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Research Article

Prevalence and Factors Associated With Selected Non-communicable Diseases (Hypertension, Type 2 Diabetes, and Depression) Among People Living With HIV at Kalisizo Hospital in Kyotera District, Uganda: A Cross-Sectional Study

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Background: In rural Uganda, there exists a paucity of data on the prevalence and factors associated with non-communicable diseases (NCDs) among people living with HIV, despite heightened concerns about their increased susceptibility. Therefore, this study aims to investigate the prevalence and assess factors associated with selected NCDs, namely hypertension, type 2 diabetes, and depression, among people living with HIV (PLHIV) seeking HIV care at Kalisizo Hospital.

Methods: A cross-sectional study was conducted at Kalisizo Hospital, involving a randomly selected sample of 290 individuals living with HIV between August 8th to 24th, 2020. Data on socio-demographics, lifestyle, and clinical characteristics were collected using an adapted WHO steps questionnaire, medical records review, and a patient Health Questionnaire-9. We further conducted anthropometric and laboratory measurements. Statistical analysis was performed using STATA Version 15.0, employing Modified Poisson regression.

Results: The overall prevalence of NCDs was 39.7% (95% CI=34.2%-45.4%). This prevalence was higher among participants with tertiary education (aPR=1.55, 95% CI=1.05,2.77, p=0.026), those who were obese (aPR=2.01, 95% CI=1.40,2.87, p<0.001), individuals in WHO clinical staging 3 and 4 of HIV (aPR=1.45, 95% CI=1.02,2.05, p=0.037), and those with unhealthy dietary habits (aPR=1.61, 95% CI=1.20,2.16, p=0.002).

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Conclusion: This study unveiled a significant prevalence of selected NCDs among PLHIV seeking HIV care at Kalisizo Hospital. This highlights the pressing necessity for swift and impactful measures to be taken by the Ugandan government, development partners, and other stakeholders. It is imperative to implement tailored interventions designed to address the high NCD prevalence observed in PLHIV who are obese, engage in unhealthy dietary habits, possess tertiary education, and fall into WHO clinical stage 3 or 4 of HIV.

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Introduction

For over three decades, HIV/AIDS has persisted as a paramount global public health concern, infecting over 75 million people, and contributing to 32 million deaths [1]. The implementation of combination antiretroviral therapy (ART) over the years has marked a significant milestone, substantially enhancing life expectancy and the overall survival of people living with HIV/AIDS (PLHIV) [2][3]. There has been successful control of viremia and HIV-induced acquired immune deficiency syndrome (AIDS) through ART [4][5]. This has resulted in a high prevalence of non-communicable diseases (NCDs) among PLHIV [6][7][8]. NCDs are now the leading cause of morbidity and mortality among PLHIV [9][10].

Moreover, there are inevitable age-related degenerative changes, primarily accelerated by HIV infection and the cumulative exposure to ART toxicities [7]. These changes manifest in heightened body inflammations, immune suppression, and immune dysfunction, collectively contributing to an elevated burden of non-communicable diseases (NCDs) in individuals with HIV [11][12]. Additionally, most of the traditional risk factors for NCDs such as alcohol and substance abuse, physical inactivity, and unhealthy diets which are present in the general population are also prevalent among PLHIV [13] [14]. The intersection of these traditional risk factors with the effects of HIV infection and ART toxicities synergistically accelerates the onset of NCDs in this vulnerable population [7][15].

The strides achieved in improving health and life quality for individuals with HIV are now facing a new challenge from non-communicable diseases (NCDs). Common among PLHIV are heart diseases, particularly hypertension (HT), metabolic conditions, especially type 2 diabetes mellitus (T2DM), and mental health issues, notably depression [16][17]. Moreover, the prevalence of specific NCDs is pronounced within the PLHIV population. A study in South Africa found that 50.1% of PLHIV had HT [18]. Similarly, in Ethiopia, a study reported a substantial burden of HT among PLHIV, with a prevalence of 29% [19]. Additionally, T2DM is notably prevalent among PLHIV, with a systematic review indicating a prevalence ranging from 1% to 26% [20]. This prevalence was observed to escalate with increasing age and higher body mass index (BMI) [20]. Another study in Ethiopia reported that 42% of PLHIV experienced depression [21].

The substantial burden of NCDs in sub-Saharan Africa significantly impacts the prognosis and quality of life for PLHIV. This heightened prevalence not only escalates healthcare costs but also imposes additional responsibilities on health workers who must screen and treat NCDs independently of HIV care. The strain of managing both HIV and NCDs further burdens already overwhelmed healthcare systems grappling with extensive healthcare needs. Additionally, the elevated prevalence of NCDs contributes to increased morbidity and mortality among PLHIV [22][23][24].

Eastern Africa stands as the second most affected region in Africa concerning the burden of HIV, trailing behind Southern Africa. Collectively, these regions account for an estimated 17.7 million PLHIV [25][26]. Additionally, the region grapples with an elevated burden of NCDs, particularly HT, T2DM, and depression [27]. Uganda, a country within East Africa, bears the highest HIV burden, with a prevalence of 6.2% [28]. Reflecting on the 1980s and 90s, HIV/AIDS was once shrouded in mystery, feared, untreated, and often fatal. However, the widespread implementation of ART has remarkably mitigated the devastating impact of the HIV epidemic in the past decade. This transformation has redefined HIV as a chronic infectious disease, with PLHIV now not only surviving but also aging, necessitating lifelong care and treatment [29].

Despite Uganda grappling with the dual challenge of HIV and non-communicable diseases (NCDs), the available studies on the burden of NCDs among PLHIV in the country are limited, yet they reveal a substantial prevalence [30][31]. For instance, Kansiime et al reported the prevalence of NCDs at 20.7% (95% CI=16.7%-24.5%) among PLHIV on ART in Kampala [31]. In terms of individual conditions, depression emerges as the most prevalent condition, affecting 30.88% of the studied population, followed by HT with prevalence of 12.4%, while T2DM is the least common with a prevalence of 4.7% [31][32].

Considerable evidence highlights the elevated burden of NCDs among PLHIV in high-income countries (HICs). Unfortunately, there is a notable scarcity of data and research evidence on such conditions in low and middle-income countries (LMICs), especially in Uganda. This research gap impedes our understanding of the prevalence and associated factors of specific NCDs, such as HT, T2DM, and depression, in these settings. Addressing this knowledge gap is crucial to sustaining the progress achieved in the battle against HIV. This study therefore determined the prevalence and factors associated with selected non-communicable diseases among PLHIV at Kalisizo Hospital in Kyotera district-Uganda.

Methods

Study design, settings, and population

This cross-sectional study was carried out at Kalisizo Hospital, situated in Kalisizo Town Council within Kyotera district. Notably, Kyotera district, a recently established district formerly part of greater Rakai district, is located 30 kms from Masaka Regional Referral Hospital [33]. The district is divided into two counties: Kakuuto and Kyotera county.

Kakuuto county has 3 clinics, 13 health center IIs, 4 health center IIIs, and 1 health center IV [34]. On the other hand, Kyotera county features 10 clinics, 39 health center IIs, 11 health center IIIs, and 1 Hospital—Kalisizo Hospital [34]. Kalisizo Hospital, a Ministry of Health (MoH) facility, plays a pivotal role in delivering comprehensive outpatient and inpatient services. These services span maternal, reproductive, child health, nutritional, HIV, NCD, and general healthcare. As the primary hospital for Kyotera district, it also serves as the referral hospital for lower-level health facilities, covering a catchment population of approximately 70,000 people with a bed capacity of 120 beds. [33][35]. The hospital predominantly caters to a population of over 87% residing in rural areas, engaged in occupations such as agriculture, trading, and fishing [36]. Notably, this population has been significantly impacted by HIV for over three decades, with an HIV prevalence ranging from 14% in agrarian communities to 42% in fishing communities [36].

Additionally, the hospital has an HIV clinic that conducts routine screening and management for approximately 7000 PLHIV. Regular blood pressure measurement is integral during each clinic visit. Furthermore, the hospital has an NCD clinic which is operational every Thursday. This clinic provides screening, diagnosis, and management of NCDs. Screening for depression is also based on presented symptoms. Despite these efforts, the quantifiable burden of NCDs among PLHIV at Kalisizo Hospital remains undocumented.

The study population comprised PLHIV attending Kalisizo Hospital aged at least 35 years. This age criterion was selected to adequately represent the prevalence of NCDs in the aging population [37].

Sample size and sampling procedure

We determined the sample size using Kish Lesley's formula for survey sample size calculation [38], considering the following assumptions: a 95% confidence interval, a prevalence of NCDs among PLHIV in Uganda at 20.7 [31], and factoring in a nonresponse rate of 14% [39], the calculated sample size was 296 respondents.

To sample the study participants, we employed a simple random sampling technique, utilizing the ART register as our sampling frame. Appointments served as the basis for selecting respondents, with the selection process taking place a day prior to the scheduled appointments. Each participant's name, serial number, and sample number were attached to each respondent for purposes of easy identification.

In instances where a selected participant couldn't honor the appointment on the designated day, our research assistant, who was a staff member at Kalisizo Hospital, promptly contacted the participant via telephone. The individual was then added to the list of respondents to be interviewed the following day. Should the participant remain unavailable the next day, a replacement participant was randomly sampled for a new appointment. This random selection was facilitated by generating a list of random numbers through a random number generator (random.org), ranging from 1 to the

maximum number of participants with appointments for the next day.

Data collection

We gathered data during the period from August 8th to August 24th, 2020. Individuals who provided their consent to take part in the study underwent a modified WHO steps questionnaire, which examined their social-demographic, lifestyle, and clinical attributes. The questionnaire was paper based and conducted in Luganda, the predominant language in the region. A proficient team of interviewers conducted the questionnaire and gathered additional information. Additionally, we recorded participants' height, weight, blood pressure, and blood sugar. The data collection process occurred immediately following the participants' arrival at the Hospital.

Height measurements were obtained using a portable stadiometer (Shorr Board stadiometer, Olney, MD) with precision up to 0.1cm. Participants were instructed to stand upright without footwear during the measurement process. Weight was determined to the nearest 0.1 kg for each participant, while they wore light clothing and no shoes. An automatic Seca scale 600, calibrated specifically for the study, was utilized for weight assessments. Body mass index (BMI) was calculated as an individual's weight in kilograms divided by the square of their height in meters, expressed in kg/m^2. BMI categories were defined as follows: a BMI less than 18.5 indicated underweight, a BMI between 18.5 and 24.9 indicated normal weight, a BMI between 25 and 29.9 indicated overweight, and a BMI of 30 or more indicated obesity. These classifications were based on internationally recognized standards [40].

Three blood pressure (BP) measurements were recorded on the same interview day. The initial measurement was taken upon the participant's arrival, followed by a second reading 10 minutes later, and a third reading another 10 minutes after the interviews. Participants were seated in a chair with their feet on the floor, and their arm was positioned on a table to ensure the elbow was approximately at heart level.

The blood pressure readings were obtained using a calibrated digital BP machine (Baso Medicus Uno®). Hypertension staging was defined in accordance with the eighth Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure [41]. Stage 1 hypertension was identified by systolic readings between 140 and 159 mmHg or diastolic readings between 90 and 99 mmHg, while Stage 2 hypertension was indicated by systolic readings of 160 mmHg or higher or diastolic readings of 100 mmHg or higher.

To measure Fasting Plasma Glucose (FPG), each participant received a phone call from our research assistant a day before their scheduled appointment. They were instructed not to eat any food after their evening meal until the blood glucose test was administered the following morning. Participants who reported consuming any food before the blood test were asked to reschedule for a new appointment the next morning.

For participants who provided consent and underwent the FPG test, a small drop of capillary blood was obtained through a finger prick using an automated lancing device. The blood was then analyzed using a simple automated glucometer (On-Call® Plus, Acon). A participant was classified as diabetic if their fasting plasma glucose (FPG) concentration exceeded 126 mg/dl or 7.0 mmol/l, or if they were taking antidiabetic medication.

A short form Patient Health Questionnaire (PHQ-9), with 9 items served as the established cutoff for identifying depressive symptoms. Participants scoring 5 or more out of the 9 items were categorized as experiencing depression. The PHQ-9 has undergone validation for use across all age groups in the African population [42]. To answer questions on social demographic characteristics and other factors associated with the selected NCDs, an adapted WHO steps tool for NCD risk factor surveillance was used. The WHO steps questionnaire has been internationally and nationally validated for use in sub-Saharan African settings, including Uganda [43][44]. Irrelevant questions were omitted from the tool, and pertinent questions not included in the tool but relevant to the study were incorporated into the questionnaire. A thorough pretest among Kalisizo Town Council residents ensured clarity and understanding of all questions. Some data was captured using medical records review.

In our study, independent variables were classified as follows: BMI was defined as an individual's weight in kilograms divided by the square of their height in meters, expressed in kg/m2. Participants with a BMI less than 18.5 were classified as underweight, those with a BMI between 18.5 and 24.9 were categorized as having normal weight, individuals with a BMI ranging from 25 to 29.9 were considered overweight, and those with a BMI of 30 or more were classified as obese.

Physical Activity was defined as any bodily movement generated by skeletal muscles, necessitating energy

expenditure. This encompassed activities involved in work, play, household chores, travel, and recreational pursuits. An individual was categorized as physically active if they engaged in either: a) at least 150 minutes of moderate-intensity physical activity throughout a week, b) at least 75 minutes of vigorous-intensity physical activity throughout a week, or c) an equivalent combination of moderate and vigorous-intensity activities over the course of a week.

A person was considered to have healthy diet if he/she consumed five portions of fruit and vegetables per day. This excluded potatoes, sweet potatoes, cassava, and other starchy roots, if he/she consumed less than 10% of total energy intake from free sugars (free sugars are all sugars added to foods or drinks by the manufacturer, cook or consumer, as well as sugars naturally present in honey, syrups, fruit juices and fruit juice concentrates) which is equivalent to 12 level teaspoons or less of sugar, and if he/she consumed less than 10% of saturated fats or less than 1% of trans-fats on a daily total energy intake. This was based on international standards for classifying diet [45].

Individuals who reported using any tobacco products in the past 1 year were categorized as tobacco smokers. Individuals who reported consuming alcohol within the last six months were considered alcohol users.

Sex was considered a binary variable, categorized into male or female. Respondents' ages were recorded in completed years. In cases where respondents were unaware of their age, significant historical local events were employed as a proxy for estimating their ages. A variable termed "age group" was then established, comprising three categories: 35-44 years represented as 1, 45-54 years as 2, and 55 years and above as 3.

Income level was used as a proxy for socioeconomic status of the participant. We asked participants how much they earned in a month. We later categorized income into four groups. Less than or equal to 100,000 Uganda shillings (ugx), greater than 100,000 ugx but less than or equal to 500,000 ugx, greater than 500,000 ugx but less than or equal to 1 million ugx, and greater than 1 million ugx.

Different marital statuses included: never married, currently married, divorced, or separated, and widowed. Education level assessed how long a person stayed in the education system and what level of education qualification they hold. It ranged from nonformal, lower primary (P1-P4), upper primary (P5-P7), secondary and tertiary (which included university education). Different religions included: Catholic, Anglican or Pentecostal, and Muslim.

Occupation was defined as person's usual or principal work or business, especially as a means of earning a living. It included white collar (government, NGO, clerical, and teaching), business, agriculture, and no occupation.

We categorized WHO clinical staging of HIV into three stages, with diagnoses based on clinical signs, simple investigations, and a thorough review of clients' files.

Clinical stage 1: This included having asymptomatic and acute retroviral syndrome.

Clinical stage 2: This stage included a participant who had any of the symptoms; moderate unexplained weight loss (less than 10% of presumed or measured body weight), recurrent respiratory tract infections, herpes zoster, having angular cheilitis, recurrent oral ulcerations, papular pruritic eruptions, seborrheic dermatitis, and fungal nail infections of the fingers.

Clinical stage 3 and 4: This included a participant who had any of the following symptoms; severe unexplained weight loss (greater than 10% of presumed or measured body weight, unexplained chronic diarrhea for longer than one month, unexplained persistent fever (intermittent or constant for longer than one month), oral candidiasis, oral hairy leukoplakia, pulmonary tuberculosis (TB) diagnosed in the last 2 years, severe presumed bacterial infections, acute necrotizing ulcerative stomatitis, gingivitis or periodontitis, HIV wasting syndrome, pneumocystis pneumonia, recurrent severe or radiological bacterial pneumonia, chronic herpes simplex infection (orolabial, genital or anorectal) of more than one month duration, esophageal candidiasis, extrapulmonary TB, Kaposi's sarcoma, central nervous system (CNS) toxoplasmosis, and HIV encephalopathy.

A participant was considered to have a family history of NCDs if he/she had a first-degree relative with any of the specified NCDs, namely T2DM, HT, or Depression. First-degree relatives included biological parents, biological children, and siblings.

Data management and analysis

Data were double entered and cleaned in Microsoft excel 2010 and then exported to STATA version 15.0 for analysis. Univariate results were presented using frequencies along with corresponding proportions for categorical variables, while means accompanied by their respective standard deviations (SD) were utilized for continuous variables.

In our study, we employed bivariate modified Poisson regression analysis to assess the association between

NCDs and each independent variable. Crude prevalence ratios (cPR) were calculated, accompanied by their corresponding 95% confidence intervals (CI) and p-values. The choice of modified Poisson regression was informed by the high prevalence of the selected NCDs, exceeding 10% [46].

Following the bivariate analysis, we conducted a multivariable modified Poisson regression analysis, with robust standard errors using a stepwise model-building approach. Biological plausibility, as informed by literature and an alpha level ≤ 0.1 influenced inclusion of a variable in multivariable model. For a variable to be significant, its 95% confidence interval did not contain the null and p value did not exceed 0.05. For each variable added in the multivariable model, its adjusted prevalence ratio (aPR) was reported with its 95% CI and p value. Final analyses were transferred and presented in Microsoft word document using texts and tables.

Ethical approval and consent to participate

Ethical review and approval were obtained from Makerere University School of Public Health Higher Degrees Research and Ethics Committee (HDREC) prior to data collection. After getting approval from Makerere University School of Public Health HDREC, administrative clearances were sought from Kyotera District Health Officer (DHO) and Kalisizo Hospital medical superintendent prior to review of patients' records, interviewing participants and conducting measurements and laboratory tests. Written informed consents were obtained from respondents prior to participation in the study. These consents were written in Luganda, a language that participants understood. Participants who were unable to write their names were guided to put a thumbprint and a study clinician wrote their name. We linked NCD cases to Kalisizo Hospital for further management.

Results

Sociodemographic characteristics of respondents

We successfully tracked 296 respondents, out of which, four declined consent and two had incomplete information, resulting into a 2% nonresponse rate. This is presented in Figure 1.

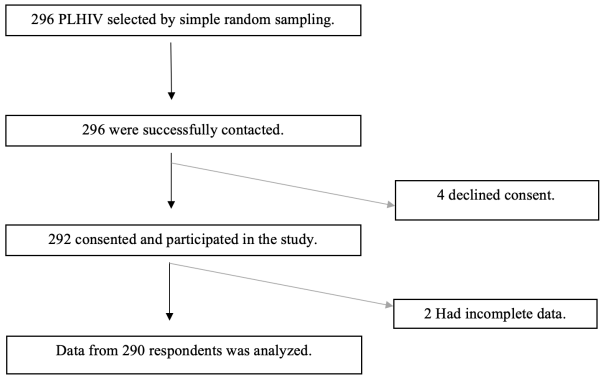

Figure 1. Participants' flow diagram

Social demographic characteristics

The mean age of the participants was 43.4 years (SD = 8.7 years). Among the 290 respondents, 193 (66.6%) were females, 139 (47.9%) were married, and 113 (39.0%) had completed lower primary education. A majority, 209 (72.1%), were Catholics. These demographic details are summarized in Table 1.

Characteristic	Number	Percentage
Sex		
Female	193	66.6
Male	97	33.4
Age group		
35-44 years	189	65.2
45-54 years	62	21.4
55 and above.	39	13.4
Marital status		
Never married.	45	15.5
Currently married.	139	47.9
Separated/divorced.	74	25.5
Widowed	32	11.1
Education level		
No formal education	14	4.8
Lower primary	113	39.0
Upper Primary	102	35.1
Secondary School	35	12.1
Tertiary education	26	9.0
Religion		
Catholic	209	72.1
Anglican/Pentecostal	46	15.8
Muslim	35	12.1
Occupation		
No occupation	16	5.5
White collar	37	12.8
Business.	115	39.6
Agriculture	122	42.1
Income level		
≤100000	71	25.5
>100000 ≤500000	100	35.8
>500000 ≤1000000	59	21.2
>1000000	49	17.5

Table 1. Sociodemographic characteristics of respondents

Risk factors for NCDs among PLHIV at Kalisizo Hospital

Regarding the risk factors for NCDs, 34 (11.7%) had family history of the NCDs, 59 (20.3%) were overweight, and 24 (8.3%) were obese. Additionally, 29 (10%) were smokers, 172 (59.3%) consumed alcohol, 56 (19.3%) had unhealthy diets, and 70 (24.1%) were physically inactive. This is provided in Table 2.

Variable	Number	Percentage
Risk factor		
Overweight	59	20.3
Obesity	24	8.3
Cigarette smoking	29	10.0
Alcohol drinking	172	59.3
Unhealthy diet	56	19.3
Physical inactivity	70	24.1
Family history of NCD		
Yes	34	11.7

Table 2. Risk factors for selected NCDs among PLHIV at Kalisizo Hospital n=290.

Prevalence of selected non-communicable diseases among PLHIV at Kalisizo Hospital

The overall prevalence of selected NCDs was 39.7% (95% CI=34.2%-45.4%). The most common NCD was depression with a prevalence of 34.5% (95% CI=29.2%-40.2%). The least common NCD was T2DM with a prevalence of 8.3% (95% CI=5.6%-12.1%). This is presented in Table 3.

Condition	Number	Prevalence (95% CI)
T2DM	24	8.3 (5.6-12.1)
HT	46	15.9 (12.1-20.6)
Depression	101	34.5 (29.2-40.2)
Prevalence of NCDs	115	39.7 (34.2-45.4)

Table 3. Prevalence of the selected NCDs among PLHIV at Kalisizo Hospital

Factors associated with each condition

Factors associated with diabetes among PLHIV at Kalisizo Hospital

Table 4 shows the factors associated with diabetes among PLHIV at Kalisizo Hospital, analyzed at both bivariate and multivariable levels. Individuals who were obese had a significantly higher prevalence of T2DM, compared to those who had normal weight, aPR=6.30 (95% CI=1.82-21.85, P=0.004). Moreover, people who lived with HIV for 6-10 years demonstrated a higher prevalence of T2DM, aPR=3.18 (95% CI=1.09-9.31, p=0.035), compared to those who lived with HIV for 1-5 years. Additionally, participants who had lived with HIV for 11 years or more years had a higher prevalence of T2DM, aPR=6.88 (95% CI=2.19-21.65, p=0.001), compared to those who lived with HIV for 1-5 years. Additionally, participants who reported consuming unhealthy diets, aPR=3.74 (95% CI=1.48-9.50, P=0.005) had higher prevalence of T2DM, compared to those who reported consuming healthy diets.

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Characteristic	cPR (95% CI)	Pvalue	aPR (95% CI)	Pvalue
Sex				
Male	1.0		1.0	
Female	0.99 (0.44-2.22)	0.990	0.89 (0.28-2.81)	0.847
Age group				
35-44 years	1.0		1.0	
45-54 years	1.78 (0.73-4.32)	0.204	0.75 (0.31-1.83)	0.528
55 and above	2.02 (0.75-5.41)	0.163	0.81 (0.32-2.04)	0.649
BMI				
Normal weight	1.0		1.0	
Underweight	1.21 (0.25-5.83)	0.808	0.83 (0.17-4.04)	0.815
Overweight	2.78 (0.93-8.30)	0.067	1.74 (0.55-5.53)	0.345
Obese	12.42 (5.00-30.90)	**<0.001**	6.30 (1.82-21.85)	**0.004**
Period with HIV				
1-5 years	1.0		1.0	
6-10 years	3.20 (0.92-11.20)	0.069	3.18 (1.09-9.31)	**0.035**
11 years or more	7.11 (2.04-24.80)	**0.002**	6.88 (2.19-21.65)	**0.001**
WHO Clinical staging				
Stage 1	1.0		1.0	
Stage 2	1.32 (0.49-3.52)	0.575	0.63 (0.26-1.52)	0.305
Stage 3 and 4	1.66 (0.64-4.30)	0.292	1.12 (0.48-2.62)	0.792
Cigarette smoking				
No	1.0		1.0	
Yes	3.00 (1.30-6.96)	**0.011**	0.56 (0.18-1.76)	0.318
Alcohol drinking				
No	1.0		1.0	
Yes	2.06 (0.85-5.04)	0.114	0.64 (0.27-1.51)	0.314
Diets				
Healthy	1.0		1.0	
Unhealthy	6.96 (3.21-15.10)	**<0.001**	3.74 (1.48-9.50)	**0.005**

Table 4. Bivariate and multivariable Modified Poisson Regression analysis of factors associated with T2DM among PLHIV at Kalisizo Hospital

Factors associated with HT among PLHIV at Kalisizo Hospital

Table 5 presents the factors associated with HT among PLHIV at Kalisizo Hospital, examined at both bivariate

and multivariable levels. In the multivariable analysis, prevalence of HT was higher among: individuals aged 55 years or more, aPR=1.97 (95% CI=1.03-3.77, P=0.041), those who were overweight, aPR of 3.28 (95% CI=1.67-6.44, P=0.001), or obese, aPR 4.24 (95% CI=1.93-9.33, P<0.001), the physically inactive individuals, aPR 2.10 (95% CI=1.26-3.52, P=0.004), and those who consumed unhealthy diets aPR=2.46 (95% CI=1.44-4.24, P=0.001).

Factor	cPR (95% CI)	Pvalue	aPR (95% CI)	Pvalue
Sex				
Male	1.0		1.0	
Female	0.55 (0.29-1.07)	0.077	0.60 (0.30=1.20)	0.149
Age group				
35-44 years	1.0		1.0	
45-54 years	1.52 (0.81-2.86)	0.191	1.67 (0.97-2.86)	0.063
55 and above	2.02 (1.05-3.88)	**0.035**	1.97 (1.03-3.77)	**0.041**
Income level				
≤100000	1.0		1.0	
>100000≤500000	0.63 (0.34-1.17)	0.143	0.87 (0.51-1.47)	0.603
>500000 ≤1000000	0.57 (0.26-1.22)	0.146	0.87 (0.41-1.85)	0.719
>1000000	0.51 (0.22-1.21)	0.126	0.66 (0.28-1.54)	0.333
BMI Categories				
Normal weight	1.0		1.0	
Underweight	1.00 (0.29-3.46)	0.992	0.93 (0.28-3.15)	0.911
Overweight	4.32 (1.35-13.87)	**<0.001**	3.28 (1.67-6.44)	**0.001**
Obese	10.22 (3.29-31.70)	**<0.001**	4.24 (1.93-9.33)	**<0.001**
Physical activity				
Yes	1.0		1.0	
No	2.64 (1.58-4.42)	**<0.001**	2.10 (1.26-3.52)	**0.004**
Diets				
Healthy	1.0		1.0	
Unhealthy	4.18 (2.53-6.89)	**<0.001**	2.46 (1.44-4.24)	**0.001**

Table 5. Bivariate and multivariable modified Poisson regression analysis of factors associated with HT among PLHIV at Kalisizo Hospital.

Factors associated with depression among PLHIV at Kalisizo Hospital

Table 6 shows both bivariate and multivariable analyses of factors associated with depression among PLHIV at Kalisizo Hospital. In a multivariable analysis, being in WHO clinical stage 2 (aPR=1.49, 95% CI=1.01-2.24, P=0.049) and 3 or 4 (APR=1.71, 95% CI=1.13-2.56, P=0.010) of HIV, and being a cigarette smoker (aPR=1.79, 95% CI=1.17-2.75, P=0.007) were associated with higher prevalence of depression.

Factor	cPR (95% CI)	Pvalue	aPR (95% CI)	Pvalue
Sex				
Male	1.0		1.0	
Female	0.89 (0.63-1.26)	0.527	0.74 (0.51-1.08)	0.113
Age group				
35-44 years	1.0		1.0	
45-54 years	0.85 (0.56-1.30)	0.455	0.84 (0.55-1.26)	0.392
55 and above	0.93 (0.57-1.50)	0.757	0.87 (0.53-1.44)	0.594
WHO Clinical staging				
Stage 1	1.0		1.0	
Stage 2	1.44 (0.96-2.16)	0.079	1.49 (1.01-2.24)	**0.049**
Stage 3 and 4	1.56 (1.04-2.33)	**0.030**	1.71 (1.13-2.56)	**0.010**
Cigarette smoking				
No	1.0		1.0	
Yes	1.59 (1.07-2.53)	**0.021**	1.79 (1.17-2.75)	**0.007**

Table 6. Bivariate and multivariable modified Poisson regression analysis of factors associated with depression among PLHIV at Kalisizo Hospital

Factors associated with prevalence of selected NCDs among PLHIV at Kalisizo Hospital

Table 7 presents the factors associated with the prevalence of selected NCDs among PLHIV at Kalisizo Hospital. In a multivariable analysis, having tertiary education (aPR=1.55, 95% CI=1.05-2.77, P=0.026), being obese (aPR=2.01, 95% CI=1.40-2.87, P<0.001), being in WHO clinical stage 3 and 4 of HIV (aPR=1.45, 95% CI=1.02-2.05, P=0.037), and consuming unhealthy diets (aPR=1.61, 95% CI=1.20-2.16, P=0.002) were associated with higher prevalence of selected NCDs.

Factor	cPR (95% CI)	Pvalue	aPR (95% CI)	Pvalue
Sex				
Male	1.0		1.0	
Female	0.77 (0.55-1.06)	0.112	0.79 (0.58-1.08)	0.152
Age group				
35-44 years	1.0		1.0	
45-54 years	1.16 (0.83-1.62)	0.392	1.10 (0.80-1.50)	0.558
55 and above	1.16 (0.78-1.73)	0.469	1.05 (0.70-1.56)	0.826
Education level				
Lower primary	1.0		1.0	
No formal	0.81 (0.34-1.92)	0.628	0.85 (0.39-1.86)	0.687
Upper primary	1.05 (0.74-1.50)	0.778	0.98 (0.71-1.36)	0.901
Secondary	1.21 (0.77-1.91)	0.412	1.05 (0.69-1.61)	0.814
Tertiary	1.96 (1.37-2.80)	**<0.001**	1.55 (1.05-2.27)	**0.026**
BMI Categories				
Normal weight	1.0		1.0	
Underweight	0.82 (0.48-1.41)	0.480	0.82 (0.49-1.38)	0.456
Overweight	1.52 (1.10-2.14)	**0.016**	1.39 (0.99-1.94)	0.058
Obese	2.95 (2.32-3.75)	**<0.001**	2.01 (1.40-2.87)	**<0.001**
WHO Clinical staging				
Stage 1	1.0		1.0	
Stage 2	1.29 (0.90-1.84)	0.167	1.17 (0.83-1.64)	0.367
Stage 3 and 4	1.40 (0.98-2.00)	0.062	1.45 (1.02-2.05)	**0.037**
Physical activity				
Yes	1.0		1.0	
No	1.49 (1.12-1.98)	**0.006**	1.29 (0.89-1.68)	0.380
Diets				
Healthy	1.0		1.0	
Unhealthy	2.06 (1.59-2.67)	**<0.001**	1.61 (1.20-2.16)	**0.002**

Table 7. Factors associated with selected NCDs among PLHIV at Kalisizo Hospital

Discussion

The overall prevalence of selected NCDs among PLHIV at Kalisizo Hospital was 39.7%. Among individual conditions, depression emerged as the most prevalent, affecting 34.5% of the population. HT ranked second, with a prevalence of 15.9%, while T2DM exhibited the lowest prevalence at 8.3%. Several factors demonstrated a statistically significant association with the prevalence of selected NCDs among PLHIV at Kalisizo Hospital. These factors included tertiary education,

obesity, WHO clinical stages 3 and 4 of HIV, and adherence to unhealthy dietary patterns.

The prevalence of selected NCDs among PLHIV at Kalisizo Hospital was 39.7% surpassing rates observed in various African contexts. Notably, this prevalence exceeded findings from a study among health educators in South African public schools, which reported an NCD prevalence of 36.9% [47]. Similarly, research conducted in Kenya documented a lower NCD prevalence at 11.5% [7]. A study conducted in Uganda reported NCD prevalence at 20.7% [31]. The elevated NCD prevalence in our study could be attributed, in part, to the adverse socio-economic and psychological impacts of the COVID-19 pandemic, particularly impacting PLHIV. The pandemic disrupted social networks, altered service delivery, heightened fears of health deterioration and mortality, and impacted income and survival among PLHIV [48][49]. This upheaval contributed to increased mental health issues, notably depression, and exacerbated existing NCDs, particularly HT and T2DM, providing insights into the high NCD prevalence observed in our study.

The prevalence of T2DM in our study was found to be 8.3%, representing a lower rate compared to several studies in different settings. Notably, a study in London documented a higher T2DM prevalence of 15.1% [50]. A study done in Ethiopia reported a T2DM prevalence of 8.6% among PLHIV on ART [51]. Similarly, a study estimating T2DM prevalence among PLHIV in the United States reported a rate of 10.3% [52].

Conversely, some studies have reported lower T2DM prevalence compared to our findings. For instance, a study assessing NCD prevalence among PLHIV on ART in Kampala, Uganda, reported a T2DM prevalence of 4.7% [31]. A study done in Ethiopia reported that 7.1% of PLHIV had T2DM [2]. These variations may stem from differences in participant characteristics influencing T2DM, including lifestyle variations, specific ART regimens with drug-specific effects, and the age and sex distribution of PLHIV in our setting relative to those in the compared settings.

The prevalence of HT in our study was determined to be 15.9%, showcasing a lower rate compared to reported figures in several sub-Saharan African countries. Notably, a study in Northeast Ethiopia found an HT prevalence of 29% among PLHIV in care [19]. Similarly, research conducted in Kenya revealed that 25.3% of males and 16.9% of females living with HIV experienced HT [53]. Another study, focusing on PLHIV on ART Central Uganda, reported an HT prevalence of 29% [54].

Conversely, other studies reported lower HT prevalence than our findings. For instance, a study assessing NCD prevalence among PLHIV on ART in Kampala reported an HT prevalence of 12.4% [31], while a study in Rakai investigating HT burden among PLHIV reported an 8.0% prevalence [30]. This variation may be attributed to differences in the guidelines used to define hypertension; for instance, [54] included prehypertensive conditions in their definition of HT. Additionally, variations in age categories among the studied populations could contribute to the observed differences, specifically for [31].

The prevalence of depression in our study was found to be 34.5%, surpassing rates reported in many studies conducted in sub-Saharan Africa. A systematic review and meta-analysis in the region indicated a depression prevalence ranging from 9% to 32% among PLHIV on ART [55]. A study done in Ethiopia reported that 20% of PLHIV had depression. On the other hand, our findings are lower than depression prevalence reported in other studies globally. A systematic review in China documented a higher prevalence of depression at 60% [56] and a meta-analysis in Ethiopia estimated a pooled prevalence of depression at 36.65% [57]. Another meta-analysis of East African studies reported a depression prevalence of 38% [57]. This disparity may stem from variations in sample size, the specific populations studied, study duration, inclusion and exclusion criteria, and the diverse measurement tools used to assess depression. Additionally, the psychological and economic impact of the coronavirus pandemic on mental health may contribute to the higher depression burden observed in our study compared to most sub-Saharan settings [49].

In this study, an association was found between tertiary education and higher prevalence of selected NCDs among PLHIV. This is consistent with findings from previous studies that reported an association between tertiary education and high NCD burden. For instance, a study which investigated risk factors for selected NCDs among PLHIV reported high education as a risk factor for overweight and obesity, yet obesity is an independent risk factor for selected NCDs among PLHIV [8]. Similar to previous studies, a strong positive association was found between obesity and NCD prevalence among PLHIV in this study [2][31][51][52]. Obese individuals have altered metabolic processes, follow a sedentary lifestyle, and are highly affected by HIV and ART toxicity [2].

In this study, an association was found between WHO clinical staging of HIV and selected NCD burden among PLHIV at the Hospital. This finding is consistent with findings from previous studies [7][58]. This study also found an association between unhealthy diets and NCD prevalence among PLHIV. This is in agreement with previous studies that reported an association between diets and NCD burden [13][59][60].

Despite factors such as sex, age, and physical activity not exhibiting significant associations with NCDs prevalence at the multivariable level in our study, it's noteworthy that numerous studies have reported associations between these factors and NCDs [31][61][62]. The observed discrepancy may be attributed to variations in social demographic characteristics and divergent study methodologies employed across different investigations.

Study Strength

The study benefited significantly from its robust methodology, with measurement and interviews conducted by proficient registered nurses and clinical officers actively engaged in Kalisizo Hospital. Their expertise and familiarity with both HIV-related research studies and non-communicable diseases contributed to the high quality of data collection. This ensured precision in measurements and interviews, enhancing the reliability and validity of the study findings. The involvement of skilled healthcare professionals added a layer of competence to the research process, instilling confidence in the accuracy and thoroughness of the data gathered.

Study Limitations

Potential recall bias in responses to the WHO Steps questionnaire and PHQ-9 was acknowledged as a limitation in this study. To mitigate this concern, the researchers employed a dual strategy: first, by cross-verifying responses through a review of medical records; and second, by providing comprehensive training to research assistants in effective interviewing techniques.

Moreover, the cross-sectional design of the study introduces a challenge in establishing causal relationships since both exposure and outcome were assessed simultaneously. The nature of this design restricts the study to evaluating associations rather than determining causation. We therefore recommend analytical study designs to assess causation.

Conclusion

Our study revealed a high prevalence of selected NCDs among PLHIV at Kalisizo Hospital. Depression emerged as the most prevalent NCD, while diabetes was the least common. Tertiary education, obesity, WHO clinical stages 3 and 4, and unhealthy diets were identified as significant factors associated with higher prevalence of these NCDs among PLHIV. This underscores the importance of integrating routine NCD screenings and risk factor assessments into regular HIV care to facilitate timely detection and effective management of NCDs. Promoting healthy dietary practices among PLHIV is crucial in controlling the prevalence of NCDs. Targeting timely interventions for PLHIV at higher risk for NCDs should be a priority during routine HIV care.

Statements and Declarations

Competing interests

Authors declare no competing interests.

Authors' contributions

AK conceived the study, designed the study, collected the data, entered the data, analyzed the data, and drafted the manuscript. LK and EB conceived the study, supported the study design, data collection, analysis, and interpretation of findings, and critically reviewed the draft manuscript. LK and EB critically reviewed the manuscript. All authors read, edited, and approved the manuscript for publication.

Availability of data and materials

The datasets used in this study are available upon request from the corresponding author.

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Declarations

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