

Prevalence of Diabetes and Hypertension among People Living With HIV/AIDS (PLWHIV) Attending Isiolo County Referral Hospital Comprehensive Care Clinic, Kenya

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ABSTRACT

People living with HIV/AIDS (PLWHIV) are increasingly experiencing a growing burden of non-communicable diseases, particularly hypertension and diabetes, alongside chronic HIV infection. However, evidence on the prevalence and associated factors of these conditions among PLWHIV in arid and semi-arid regions of Kenya remains limited. This study aimed to determine the prevalence of hypertension and diabetes and examine their socio-demographic and anthropometric correlates among PLWHIV attending the Comprehensive Care Clinic at Isiolo County Referral Hospital, Kenya. A hospital-based cross-sectional analytical study was conducted among 231 HIV-positive adults receiving antiretroviral therapy. Data were collected using a structured interviewer-administered questionnaire and standardized clinical measurements, including blood pressure, fasting blood glucose, weight, and height. Data were analyzed using IBM SPSS Statistics version 25.0 through descriptive statistics and chi-square tests of association. The findings revealed that 42.4% of respondents had previously been diagnosed with hypertension, while 23.4% had previously been diagnosed with diabetes. Clinical assessment further showed that 39.4% of respondents were classified within Stage 1 hypertension and 16.0% within Stage 2 hypertension, while 39.4% were diabetic and 24.2% were pre-diabetic based on fasting blood glucose measurements. Hypertension prevalence was significantly associated with age group, gender, education level, occupation, BMI category, and blood pressure classification ($p < 0.05$). Similarly, diabetes prevalence demonstrated significant associations with age, gender, education level, occupation, income status, and BMI category ($p < 0.05$). Older respondents, females, and underweight participants generally exhibited higher prevalence of both conditions. The study concludes that hypertension and diabetes represent a significant cardiometabolic burden among PLWHIV in Isiolo County and highlights the need for integrated HIV-NCD screening and management within Comprehensive Care Clinics in resource-limited settings.

Keywords: Hypertension, Diabetes, PLWHIV, Prevalence, Comprehensive Care Clinic, Kenya, Non-communicable Diseases, Antiretroviral Therapy

INTRODUCTION

Background to the Study

The global HIV/AIDS landscape has undergone a profound epidemiological transformation over the past two decades. The widespread scale-up of antiretroviral therapy (ART) has converted HIV from an acute, rapidly fatal infection into a manageable chronic condition, extending life expectancy significantly among people living with HIV (PLWHIV). As this population ages, however, a new and equally formidable challenge has emerged: the rising burden of non-communicable diseases (NCDs), particularly hypertension and diabetes, which increasingly

co-exist with and complicate HIV management. Globally, NCDs account for approximately 41 million deaths annually, with cardiovascular diseases contributing 17.9 million of these deaths each year, and the convergence of HIV with this NCD burden represents one of the defining public health challenges of the 21st century (World Health Organization [WHO], 2018; WHO, 2023).

Evidence consistently demonstrates that PLWHIV experience disproportionately elevated rates of hypertension and diabetes compared to HIV-negative populations of similar age. Meta-analytic reviews have estimated the global prevalence of hypertension among PLWHIV at approximately 23–24%, representing approximately 8.9 million hypertensive individuals within the HIV-positive population worldwide (Bigna & Noubiap, 2021; Bigna et al., 2020). Diabetes and prediabetes are similarly prevalent, driven by the interplay of chronic immune activation, antiretroviral-related metabolic effects, aging, and modifiable behavioral risk factors. The ART regimens associated with the greatest metabolic risk include nucleoside reverse transcriptase inhibitors (NRTIs), particularly stavudine and zidovudine-containing regimens, and protease inhibitor-based combinations, which are associated with increased insulin resistance, dyslipidemia, and lipodystrophy (Dubé et al., 2008; Nduka et al., 2017; Ekrikpo et al., 2016). These drug-related metabolic perturbations compound the cardiovascular and metabolic risks already elevated through HIV-related inflammation and immune dysregulation.

Across Sub-Saharan Africa (SSA), the HIV-NCD nexus has assumed particular urgency. The region carries the world's greatest HIV burden, with approximately 25 million individuals living with HIV, while simultaneously experiencing the fastest-rising rates of NCDs driven by urbanization, dietary transitions, and aging populations (Nansseu et al., 2018; Kagaruki et al., 2018). Studies from Tanzania, Uganda, Cameroon, and South Africa have documented hypertension prevalence ranging from 10% to over 30% among PLWHIV on ART, while diabetes and prediabetes prevalence has been reported at 2–16% across SSA settings (Patel et al., 2018; Todowede et al., 2019; Magodoro et al., 2016). These conditions remain substantially underdiagnosed, as integrated NCD screening within HIV care is not yet routinely standardized in many resource-limited settings. The result is a population that achieves virological suppression while silently accumulating cardiometabolic risk factors that lead to preventable morbidity and mortality.

In Kenya, the convergence of HIV and NCDs is increasingly recognized as a major public health priority. National data indicate that approximately 23.8% of Kenyan adults aged 18–69 years are hypertensive, while the HIV prevalence remains significant at the national level, with concentrated burdens in specific counties (Kenya National Bureau of Statistics [KNBS] et al., 2015; Ministry of Health [MoH], 2023). Among PLWHIV in Kenya, Achwoka et al. (2019; 2020) documented a substantial and growing burden of hypertension, diabetes, and obesity, highlighting that these conditions now represent a leading cause of morbidity alongside traditional HIV-related complications. The Kenya National Guidelines on Antiretroviral Use (NASCOP, 2016) explicitly recommend the integration of screening and management of diabetes, hypertension, dyslipidemia, and mental health into routine HIV care; however, implementation remains inconsistent, particularly in arid and semi-arid land (ASAL) settings.

Isiolo County in Northern Kenya represents a particularly underserved and understudied context. Located within Kenya's ASAL region, the county is characterized by predominantly pastoralist livelihoods, high poverty levels, limited health infrastructure, low literacy rates, and significant barriers to healthcare access (KNBS, 2020). HIV prevalence in the county stands at 3.8%, with 1,212 HIV-positive adults registered for care at Isiolo County Referral Hospital.

Clinical care at the Comprehensive Care Clinic (CCC) has historically focused on ART initiation and viral suppression, with limited systematic capacity for NCD screening or integrated chronic disease management (MoH, 2023). Against this backdrop, the dual burden of HIV and cardiometabolic disease is likely to be evolving within this population without adequate detection or response. The epidemiological, clinical, and health systems context of Isiolo thus creates an urgent need for locally grounded evidence to characterize the burden of hypertension and diabetes and to identify the factors that shape their distribution within the HIV-positive population.

Problem Statement

Despite compelling global and regional evidence demonstrating the rising prevalence of hypertension and diabetes among PLWHIV, a critical gap exists in locally grounded, empirically derived estimates from arid and semi-arid Kenyan settings. Existing evidence from Kenya is predominantly derived from urban populations and national household surveys, which may not accurately reflect the unique risk profiles, health behaviors, and access constraints characteristic of pastoralist and ASAL communities (Achwoka et al., 2019; 2020; MoH, 2023). The absence of facility-specific, clinically measured prevalence data for a population actively receiving HIV care creates a significant obstacle for clinical decision-making, program planning, and evidence-based policy development at the county level.

Beyond the prevalence gap, there is insufficient understanding of how socio-demographic, anthropometric, and clinical factors interact to shape the distribution of hypertension and diabetes within this specific population. While predictors such as age, sex, BMI, ART regimen, and educational attainment have been identified in other settings, the extent to which these factors operate within the Isiolo PLWHIV population is unknown. Furthermore, clinical indicators such as blood pressure categories and fasting glucose levels, which reflect the biological clustering of cardiometabolic conditions, have not been examined in relation to one another within this context. Without this evidence, comprehensive care programming risks remaining narrowly focused on viral suppression, leaving a growing cardiometabolic burden unaddressed.

This study therefore addressed the following research question: What is the prevalence of diabetes and hypertension, and what socio-demographic, anthropometric, and clinical factors are independently associated with these conditions, among PLWHIV attending the Comprehensive Care Clinic at Isiolo County Referral Hospital?

Objective of the Study

The objective of this study was to determine the prevalence of diabetes and hypertension among PLWHIV attending the Comprehensive Care Clinic at Isiolo County Referral Hospital, and to examine the socio-demographic and anthropometric characteristics significantly associated with both conditions.

Significance of the Study

This study is significant on multiple dimensions. Clinically, it generates the first locally measured, facility-based prevalence estimates of hypertension and diabetes among PLWHIV in Isiolo County, providing a critical evidence base for the integration of cardiometabolic screening into routine HIV care. Programmatically, the identification of independent correlates of both conditions enables targeted risk stratification and prioritization of interventions within the CCC setting. At the policy level, the findings directly inform county health governance decisions regarding integrated HIV-NCD care models, resource allocation, and health worker training in Northern Kenya. Academically, the study extends the evidence base on the HIV-NCD nexus to an ASAL population that has been significantly underrepresented in published research, thereby addressing an important knowledge gap and contributing to the growing body of literature on integrated chronic disease management in resource-limited settings.

LITERATURE REVIEW

Global and Regional Burden of Hypertension and Diabetes Among PLWHIV

The convergence of HIV infection and non-communicable diseases, particularly hypertension and diabetes, is one of the most clinically significant transitions in global HIV epidemiology. As ART has extended survival among PLWHIV to near-normal life expectancy in many settings, the morbidity profile of this population has shifted from AIDS-defining opportunistic infections toward chronic, age-related conditions (Triant, 2014; Peck et al., 2014). Meta-analytic evidence has estimated the global prevalence of hypertension among PLWHIV at 23–24%, with substantial heterogeneity across regions and settings (Bigna & Noubiap, 2021). Diabetes prevalence has been estimated at approximately 5–10% among PLWHIV in low- and middle-income countries, with prediabetes adding a further significant layer of disease burden (Nansseu et al., 2018; Patel et al., 2018). These figures substantially exceed age-matched estimates in the general population in comparable settings,

reflecting the compounding metabolic effects of chronic HIV infection, immune activation, and ART-related metabolic disturbances.

In Sub-Saharan Africa, the burden is particularly pronounced. Studies in Tanzania, Ethiopia, Cameroon, and South Africa have reported hypertension prevalence ranging from 10% to over 30% among PLWHIV on long-term ART, while diabetes and prediabetes prevalence has been documented at 2–16% across diverse SSA cohorts (Todowede et al., 2019; Kagaruki et al., 2018; Dimala et al., 2016). The etiology of cardiometabolic disease in this population is multifactorial, encompassing the direct metabolic effects of specific ART regimens, chronic low-grade inflammation driven by HIV-related immune activation, aging, unhealthy lifestyle transitions associated with urbanization, and socioeconomic vulnerabilities that restrict access to preventive and curative care (Magodoro et al., 2016; Nansseu et al., 2018; Atun et al., 2017). Despite this evidence, integrated NCD screening within HIV care is inconsistently implemented across the region, contributing to high rates of undiagnosed and unmanaged cardiometabolic conditions.

Socio-Demographic Determinants of Hypertension and Diabetes Among PLWHIV

Socio-demographic characteristics have been consistently identified as important determinants of hypertension and diabetes burden among PLWHIV. Advancing age is one of the most robust predictors of both conditions, reflecting cumulative exposure to cardiometabolic risk factors and physiological changes such as arterial stiffness, reduced insulin sensitivity, and declining renal function (Kaze et al., 2021; Bigna et al., 2017). Studies in Kenya and Rwanda have documented markedly higher hypertension and diabetes prevalence among PLWHIV aged 45 years and above, consistent with patterns in the general population but amplified by prolonged ART exposure (Dushimiyimana et al., 2026). Gender differences are also evident, with female PLWHIV often exhibiting higher hypertension detection rates, potentially reflecting greater engagement with healthcare services and differential biological risk profiles (Moyo-Chilufya et al., 2023; Kintu et al., 2020).

Educational attainment and socioeconomic status play critical mediating roles. Lower educational levels are associated with reduced health literacy, poorer awareness of NCD risk factors, and constrained access to preventive health services, all of which increase vulnerability to cardiometabolic conditions (Okoh et al., 2019; Hagstrom et al., 2025). Occupational status and income further shape disease risk through their influence on dietary patterns, physical activity, and access to care. Among PLWHIV in African settings, poverty has been shown to limit access to NCD diagnostics and management, creating a feedback cycle in which socioeconomic disadvantage amplifies cardiometabolic risk (Kavishe et al., 2019; Atun et al., 2017).

Anthropometric and Clinical Correlates

Body mass index (BMI) is a key anthropometric correlate of hypertension and diabetes among PLWHIV. Both undernutrition and overweight or obesity have been associated with adverse cardiometabolic outcomes in this population, reflecting the dual nutritional burden prevalent in many SSA settings (Manne-Goehler et al., 2019; Bloomfield et al., 2018). Overweight and obesity have been directly linked to elevated blood pressure, insulin resistance, and metabolic syndrome in multiple African cohorts, while underweight status may reflect underlying disease severity, nutritional deficiencies, or wasting associated with advanced HIV disease, all of which carry independent metabolic implications (Kalyesubula et al., 2016; Semu et al., 2014).

The clinical relationship between ART regimens and cardiometabolic risk has been extensively documented. Protease inhibitor-based regimens and older NRTI backbones, particularly stavudine and zidovudine-containing combinations, are associated with elevated triglycerides, reduced high-density lipoprotein, increased insulin resistance, and higher hypertension risk (Currier et al., 2008; Ekrikpo et al., 2016). The newer integrase inhibitor-based regimens, particularly dolutegravir, while demonstrating improved tolerability, have been associated with weight gain and potential glucose dysregulation in some cohorts (Nduka et al., 2017). The clustering of hypertension and diabetes within the same clinical population underscores the concept of metabolic syndrome, where impaired glucose regulation, elevated blood pressure, dyslipidemia, and abdominal obesity co-occur and mutually reinforce disease progression (Kagaruki et al., 2018). Understanding these clinical inter-relationships is essential for designing comprehensive screening and management protocols.

Research Gaps

Despite the substantial global and regional evidence base, significant gaps persist in the literature as it pertains to the Kenyan ASAL context. Existing Kenyan studies on HIV-related NCDs are predominantly urban-based, facility-specific to higher-level or specialized centers, or nationally representative without disaggregation for populations with distinct socioeconomic and geographic profiles (Achwoka et al., 2019; Achwoka et al., 2020). No published study has measured clinically confirmed hypertension and diabetes prevalence, using standardized blood pressure and glucose protocols, among PLWHIV attending a comprehensive care clinic in an arid and semi-arid land county in Kenya. Furthermore, the correlates of these conditions within this specific population — including the role of ART regimen type, BMI, blood pressure-glucose clustering, and socioeconomic factors — have not been empirically examined. This study directly addresses these gaps.

MATERIALS AND METHODS

Study Design and Setting

This study adopted a hospital-based cross-sectional analytical design to determine the prevalence and correlates of hypertension and diabetes among PLWHIV. A cross-sectional design was considered appropriate because it enables the simultaneous measurement of disease outcomes and explanatory variables within a defined population at a single point in time, allowing for the estimation of disease burden and the assessment of statistical associations between clinical and socio-demographic predictors and the occurrence of hypertension and diabetes (Setia, 2016). The observational nature of the design was well-suited to a real-world clinical setting, where participants were assessed under routine care conditions rather than experimental manipulation. The design further supported both descriptive and inferential analytical procedures, enabling the estimation of prevalence and the testing of multivariable associations relevant to the study objective.

The study was conducted at Isiolo County Referral Hospital (Level 5), located in Isiolo County within Kenya's arid and semi-arid North. The hospital hosts the Comprehensive Care Clinic (CCC), which serves as the primary HIV care platform for the county and provides ART initiation, routine clinical monitoring, and follow-up services for HIV-positive adults. The clinic population comprises approximately 1,212 registered HIV-positive adult patients. The study setting was selected for its relevance to an underrepresented population of pastoralist, agro-pastoralist, and peri-urban residents who face unique structural, geographic, and socioeconomic determinants of health. The CCC context also provided direct access to both clinical records and patient-level data required for the assessment of cardiometabolic risk.

Study Population and Sampling

The study population comprised HIV-positive adults aged 18 years and above who were actively receiving ART at the Isiolo CCC during the study period. Inclusion criteria required that participants had been on ART for at least six months — a period considered sufficient to reflect treatment-related metabolic effects — and that they provided written informed consent. Participants were required to have resided in Isiolo County for a minimum of six months to ensure contextual relevance and were clinically stable at the time of enrollment. Exclusion criteria included individuals who were critically ill, unwilling to consent, unable to complete study procedures, or had previously been enrolled to avoid duplication.

The sample size was determined using the Yamane (1967) formula for finite populations: $n = N / [1 + N(e^2)]$, where $N = 1,212$ and $e = 0.05$, yielding a calculated sample of 301 participants. Systematic random sampling was employed to recruit participants from the clinic register. Upon arrival at the CCC, patients were assigned sequential identification numbers, with the first participant randomly selected from among the first ten patients, after which every third eligible patient was recruited. This approach ensured probability-based selection and minimized selection bias. A total of 231 valid questionnaires were obtained, representing a response rate of 76.7% relative to the target, which is considered adequate for robust statistical analysis in health science research (Fincham, 2008).

Data Collection Procedures and Instruments

Data were collected using a structured interviewer-administered questionnaire informed by the WHO STEPwise approach to NCD risk factor surveillance. The questionnaire captured socio-demographic characteristics, behavioral risk factors (tobacco use, alcohol consumption, physical activity, dietary patterns), HIV treatment history, and self-reported NCD history. Clinical assessments included standardized measurement of blood pressure, fasting plasma glucose, body weight, height, waist circumference, and waist-hip ratio, supplemented by review of clinical records for ART regimen, CD4 count, and viral load.

Blood pressure was measured using a calibrated automated sphygmomanometer with participants seated and rested for five minutes, with three readings taken at one-to-two-minute intervals; the mean of the three readings was used for classification. Hypertension was defined as systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg, or being on antihypertensive medication. Blood pressure was classified as normal, elevated, Stage 1 hypertension, and Stage 2 hypertension according to standard clinical criteria. Fasting plasma glucose was assessed and classified as normal (< 5.6 mmol/L), pre-diabetic (5.6–6.9 mmol/L), or diabetic (≥ 7.0 mmol/L on fasting, or ≥ 11.0 mmol/L on random measurement). Participants were classified as diabetic if they met the glucose criteria or were on antidiabetic medication. The questionnaire was pre-tested at Meru County Referral Hospital CCC prior to implementation to assess feasibility and refine instrument phrasing.

Data Analysis Techniques

Data were entered into Microsoft Excel, cleaned to ensure completeness, consistency, and accuracy, and subsequently exported to IBM SPSS Statistics version 25.0 for analysis. Descriptive statistical techniques, including frequencies, percentages, means, and standard deviations, were used to summarize the socio-demographic, anthropometric, and clinical characteristics of respondents. Prevalence estimates for hypertension and diabetes were determined using proportions based on self-reported diagnosis and clinical classifications of blood pressure and fasting blood glucose levels. Blood pressure measurements were categorized into normal, elevated, Stage 1 hypertension, and Stage 2 hypertension, while fasting blood glucose levels were categorized as normal, pre-diabetic, and diabetic according to established clinical thresholds. Chi-square tests of independence were used to examine associations between hypertension and diabetes status and selected socio-demographic, socioeconomic, anthropometric, and clinical variables, including age group, gender, education level, occupation, income category, BMI category, and blood pressure classification. Statistical significance was assessed at $p < 0.05$, and findings were presented using tables and narrative interpretation.

RESULTS

Socio-Demographic Profile of Respondents

A total of 231 participants were enrolled and provided valid data, representing a response rate of 76.7% against the targeted sample of 301. The socio-demographic characteristics of respondents are summarized in Table 1. The majority were female (61.0%, $n = 141$), consistent with the gender distribution typically observed in HIV care utilization patterns in Sub-Saharan Africa, where women access services at higher rates than men. In terms of age distribution, respondents aged 30–39 years constituted the largest group (27.7%), followed closely by those aged 18–29 years (27.3%) and those 50 years and above (23.4%), with the 40–49-year age group representing the smallest proportion (21.6%). This distribution, with nearly one-quarter of respondents in the oldest age category, is particularly relevant given the established relationship between advancing age and elevated cardiometabolic risk.

Marital status was diverse, with the largest proportions being single (29%) and married (29%), and 26% reporting divorce. Most respondents were Muslim (56%), reflecting the socio-cultural context of the study setting in Isiolo County. Occupationally, trading was the predominant activity (43%), followed by farming (30%) and pastoralism (18%), with formal employment and unemployment each at 3.9%, highlighting a predominantly informal livelihood structure. Household income data revealed that the majority of respondents fell within lower to middle income categories, with most earning between KSh 0–24,999 monthly, consistent with the county's high poverty profile.

Table 1: Socio-Demographic Profile of Respondents (N = 231)

Characteristic	Category	Frequency (n)	Percentage (%)
Gender	Female	141	61.0
	Male	90	39.0
Age Group (years)	18–29	63	27.3
	30–39	64	27.7
	40–49	50	21.6
	≥50	54	23.4
Marital Status	Single	68	29.4
	Married	66	28.6
	Divorced	61	26.4
	Separated / Cohabiting	36	15.6
Religion	Muslim	130	56.3
	Christian	101	43.7
Occupation	Trader	99	42.9
	Farmer	69	29.9
	Pastoralist	42	18.2
	Formally Employed / Unemployed	21	9.1
Household Size	1–3 members	90	39.0
	4–5 members	108	46.8
	≥6 members	33	14.3

Anthropometric and Vital Signs Profile of Respondents

The anthropometric profile of respondents revealed a heterogeneous nutritional status. The majority of respondents had weights concentrated in the 60–69.9 kg range (31%), with 8% recording weights of 80 kg and above and 16% below 50 kg, indicating the co-existence of underweight and overweight individuals within the cohort.

Height distribution was concentrated between 155–174.9 cm, accounting for 85.3% of respondents. BMI analysis showed that a significant proportion of respondents fell within the normal BMI range but with a notable presence of underweight (BMI < 18.5 kg/m²) and overweight or obese (BMI > 25 kg/m²) individuals, illustrating the dual nutritional burden characteristic of HIV-affected populations in resource-limited settings.

Vital signs assessment indicated a mean systolic blood pressure concentration in the 120–140 mmHg range, with a visible right skew toward higher values, while diastolic readings were predominantly within 70–90 mmHg with an upper tail extending beyond 100 mmHg. Blood pressure clinical category distribution is presented in Table 2.

Table 2: Blood Pressure and Fasting Glucose Clinical Category Distribution (N = 231)

Clinical Indicator	Category	Frequency (n)	Percentage (%)
Blood Pressure Category	Normal	60	26.0

	Elevated	43	18.6
	Stage 1 Hypertension	91	39.4
	Stage 2 Hypertension	37	16.0
Fasting Glucose Category	Normal	84	36.4
	Pre-diabetic	56	24.2
	Diabetic	91	39.4

Hypertension Prevalence Based on Socio-Demographic and Anthropometric Characteristics

The findings showed that 42.4% of respondents (n = 98) had previously been informed by a health professional that they had hypertension, while 57.6% (n = 133) reported no prior diagnosis. This indicates that a considerable proportion of PLWHIV attending the Comprehensive Care Clinic were already living with clinically recognized hypertension. To further examine the distribution of hypertension across population subgroups, chi-square analysis was conducted to assess the association between hypertension status and selected socio-demographic, anthropometric, and clinical characteristics. The results presented in Table 3 demonstrate statistically significant associations between hypertension status and age group, gender, education level, occupation, BMI category, and blood pressure classification ($p < 0.05$).

Table 3: Association Between Hypertension Status and Selected Socio Demographic, Anthropometric and Clinical Characteristics

Predictor Variable	Category	NCD_No	NCD_Yes	p_value
Age Group	18-29	47 (74.6%)	16 (25.4%)	0.0109*
	30-39	35 (54.7%)	29 (45.3%)	
	40-49	23 (46%)	27 (54%)	
	50+	28 (51.9%)	26 (48.1%)	
Gender	Female	71 (50.4%)	70 (49.6%)	0.0082*
	Male	62 (68.9%)	28 (31.1%)	
Education Level	Primary	17 (37.8%)	28 (62.2%)	0.0031*
	Secondary	92 (65.7%)	48 (34.3%)	
	Tertiary	24 (52.2%)	22 (47.8%)	
Occupation	Employed	7 (77.8%)	2 (22.2%)	0.0194*
	Farmer	40 (58%)	29 (42%)	
	Other (specify)	3 (100%)	0 (0%)	
	Pastoralist	28 (66.7%)	14 (33.3%)	
	Trader	54 (54.5%)	45 (45.5%)	
	Unemployed	1 (11.1%)	8 (88.9%)	
BMI Category	Normal	59 (59.6%)	40 (40.4%)	0.0084*
	Overweight/Obese	58 (65.2%)	31 (34.8%)	
	Underweight	16 (37.2%)	27 (62.8%)	
BP Category	Elevated	28 (65.1%)	15 (34.9%)	0.0029*

	Normal	43 (71.7%)	17 (28.3%)	
	Stage 1 Hypertension	49 (53.8%)	42 (46.2%)	
	Stage 2 Hypertension	13 (35.1%)	24 (64.9%)	

Table 3 shows that hypertension prevalence increased progressively with advancing age. Respondents aged 18–29 years had the lowest proportion of hypertension cases (25.4%), while those aged 40–49 years recorded the highest prevalence (54.0%). The association between age and hypertension status was statistically significant ($p = 0.0109$), suggesting that increasing age is an important factor associated with elevated hypertension risk among PLWHIV. Gender differences were also observed, with females reporting a markedly higher prevalence of hypertension (49.6%) compared to males (31.1%). This association was statistically significant ($p = 0.0082$), indicating that female respondents in the study population experienced a greater burden of hypertension.

Educational attainment was significantly associated with hypertension status ($p = 0.0031$). Respondents with primary-level education recorded the highest prevalence of hypertension (62.2%), compared to those with secondary education (34.3%) and tertiary education (47.8%). This pattern suggests that lower educational attainment may be associated with increased vulnerability to cardiometabolic conditions, potentially through reduced health literacy, limited access to preventive care, and poorer socioeconomic conditions. Occupational status also demonstrated a statistically significant relationship with hypertension prevalence ($p = 0.0194$). The highest prevalence was observed among unemployed respondents (88.9%), followed by traders (45.5%) and farmers (42.0%), whereas employed respondents recorded comparatively lower prevalence levels (22.2%). These findings indicate possible socioeconomic influences on hypertension risk within the study population.

Anthropometric assessment further revealed a significant association between BMI category and hypertension status ($p = 0.0084$). Underweight respondents recorded the highest prevalence of hypertension (62.8%), compared to respondents with normal BMI (40.4%) and those classified as overweight or obese (34.8%). Although overweight and obesity are conventionally associated with hypertension risk, the elevated burden observed among underweight PLWHIV may reflect underlying nutritional deficiencies, chronic illness effects, or HIV-related metabolic complications. Clinical blood pressure categories were also strongly associated with hypertension status ($p = 0.0029$). Respondents classified within Stage 2 hypertension recorded the highest proportion of hypertension cases (64.9%), followed by those in Stage 1 hypertension (46.2%), while respondents with normal blood pressure recorded the lowest prevalence (28.3%). Overall, the findings indicate that hypertension among PLWHIV is influenced by a combination of demographic, socioeconomic, nutritional, and clinical factors.

Hypertension Prevalence Based on Socio-Demographic and Anthropometric Characteristics

The findings further revealed that 23.4% of respondents ($n = 54$) had previously been informed by a health professional that they had diabetes, while the majority, 76.6% ($n = 177$), reported no prior diagnosis. Although the proportion of formally diagnosed diabetes cases was lower than that observed for hypertension, the findings still indicate a considerable burden of diabetes among PLWHIV attending the Comprehensive Care Clinic.

To determine factors associated with diabetes prevalence, chi-square analysis was conducted between diabetes status and selected socio-demographic, economic, anthropometric, and clinical characteristics. The results presented in Table 4.4 demonstrate statistically significant associations between diabetes status and age group, gender, education level, occupation, monthly income, and BMI category ($p < 0.05$).

Table 4: Association Between Diabetes Status and Selected Socio Demographic, Anthropometric and Clinical Characteristics

Predictor	Category	NCD_No	NCD_Yes	p_value
Age Group	18-29	57 (90.5%)	6 (9.5%)	0.0057*
	30-39	49 (76.6%)	15 (23.4%)	

	40-49	37 (74%)	13 (26%)	
	50+	34 (63%)	20 (37%)	
Gender	Female	99 (70.2%)	42 (29.8%)	0.0065*
	Male	78 (86.7%)	12 (13.3%)	
Education Level	Primary	36 (80%)	9 (20%)	0.0015*
	Secondary	115 (82.1%)	25 (17.9%)	
	Tertiary	26 (56.5%)	20 (43.5%)	
Occupation	Employed	9 (100%)	0 (0%)	0.0099*
	Farmer	59 (85.5%)	10 (14.5%)	
	Other (specify)	3 (100%)	0 (0%)	
	Pastoralist	31 (73.8%)	11 (26.2%)	
	Trader	66 (66.7%)	33 (33.3%)	
	Unemployed	9 (100%)	0 (0%)	
Monthly Income	0–9,999	51 (79.7%)	13 (20.3%)	0.0029*
	10,000–24,999	86 (68.3%)	40 (31.7%)	
	100,000 or more	3 (100%)	0 (0%)	
	25,000–49,999	32 (100%)	0 (0%)	
	50,000–99,999	5 (83.3%)	1 (16.7%)	
BMI Category	Normal	83 (83.8%)	16 (16.2%)	0.0038*
	Overweight/Obese	69 (77.5%)	20 (22.5%)	
	Underweight	25 (58.1%)	18 (41.9%)	

As shown in Table 4, diabetes prevalence increased steadily with advancing age. Respondents aged 18–29 years recorded the lowest prevalence of diabetes (9.5%), while respondents aged 50 years and above had the highest prevalence (37.0%). The relationship between age and diabetes status was statistically significant ($p = 0.0057$), indicating that older PLWHIV were disproportionately affected by diabetes. Gender differences were similarly observed, with female respondents reporting a higher prevalence of diabetes (29.8%) compared to male respondents (13.3%). The association between gender and diabetes status was statistically significant ($p = 0.0065$), suggesting that female PLWHIV in the study population experienced greater vulnerability to diabetes.

Educational attainment demonstrated a statistically significant association with diabetes prevalence ($p = 0.0015$). Respondents with tertiary education recorded the highest prevalence of diabetes (43.5%), followed by those with primary education (20.0%) and secondary education (17.9%). Occupational status was also significantly associated with diabetes prevalence ($p = 0.0099$). Traders recorded the highest proportion of diabetes cases (33.3%), followed by pastoralists (26.2%) and farmers (14.5%), while no diabetes cases were reported among formally employed and unemployed respondents. These occupational differences may reflect variations in lifestyle patterns, dietary practices, and levels of physical activity across livelihood groups.

Monthly income demonstrated a statistically significant association with diabetes prevalence ($p = 0.0029$). Respondents earning between KSh 10,000–24,999 recorded the highest prevalence of diabetes (31.7%), while no diabetes cases were reported among respondents earning KSh 25,000 and above in several income categories. This pattern may indicate complex interactions between income status, dietary transitions, access to healthcare, and lifestyle behaviors. BMI category was also significantly associated with diabetes status ($p = 0.0038$). Underweight respondents recorded the highest prevalence of diabetes (41.9%), compared to overweight/obese respondents (22.5%) and respondents with normal BMI (16.2%). The elevated diabetes burden among

underweight PLWHIV may reflect HIV-related metabolic disturbances, nutritional deficiencies, or chronic disease progression. Overall, the findings suggest that diabetes prevalence among PLWHIV is shaped by interconnected demographic, socioeconomic, and nutritional factors.

DISCUSSION

Prevalence of Hypertension and Diabetes Among PLWHIV

The present study established a considerable burden of hypertension and diabetes among people living with HIV/AIDS attending the Comprehensive Care Clinic at Isiolo County Referral Hospital. The findings revealed that 42.4% of respondents had previously been diagnosed with hypertension, while 23.4% had previously been diagnosed with diabetes. In addition, clinical assessment demonstrated that 39.4% of respondents were classified within Stage 1 hypertension and 16.0% within Stage 2 hypertension, while 39.4% were classified as diabetic and 24.2% as pre-diabetic based on fasting glucose measurements. These findings indicate that cardiometabolic conditions represent an important and growing public health challenge among PLWHIV within the study setting. The substantial proportion of respondents classified as pre-diabetic further suggests the existence of a large at-risk population that may progress to overt diabetes without timely screening and intervention.

The prevalence of hypertension observed in this study is comparable to findings reported in several studies conducted among PLWHIV in Sub-Saharan Africa. Studies conducted in Tanzania, Uganda, Cameroon, and South Africa have similarly documented elevated hypertension prevalence among PLWHIV receiving ART (Kagaruki et al., 2014; Kalyesubula et al., 2016; Magodoro et al., 2016). The findings are also consistent with the systematic review and meta-analysis by Bigna and Noubiap (2021), which established that PLWHIV experience a substantial burden of hypertension globally. The elevated prevalence observed in the present study may partly be attributed to prolonged survival associated with ART, aging of the HIV-positive population, chronic inflammation, and increasing exposure to non-communicable disease risk factors.

Similarly, the diabetes burden observed among respondents supports existing evidence suggesting that glucose metabolism abnormalities are increasingly common among PLWHIV. Comparable findings have been reported in previous studies conducted in African HIV care settings, where diabetes and pre-diabetes prevalence among PLWHIV have continued to rise alongside improved HIV survival outcomes (Nansseu et al., 2018; Patel et al., 2018). Chronic HIV infection, long-term antiretroviral therapy exposure, and metabolic alterations associated with immune dysregulation may contribute to impaired glucose metabolism among PLWHIV. The findings therefore reinforce growing concerns regarding the epidemiological transition from predominantly infectious disease morbidity toward chronic non-communicable diseases within HIV care programs.

Association Between Socio-Demographic Characteristics and Hypertension

The study findings demonstrated a statistically significant association between age and hypertension prevalence among PLWHIV. Respondents aged 40 years and above recorded markedly higher hypertension prevalence compared to younger respondents. This finding is consistent with previous studies which have demonstrated that advancing age is a major determinant of hypertension among both HIV-positive and general populations (Kaze et al., 2017; Mohamed et al., 2018). Aging is commonly associated with progressive vascular stiffness, endothelial dysfunction, and cumulative exposure to cardiovascular risk factors, all of which contribute to elevated blood pressure. Among PLWHIV, prolonged exposure to ART and chronic immune activation may further accelerate cardiometabolic aging processes.

Gender was also significantly associated with hypertension prevalence, with female respondents recording higher hypertension prevalence compared to males. Similar findings have been reported in studies conducted among PLWHIV in Sub-Saharan Africa (Moyo-Chilufya et al., 2023). The higher burden observed among females may partly reflect differences in healthcare utilization patterns, as women are generally more likely to seek HIV care services and therefore have greater opportunities for clinical assessment and diagnosis. In addition, biological, hormonal, and socioeconomic factors may contribute to gender differences in hypertension risk among PLWHIV.

Educational attainment demonstrated a significant relationship with hypertension prevalence, with respondents possessing primary-level education recording the highest burden of hypertension. This finding supports evidence suggesting that lower educational attainment is associated with limited health literacy, poorer awareness of disease risk factors, and reduced access to preventive healthcare services (Okoh, 2025). Individuals with limited education may experience greater difficulty understanding chronic disease prevention strategies and navigating healthcare systems, thereby increasing vulnerability to non-communicable diseases.

Occupation was similarly associated with hypertension prevalence. Unemployed respondents recorded the highest prevalence, followed by traders and farmers. These findings may reflect the influence of socioeconomic stressors, unstable livelihoods, and limited healthcare access on cardiometabolic health. Previous studies have demonstrated that socioeconomic disadvantage contributes significantly to chronic disease vulnerability through reduced healthcare access, financial stress, and limited preventive care utilization (Atun et al., 2017). The predominance of informal occupations within the study population further suggests the importance of structural and livelihood-related determinants in shaping hypertension risk among PLWHIV.

The study additionally established a significant association between BMI category and hypertension prevalence. Underweight respondents recorded the highest prevalence of hypertension compared to respondents with normal or overweight BMI. The elevated prevalence of hypertension and diabetes among underweight PLWHIV in this study, while counterintuitive, is consistent with emerging evidence on HIV-associated metabolic abnormalities. Several mechanisms may explain this pattern. First, HIV-associated wasting syndrome and lipodystrophy can lead to metabolic dysregulation independent of overall BMI, with redistribution of adipose tissue contributing to insulin resistance and vascular dysfunction (Grinspoon & Carr, 2005). In addition, underweight PLWHIV may represent individuals with more advanced HIV disease progression, characterized by prolonged immunosuppression and cumulative metabolic stress. Further, certain ART regimens, particularly older nucleoside reverse transcriptase inhibitors, are known to cause mitochondrial toxicity leading to lipodystrophy and metabolic complications even in the absence of weight gain (Koethe et al., 2020). The possibility of residual confounding from disease severity, ART exposure duration, or unmeasured lifestyle factors cannot be excluded in the cross-sectional design of this study.

Association Between Socio-Demographic Characteristics and Diabetes

The findings further demonstrated that age was significantly associated with diabetes prevalence, with respondents aged 50 years and above recording the highest burden of diabetes. This finding aligns with previous studies showing that advancing age increases susceptibility to impaired glucose metabolism and diabetes among PLWHIV (Nansseu et al., 2018; Patel et al., 2018). Age-related metabolic changes, prolonged ART exposure, reduced insulin sensitivity, and cumulative lifestyle-related risk factors may collectively contribute to elevated diabetes prevalence among older PLWHIV.

Gender differences were similarly observed, with female respondents recording significantly higher diabetes prevalence compared to males. Comparable findings have been documented in studies conducted among HIV-positive populations in Sub-Saharan Africa (Moyo-Chilufya et al., 2023). The higher burden among women may reflect a combination of biological susceptibility, healthcare utilization patterns, and socioeconomic vulnerabilities that disproportionately affect women in resource-limited settings.

Educational attainment also demonstrated a statistically significant association with diabetes prevalence. Respondents with tertiary education recorded the highest prevalence of diabetes, contrary to the pattern observed for hypertension. This finding may reflect lifestyle transitions associated with higher educational attainment, including reduced physical activity, urbanized living patterns, and dietary changes that predispose individuals to metabolic disorders. Similar observations linking socioeconomic transition and increasing diabetes burden have been reported in several developing-country settings undergoing epidemiological transition (Oni et al., 2014).

Occupation and income status were also significantly associated with diabetes prevalence. Traders recorded the highest burden of diabetes, while respondents within the KSh 10,000–24,999 income category demonstrated comparatively higher prevalence than other income groups. These findings may reflect differences in lifestyle behaviors, work-related sedentary patterns, and dietary practices across occupational and economic groups.

Informal trading activities often involve prolonged sitting periods and irregular feeding patterns, which may contribute to increased metabolic risk.

The association between BMI category and diabetes prevalence was also statistically significant, with underweight respondents recording the highest diabetes prevalence. Similar findings have occasionally been reported among PLWHIV where chronic HIV infection, ART exposure, and metabolic dysregulation contribute to abnormal glucose metabolism even in the absence of overweight or obesity (Manne-Goehler et al., 2017). The findings therefore highlight the complex metabolic profile of PLWHIV and suggest that diabetes screening within HIV care settings should not exclusively target overweight individuals.

The relationship between socioeconomic vulnerability and cardiometabolic burden among PLWHIV in ASAL settings likely operates through multiple interconnected pathways. In resource-limited pastoral communities such as Isiolo County, food insecurity may lead to irregular meal patterns and consumption of calorie-dense but nutrient-poor foods when available, contributing to metabolic dysregulation (Weiser et al., 2011). Limited access to healthcare facilities, long travel distances, and competing livelihood demands may delay diagnosis and reduce opportunities for preventive care and health education. Furthermore, the psychosocial stress associated with poverty, HIV-related stigma, and livelihood uncertainty may elevate cortisol levels and contribute to hypertension through chronic activation of the hypothalamic-pituitary-adrenal axis (Mendenhall et al., 2017). The informal nature of predominant occupations; trading, farming, and pastoralism, may also limit access to employer-based health benefits and regular medical check-ups that could facilitate early detection.

CONCLUSION AND RECOMMENDATIONS

Conclusions

This study established that hypertension and diabetes constitute a significant and growing public health burden among people living with HIV/AIDS attending the Comprehensive Care Clinic at Isiolo County Referral Hospital. The findings revealed a relatively high prevalence of both conditions within the study population, with a substantial proportion of respondents presenting with elevated blood pressure, diabetic fasting glucose levels, and pre-diabetic status. The study further demonstrated that hypertension and diabetes among PLWHIV are significantly associated with several socio-demographic and anthropometric characteristics, including advancing age, gender, educational attainment, occupation, income status, and BMI category. Older respondents, females, individuals with lower educational attainment, and underweight participants generally exhibited higher prevalence of cardiometabolic conditions, highlighting the complex interaction between biological, socioeconomic, and nutritional vulnerabilities within the HIV-positive population.

The findings underscore the ongoing epidemiological transition within HIV care settings, where non-communicable diseases are increasingly emerging alongside chronic HIV management as important contributors to morbidity among PLWHIV. The coexistence of hypertension, diabetes, and abnormal glucose regulation observed in this study demonstrates the need for integrated and patient-centered approaches to HIV care that extend beyond viral suppression alone. Furthermore, the study contributes important empirical evidence from an underrepresented arid and semi-arid region of Kenya, where limited healthcare resources, poverty, and structural barriers may intensify vulnerability to chronic disease among PLWHIV. Overall, the findings provide a strong basis for strengthening routine cardiometabolic screening, early diagnosis, and integrated chronic disease management within Comprehensive Care Clinics in Kenya.

Recommendation

Based on the study findings, routine integrated screening for hypertension and diabetes should be institutionalized within Comprehensive Care Clinics through standardized blood pressure measurement and regular fasting blood glucose assessment during routine HIV care visits. This would support early detection and timely management of cardiometabolic conditions among PLWHIV. Targeted surveillance and follow-up programs should particularly prioritize older adults, female patients, socioeconomically vulnerable individuals, and underweight PLWHIV who demonstrated higher prevalence of hypertension and diabetes within the study

population. County and national health authorities should further strengthen integrated HIV-NCD care frameworks through capacity building of healthcare workers, improved availability of diagnostic and treatment resources, and establishment of effective referral and follow-up systems within HIV care settings. In addition, health education and awareness programs focusing on chronic disease prevention among PLWHIV should be strengthened within communities and healthcare facilities. Further, prospective longitudinal cohort studies are needed to expound on the temporal relationships between HIV infection, specific ART regimens, and cardiometabolic disease progression among PLWHIV. Such studies should incorporate detailed clinical data including CD4 trajectories, viral load suppression, and ART regimen histories. Additionally, implementation research evaluating integrated HIV-NCD care models, including feasibility, cost-effectiveness, and patient outcomes of routine cardiometabolic screening within CCCs, is needed to inform scalable interventions in underserved ASAL regions of Kenya. Comparative effectiveness studies examining different screening algorithms and referral pathways would further strengthen the evidence base for HIV-NCD integration in resource-limited settings

STUDY LIMITATIONS

Several limitations should be considered when interpreting these findings. The cross-sectional design of this study precludes the establishment of temporal or causal relationships between HIV infection, ART exposure, and cardiometabolic outcomes. Additionally, the achieved sample size of 231 participants, representing 76.7% of the targeted 301, may have reduced statistical power to detect smaller effect sizes while also limiting the precision of prevalence estimates. Related to this, non-response may have introduced selection bias if non-participants differed systematically from participants in their cardiometabolic risk profiles. The reliance on self-reported data for prior hypertension and diabetes diagnoses presents another limitation, as such information is subject to recall bias and may underestimate true prevalence, particularly among individuals with limited healthcare access who may have undiagnosed conditions. Furthermore, the study did not collect detailed clinical data on ART regimen type, duration of ART exposure, viral suppression status, or CD4 count, all of which are important variables that may confound the observed associations between socio-demographic characteristics and cardiometabolic outcomes. Lastly, since data were collected from a single health facility in one ASAL county, the findings may not be generalizable to other PLWHIV populations across Kenya or in similar resource-limited settings elsewhere.

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