

RESEARCH ARTICLE

Prevalence and Factors Associated with Diabetes and Hypertension Among HIV Patients at Tertiary Hospital, Kilimanjaro, Tanzania

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Abstract

Introduction: Diabetes and hypertension are prevalent non-communicable diseases that significantly affect people living with HIV, particularly those on antiretroviral therapy. Despite the increasing recognition of these conditions, their prevalence and associated risk factors among people living with HIV in Tanzania remain underexplored. This study aimed to determine the prevalence and risk factors of diabetes and hypertension among HIV patients attending the Child-Centred Family Care Clinic at KCMC Hospital.

Methods: A cross-sectional study was conducted from May to June 2024, involving 341 people living with HIV attending the Child-Centred Family Care Clinic at KCMC

Hospital. Data were collected through face-to-face interviews, file reviews, and physical measurements. Hypertension was defined as systolic blood pressure ≥ 140 mmHg/ or diastolic blood pressure ≥ 90 mmHg. Diabetes was defined as a blood glucose level of ≥ 126 mg/dL. A logistic regression model was used to identify factors associated with diabetes and hypertension.

Results: Prevalence of hypertension was 23.5% (80), while the prevalence of diabetes was 14.1% (48) was diabetes. Hypertension was most prevalent in individuals aged 36-62 years (71.3%), whereas 70.9% of diabetic patients reported a family history of diabetes. Multivariate analysis revealed that older age was significantly associated with hypertension, with participants aged 18-35 years showing a lower likelihood of hypertension (AOR=0.10; 95% CI: 0.03-0.41; $p=0.004$) compared to those over 63 years. Participants earning TZs 500,000 or more per month were more likely to develop diabetes than others (AOR=4.112; 95% CI: 1.199-14.108; $p=0.025$).

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Conclusion: The findings indicate that socioeconomic determinants are critical in influencing the prevalence of diabetes and hypertension among people living with HIV, suggesting that interventions should focus on

improving screening and early treatment for at-risk groups.

Key Words: *Diabetes; Hypertension; HIV; Prevalence; Factors; Tanzania*

Introduction

HIV/AIDS remains a global epidemic, with approximately 39 million individuals infected worldwide as of 2022. The increasing prevalence of Non-Communicable Diseases (NCDs) among people living with HIV (PLWH) has emerged as a significant public health concern, particularly in low- and middle-income countries [1-5]. In sub-Saharan Africa, the prevalence of NCDs among PLWH is estimated to be around 20.1%, highlighting the urgent need for comprehensive healthcare strategies that address both HIV management and the rising incidence of NCDs [6]. The prevalence of diabetes among PLWH varies widely across different studies; however, estimates suggest that it ranges from 6.8% to 26% in low- and middle-income countries [7]. In Tanzania specifically, recent studies have reported a diabetes prevalence of approximately 13% among HIV-infected individuals [8]. Hypertension prevalence among PLWH has been reported to be between 25% and 70% in various studies across sub-Saharan Africa [9].

The intersection of HIV and NCDs is complex, influenced by various factors such as socioeconomic status, access to healthcare, and the long-term effects of Antiretroviral Therapy (ART) [6]. Research indicates that PLWH are at an elevated risk for developing diabetes due to several factors, including lifestyle changes associated with HIV treatment and the metabolic effects of ART [10].

The management of diabetes and hypertension in PLWH requires a multifaceted approach that includes regular screening, patient education on lifestyle modifications, and appropriate

pharmacological interventions. However, many healthcare systems in low-resource settings face significant challenges in providing comprehensive care for NCDs alongside HIV treatment.

Among other challenges that healthcare systems face is limited access to diagnostic tools and inadequate training for healthcare providers on managing co-morbidities [11]. There is a need to explore the factors in the population living with HIV who are at increased risk for conditions such as diabetes and hypertension. The knowledge is crucial for developing effective interventions aimed at improving health outcomes for PLWH. Understanding these factors can inform targeted interventions that address the unique needs of this population [12].

Methods

Study design and setting

A cross-sectional study was conducted at the Child-Centered Family Care Clinic (CCFCC) in KCMC hospital from 01-05-2024 to 03-06-2024.

KCMC hospital is a tertiary referral hospital in Tanzania, located on the foothills of Mt Kilimanjaro, serving more than 15 million people in Northern Tanzania. KCMC has three dedicated HIV clinics, namely the Care and Treatment Clinic (CTC), Child-Centered Family Care Clinic (CCFCC), and the Infectious Disease Clinic (IDC). Approximately 2630 HIV patients receive care and treatment in these clinics in a month. Patients attend clinics three days a week, Monday and Thursday for adults at CTC and children at CCFCC, then Friday

only at CTC for adults. Also, there is a special clinic on Saturday that includes adolescents and youth only.

Study population

The study included PLHIV who attended clinics at the CCFCC. Participants with pre-existing conditions that could influence blood glucose or blood pressure levels—such as kidney disease, thyroid disease, cancer, and those who are pregnant or breastfeeding were excluded from the study. Additionally, individuals unable or unwilling to provide the necessary information or blood samples were also excluded.

Sample size calculation

The following formula was used to calculate the sample size:

$$n = \frac{z^2 p(1 - P)}{E^2}$$

In this equation, n represents the required minimum sample size, Z denotes the degree of confidence, E signifies the desired precision, and P indicates the estimated proportion of the population. For this study, a confidence level of 95% was selected, corresponding to a Z value of 1.96. The estimated proportion of individuals living with diabetes among people living with HIV was set at 0, based on prior study [13]. The desired precision was established at 0.05.

Data collection

Data collection involved a multi-faceted approach utilizing face-to-face interviews, medical file reviews, and physical measurements. A pretested structured questionnaire was developed to gather information on socio-demographic characteristics, medical history, lifestyle factors, and family history of diabetes and hypertension. The questionnaire was validated through a pilot study involving 30 participants who were not included in the

main study. The data collected from medical files included information regarding clinical conditions, co-morbidities, and viral load results.

Physical measurements were taken by trained research assistants. Blood pressure was measured using a calibrated sphygmomanometer, with participants in a seated position after resting for at least five minutes. Hypertension was defined as having a systolic blood pressure of 140 mmHg or higher, or a diastolic blood pressure of 90 mmHg or higher. Diabetes was assessed through fasting blood glucose levels, with diabetes defined as a fasting glucose level of 126 mg/dL or higher or a previous diagnosis of diabetes.

Statistical analysis

Data analysis was performed using SPSS version 25. Descriptive statistics were computed to summarize participant characteristics and prevalence rates of diabetes and hypertension. Bivariate analyses were conducted to explore associations between demographic variables and the outcomes of interest using chi-square tests. Logistic regression models were employed to identify factors significantly associated with diabetes and hypertension while controlling for potential confounders. Adjusted Odds Ratios (AOR) with 95% Confidence Intervals (CI) were calculated to quantify the strength of associations.

Ethical consideration

Ethical approval to conduct this study was obtained from the Kilimanjaro Christian Medical University College (KCMUCo) ethical review board with certificate number CRERC No.UG116/2024. Permission to conduct the study was obtained from the head of CCFCC at KCMC hospital. Written informed consent was obtained from all participants. Assent involved participants in the age range less or

equals to 17 years, who were legally not able to consent by themselves. Parents or guardians consented on behalf of participants who were under 18 years old. Participants' information was kept confidential, and only participants' numbers were used in the questionnaire.

Results

Socio-demographic characteristics

A total of 341 study participants were recruited.

The majority, 66.6% (227), were female, their mean age was 44.7, STD 17.1, ranging from 8-82, most of them their age ranges from 36-62 years, 55.7% (190). Participants with primary education were mostly represented, 44.6% (152). Most participants, 52.2% (178) were self-employed and those with an income below TZs 50,000/= per month 42.8% (146) were more represented, whereby 85% (290) had number of people per household between 1-5 and most of them were dependents 67.2% (229), Table 1.

TABLE 1

Socio-demographic characteristics of the studied population (n=341).

Variable		Frequency	Percent
Mean 44.7, STD = 17.1			
Age	8-35	97	28.4
	36-62	190	55.7
	>63	54	15.8
Gender	Female	227	66.6
	Male	114	33.4
Level of education	No formal education	6	1.8
	Primary education	152	44.6
	Secondary education	143	41.9
	Tertiary education	40	11.7
Employment status	Unemployed	31	9.1
	Employed	54	17
	Self-employed	178	52.2
	Student	49	14.4
	Retired	24	7
Income in TZs	<50000	146	42.8
	50000-200000	131	38.4
	200000-500000	46	13.5
	>500000	18	5.3
Number of people per household	01-May	290	85
	06-Oct	50	14.7
	>10	1	0.3
Dependable	No	112	32.8
	Yes	229	67.2
1USD = 2685.68 TZs			

Prevalence of diabetes among HIV patients

Out of 341 HIV patients, 14.1% (48) were diabetic, Figure 1. The prevalence of diabetes was notably higher among individuals aged 36 to 62 years, with a rate of 60.4% (29), compared to other age groups, $p < 0.001$. Among diabetic positive patients, approximately 72.9% (35) were female. Most of the patients were dependents, 70.8% (34). Fifty percent (24) had a primary education level, and in terms of employment status, 43.8% (21) were self-employed, $p = 0.001$. A significant majority of the subjects had a family history of diabetes, accounting for 70.9% (34), $p < 0.001$. Most participants, 66.7% (32), were using ART for a duration between 21-37 years, $p = 0.003$, Table 2.

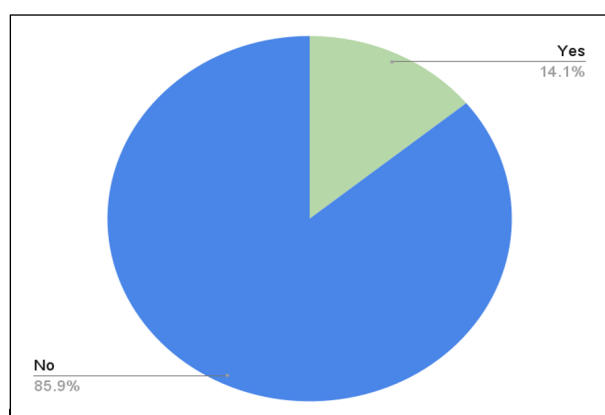


Figure 1) Prevalence of diabetes among HIV patients (n=341).

Prevalence of high blood pressure among HIV patients

Out of 341 HIV patients, 23.5% (80) were hypertensive, Figure 2. The prevalence of hypertension was notably higher among individuals aged 36 to 62 years, with a rate of 71.3% (57), compared to other age groups, $p < 0.001$. Among hypertensive patients, approximately 65% (52) were female. Most of the patients were dependents, 81.3% (65).

In terms of employment status, 63.8% (51) were self-employed, $p = 0.001$, and 57.5% (46) had attained only a primary education level. A significant majority of the subjects had a family history of hypertension, accounting for 63.7% (51), $p < 0.001$, Table 3.

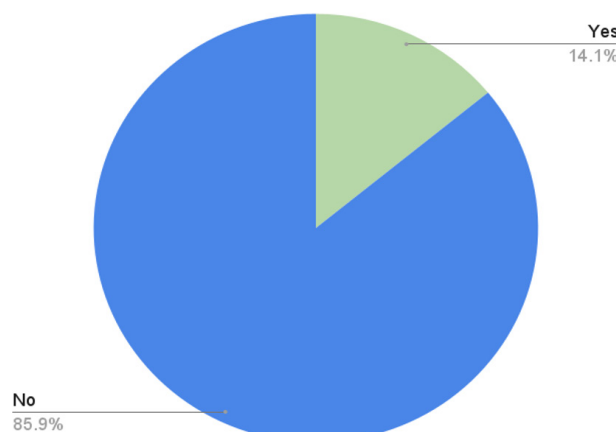


Figure 2) Prevalence of high blood pressure among HIV patients (n=341).

Factors associated with diabetes among HIV patients

In bivariate logistic regression analysis, age, monthly income, diet, and duration of HIV (set p -value < 0.05) were included in the multivariate logistic regression analysis. In the multivariate analysis, age, diet, and income were significantly associated with diabetes mellitus. Those with an age range 8-35 and 36-62 years were less likely to have diabetes as compared to those with greater than 63 years with AOR=0.017 (95% CI: 0.002-0.137), $p < 0.001$ and (AOR=0.295 (95% CI: 0.137-0.636), $p = 0.002$ respectively. Participants with an income of TZs 500,000/= per month were more likely to develop diabetes than others (AOR=4.112, 95% CI (1.199-14.108), $p = 0.025$). Those who were taking fruit and vegetables were more likely to have diabetes as compared to others (AOR=0.15, 95% CI (0.030-0.746), $p = 0.03$) Table 4.

TABLE 2
Association of demographic characteristics with diabetes among HIV patients (n=341).

Variable		Diabetic status		P value
		Non-diabetic n (%)	Diabetic n (%)	
Age	8-35	96 (32.8)	1 (2.1)	* <0.001
	36-62	161 (54.9)	29 (60.4)	
	>63	36 (12.3)	18 (37.5)	
Gender	Female	192 (65.5)	35 (72.9)	0.31
	Male	101 (34.5)	13 (27.1)	
Education level	No formal education	6 (2.1)	0 (0.0)	0.32
	Primary education	128 (43.7)	24 (50.0)	
	Secondary education	127 (43.3)	16 (33.3)	
	Tertiary education	32 (10.9)	8 (16.7)	
Employment status	Un-employed	21 (7.2)	10 (20.8)	*0.001
	Employed	49 (16.7)	9 (18.8)	
	Self-employed	157 (53.6)	21 (43.8)	
	Student	48 (16.4)	1 (2.1)	
	Retired	17 (5.8)	7 (14.6)	
Income in TZs	200,000-500,000/=	40 (13.7)	6 (12.5)	0.12
	50,000-200,000/=	114 (38.9)	17 (35.4)	
	>500,000/=	12 (4.1)	6 (12.5)	
	<50,000/=	127 (43.3)	19 (39.6)	
Dependent	No	98 (33.4)	14 (29.2)	0.55
	Yes	195 (66.6)	34 (70.8)	
Physical exercise	No	32 (10.9)	6 (12.5)	0.7
	Yes	261 (89.1)	41 (85.5)	
Smoking	No	288 (98.3)	47 (97.9)	0.85
	Yes	5 (1.7)	1(2.1)	
Alcohol consumption	No	208 (71.0)	37 (77.1)	0.38
	Yes	85 (29.0)	11 (22.9)	
Diet	Occasionally	5 (1.7)	4 (8.4)	0.102
	Daily	245 (83.6)	39 (81.3)	
	Weekly	37 (12.6)	4 (8.3)	
	Monthly	5 (1.7)	1 (2.1)	
	Never	1 (0.3)	0 (0.0)	
Diabetic history	No	188 (64.2)	13 (27.1)	* <0.001
	Yes	96 (32.8)	34 (70.9)	
	I don't know	9 (3.0)	1 (2.0)	
Duration of ART	1-10 years	40 (13.7)	3 (6.3)	*0.003
	11-20 years	134 (45.7)	13 (27.0)	
	21-37 years	119 (40.6)	32 (66.7)	

*p value computed using Fisher's exact test, **ART:** Anti-retroviral therapy, **TZs:** Tanzania shillings, **1 USD = 2700 TZs**

TABLE 3
Association of demographic characteristics with hypertension among HIV patients (n=341).

Variables		Blood Pressure status		P value
		Non-hypertensive n (%)	Hypertensive n (%)	
Age	8-35	93 (35.6)	4 (5.0)	*<0.001
	36-62	133 (51.0)	57 (71.3)	
	>63	35 (13.4)	19 (23.7)	
Gender	Female	175 (67.0)	52 (65.0)	0.73
	Male	86 (33.0)	28 (35.0)	
Education level	No formal education	6 (2.3)	0 (0.0)	*0.008
	Primary education	106 (40.6)	46 (57.5)	
	Secondary education	121 (46.4)	22 (27.5)	
	Tertiary education	28 (10.7)	12 (15.0)	
Employment status	Unemployed	27 (10.3)	4 (5.0)	*0.001
	Employed	43 (16.5)	15 (18.8)	
	Self employed	127 (48.7)	51 (63.8)	
	Student	48 (18.4)	1 (1.2)	
	Retired	16 (6.1)	9 (11.2)	
Income in TZs	200,000-500,000	33 (12.6)	13 (16.3)	0.03
	50,000-200,000	97 (37.2)	34 (42.5)	
	>500,000	10 (3.8)	8 (10.0)	
	<50,000	121 (46.4)	25 (31.2)	
Dependent	No	97 (37.2)	15 (18.7)	0.002
	Yes	164 (62.8)	65 (81.3)	
Physical exercise	No	30 (11.5)	9 (11.2)	0.73
	Yes	231 (88.5)	71 (88.8)	
Smoking	No	258 (98.9)	77 (96.2)	0.12
	Yes	3 (1.1)	3 (3.8)	
Alcohol consumption	No	194 (74.3)	51 (63.7)	0.06
	Yes	67 (25.7)	29 (36.3)	
Diet	Occasionally	5 (1.9)	4 (5.0)	0.28
	Daily	220 (84.3)	64 (80.0)	
	Weekly	32 (12.3)	9 (11.2)	
	Monthly	3 (1.1)	3 (3.3)	
BP history	No	167 (64.0)	29 (36.3)	*<0.001
	Yes	87 (33.3)	51 (63.7)	
	I don't know	7 (2.7)	0 (0.0)	
Duration of ART	1-10 years	37 (14.2)	6 (7.5)	0.28
	11-20 years	111 (42.5)	36 (45.0)	
	21-37 years	113 (43.3)	38 (47.5)	
Diabetes	No	233 (89.3)	60 (75)	0.001
	Yes	28 (10.7)	20 (25)	
Salt intake	Daily	215 (82.4)	29 (36.2)	<0.001
	Weekly	18 (6.9)	7 (8.8)	
	Monthly	28 (10.7)	44 (55.0)	
*p value computed using Fisher's exact test, ART: anti-retroviral therapy, TZs: Tanzania shillings, 1 USD = Tanzania shillings				

TABLE 4

Bivariate and multivariate analyses of factors associated with diabetes in people living with HIV/AIDS receiving care at KCMC hospital.

Associated factors	N	N (%) with diabetes	COR (95%CI)	P Value	AOR (95%CI)	P Value
Age(years)						
8-35	97	1(2.1)	0.02 (0.03-0.16)	<0.001	0.01(0.002-0.13)	<0.001
36-62	190	29(60.4)	0.36 (0.18-0.71)	0.004	0.29 (0.13-0.63)	0.002
>63	54	18(37.5)	1.0		1.0	
Gender						
Female	227	13(27.1)	1.41 (0.71-2.79)	0.31	-	
male	114	35(72.9)	1.0			
Income in TZS						
200,000-500,000/=	46	6(12.5)	1.003 (0.38-2.68)	0.99	4.11(1.19-14.10)	0.02
50,000-200,000/=	131	17(35.4)	0.99 (0.49-2.01)	0.99	-	
>500,000/=	18	6(12.5)	3.34 (1.12-9.96)	0.03	-	
<50,000/=	146	19(39.6)	1.0		1.0	
Physical exercise						
No	39	7(14.6)	1.19 (0.47-3.03)	0.71	-	
Yes	302	41(85.4)	1.0			
Cigarette smoking						
No	335	47(97.9)	0.81 (0.09-7.14)	0.85	-	
Yes	6	1(2.1)	1.0			
Alcohol consumption						
No	96	37(77.1)	1.37 (0.67-2.82)	0.38	-	
Yes	245	11(22.9)	1.0			
Diet						
Monthly	7	1(2.1)	0.21 (0.02-2.52)	0.22	-	
Daily	284	39(81.3)	0.19 (0.05-0.77)	0.02	0.15 (0.03-0.83)	0.03
Weekly	41	4(8.3)	0.13 (0.03-0.71)	0.02	0.09 (0.01-0.62)	0.01
Occasionally	9	4(8.3)	1.0		1.0	
Diabetic History						
No	201	13(27.1)	0.62 (0.07-5.29)	0.66	-	
Yes	130	34(70.8)	3.18 (0.39-26.1)	0.28	-	
I don't know	10	1(2.1)	1.0			
Duration of HIV						
1992-2002	54	18(37.5)	4.59 (1.98-10.65)	<0.001	2.34 (0.88-6.19)	0.08
2003-2013	115	19(39.6)	1.11 (0.51-2.45)	0.78	-	
2014-2024	112	11(22.9)	1.0		1.0	
AOR = Adjusted odds ratio, COR = Crude odds ratio, TZs: Tanzania shillings, 1 USD = 2700 TZs						

TABLE 5

Bivariate and multivariate analyses of factors associated with hypertension in people living with HIV/AIDS receiving care at KCMC hospital.

Associated factors	N	N (%) with hypertension	COR (95%CI)	P Value	AOR (95%CI)	P value
Age(years)						
8-35	97	4(5.0)	0.07 (0.02-0.24)	<0.001	0.10 (0.03-0.41)	0.004
36-62	190	57(71.25)	0.07 (0.41-1.49)	0.46		
>63	54	19(23.75)	1.0		1.0	
Gender						
Female	227	52(65.0)	0.91 (0.54-1.54)	0.73		
Male	114	28(35.0)	1.0			
Income in TZs						
200,000-500,000/=	46	13 (16.25)	1.90 (0.88-4.13)	0.1		
50,000-200,000/=	131	34 (42.5)	1.69 (0.94-3.03)	0.07		
>500,000/=	18	8 (10.0)	3.87 (1.39-10.78)	0.01	3.50 (0.91-13.49)	0.03
<50,000/=	146	25 (31.25)	1.0		1.0	
Physical exercise						
No	39	9 (11.25)	0.89 (0.38-1.98)	0.73		
Yes	302	71 (88.75)	1.0			
Cigarette smoking						
No	335	77 (96.25)	0.29 (0.06-1.51)	0.14		
Yes	6	3 (3.75)	1.0			
Alcohol consumption						
No	96	51(63.75)	0.61 (0.36-1.04)	0.06		
Yes	245	29(36.25)	1.0			
Diet						
Monthly	7	3 (3.75)	0.94 (0.13-6.90)	0.95		
Daily	284	64 (80)	0.36 (0.09-1.39)	0.14		
Weekly	41	9 (11.25)	0.35 (0.08-1.59)	0.17		
Occasionally	9	4 (5)	1.0			
Dependent						
No	112	15 (18.75)	0.39 (0.21-0.72)	0.003	1.01 (0.45-2.22)	0.97
yes	229	65 (81.3)	1.0		1.0	
Duration of ART						
1-10 years	43	6(7.5)	0.48 (0.19-1.23)	0.12		
11-20 years	147	36(45)	0.96 (0.57-1.63)	0.89		
21-37 years	151	38(47.5)	1.0			
Occupation						
Self employed	178	51(63.8)	2.71 (0.90-8.14)	0.07		
Retired	24	9(11.25)	4.05 (1.06-15.4)	0.04	2.97 (0.74-12.01)	0.63
Employed	58	15(18.75)	2.35 (0.71-7.44)	0.16		
Student	49	1(1.25)	0.14 (0.02-1.32)	0.08		
Unemployed	31	4(5)	1.0		1.0	
Hypertension history						
No	203	29(36.25)	0.28 (0.16-0.48)	<0.001	0.36 (0.19-0.68)	0.002
Yes	138	51(63.75)	1.0		1.0	
Salt intake						
Never	38	26(32.5)	5.57 (1.84-16.9)	0.002	5.73 (1.65-19.97)	0.006
Monthly	34	18(22.5)	2.89 (0.96-8.71)	0.05	0.00 (0-0.001)	1.0
Daily	244	29(36.3)	0.35 (0.13-0.90)	0.03	0.49 (0.17-1.42)	0.19
Weekly	25	7(8.7)	1.0		1.0	

AOR = Adjusted odds ratio, **COR** = Crude odds ratio, **ART** = Anti-retroviral therapy **1 USD** = 2700 TZs, **TZs**: Tanzania shillings

Factors associated with hypertension among HIV patients

In bi-variate logistic regression analysis, age, monthly income, dependability, hypertension history, and salt intake (set $p\text{-value} < 0.05$) were included in multivariate logistic regression analysis. In multivariate analysis, age, income, hypertension history, and salt intake were significantly associated with hypertension. Those with age range 8-35 years were less likely to have hypertension as compared to those with greater than 63 years with AOR=0.10 (95% CI: 0.03-0.41), $p=0.004$, Participants with income of above TZs 500,000/= per month were more likely to develop hypertension as compared to other (AOR= 3.50, 95% CI (0.91-13.49), $p=0.03$, Individuals who had not family history of hypertension were less likely to develop hypertension compared to those who had AOR=0.36 (95% CI: 0.19-0.68), $p=0.002$ and those who were never taking salt were more likely to have hypertension compare to those took salt weekly with AOR= 5.73 (95% CI: 1.65-19.97), $p=0.006$, Table 5.

Discussion

Diabetes and hypertension among HIV patients and their associated factors are global health challenges. This study aimed to determine the prevalence and associated factors for diabetes and high blood pressure among HIV patients at KCMC hospital in Moshi district.

The overall prevalence of diabetes among HIV patients was 14.1%, which is higher than previously reported in Tanzania, where it was 13% in Mwanza., and 8.8% in Ethiopia. On the other hand, our findings are lower than the study conducted in Uganda, which was 4.7% [14]. The observed differences in the prevalence between our findings and previous studies could be because of the low sample size. High prevalence of diabetes among HIV patients implies that the

development of non-communicable diseases still to be a health challenge, so clinicians should implement diabetes screening and treatment programs among HIV patients.

Notably, the majority of our study participants (66.6%) were female. This demographic distribution is a common observation in HIV care and treatment clinics in sub-Saharan Africa, including Tanzania [15]. Several factors contribute to this pattern. Women generally have higher rates of HIV prevalence and incidence in many parts of the region due to a combination of biological, social, and economic vulnerabilities that increase their risk of exposure and acquisition of HIV. Furthermore, women tend to be more engaged with healthcare services, including HIV testing and follow-up care, which might lead to higher rates of diagnosis and consistent clinic attendance compared to men [16]. This increased healthcare-seeking behavior among women could result in their overrepresentation in clinic-based studies like ours. While our study's primary aim wasn't to explore gender disparities in healthcare access, this observed demographic pattern is consistent with the broader epidemiology of HIV in Tanzania.

Additionally, our study reports a high prevalence of diabetes among the older age group above or equal to 63 years. This implies that individuals of older age have predisposing factors that could explain the higher prevalence, including a decrease in physical activity level and duration of ART [17]. Also, our study reports a high prevalence of diabetes among self-employed maybe they have higher income, which could have led them to have a sedentary lifestyle [18]. A study reports a high prevalence of diabetes among HIV patients who had a diabetic family history because diabetes can be inherited from one generation to another [13]. The prevalence of diabetes in our study was reported to be

higher among patients who were on long-term duration of ART for 21 to 37 years, which could lead to interference with the body's glucose metabolism, as highlighted in a study conducted in South Africa

The predetermined risk factors for diabetes among PLWHIV in this study were older age, High income, and a Daily intake of a diet consisting of fruits and vegetables, while it was different in the study conducted in Ethiopia, which showed long duration of ART, alcohol consumption, and physical exercise to be associated factors [19].

The long-term impact of Antiretroviral Therapy (ART) on the development of non-communicable diseases like diabetes and hypertension in PLWH is a significant concern. Our bivariate findings indicated a higher prevalence of diabetes among patients on long-term ART (21 to 37 years), consistent with existing literature [20,21]. The molecular mechanisms underlying this association are complex and multifaceted [22]. Certain classes of ART, particularly older Nucleoside Reverse Transcriptase Inhibitors (NRTIs) like stavudine and zidovudine, and some Protease Inhibitors (PIs), have been linked to metabolic disturbances, including insulin resistance leading to diabetes, hypertension, and other complications [1-4].

The overall prevalence of hypertension among HIV patients was 23.5%, which was higher than previously reported in Tanzania, in one northern Tanzania, which was 5.5% [19]. The difference in prevalence could be due to variation in sample size and geographical locations, and other factors, conducted in Dar es Salaam, 12.5% [23]. Additionally, our study reports a high prevalence of hypertension among the older age group between 36-62 years. This implies that individuals of older age have predisposing factors that could explain the higher prevalence, including a decrease in physical activity and

dietary patterns [6]. Also, our study reports a high prevalence of hypertension among primary education individuals due to the low awareness of hypertension; a low hypertension awareness among PLHIV indicates a missed opportunity to screen and diagnose hypertension [9]. The prevalence of hypertension in our study was reported to be higher among patients who were self-employed due to stress, which can exacerbate health issues.

The prevalence of hypertension in our study was reported to be higher among patients who had income between 50,000-200,000 TZs because to their income, they might be aware of their health condition due to regular check-ups, leading to a higher reported prevalence of hypertension [24]. Also, prevalence of hypertension in our study was reported to be higher among patients who were dependent due to high workload, because reliable individuals may have demanding jobs or roles that can be stressful and contribute to hypertension; the pressure of meeting high expectations or managing multiple responsibilities can affect blood pressure [25]. A study reports a high prevalence of hypertension among HIV patients who had hypertension family history because hypertension can be inherited from one generation to another; these genetic factors are independent of HIV but can interact with the virus and its treatment [26].

Also, the prevalence of hypertension is higher in people with diabetes, because diabetes might compromise kidney function, leading to diabetic nephropathy, which affects the kidney's ability to regulate blood pressure. Combined with HIV-related kidney complications, this can further increase hypertension risk [13]. The people who were taking salt food were found to have a higher prevalence of hypertension due to their hypertensive condition, because excessive salt intake could lead to high blood pressure. The predetermined risk factors for hypertension among PLWH in this study were age, income,

and family history, while the associated factors in the studies conducted in Kenya were sex, BMI, and history of alcohol consumption [27].

Strengths and limitations of the study

The study highlights a significant prevalence of diabetes among individuals living with HIV, which is critical for understanding the burden of comorbidities in Tanzania population. These findings suggest socioeconomic factors play a significant role in the prevalence of diabetes among PLWH, offering insights into potential areas for targeted intervention. Utilizing multivariable regression analyses allows for an insightful understanding of the association between HIV and these comorbidities. This methodological rigor enhances the credibility of the findings.

Exclusion of BMI measurements was primarily due to logistical constraints during data collection, which prioritized core clinical measurements and interview-based data within the clinic setting. While we collected self-reported information on lifestyle factors and conducted physical measurements for blood pressure, the lack of objective BMI data prevents us from exploring its potential role as a confounding factor or an independent predictor in the development of these non-communicable diseases among PLWH in our cohort. Future studies should aim to include comprehensive physical measurements, including BMI, to provide a more complete understanding of these associations.

The cross-sectional nature of the studies precludes establishing temporality and causality between HIV status and diabetes/hypertension prevalence. Longitudinal studies are needed to

better understand the incidence and progression of these conditions about HIV infection over time.

Conclusion

The result suggests that social determinants, rather than HIV status alone, may significantly influence the prevalence of diabetes and hypertension. This insight can inform public health strategies and resource allocation, emphasizing the need to address broader socioeconomic factors in managing health outcomes for people living with HIV. More research should be done with a cohort nature to establish the association of diabetes and hypertension in PLWH. Healthcare givers should be made aware of the problem to be able to identify it early, investigate, and provide prompt management. Implement regular screening of diabetes and hypertension among HIV patients. Educate patients about the risks of diabetes and hypertension in the context of HIV based on lifestyle, which can help in management and prevention.

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Authors Contributions

DCK conceived the study, analyzed the data, and drafted the manuscript. ALH, GF, JB, and EM performed all the measurement and revised the manuscript. DM, BMN, JJS, FM, IL, contributed to the interpretation of the data and critical review of the manuscript. All authors read and approved the final manuscript.

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