (27). In Sub-Saharan Africa, HIV care delivery platforms have made significant progress over the past decade by integrating HIV and NCD care through community-based and clinic-based screening(28, 29). However, the 2017 NCD progress monitor report shows inconsistent outcomes, with over half of African countries not meeting 2015

targets. Gaps in HIV/NCD integration in SSA, infrastructure, human resources, and cost-effectiveness data threaten HIV control programs (30) (31).

If NCDs are left unaddressed they can counteract the progress made in promoting healthy life years through global HIV prevention and treatment efforts. Particularly in the case of HIV-related multimorbidity, failure to address NCDs has the potential to undermine the process of healthy aging and place a burden on healthcare systems in countries such as Ethiopia. (32) (33).

Different studies were conducted in Ethiopia previously on NCDs among PLHIV (18-20, 23), a lot of them utilized a crossectional study design which doesn't show temporal relation, and the one that utilized a cohort study design used a short follow-up period and included only one or two NCD (15, 21, 24). Therefore this study aimed to determine the incidence of NCDs by including the major NCDs(HTN, DM, CA, CVD, and COPD) with a long follow-upperiod (between June 2003 to February 2022)

1.3 Significance of Study

Failure to address NCDs among PLHIV can undermine global HIV prevention efforts and burden healthcare systems, impacting healthy aging. Proactive measures within HIV care programs are crucial to effectively address NCDs. Previous studies in Ethiopia on NCDs among PLHIV predominantly used cross-sectional or short-term cohort study designs, limiting the understanding of temporal relationships and comprehensive NCD patterns. Therefore, this longitudinal study on major NCD incidence among PLHIV will offer valuable insights into these patterns and temporal relationships by tracking the development of multiple NCDs over an extended period. The findings of this study will play a vital role in developing potential mitigating strategies for NCDs, informing clients, healthcare professionals, and local and national planners to exert their efforts in overcoming the issue and implementing appropriate interventions. Additionally, the results will contribute to scientific knowledge and guide evidence-based interventions for managing NCDs in this population, providing a foundation for future research endeavors.

2. LITERATURE REVIEW

2.1 Incidence of non-communicable diseases among PLHIV

The incidence rates of hypertension among PLHIV vary across different regions. In a study conducted in China, the incidence rate was found to be 7.6 (34). In South Africa, 13.4% of incident hypertension cases were diagnosed after the start of antiretroviral therapy (ART), with an overall incidence rate of 5.44 per 100 person-years(35). Uganda reported a crude incidence rate of 111.5 per 1000 person-years among PLHIV(36). while Tanzania showed an incidence rate of 120.0 cases per 1000 person-years (37). A one-year multicenter prospective follow-up study in Northwest Ethiopia observed an overall incidence rate of hypertension of 16.35 per 1000 person-months (15).

Regarding diabetes mellitus (DM), a study in Sweden reported an incidence rate of 1.2 cases per 100 patient-years among PLHIV (38). In Brazil, the incidence rate of Type 2 Diabetes Mellitus (T2DM) among the HIV cohort was 17.3 cases per 1000 person-years (39). In Zimbabwe, the incidence of diabetes mellitus (DM) among HIV-positive individuals was found to be 12% (40), while a prospective study in southern Ethiopia reported an incidence rate of DM of 4% (24).

In terms of cardiovascular disease (CVD), a study conducted in Brazil showed a rate of 3.5 per 1000 person-years among a cohort of 5614 patients (41). A systematic review in the Asia-Pacific region revealed that the incidence rate of clinical CVD among PLWH ranged from 0.37 to 1.17 per 100 person-years. (42).

In South Africa, a study found the crude incidence rate of cancer was 169 per 100,000 person-years (py). In Cameroon, the cancer incidence rate was 7.4 per 1000 person-years(43, 44). A Zimbabwe cohort study reported a cancer incidence of 1.9% among PLHIV(40).

2.2 Predictors of non-communicable diseases among HIV patients

2.2.1 Sociodemographic factors

Several socio-demographic factors have been studied about their association with the development of non-communicable diseases (NCDs) among people living with HIV (PLHIV). Old age has been consistently identified as a risk factor for NCDs. A Brazilian study found that old age was linked to a higher risk of developing NCDs (45). Similarly, studies conducted in South Africa, Ethiopia, and the Gurage Zone in southern Ethiopia also found a correlation between age and an increased risk of NCDs and hypertension among HIV patients (15, 18, 20, 35). Additionally, older participants were found to have a higher prevalence of chronic comorbidity compared to younger individuals (24). In Bahir Dar, Ethiopia, the odds of HIV-NCD comorbidity were found to be greater in the age group of 35 to 54 years compared to those aged between 18 and 34 years (19).

Gender is another socio-demographic factor that has been studied. In a Brazilian study, a higher risk of multimorbidity was independently correlated with female sex (45). However, a study in South Africa found that male patients had a 23% higher risk of developing hypertension compared to their counterparts (35). Similarly, in a study conducted in Northwest Ethiopia, being male was associated with a 2.45 times higher risk of developing hypertension (15).

Marital status has also been found to be associated with the development of NCDs among PLHIV. In comparison to married participants, widower participants were found to have a 2.1-fold higher likelihood of hypertension (46). Occupation is another socio-demographic factor that has been explored. A study conducted in southern Ethiopia revealed that the frequency of hypertension among individuals infected with HIV was significantly correlated with their occupation. Specifically, the risk of acquiring hypertension was 64% lower for HIV patients working as merchants compared to housewives (21).

2.2.2 Clinical Characteristics

CD4 cell count is an important indicator of immune function in PLHIV. A research study in Brazil found that individuals with a low CD4 count had a significantly higher risk of cardiovascular disease (CVD). Specifically, those with a CD4 count below 200 cells/mm3 had a

7.7 times higher risk of developing CVD (37). Similarly, a systematic review in Southeast Asia showed that lower CD4 counts were associated with almost twice the risk of developing CVD (38). In Cameroon, a cohort study demonstrated that the risk of cancer varied depending on the CD4+ cell count, with higher counts associated with lower risk (39). In Harar, Ethiopia, a study found a significant association between a CD4 count below 500 cells/mL and hypertension (46).

The World Health Organization (WHO) staging system has shown varying associations with the development of NCDs in different settings. In Senegal, a study found that individuals in WHO stage 1 or 2 had a higher odds ratio (OR) of 1.99 for developing hypertension(47). However, a prospective study in South Africa showed that individuals in WHO stage III/IV were protective against prevalent hypertension (35). On the other hand, a study conducted in Uganda did not find any association between WHO staging and the development of NCDs among PLHIV (46). Similarly, studies conducted in Hara, Ethiopia also did not find any association between WHO class and the development of hypertension (23).

In addition to WHO staging, the specific antiretroviral therapy (ART) regimen used has an impact on the incidence and prevalence of NCDs. For example, in South Africa, patients starting on nevirapine had a 27% higher risk of developing hypertension compared to those starting on efavirenz. Patients starting on zidovudine or stavudine had a 40% higher risk of developing hypertension compared to those starting on tenofovir(35). However, a Chinese cohort study showed that exposure to TDF and zidovudine was associated with a decreased risk of hypertension(34).

In the context of Ethiopia, a prospective study conducted in Northwest Ethiopia revealed that patients on zidovudine (AZT)-based ART regimen had a 3.47 times higher risk of developing hypertension compared to their counterparts (15). However, contrasting these findings, a study conducted in Bahir Dar, Ethiopia found that the odds of having HIV-NCD comorbidity were 2.7 times higher among participants who took second-line ART drug regimens containing TDF compared to those containing AZT (19).

Body mass index (BMI), is associated with non-communicable diseases (NCDs) in various studies. Research conducted in South Africa indicated that patients with a BMI of ≥25 kg/m2

were at an increased risk of developing hypertension (10). Similarly, a study in Harar, Ethiopia demonstrated that individuals with a high current BMI had 3.8 times higher odds of developing hypertension compared to those with a normal BMI (50) This correlation was further supported by a study in Bahir Dar, Ethiopia, which revealed that the likelihood of hypertension was higher among patients with a BMI of 18.5-24 and ≥25 compared to those with a BMI less than 18.5 (47).

2.3 CONCEPTUAL FRAMEWORK OF THE STUDY

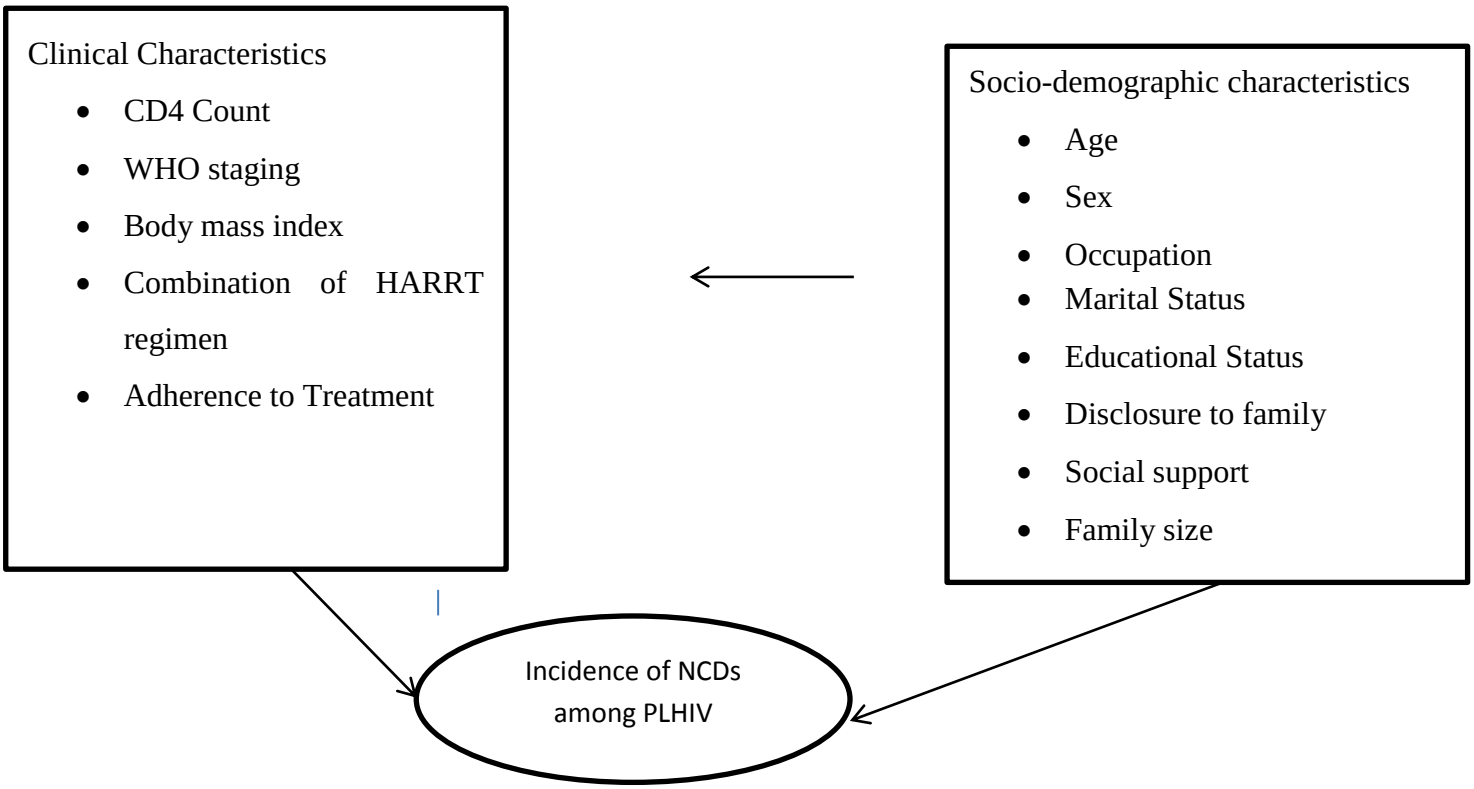

Figure 1 Conceptual Framework for incidence and predictors of non-communicable diseases among adult HIV-positive patients at Hawassa University Comprehensive Specialized Hospital.(prepared after a thorough review of several literatures)

3. OBJECTIVE

3.1General objective

To determine the incidence and predictors of non-communicable diseases among adult HIV-positive patients at Hawassa University Comprehensive Specialized Hospital 2024 .

3.2 Specific Objectives

- To determine the incidence of non-communicable diseases among adult HIV-positive patients at Hawassa University Comprehensive Specialized Hospital 2024.
- To identify predictors of non-communicable diseases among adult HIV-positive patients at Hawassa University Comprehensive Specialized Hospital 2024.

4. METHODS AND MATERIALS

4.1 Study Area

HUCSH is found in Hawssa which is located about 273 kilometers south of Addis Ababa. It is a tertiary-level specialized hospital that serves as a referral center for general hospitals and is the biggest in the southern region of Ethiopia. The hospital provides service for about 20 million populations the Southern region and neighboring Oromia region people in the area. Currently, the hospital has 382 beds, it offers services at general, specialty, and sub-specialty levels including internal medicine, pediatrics, child health, neonatal intensive care unit, surgery, gynecology & obstetrics, ENT (Ear, Nose, and Throat), orthopedic surgery, neurosurgery, neurology, urology, psychiatry, ophthalmology, dermatology, and sexually transmitted infection, dentistry, and maxillofacial surgery, plastic and reconstructive surgery, radiology, pathology, oncology, intensive care unit, palliative care, HIV TB unit, laboratory and pharmacy services. ART clinic is a major unit under the Department of Internal Medicine. The center diagnoses new cases and follows those on therapy.

4.2 Study design and period

An institution-based retrospective cohort study was conducted from April 1– April 30, 2024

4.3 Population

4.3.1 Source population

All HIV-positive patients aged 18 years and above who were registered or received care and treatment at Hawassa University Comprehensive Specialized Hospital.

4.3.2 Study population

All HIV-positive patients aged 18 years and above who were registered or received care and treatment at Hawassa University Comprehensive Specialized Hospital, between June 2003 to February 2022

4.4 Inclusion and Exclusion Criteria

4.4.1 Inclusion criteria:

All HIV-positive patients aged >=18 years old, who had follow up at Hawassa University Comprehensive Specialized Hospital from June 2003 to February 2022

4.4.2Exclusion Criteria:

Those who had any one of the NCDs at the start of the cohort.

4.5 Sample Size and Sampling Procedure

All HIV-positive patients who fulfilled the eligible criteria were considered as the total sample size for this particular study.

4.6 Variables

4.6.1 Outcome Variable

incidence of non-communicable diseases(hypertension, diabetic mellitus, cardiovascular disease, cancer, chronic respiratory diseases).

4.6.2 Independent Variables

- Socio-demographic characteristics: Age, Sex, Occupation, Marital Status, Disclosure to family, Social support, Family size
- Clinical Characteristics: CD4 Count, WHO staging, Combination of HARRT regimen, Adherence to Treatment, Body mass index.

4.7 Data Collection Technique

The data were collected using a chart review. A checklist based on Ethiopian ART clinic records was used to collect data from patient charts. The checklist consisted of variables such as sociodemographic characteristics and clinical characteristics, An electronic Kobo toolbox was used for data collection.

4.8 Data Quality Management

The data collection tool was pretested for its completeness, consistency, and accuracy before the actual data collection. It was pre-tested at Adare Hospital on 5% of the sample sample. Data was collected by a total of four BSc nurses, who were recruited and were given a one-day orientation and training on the data collection tools and procedure. There was one additional supervisor, other than the investigator. Regarding inconsistent follow-up status, patients with incomplete or inconsistent data were excluded from the analysis and regular data validation and cleaning were conducted.

4.9 Data Entry and Analysis

Statistical Package for the Social Sciences (SPSS) for data analysis. We performed a descriptive statistic to summarize and present the data. We calculated the NCD incidence as incidence per 100 person-years after computing the period. We used the Kaplan–Meier survival function to estimate the mean time of NCD occurrence and to compare survival curves between different categories of explanatory variables by using the log-rank test. The Cox proportional hazard model was used to identify the predictors of time to NCD occurrence. We have done a bivariable Cox proportional hazard analysis initially variables with < 0.2 P-values were entered into multivariable Cox proportional hazard model. Compute Adjusted Hazard Ratios (AHR) with 95% confidence intervals and we declared statistical significance at a P-value of < 0.05. The assumptions of the Cox proportional hazard regression model were checked based on the Schoenfeld residual global test and graphically using the log-log plot test.

4.10 Operational Definitions

Incidence of NCDs: the development of non-communicable disease in the follow-up period

NCD: Noncommunicable diseases (NCDs) are chronic conditions resulting from genetic, physiological, environmental, and behavioral factors, including cardiovascular, cancer, respiratory, and diabetes-related conditions (48).

CVD: Cardiovascular disease (CVD) is a general term that describes a disease of the heart or blood vessels (49).

Hypertension: high blood pressure of 130 systolic or higher, or 80 diastolic or higher at least on two or more consecutive visits (50).

Diabetes mellitus: diabetes mellitus as having a fasting blood sugar level equal to or higher than 126 mg/dL (7.0 mmol/L) on two separate occasions, or a random blood sugar level of 200 mg/dL (11.1 mmol/L) or higher in the presence of symptoms (51).

COPD: refers to a group of diseases that cause airflow blockage and breathing-related problems. It includes emphysema and chronic bronchitis(52).

Chronic bronchitis refers to a chronic cough with the production of phlegm resulting from inflammation in the airways.

Emphysema: we say there is emphysema when the FEV1/FVC ratio is less than 0.70. The severity will be determined by FEV1 measurements as a percentage of predicted values, with mild (≥80% predicted), moderate (50-79% predicted), severe (30-49% predicted), and very severe (<30% predicted) stages.

Asthma: Assed using Medical history includes symptoms such as wheezing, coughing, shortness of breath, and chest tightness. Objective measurements can include spirometry, which assesses lung function, and bronchodilator reversibility testing, which measures the response to bronchodilator medication (53).

Body mass index (BMI): Body mass index (BMI): BMI is calculated by dividing a person's weight in kilograms by the square of their height in meters (kg/m2). The classification of BMI categories is as follows: underweight for BMI < 18.5 kg/m2, normal weight for BMI 18.5–24.9 kg/m2, overweight for BMI 25.0–29.9 kg/m2, and obesity for BMI ≥ 30 kg/m2. Obesity is further categorized into three classes: Class I BMI 30.0-34.9 kg/m2, Class II (BMI 35.0-39.9 kg/m2), and Class III (BMI ≥ 40 kg/m2 (54).

Adherence to Treatment: documented adherence level to ART medications at the first visit or the first month after enrollment, whichever comes early, as Good (≥95% or < 2 doses missed per

month or < 3 doses missed per 2 months), fair (85–94% or 3–5 doses missed per 30 doses or 3–9 doses of 60 doses), and poor (less than 85% or > 6 doses of 30 doses or > 9 dose of 60 doses(55).

Social support: Support that society will provide to HIV-positive patients to enhance the well-being of those patients.

Good social support: Scores to multidimensional social support scales that respond to receiving social support above the mean score.

Poor social support: Scores to multidimensional social support scales that respond to receiving social support below the mean score(56).

4.11 Ethical Considerations

Data collection was done after obtaining an ethical clearance letter from the Hawassa University Institutional Review Board (IRB) of the College of Medicine and Health Sciences Reference number IRB230/16 and a support letter from the School of Public Health Formal letter of permission was provided to the ART clinic. Adherence to legal and ethical guidelines on data ownership was maintained, guaranteeing that data is used solely for its intended purpose.

.4.12 Dissemination of the result

After completion of the study, the result will be presented to Hawassa University College of Medicine and Health Science, School of Public Health. And will be presented to the hospital's scientific community and also it will also be given for peer review for publication.

5 RESULT

5.1 Baseline Socio-demographic characteristics

We included 4016 participants in the study; we excluded 420 participants since they were under 18 age and had NCDs at the start of the cohort. The total number of participants included in the study was 3596 (89.5%) (figure 2). The median (IQR) age of the study participants was 33 (12), 2163 (60.2%) were female, 1937 (53.9%) were married, the median (IQR) of family size was 3(2), and 2671 (74.3%)had a family size below <4. At the time of enrollment, 943 (26.2%) were employed, 2126 (59.1%) disclosed their status to their families, and only 801 (222.3%) had social support. (Table 1).

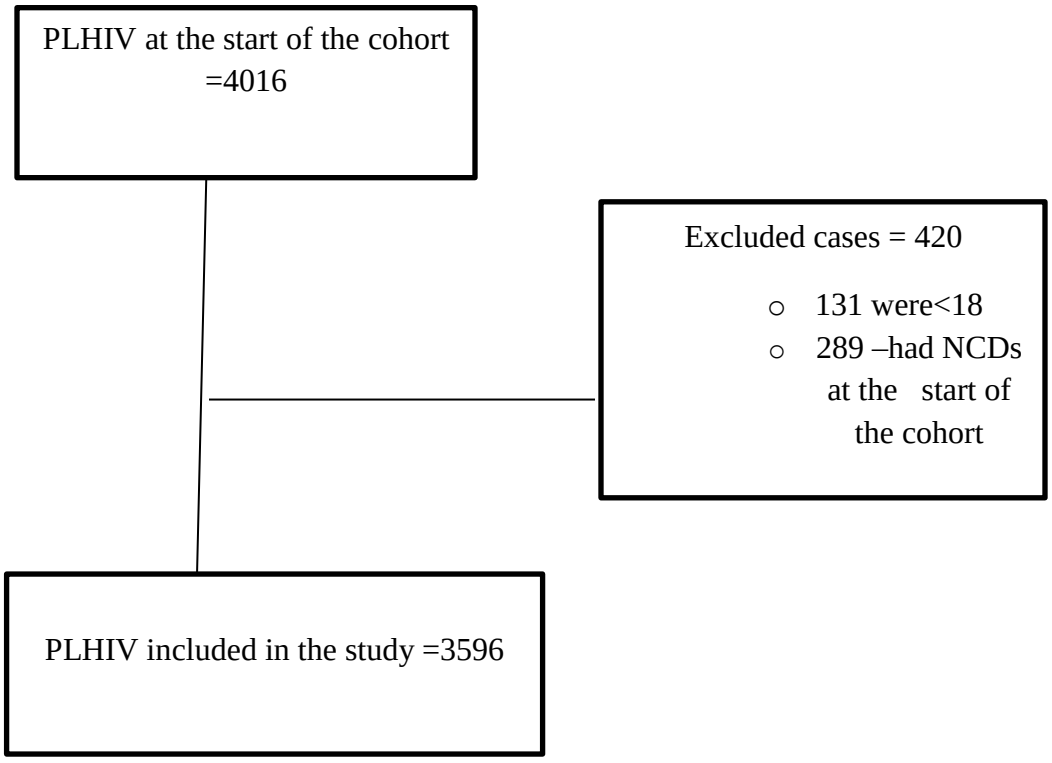

Figure 2 The study profile

Table 1-.Baseline Socio-demographic characteristics of study participants, HUCSH, June 2003 to February 2022

variable	Categories	Number	Percent	
1. Age				Median(IQR) 33(12)
	18-29	1140	31.7	
	30-39	1446	40.2	
	>=40	1010	28.1	
Family size				Median(IQR) 3(2)
	<4	2671	74.3	
	>=4	925	25.7	
Marital status	Single	486	13.5	
	Married	1937	53.9	
	Divorced/ Separated	602	16.7	
	Widowed	571	15.9	
Occupation at the start	Employed	943	26.2	
	Private work	1052	29.3	
	Housewife	739	20.6	
	Other	862	24.0	
Disclosure to family	Yes	2126	59.1	
	No	1470	40.9	
Social support	Yes	801	22.3	
	No	2795	77.7	

NOTE: Occupational status:-others: student, prisoner, commercial sex worker

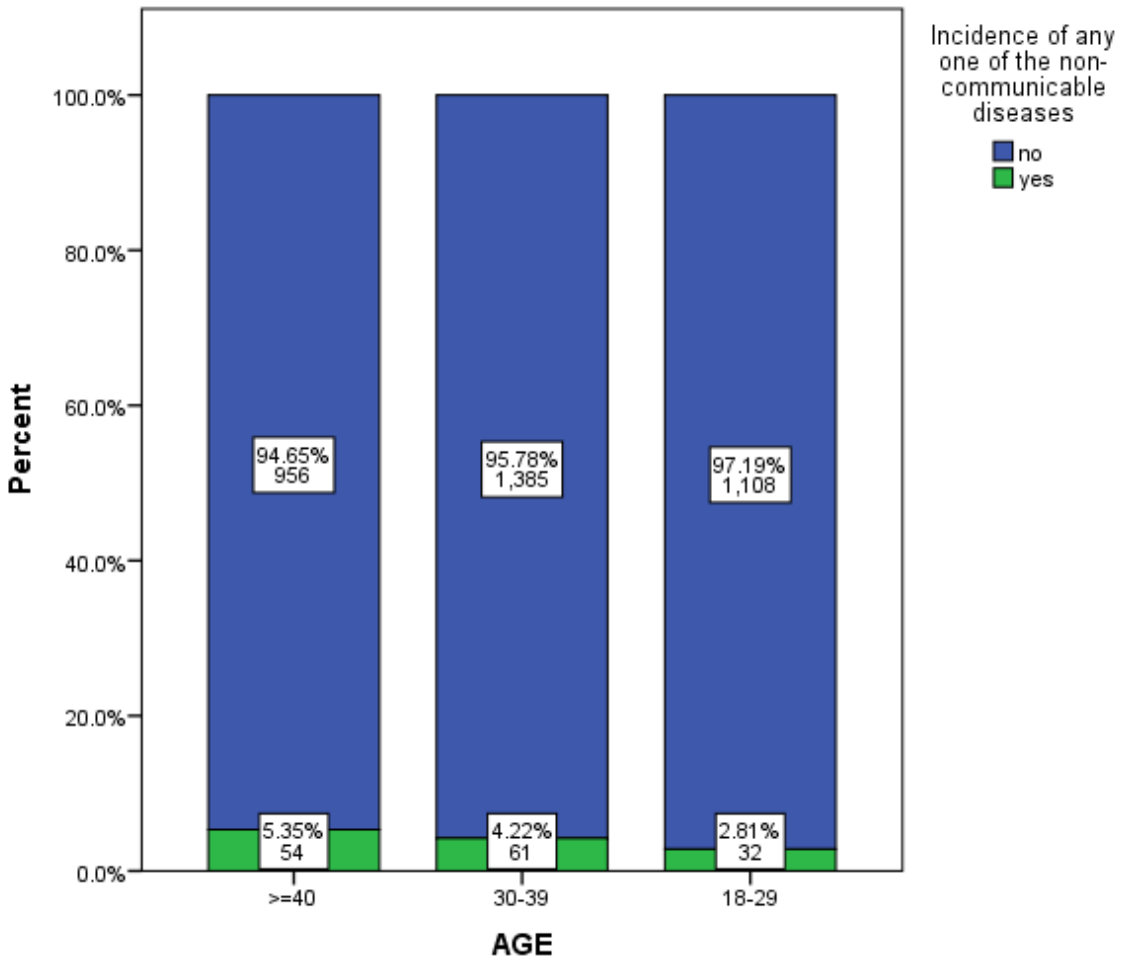

Figure 3 Age of PLHIV by any one of the non-communicable diseases, at HUCSH, June 2003 to February 2022

5.2 .Baseline Clinical characteristic

The most common regimen was TDF-based 2069 (57.5%). The median (IQR) of the BMI was 20.3(4.8)kg/m2, and 2051(57.0) PLHIV had a BMI score of between 18.5 and 24.9. The median (IQR) CD4 count was 210(211.7), with the majority of participants, 2833 (78.8%) having a CD4 count of less than 300. Additionally, 1582 (44.0%) were in WHO clinical stage III. Furthermore, 2924 (81.3%) of the participants had good adherence to ART. (Table 2).

Table 2- Baseline Clinical characteristics of study participants, HUCSH, June 2003 to February 2022

Variable	Categories	Frequency	Percent	
CD4 count				Median (IQR)= 210(211.7)
	<350	2833	78.8	
	350-500	409	11.4	
	>500	354	9.8	
BMI				Median(IQR)= 20.3(4.8)
	<18.5	1043	29.0	
	18.5-24.9	2051	57.0	
	>25	502	14.0	
WHO stage	I	819	22.8	
	II	785	21.8	
	III	1582	44.0	
	IV	410	11.4	
ART combination	TDFbased	2069	57.5	
	d4T based	471	13.1	
	AZT based	1049	29.2	
	ABC based	7	.2	
ART adherence	Good	2924	81.3	
	Fair	177	4.9	
	Poor	495	13.8	

Notes: ART combination: -ABC based:ABC+3TC+LPV/r,ABC+3TC+EFV; AZT based: AZT+3TC+NVP,AZT+3TC+LPV/r,AZT+3TC+EFV; d4T based :d4T+3TC+NVP d4T+3TC+EFV; TDFbased: TDF+3TC+NVP,TDF+3TC+EFV,TDF+3TC+DTG,TDF+3TC+ATV/r

Abbreviations: ART, Antiretroviral Therapy; BMI, Body mass index; CD4Cluster of Differentiation 4; VL, Viral load, WHO, World Health Organization

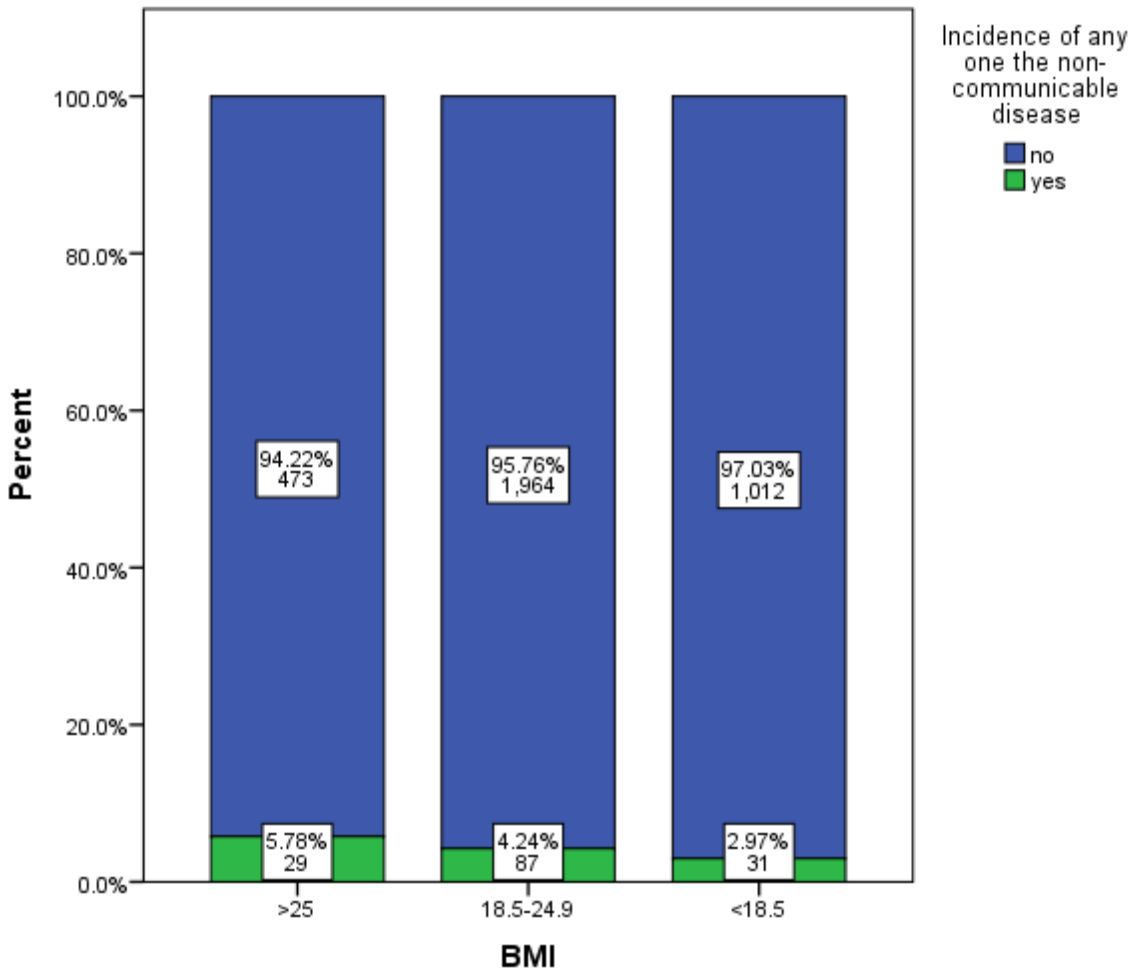

Figure 4 BMI of the adult HIV positive patients by the incidence of any one of the non-communicable diseases,atHUCSH, June 2003 to February 2022.

5.3 Incidence of any of the non-communicable diseases

Out of 3596 study participants included in the final analysis, one hundred forty-seven participants developed any one of the NCDs during the follow-up period (4.09%). Hypertension is the most commonly observed disease. The incidence rate of HTN was 7.9 (95% CI: 6.1-10.0) per 100 PYs, the incidence rate of DM was 7.2 (95% CI: 5.4-9.6) per 100 PYs, the incidence rate of CVD was 8.8 (95% CI: 5.3-14.2) per 100 PYs, the incidence rate of CA was 10 (95% CI: 7.6-13.0) per 100 PYs, the incidence rate of COPD was 10.2 (95% CI: 4.4-21.8) per 100 PYs, and the rate of any one of the NCDs was 8.5 (95% CI: 7.2-9.9) per 100 PYs. The highest incidence rate of any of the NCDs was found in those who had poor ART adherence (13.6 per 100 PYs),

followed by patients who had fair ART adherence (11.9% per 100 PYs). On the other hand, the lowest incidence rate was among patients who were housewives (7.6per 100 PYs). (Table 3)

Table 3-Incidence of any of the noncommunicable diseases by different characteristics among PLHIV, at HUCSH,2024

Characteristics		Survival status		PYs Observation	IDR b (per 100 PYs)	CI95%
		NCDs n=147	Censored n=3449			
Age	18-29	32	1108	345	9.3	(6.6-12.8)
	30-39	61	1385	726	8.4	(6.6-10.6)
	>=40	54	956	660	8.2	(6.3-10.5)
Occupational status	Employed	50	893	512	9.8	(7.5-12.6)
	Private work	40	1012	487	8.2	(6.1-11)
	Housewife	33	706	432	7.6	(5.5-10.5)
	Other	24	838	300	8	(5.4-11.6)
Family size	<4	120	2551	1390	8.6	(7.3-10.23)
	>=4	27	898	341	7.9	(5.4-11.3)
WHO stage	I	26	793	254	10.6	(7.4-15)
	II	34	751	408	8.3	(6-11.4)
	III	71	1511	873	8.1	(6.5-10)
CD4 count	IV	16	394	196	8.2	(5.1-12.8)
	<350	117	2716	1379	8.5	(7-10)
	350-500	17	392	193	8.8	(5.6-13.6)
	>500	13	341	159	8.2	(4.8-13.5)
BMI	<18.5	31	1012	358	8.6	(6.2-12)
	18.5-24.9	87	1964	1040	8.4	(6.8-10)

	>=25	29	473	333	8.7	(6.1-12.2)
ART adherence	Good	123	2801	1549	7.9	(6.7-9.4)
	Faire	5	172	42	11.9	(5.2.4- 25.0)
	Poor	19	476	140	13.6	(8.9- 20.22)

Abbreviations: ART, Antiretroviral Therapy; BMI, Body Mass Index ; CD4,Cluster of Differentiation 4CI,Confidence interval IDR, incidence density rate;PYs, person-years; WHO, world health organization

5.4 Kaplan-Meier Survival Curve

The cumulative probability of NCD-free survival of the PLHIV at the end of the 5th, 10th, 15th, and 17th years of follow-up was 0.98, 0.95, 0.73, and 0.7, respectively (Figure 5). A lower mean survival time was observed for those who were employed (Figure 6), for those who had family size <4 (Figure 7), for those who had a BMI >=25 (Figure 8), and for those who had poor ART adherence (Figure 9).

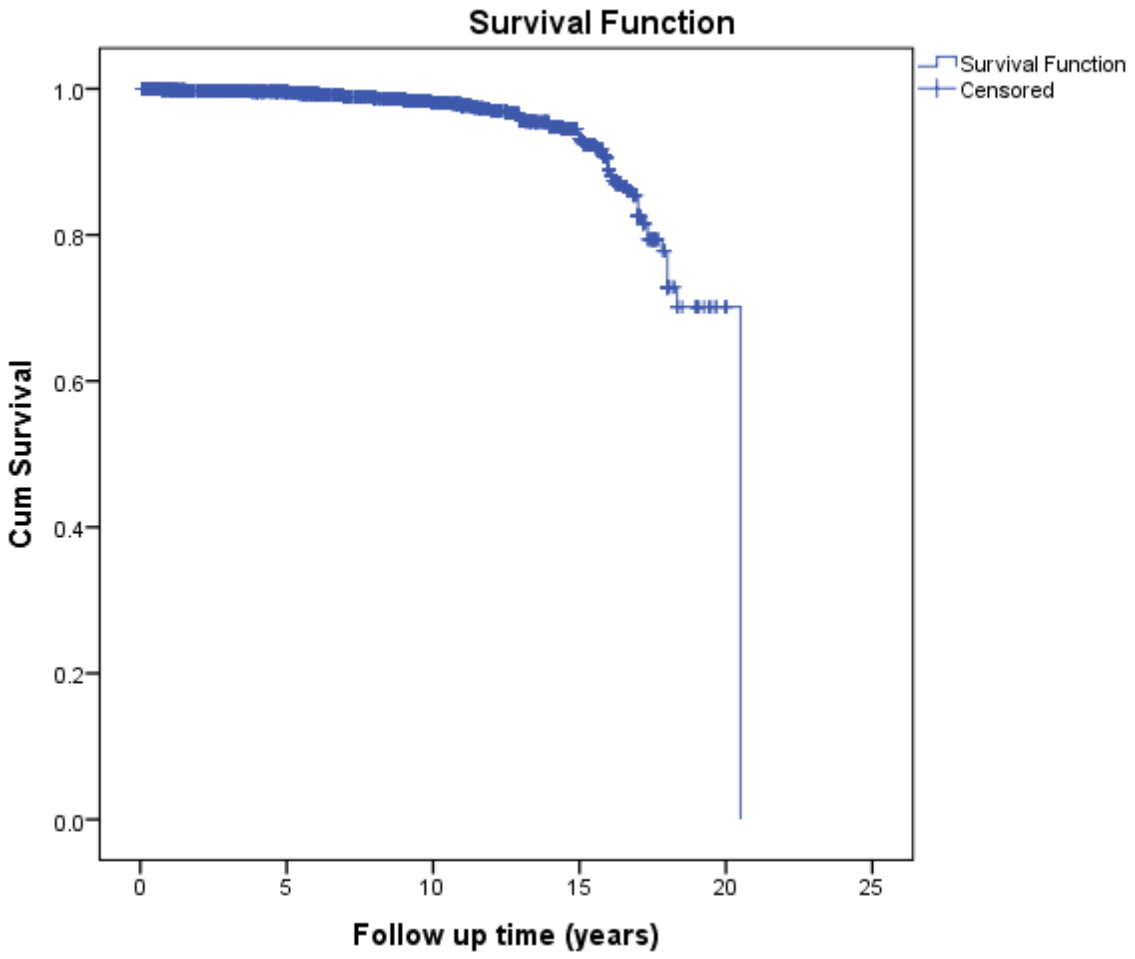

Figure 5 Disease-free survival for PLHIVat HUCSH from, June 2003 to February 2022

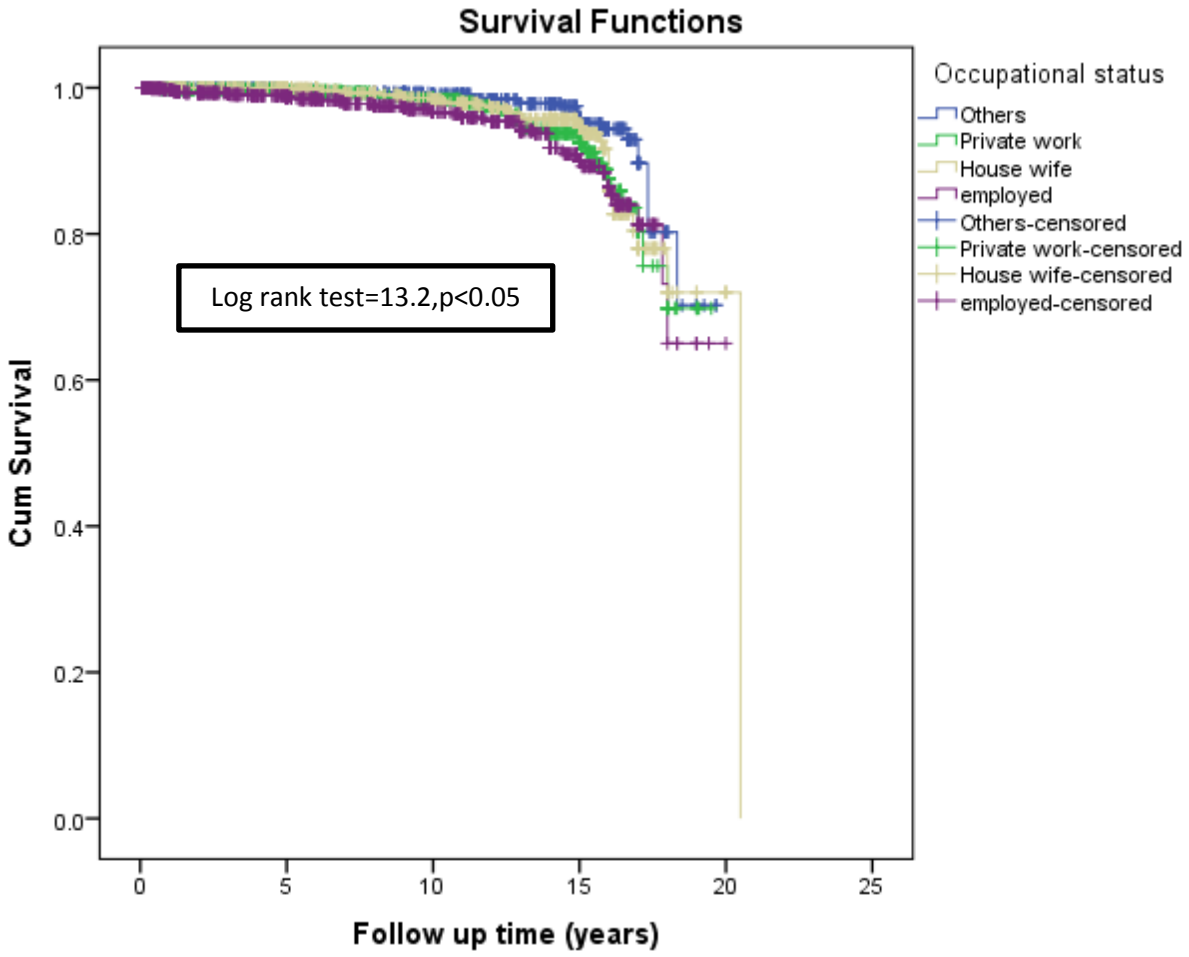

Figure 6 Disease-free survival by Occupational status for PLHIVat HUCSH from, June 2003 to February 2022

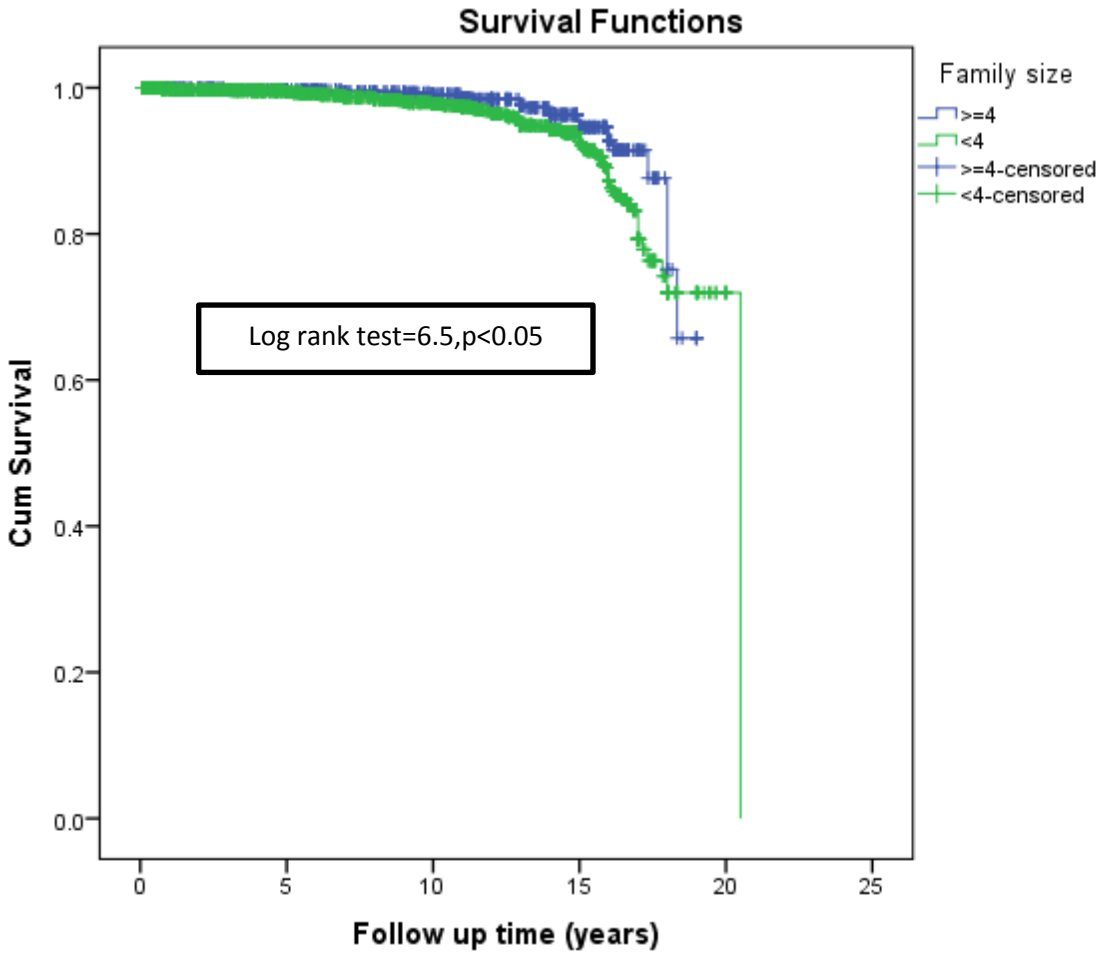

Figure 7 Disease-free survival by Family size for PLHIVat HUCSH from, June 2003 to February 2022.

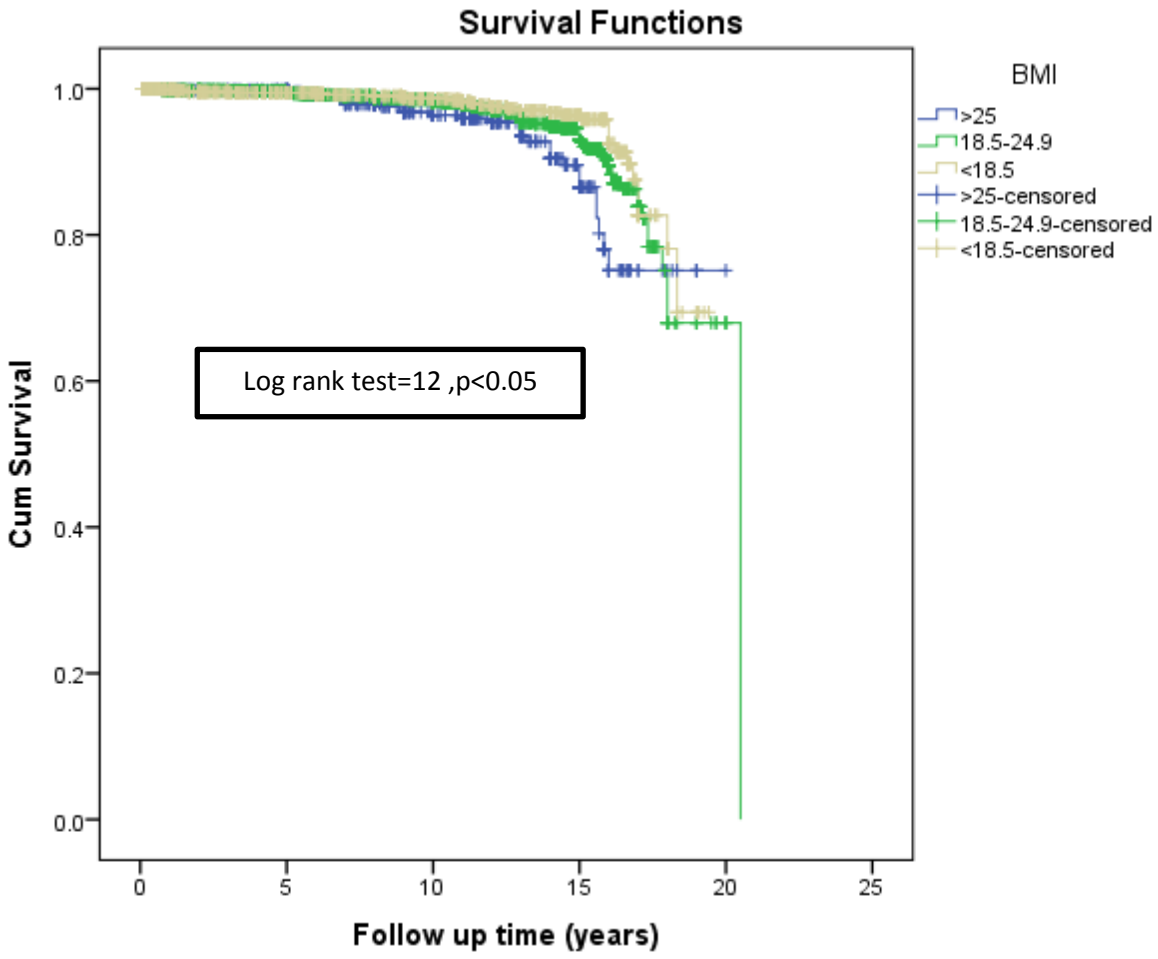

Figure 8 Disease-free survival by BMI for PLHIVat HUCSH from, June 2003 to February 2022.

.

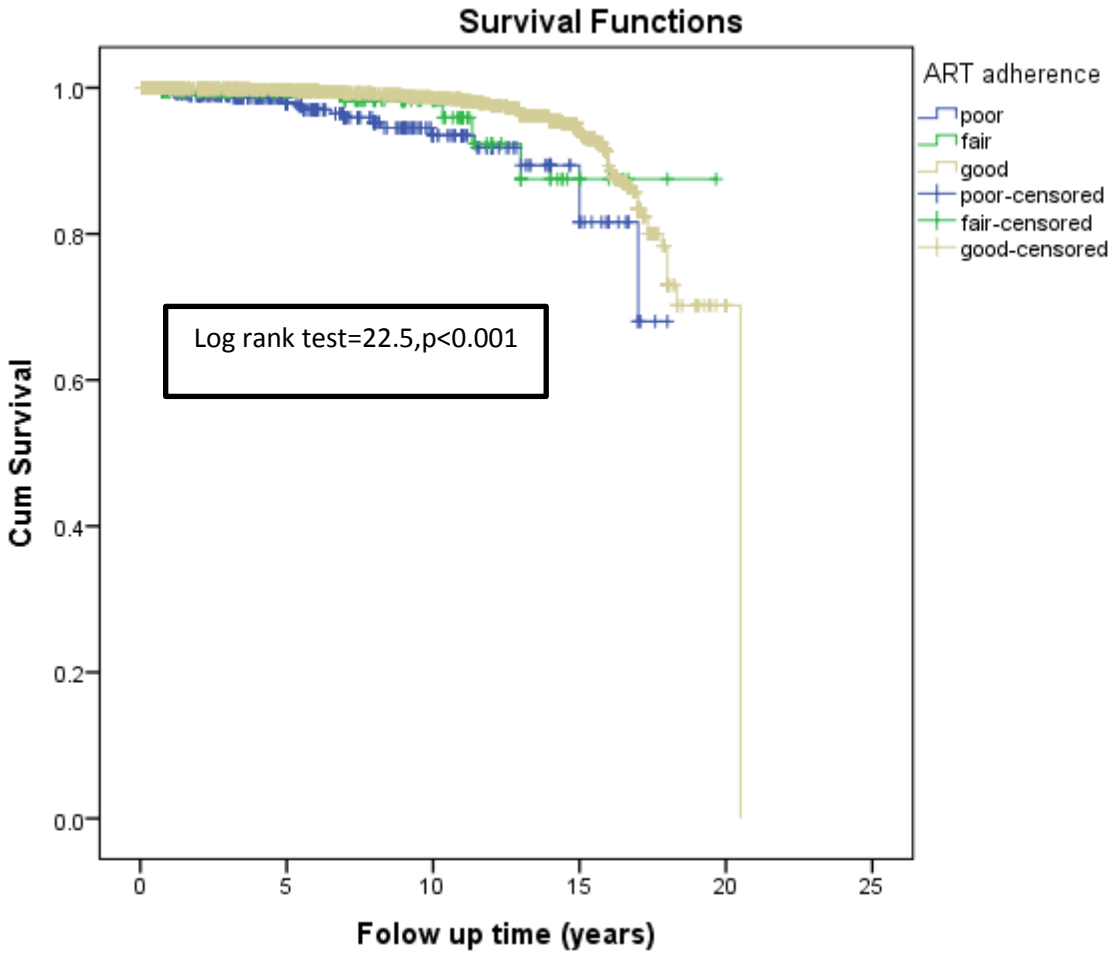

Figure 9 Disease-free survival by ART adherence for PLHIVat HUCSH from June 2003 to February 2022

5.5 Predictors of any of the non-communicable diseases

In the bi-variable Cox proportional hazard analysis Age, family size, Occupational status, BMI, and ARTadherence predicted the development of any of the non-communicable diseases. However, in the multivariable Cox proportional hazard analysis, only family size, Occupational status, BMI, and ART adherence were predictors for having any one of the non-communicable diseases. Participants who had a family size of >=4 had 40% (AHR = 0.6, 95%). CI: 0.4-0.9) less chance of any of the non-communicable disease's occurrence than those who had a family size of <4; those who engaged in other Occupational status (student, prisoner, commercial sex

worker)had 60% (AHR = 0.4, 95%)CI: (0.3-0.7) less chance of anyone of the non-communicable diseases occurrence than those who were employed, those who had BMI >=25 had 2.2 times higher risk of developing any of the non-communicable diseases (AHR= 2.2, CI: 1.3-3.7) than those who had current BMI <=18 and those who had poor ART adherence had 3.3 times higher risk of developing any NCDs (AHR= 3.3 CI: 2-5.5) than those who had good ART adherence. (Table 4).

Table 4-Sociodemographic and clinical risk factors of any one of the non-communicable diseases among study participants, at, HUCSH, 2024

Characteristics		Cases	PYs Observation	CHR 95%CI	AHR95%CI	p-value
Age	18-29	32	345	1	1	
	30-39	61	726	1.4(0.9-2.2)	1.2(0.8-1.9)	0.3
	>40	54	660	1.7(1.1-2.7)	1.5(1-2.4)	0.07
Occupational status	Employed	50	512	1	1	
	Private work	40	487	0.8(0.5-1.2)	0.8(0.5 -1.2)	0.2
	Housewife	33	432	0.7(0.4-1.1)	0.7(0.4-1.1)	0.08
	Others	24	300	0.4(0.3-0.7)	0.4(0.3-0.7)	0.00
Family size	<4	120	1390	1	1	
	>=4	27	341	0.6(0.4-0.9)	0.6(0.4-0.9)	0.01
BMI	<18.5	31	1012	1	1	
	18.5-24.9	87	1964	1.4(0.9-2.1)	1.4 (0.9-2.2)	0.09
	>=25	29	473	2.4(1.4-4)	2.2(1.3-3.7)	0.00

ART adherence	Good	123	1549	1	1	
	Faire	5	42	1.7(0.7-4.2)	1.9(0.8-4.8)	0.1
	Poor	19	140	3.1(1.9-5)	3.3 (2-5.5)	0.00

Note:- Occupational status:-others: student, prisoner, commercial sex worker

Abbreviations: AHR, adjusted hazard ratio; ART, Antiretroviral Therapy; BMI, Body Mass Index; Differentiation 4; CHR, crude hazard ratio; CI, Confidence Interval; IDR, incidence density rate; PYs, person-years.

6 DISCUSSION

A retrospective cohort study was conducted to determine the incidence and identify predictive factors of non-communicable disease among PLHIV at HUCSH. Our study's findings showed that the overall incidence of any one of the NCDs was high. Hypertension was the predominant disease that affected the study participants. Family size, Occupational status, BMI, and ART adherence were predictors of the development of any one of the non-communicable diseases.

The incidence of any one of the NCDs among HIV-positive patients in this study (8.5 per 100 person-years) is comparable with Chinese prospective cohort studies (7.6 per 100 PYsbut was higher than prospective cohort studies previously done in Northwest Ethiopia (16.35 per 1000 person-month)(15), and South Africa (5.4 per 100 person-years) (5.4 per 100 person-years)(35). This variance may be related to the differences in study setting, socio-demographic characteristics of study participants, and duration of the study. On the contrary, the incidence in the current study was lower than that conducted in Tanzania (120.0 cases per 1000 person-years)(57). The disparity might be due to differences in the age of participants; in the current study, only 28.1 were in the age range of >=40, compared to 43.2% in the Tanzania study. A high proportion of participants being in a higher age group increases the risk of developing NCDs.

In the current study, hypertension is the most commonly observed disease; similarly, hypertension is the most commonly reported disease in Kenya and Zimbabwe(40, 58), Contrary to observed NCDs, the most commonly reported disease in the Brazilian cohort study was HLD(45).

Old age was one of the risk factors for NCD development among PLHIVs, according to studies conducted in different parts of Africa (35, 40, 46). This is also in line with other prospective studies conducted in north-west Ethiopia(15). As people got older, they became more prone to NCDs due to biological changes related to increased age. because the incidence of NCD needs a long duration to happen due to slow disease progression (59), in addition to the fact that HIV infections may increase the risk of age-related NCDs as a result of persistent low-grade inflammation, HIV-induced chronic immune activation, and potentially accelerated aging(60). However, in this study Age was significant in bivariate analysis but in multivariate analysis, it was not significant.

Gender was one of the risk factors for NCD development among PLHIVs elsewhere (15, 35). Contrary to these reports, in the current study, there was no association between gender and having any of the NCDs.A possible explanation could be a difference in lifestyle and behavioral factors. In the previous study, more males were overweight, drank alcohol, and smoked than females(15).

In this study, those who were employed PLHIV had an increased risk of any one of the NCDs developing. In line with this, according to a study conducted in India, higher odds of NCDs were found for the professional occupation group compared with non-workers(61). A possible explanation may be different lifestyles or risk factors associated with being employed.

Family size >4 was associated with increased risk of NCDs according to a study conducted in Nigeria,(62), however, in our study, those who had a family size of >=4 had 40% less chance of the non-communicable disease's occurrence than those who had a family size of <4, a possible explanation could be, in a previous study conducted in Ethiopia large family size was positively associated with ART adherence(63), which is related with consistent suppressed viral load(64, 65), a high CD4+ cell count, virologic suppression and high of CD4+ counts is protective towards CVD incidence (66), in line with this in another study low CD4 was associated with the development hypertension(35).

High BMI is among the well-known risk factors for NCD(67). According to studies, high BMI or obesity in PLHIV is also related to an increased risk of NCD (68, 69).In the current study, patients with a high BMI (>=25) had a 2.2 increased risk of developing any one of the non-communicable diseases, which is supported by a cohort study conducted in South Africa and also in a previous prospective study conducted in our country. Patients with a body mass index of ≥25 kg/m2 were at increased risk of developing NCDs(15, 35). Weight gain in PLHIV is more highly associated with NCDs than in the general population; according to the study, the study, every 5-pound gain is associated with a 14% increased risk for diabetes compared with only 8% in the general population (70).

Our study showed that participants with poor ART adherence were at increased risk of developing any of the non-communicable diseases. An explanation for this could be that poor ART adherence is related to less effective viral suppression(71), unsuppressed viral replication leads to a high viral load, which is associated with NCD development, and poor adherence may lead to medication interruption. It was found that there is an increased trend towards NCDs with ART interruptions(72). In addition to that, poor ART adherence is related to increased susceptibility to other opportunistic infections(71), which are associated with an increased risk of NCD development. According to a study in Uganda, individuals with opportunistic infections were 3.33 times more likely to have a non-communicable disease compared to those without opportunistic infections (46). Moreover, Individuals with poor adherence may be less likely to engage in regular medical care, receive preventive screenings, and adhere to recommended lifestyle modifications, all of which are important for preventing and managing NCDs.

7 STRENGTH AND LIMITATIONS OF THE STUDY

The strength of our study lies in the cohort nature of the study, which ensured temporality between exposure and outcome variables in the associations produced. And the fact that we conducted a study by reviewing a large set of data, despite its strength, is not without limitations. Its limitation is that since it is a retrospective study conducted by reviewing medical charts, some variables, such as health-related and behavioral factors (alcohol consumption, smoking, physical activity, diet), were not available, and their association with the incidence of any one of the NCDs was not assessed.

8 CONCLUSION

The findings of this study showed that the overall incidence of any one of the NCDs was high, with hypertension being the most common observed disease. The study has also identified family size, Occupational status, BMI , and ART adherence as predictors of the development of any one of the non-communicable diseases**.**

9 RECOMMENDATION

Policymakers: may need to focus on targeted screening programs for NCDs for PLHIV, reinforcement of dietary advice, guidance, and prevention of excessive weight gain (high BMI), and the prevention of NCDs among PLWHIV/AIDS. Policies should also focus on promoting sustained ART adherence and long-term treatment strategies to reduce the burden of NCDs among PLHIV.

For health care providers (HCPs): Good counseling to patients on the importance of drug compliance should be given by professionals, as should health education on lifestyle modification and diet to prevent obesity among PLHIV.

For researchers in the future, conducting a prospective cohort study including health-related behavioral factors not included in this study would be important to identify additional predictors.

10 REFERENCE

1. Global HIV & AIDS statistics — Fact sheet 2023 [press release]. 13 Jul 2023.
2. HIV.gov. The Global HIV and AIDS Epidemic November 15, 2023 [
3. UNAIDScountryEthiopiafoudat https://www.unaids.org/en/regionscountries/countries/ethiopia.
4. Smit M, Olney J, Ford NP, Vitoria M, Gregson S, Vassall A, et al. The growing burden of noncommunicable disease among persons living with HIV in Zimbabwe. AIDS (London, England). 2018;32(6):773.
5. WHO CO. World health organization. Responding to Community Spread of COVID-19 Reference WHO/COVID-19/Community_Transmission/20201. 2020.
6. Hemkens LG, Bucher HC. HIV infection and cardiovascular disease. European heart journal. 2014;35(21):1373-81.
7. Narayan KV, Miotti PG, Anand NP, Kline LM, Harmston C, Gulakowski III R, et al. HIV and noncommunicable disease comorbidities in the era of antiretroviral therapy: a vital agenda for research in low-and middle-income country settings. JAIDS Journal of Acquired Immune Deficiency Syndromes. 2014;67:S2-S7.
8. Bigna JJ, Kenne AM, Asangbeh SL, Sibetcheu AT. Prevalence of chronic obstructive pulmonary disease in the global population with HIV: a systematic review and meta-analysis. The Lancet Global Health. 2018;6(2):e193-e202.
9. Mayer KH, Loo S, Crawford PM, Crane HM, Leo M, DenOuden P, et al. Excess clinical comorbidity among HIV-infected patients accessing primary care in US community health centers. Public Health Reports. 2018;133(1):109-18.
10. Kyu HH, Abate D, Abate KH, Abay SM, Abbafati C, Abbasi N, et al. Global, regional, and national disability-adjusted life-years (DALYs) for 359 diseases and injuries and healthy life expectancy (HALE) for 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. The Lancet. 2018;392(10159):1859-922.
11. Bloomfield GS, Khazanie P, Morris A, Rabadan-Diehl C, Benjamin LA, Murdoch D, et al. HIV and non-communicable cardiovascular and pulmonary diseases in low-and middle-income countries in the ART era: what we know and best directions for future research. Journal of acquired immune deficiency syndromes (1999). 2014;67(0 1):S40.
12. World Health Organisation. (2018). Noncommunicable diseases [Fact sheet].
13. Levitt NS, Steyn K, Dave J, Bradshaw D. Chronic noncommunicable diseases and HIV-AIDS on a collision course: relevance for health care delivery, particularly in low-resource settings—insights from South Africa. The American journal of clinical nutrition. 2011;94(6):1690S-6S.
14. Berhane T, Yami A, Alemseged F, Yemane T, Hamza L, Kassim M, et al. Prevalence of lipodystrophy and metabolic syndrome among HIV positive individuals on Highly Active Anti-Retroviral treatment in Jimma, South West Ethiopia. Pan African Medical Journal. 2012;13(1).
15. Mulugeta H, Afenigus AD, Haile D, Amha H, Kassa GM, Wubetu M, et al. Incidence and predictors of hypertension among HIV patients receiving ART at public health facilities, northwest Ethiopia: A one-year multicenter prospective follow-up study. HIV/AIDS-Research and Palliative Care. 2021:889-901.
16. Jember D, Belayneh F, Abuka T, Mengesha S, Tsegaw D. Non-communicable diseases comorbidity among HIV Patients on Antiretroviral Therapy in Sidama Region, Ethiopia: a cross-sectional study. 2023.
17. Divala OH, Amberbir A, Ismail Z, Beyene T, Garone D, Pfaff C, et al. The burden of hypertension, diabetes mellitus, and cardiovascular risk factors among adult Malawians in HIV care: consequences for integrated services. BMC public health. 2016;16(1):1-11.
18. Woldesemayat EM. Chronic diseases multimorbidity among adult people living with HIV at Hawassa University Comprehensive Specialized Hospital, Southern Ethiopia. International journal of chronic diseases. 2020;2020.

19. Getahun Z, Azage M, Abuhay T, Abebe F. Comorbidity of HIV, hypertension, and diabetes and associated factors among people receiving antiretroviral therapy in Bahir Dar city, Ethiopia. Journal of comorbidity. 2020;10:2235042X19899319.
20. Zewudie BT, Geze Tenaw S, Solomon M, Mesfin Y, Abebe H, Mekonnen Z, et al. The magnitude of undiagnosed hypertension and associated factors among HIV-positive patients attending antiretroviral therapy clinics of Butajira General Hospital, Gurage Zone, Southern Ethiopia. SAGE Open Medicine. 2022;10:20503121221094454.
21. Debiso AT. Incidence and predictors of systemic hypertension among cohort of HIV/AIDS infected patients in health facilities of South Ethiopia. Advances in Infectious Diseases. 2020;10(2):47-63.
22. Lukas K, Markos E, Belayneh F, Habte A. The magnitude of hypertension and associated factors among clients on highly active antiretroviral treatment in Southern Ethiopia, 2020: A hospital-based cross-sectional study. Plos one. 2021;16(10):e0258576.
23. Ataro Z, Ashenafi W, Fayera J, Abdosh T. Magnitude and associated factors of diabetes mellitus and hypertension among adult HIV-positive individuals receiving highly active antiretroviral therapy at Jugal Hospital, Harar, Ethiopia. HIV/AIDS-Research and Palliative Care. 2018:181-92.
24. Tegene Y, Mengesha S, Putman E, Toma A, Spigt M. Development of Hypertension and Diabetes Mellitus, and Associated Factors, Among Adult HIV Patients in Ethiopia. HIV/AIDS-Research and Palliative Care. 2023:41-51.
25. World Health Organization. Global Action Plan for the Prevention and Control of Noncommunicable Diseases 2013-2020.
26. Allen LN PJ, Wickramasinghe KK, Williams J, Roberts N, Mikkelsen B et al. Evaluation of research on interventions aligned to WHO , 2015. BBfNil-ial-icasrft.
27. World Health Organization. Package of essential noncommunicable (PEN) disease interventions for primary health care in low resource settings. Geneva.
28. Rabkin M, de Pinho H, Michaels-Strasser S, Naitore D, Rawat A, Topp SM. Strengthening the health workforce to support integration of HIV and noncommunicable disease services in sub-Saharan Africa. Aids. 2018;32:S47-S54.
29. Njuguna B, Vorkoper S, Patel P, Reid MJ, Vedanthan R, Pfaff C, et al. Models of integration of HIV and noncommunicable disease care in sub-Saharan Africa: lessons learned and evidence gaps. AIDS (London, England). 2018;32(Suppl 1):S33.
30. Juma PA M-TC, Mohamed SF, Matanje Mwagomba BL, Ndinda C, Oluwasanu M et al. Multi-sectoral action in noncommunicable disease prevention policy development in five African countries. BMC public health. .
31. Mwagomba BLM, Ameh S, Bongomin P, Juma PA, MacKenzie RK, Kyobutungi C, et al. Opportunities and challenges for evidence-informed HIV-noncommunicable disease integrated care policies and programs: lessons from Malawi, South Africa, Swaziland and Kenya. Aids. 2018;32:S21-S32.
32. Daniels M, Donilon T, Bollyky TJ. The emerging global health crisis: noncommunicable diseases in low-and middle-income countries. Council on Foreign Relations independent task force report. 2014(72).
33. Deeks SG, Lewin SR, Havlir DV. The end of AIDS: HIV infection as a chronic disease. The lancet. 2013;382(9903):1525-33.
34. Fan H, Guo F, Hsieh E, Chen W-T, Lv W, Han Y, et al. Incidence of hypertension among persons living with HIV in China: a multicenter cohort study. BMC public health. 2020;20(1):1-11.
35. Brennan AT, Jamieson L, Crowther NJ, Fox MP, George JA, Berry KM, et al. Prevalence, incidence, predictors, treatment, and control of hypertension among HIV-positive adults on antiretroviral treatment in public sector treatment programs in South Africa. PloS one. 2018;13(10):e0204020.
36. Okello S, Kanyesigye M, Muyindike WR, Annex BH, Hunt PW, Haneuse S, et al. Incidence and predictors of hypertension in adults with HIV initiating antiretroviral therapy in Southwestern Uganda. Journal of hypertension. 2015;33(10):2039.

37. Capeau J, Bouteloup V, Katlama C, Bastard J-P, Guiyedi V, Salmon-Ceron D, et al. Ten-year diabetes incidence in 1046 HIV-infected patients started on a combination antiretroviral treatment. Aids. 2012;26(3):303-14.
38. Bratt G, Brännström J, Missalidis C, Nyström T. Development of type 2 diabetes and insulin resistance in people with HIV infection: prevalence, incidence and associated factors. Plos one. 2021;16(6):e0254079.
39. Cassenote AJ, Grangeiro A, Escuder MM, Abe JM, Santos RD, Segurado AC. Incidence and associated factors of type 2 diabetes mellitus onset in the Brazilian HIV/AIDS cohort study. Brazilian Journal of Infectious Diseases. 2021;25.
40. Cheza A, Tlou B, Zhou DT. Incidence of non-communicable diseases (NCDs) in HIV patients on ART in a developing country: case of Zimbabwe's Chitungwiza Central Hospital—A retrospective cohort study (2010–2019). Plos one. 2021;16(5):e0252180.
41. Boettiger DC, Escuder MM, Law MG, Veloso V, Souza RA, Ikeda ML, et al. Cardiovascular disease among people living with HIV in Brazil. Tropical Medicine & International Health. 2020;25(7):886-96.
42. Ruamtawee W, Tipayamongkholgul M, Aimyong N, Manosuthi W. Prevalence and risk factors of cardiovascular disease among people living with HIV in the Asia-Pacific region: a systematic review. BMC Public Health. 2023;23(1):1-8.
43. Ebogo-Belobo J-T, Simeni L-AK, Nnouma GM, Loubou ML, Abamé I, Hapi AT, et al. Incidence of cancer in people living with HIV and prognostic value of current CD4+. Bulletin du Cancer. 2019;106(3):201-5.
44. Ruffieux Y, Muchengeti M, Egger M, Efthimiou O, Bartels L, Olago V, et al. Immunodeficiency and cancer in 3.7 million people living with HIV: the South African HIV Cancer Match Study. 2020.
45. Castilho JL, Escuder MM, Veloso V, Gomes JO, Jayathilake K, Ribeiro S, et al. Trends and predictors of non-communicable disease multimorbidity among adults living with HIV and receiving antiretroviral therapy in Brazil. Journal of the International AIDS Society. 2019;22(1):e25233.
46. Kansiime S, Mwesigire D, Mugerwa H. Prevalence of non-communicable diseases among HIV positive patients on antiretroviral therapy at joint clinical research centre, Lubowa, Uganda. PloS one. 2019;14(8):e0221022.
47. Benzekri NA, Seydi M, N. Doye I, Toure M, Sy MP, Kiviat NB, et al. Increasing prevalence of hypertension among HIV-positive and negative adults in Senegal, West Africa, 1994-2015. PloS one. 2018;13(12):e0208635.
48. Noncommunicable diseases World Health Organization (WHO).
49. American Heart Association. (n.d.). What is cardiovascular disease?
50. Abdalla M, Bolen SD, Brettler J, Egan BM, Ferdinand KC, Ford CD, et al. Implementation strategies to improve blood pressure control in the United States: a scientific statement from the American Heart Association and American Medical Association. Hypertension. 2023;80(10):e143-e57.
51. Association AD. 2. Classification and diagnosis of diabetes: standards of medical care in diabetes—2021. Diabetes care. 2021;44(Supplement_1):S15-S33.
52. Global Initiative for Chronic Obstructive Lung Disease. (2021). Global Strategy for the Diagnosis, Management, and Prevention of COPD.
53. Global Initiative for Asthma. (2021). Global Strategy for Asthma Management and Prevention.

.
54. World Health Organization. (2020). Body mass index - BMI.
55. FMoH. National comprehensive Prevention, Care and Treatment Training for Health

care providers. 2021

56. Zimet G. Multidimensional scale of perceived social support (MSPSS)-Scale Items and Scoring Information. Multidimensional Scale of Perceived Social Support (MSPSS)—Scale Items and Scoring Information. 2016.
57. Rodríguez-Arbolí E, Mwamelo K, Kalinjuma AV, Furrer H, Hatz C, Tanner M, et al. Incidence and risk factors for hypertension among HIV patients in rural Tanzania–A prospective cohort study. PloS one. 2017;12(3):e0172089.
58. Achwoka DE. Non-communicable Diseases (NCDS) Burden Among People Living With HIV/AIDS (PLHIV) in Kenya: University of Nairobi; 2021.
59. Sari NPWP, Artsanthia J. Comparison of blood pressure and blood glucose level among elderly with non-communicable disease. International Journal of Public Health Science (IJPHS). 2019;8(2):105-13.
60. Deeks SG. HIV infection, inflammation, immunosenescence, and aging. Annual review of medicine. 2011;62:141-55.
61. Migora B, Geleso MG, Girum T, Bireda M, Gebru M, Dessu S. Survival time to development of hypertension and its predictors among a cohort of diabetic patients in health facilities of gurage zone: A retrospective follow-up study. Vascular Health and Risk Management. 2021:259-66.
62. Iloh GUP, Amadi AN. Essential hypertension in adult Nigerians in a primary care clinic: A cross sectional study of the prevalence and associated family socio-biological factors in Eastern Nigeria. Eur J Prev Med. 2014;2(6):81-9.
63. Sisay WA, Alemayehu AA. Determinants of adherence to antiretroviral therapy drugs in the phase of rapid scale-up of antiretroviral treatment in sub-Saharan Africa: the case of Ethiopia. Fetene GT, Mesfin R Antiretroviral treatment in sub-Saharan Africa Challenges and prospects Ethiopia: Organisation for Social Science Research in Eastern and Southern Africa (OSSREA). 2013:87-112.
64. Byrd KK, Hou JG, Bush T, Hazen R, Kirkham H, Delpino A, et al. Adherence and viral suppression among participants of the patient-centered human immunodeficiency virus (HIV) care model project: a collaboration between community-based pharmacists and HIV clinical providers. Clinical infectious diseases. 2020;70(5):789-97.
65. Gandhi RT, Bedimo R, Hoy JF, Landovitz RJ, Smith DM, Eaton EF, et al. Antiretroviral drugs for treatment and prevention of HIV infection in adults: 2022 recommendations of the International Antiviral Society–USA panel. Jama. 2023;329(1):63-84.
66. Mesquita EC, Coelho LE, Amancio RT, Veloso V, Grinsztejn B, Luz P, et al. Severe infection increases cardiovascular risk among HIV-infected individuals. BMC Infectious Diseases. 2019;19:1-8.
67. Lin X, Xu Y, Xu J, Pan X, Song X, Shan L, et al. Global burden of noncommunicable disease attributable to high body mass index in 195 countries and territories, 1990–2017. Endocrine. 2020;69:310-20.
68. Petoumenos K, Kuwanda L, Ryom L, Mocroft A, Reiss P, De Wit S, et al. Effect of changes in body mass index on the risk of cardiovascular disease and diabetes mellitus in HIV-positive individuals: results from the D: A: D Study. JAIDS Journal of Acquired Immune Deficiency Syndromes. 2021;86(5):579-86.
69. Han WM, Jiamsakul A, Jantarapakde J, Yunihastuti E, Choi JY, Ditangco R, et al. Association of body mass index with immune recovery, virological failure and cardiovascular disease risk among people living with HIV. HIV medicine. 2021;22(4):294-306.
70. Herrin M, Tate JP, Akgün KM, Butt AA, Crothers K, Freiberg MS, et al. Weight gain and incident diabetes among HIV-infected veterans initiating antiretroviral therapy compared with uninfected individuals. JAIDS Journal of Acquired Immune Deficiency Syndromes. 2016;73(2):228-36.
71. Abadiga M, Hasen T, Mosisa G, Abdisa E. Adherence to antiretroviral therapy and associated factors among Human immunodeficiency virus positive patients accessing treatment at Nekemte referral hospital, west Ethiopia, 2019. PloS one. 2020;15(5):e0232703.
72. Casper C, Crane H, Menon M, Money D. HIV/AIDS comorbidities: impact on cancer, noncommunicable diseases, and reproductive health. Major Infectious Diseases 3rd edition. 2017.

Annex

Data collection Instrument

Data Extraction Format for Research proposal at Hawassa University Comprehensive Specialized Hospital, Sidama region, Ethiopia.

Title: Incidence and predictors of non-communicable disease among HIV patients at Hawassa University Comprehensive and Specialized Hospital, Sidama region, Ethiopia

Part I: Data from ART follow-up form

1.1 Facility _____ 1.2 Card no _____ 1.3 Age at start _____ 1.4 Age now _____

1.5 Sex: 1. Male 2. Female 1.6 Date of HIV Dx _____ 1.7 Date ART start _____
1.8 Type of HIV test: 1. Rapid HIV tests 2. DNA/PCR 3. Other specify _____

1.9 Client readienesss date _____ 1.10 Ht in cm _____ 1.11 Address: Regiocn _____ District _____ Kebele _____ 1.12 Telephone _____ 1.13 ART no _____

1.14 Occupation at diagnosis _____ Current occupation _____

1.15 Marital status 1. Single 2. Married 3. Divorced 4. Widowed 5. Other specify _____

1.16 Family size _____

1.17 Status disclosure to family 1. Yes, 2. No

1.18 Social support availability 1. Yes , 2. No _____

1.19BMI at start (date) _____ 1.20 BMI recent (date) _____

1.21 WHO stage at start of follow-up _____ 1.22Recent WHO stage of follow-up _____

1.23 First CD4/mm3 (date) _____1.24 Most recent CD4 values (date) _____

1.25 ARVs at start _____ 1.26 ARVs recent _____

1.27ART adherence (G, F, P) 1. good 2. fair 3. poor

1.28 Date of data collection _____ 1.29 Client status at data collection 1. In the cohort 2. Died 3. LTFU 4. Other specify _____ 5, For died or LTFU specify the date _____

Time to NCDs development

2. Did the client have hypertension at the start of the cohort (B/P record above 130/90 mmHg)? 1. Yes 2. No

2.1 Did the client have hypertension now (B/P record above 130/90 mmHg)? 1. Yes 2. No If yes, diagnosis date _____

2.2 Did the client have DM at the start of the cohort? 1. Yes 2. No

Did the client have DM now? 1. Yes 2. No If yes, diagnosis date _____

The type of DM? 1. Type 1 2. Type 2 Is the patient on treatment now? 1. Yes 2. No

2.3 Did the client have any COPD at the start of the cohort ? 1. Yes 2. No

Did the client have any of the COPDs now? 1. Yes 2. No If yes, diagnosis date _____

Specify the COPD he or she developed _____

2.4 Did the client have cancer of any organ at the start of the cohort? 1. Yes 2. No

Did the client have cancer now or at any time during the cohort? 1. Yes 2. No

Specify the type/organ involved of cancer he or she developed _____

Type of cancer 1. benign 2. malignant 3. specify the type _____

Date diagnosed the cancer/s? _____

2.5 Did the client have CVD before starting the cohort? 1. Yes 2. No

Did the client have CVD now or any time during the cohort? 1. Yes 2. No

Specify the type of CVD _____ Date diagnosed _____