

Original Research Article

Missed HIV care appointments and high body mass index predict hypertension risks at diagnosis: a risk identifying opportunity among people living with HIV for global health

Sylvia Ngugi^{1*}, Cyrus Mutie¹, Victoria Wanjiku¹, Reagan Chweya¹,
John Gachohi¹⁻³, Kenneth Ngunjiri^{1,4}

¹School of Public Health, Jomo Kenyatta University of Agriculture and Technology, Kenya

²Global Health Program, Washington State University, Washington, US

³Paul G. Allen School of Global Health, Washington State University, Washington, US

⁴Department of Global Health, University of Washington, Washington, US

Received: 11 February 2024

Accepted: 26 February 2024

*Correspondence:

Dr. Sylvia Ngugi,

E-mail: maina.sly@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: Chronic conditions, including diabetes and hypertension among people living with HIV/AIDS (PLWHIV), require long-term adherence to treatment and regular follow-ups for symptom checkups and management to prolong life and improve its quality. To inform the design of patient-centered HIV-NCD interventions, this study determined predictors of hypertension and diabetes (non-communicable diseases-NCD) among PLWHIV.

Methods: This study adopted a cross-sectional study design. Attendance registers of PLWHIV attending the comprehensive care clinic at Murang'a referral hospital served as a sampling frame. The first study participant was randomly selected using a lottery method, while other participants were systematically sampled and enrolled. PLWHIV were clinically examined for NCD (hypertension and/or diabetes) screening and body mass index (BMI). Logistic regression models predicted associations with risk factors linked to the selected NCD among PLWHIV.

Results: A total of 281 PLWHIV were recruited, of these 192 (68%) were female, while 91% were aged above 35 years. We identified 77 (27%) PLWHIV with hypertension, and none had diabetes. About 70% of the PLWHIV with NCD missed HIV care appointments. About 89% of the PLWHIV were obese and overweight. Higher BMI (Odds ratio (OR)=1.15 95%CI 1.06, 1.24) and missing HIV care appointments (OR=2.12 95%, CI 1.23, 3.95) increased the risk of hypertension among PLWHIV.

Conclusions: We establish increased risks to NCD associated with higher BMI and missed scheduled HIV-linked care among PLWHIV. To improve global health, identifying and understanding determinants of missed HIV care appointments will help to re-engage defaulters while promoting regular screening for NCD profiles.

Keywords: NCD, Diabetes, Hypertension, PLWHIV

INTRODUCTION

The world health organization (WHO) estimates that >75% of people living with HIV (PLWHIV) are susceptible to NCD, among them hypertension and diabetes.¹ Globally, Sub-Saharan Africa (SSA) accounts for 55% of PLWHIV who are at a growing risk of

hypertension and diabetes co-morbidities partly due to lifestyles changes and rising life expectancy following long-time antiretroviral therapy (ART) use.²⁻⁴ In Kenya, despite the exponential growth of HIV treatment programs, 21% of PLWHIV currently suffer from NCDs, thus, contributing to half of all hospital admissions and deaths, as well as aiding the sustained HIV-NCD twin burden, especially among women of reproductive age.⁵

Yet, the combined HIV-NCD impacts on the country are still not adequately studied.⁶ Understanding HIV-NCD epidemic dynamics is needed in integrating NCD screening and management services at HIV care and treatment centers.^{6,7}

Managing hypertension and diabetes by PLWHIV requires long-term regular medication access, treatment adherence, and continuous health status monitoring.⁸ Besides, PLWHIV often miss clinic appointments interrupting their ART care and thus the effectiveness of HIV management programs while compromising the tracking of their conditions, including NCD, consequently promoting poor health outcomes and increasing healthcare costs or other indirect burdens.^{8,9} Missed HIV care appointments by PLWHIV indicate limited ART adherence highlighting inconsistencies important for developing defaulter tracing programs.⁹ Nonetheless, patient-related factors and beliefs, facility-level barriers, poor record-keeping, inadequate treatment medication, limited health facility staff capacity, over-burdened healthcare facilities, and long waiting times increase instances of missed appointment schedules among PLWHIV.^{9,10} However, routine home visits and telephone calls by designated clinical staff engage PLWHIV, ensuring they receive continued care and act on scheduled follow-up visits.¹⁰ Moreover, understanding the characteristics of PLWHIV missed HIV care appointments provides insights for re-engaging interventions that better optimize treatment care successes while monitoring programmatic performance that guesstimates defaulter rates.¹⁰

Influences of higher BMI in the development of NCD among PLWHIV are well described.^{11,12} Development of NCDs among PLWHIV with a normal BMI reflects differential risks, including sedentary lifestyle behaviours and biological effects of adipose tissue after ART initiation.¹¹ This has necessitated calls for further studies that link well-managed HIV infection, excess adiposity and the growing NCD conditions among PLWHIV.¹³ Managing the ever-increasing HIV-NCD co-morbidities guarantees an improved quality of life among PLWHIV.¹² In this study, we estimated sub-national prevalence and investigated the NCD risks among PLWHIV in a referral facility in Central Kenya. PLWHIV in our study setting face limited access to diagnostic test kits for testing and screening blood pressure (BP) and random sugar levels (RBS), the key surrogate markers of prognosis in HIV-NCD conditions.

METHODS

Study area, design, and PLWHIV selection

This study was conducted between February to May 2021 in the comprehensive care centre (CCC) of Murang'a referral hospital. The health facility is the largest public referral hospital in Murang'a County in central Kenya, serving referred PLWHIV for Gatanga, Kandara,

Kangema, Kigumo, Kiharu, Maragwa, and Mathioya wards in Murang'a County (Figure 1). The county has an estimated population of 1,056,600 people in a total land area of 2,523 km², representing a population density of 419 people per km².¹⁴

This study adopted a cross-sectional study design. We estimated a sample size of 281 participants using a 95% confidence interval, 0.05 margin of error, 21% NCD prevalence among PLWHIV, and a 10% non-response rate using Epi-info software.¹¹ A total of 281 eligible study participants aged 18 years or above were systematically sampled from the facility appointment registers, with the first participant randomly selected using a lottery method. We included >18-year-old PLWHIV and studied them for the occurrences of NCDs.

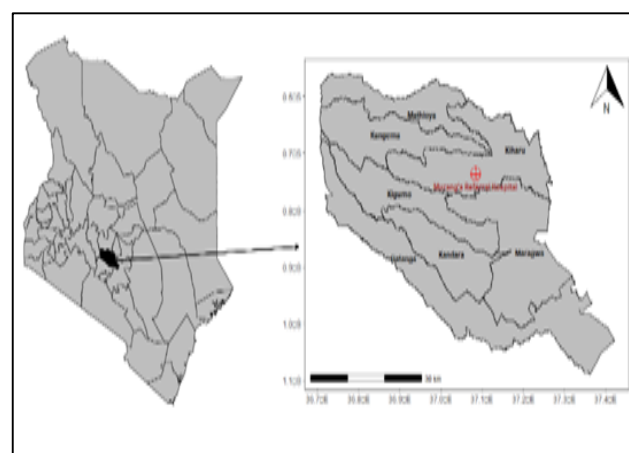


Figure 1: Map of the study area. Left: Map of Kenya showing the study selected Murang'a county (black polygon). Right: A map showing the location of Murang'a referral hospital (brown circle symbol) in Muranga County and the wads serviced by hospital.

HIV and NCD case definition

PLWHIV included in the study had a laboratory-confirmed HIV test or were currently on ART medication and clinically examined for NCD. PLWHIV with systolic (SBP) and diastolic (DBP) blood pressure of $\geq 140/90$ mmHg were considered hypertensive.¹⁵ Those on diabetes medication or with a random blood glucose of >11.1 mmol/L (≥ 200 mg/dL) and 7 to 11 mmol/L were considered diabetic and pre-diabetic respectively.¹⁶ Additionally, the PLWHIV were classified using their BMI, kg/m² as underweight (<18.5 kg/m²), normal (18.5 to <25 kg/m²), overweight (25 to <30 kg/m²), and obese (≥ 30 kg/m²).

Data collection and analysis

Using an interviewer-administered questionnaire, we first obtained PLWHIV characteristics, including the level of education categorized as those who attained primary, secondary, and post-secondary education and without

formal schooling. PLWHIV were categorized into those with formal and informal occupations and/or those with unemployment. We also obtained the PLWHIV monthly income, marital status, religion, family support in accessing health facilities, and medical history. We also collected information on risk factors for NCDs and treatment history. PLWHIV on medication produced their hospital cards during their CCC visits that provided information on their health-seeking behaviours, including missed HIV care appointments and any history of hypertension and diabetes in their family. Other health-related characteristics obtained included mode of transport to the facility, availability of medical insurance coverage, NCD services satisfaction, and health providers' professionalism. Weekly behavioural risk factors for NCDs, including smoking tobacco, consuming alcohol, checking blood glucose, physical activity, balanced diet intake, and daily salt, fatty, fruit, or vegetable meal servings, were collected.

Measurements from the PLWHIV included weight and height (used to compute BMI), BP, and RBS measurement. We generated a study outcome variable dichotomized to yes versus no for those diagnosed with and without the NCD of interest (hypertension and/or diabetes), respectively. Using correlation analysis, BP, BMI, and blood glucose measurements were tested for correlation with increasing age. The chi-square test was used to compare categorical variables. To predict the factors associated with the NCD (hypertension and diabetes) among PLWHIV, we utilized logistic regression models, performed in R software version 4.2.0.

RESULTS

Characteristics of PLWHIV

Table 1 shows the characteristics of 281 PLWHIV enrolled in the study. Of these, 68% were female, while 91% were aged above 35 years. The average age of these study participants was 43 ± 7 years. About 60% of the PLWHIV had attained primary or secondary education. Additionally, 180 (64%) were married, with a majority (90%) in monogamous relationships. Largely, 71% of the PLWHIV earned more than 10,000 Kenya shillings (KES) per month with a majority (61%) working in the informal sector. 89% of these PLWHIV were obese and overweight.

Prevalence of NCD among PLWHIV

Of the 281 PLWHIV, 77 (27%) and 154 (55%) were diagnosed with hypertension and at prediabetes. Of these PLWHIV, 56 (20%) were diagnosed to have both pre-diabetes and hypertension. None of the PLWHIV was diabetic. The prevalence of hypertension among PLWHIV was higher among females (19%) and those aged above 35 years (24%). Hypertension was prevalent among married PLWHIV, those who had attained secondary education (17%), and those working in the

informal sector or self-employed (15%). Hypertension was prevalent among obese (18%) and overweight PLWHIV (9%) (Table 1).

In correlation analysis, the 204 PLWHIV without the NCD, their SBP, DBP, and BMI measurements were directly correlated with increasing age. Their random blood glucose measurements positively correlated with increasing age among males while negatively correlating in females (Figure 2). For the 77 PLWHIV with hypertension, their DBP measurement positively correlated with increasing age among females ($R=0.28$) and males ($R=0.05$) (Figure 3 A). The SBP and BMI measurements among these PLWHIV positively correlated with increasing age among females while negatively correlated among males (Figure 3 B and C). Additionally, their blood glucose levels remained constant with increasing age (Figure 3 D). The overall average distribution of SBP, DBP, BMI, and blood glucose measurements among the PLWHIV are described in Table 2.

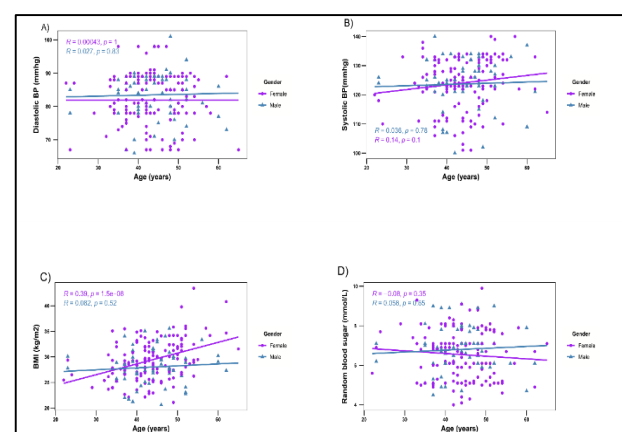


Figure 2 (A-D): Correlation analysis of-diastolic BP, systolic BP, BMI, and blood glucose measurement with increasing age among PLWH without NCD (hypertension).

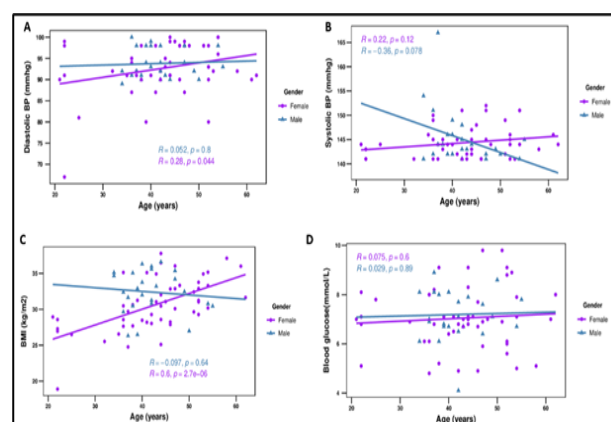


Figure 2 (A-D): Correlation analysis of-diastolic BP, systolic BP, BMI, and blood glucose measurement with increasing age among PLWHIV with hypertension.

Healthcare-seeking behaviour among PLWHIV

Table 3 describes healthcare-seeking behaviour among 281 PLWHIV and those with NCD. Of these PLWHIV, 88% used public means of transport to the health facility. Only 13% of PLWHIV had medical insurance coverage (Table 3). Generally, PLWHIV utilized an average of 234 KES in hospital costs to a max of 1,980 KES. Among the 77 PLWHIV with hypertension, 70% missed HIV care appointments and were in families with history of diabetes. Only five (6%) of these PLWHIV received familial support when going to a clinical appointment. Only 10 (13%) of these PLWHIV responded to satisfaction of their service providers and the services they provided while also responding to queries on NCDs (Table 3). Moreover, hypertension was prevalent among PLWHIV lacking medical coverage and using public and taxi (privately paid) means to the health facility (24%).

Behavioural risk characteristics among PLWHIV with NCDs

Table 4 describes NCD behavioural risk factors among PLWHIV. Of 77 PLWHIV with hypertension, 11 (14%) were smoking tobacco products, with most (90%) smoking more than once a day. About 13 (17%) of these PLWHIV consumed alcoholic drinks, with the half

consuming alcohol at least weekly. Only 14 (18%) and 17 (22%) of 77 PLWHIV engaged in moderate physical activities and exercises and took a balanced diet daily, respectively. Only 8 of these PLWHIV checked their blood glucose weekly. Largely (99%) these PLWHIV added table salt to their food servings and consumed fatty meals daily (Table 3). More than 90% of these PLWHIV included fruits and vegetables in their daily serving and taking processed foods such as bread weekly (Table 3). Further, though non-significant, weekly physical activity among the 77 PLWHIV is associated with reduced SBP, DBP and blood glucose levels ($p>0.05$).

Risk factors associated with NCDs among PLWHIV

Using univariable analysis, we determined factors discretely associated with NCDs among PLWHIV. These factors included education level, physical activity, processed food, adding salt to daily food servings, BMI, and missing HIV care appointments at $p\leq 0.1$ (Table 5). Multivariate analysis independently associated increasing BMI and missing HIV care appointments with NCDs among PLWHIV at $p\leq 0.05$. PLWHIV missing HIV care appointments had two folds increased risk of NCD compared to those not missing the appointments. Additionally, the risk of an NCD among PLWHIV increased by 15% for one unit increase of BMI (Table 6).

Table 1: Distribution of systolic blood pressure, diastolic blood pressure, BMI, and blood sugar levels among PLWH without NCD (n=204) and those with NCDs (n=77).

Sex	Age (In years)	PLWH without NCDs, (n=204)			PLWH with NCD, (n=77)		
		N	Mean	SD	N	Mean	SD
Female							
SBP	≤35	14	124.93	8.78	7	142.43	1.40
	>35	126	123.90	8.45	45	144.67	3.28
	Total	140	124.01	8.45	52	144.37	3.18
DBP	≤35	14	81.21	6.72	7	88.29	11.10
	>35	126	82.02	8.11	45	93.4	4.81
	Total	140	81.94	7.97	52	92.71	6.13
BMI (kg/m²)	≤35	14	26.99	3.20	7	26.10	3.38
	>35	126	29.68	3.89	45	31.31	3.21
	Total	140	29.41	3.90	52	30.61	3.67
Blood glucose	≤35	14	7.09	1.29	7	6.97	0.96
	>35	126	6.49	1.22	45	7.05	1.31
	Total	140	6.55	1.24	52	7.04	1.26
Male							
SBP	≤35	2	125	8.50	2	147.5	9.19
	>35	62	123.66	8.63	23	145	5.46
	Total	64	123.70	8.50	25	145.2	5.60
DIA	≤35	2	81.5	7.22	2	90.5	2.12
	>35	62	83.53	7.30	23	94.09	3.45
	Total	64	83.47	7.22	25	93.8	3.48
BMI	≤35	2	28.94	4.76	2	34.89	0.31
	>35	62	27.65	4.83	23	32.20	3.02
	Total	64	27.69	4.76	25	32.41	2.99
Blood glucose	≤35	2	6.65	1.20	2	7.1	1.41
	>35	62	6.81	1.21	23	7.2	1.01
	Total	64	6.80	1.20	25	7.20	1.01

Continued.

Sex	Age (In years)	PLWH without NCDs, (n=204)			PLWH with NCD, (n=77)		
		N	Mean	SD	N	Mean	SD
All							
SBP	≤35	16	124.94	8.19	9	143.56	4.13
	>35	188	123.82	8.49	68	144.78	4.11
	Total	204	123.91	8.45	77	144.64	4.10
DIA	≤35	16	81.25	6.38	9	88.78	9.69
	>35	188	82.52	7.87	68	93.63	4.38
	Total	204	82.42	7.76	77	93.06	5.41
BMI (kg/m²)	≤35	16	27.24	3.08	9	28.05	4.86
	>35	188	29.01	4.31	68	31.61	3.15
	Total	204	28.87	4.25	77	31.19	3.55
Blood glucose	≤35	16	7.03	1.22	9	7	0.97
	>35	188	6.59	1.23	68	7.10	1.21
	Total	204	6.63	1.23	77	7.10	1.18

Table 2: Univariable analysis of risk factors associated with NCDs among PLWH.

Variables		All PLWH, n (%)	OR	OR 95% CI	P value
Gender	Female	192 (68)	Ref	-	-
	Male	89 (32)	1.05	0.59, 1.83	0.86
Age (in years)	≤35	25 (9)	Ref	-	-
	>35	256 (91)	0.64	0.28, 1.58	0.316
Marital status	Married	180 (64)	Ref	-	-
	Separated, divorced	52 (19)	0.89	0.43, 1.77	0.750
	Single, widowed	49 (17)	1.18	0.58, 2.3	0.639
Education level	Primary	18 (7)	Ref	-	-
	Secondary	150 (54)	0.74	0.27, 2.12	0.557
	Diploma, certificate, bachelor	110 (40)	0.39	0.14, 1.17	0.0831
Religion	Christian	238 (85)	Ref	-	-
	Muslim, others	43 (15)	1.18	0.56, 2.36	0.651
Employment type	Student, unemployed	172 (61)	Ref	-	-
	Formal, casual	38 (14)	0.73	0.32, 1.71	0.469
	Self	70 (25)	0.55	0.27, 1.19	0.120
Income (ksh)	<10000	82 (29)	Ref	-	-
	>10000	199 (71)	0.74	0.42, 1.31	0.299
Medical cover	Yes	245 (88)	1.06	0.47, 2.27	0.879
	No	35 (13)	Ref	-	-
Transport to PHC	Cycle, car, walk, other	34 (12)	Ref	-	-
	Public, taxi	247 (88)	1.06	0.48, 2.49	0.897
PHC transport cost	-	-	1.00	0.99, 1.00	0.734
BMI (kg/m²)	-	-	1.17	1.09, 1.26	<0.001
Satisfied with NCD services	Yes	24 (74)	0.69	0.09, 3.03	0.658
	No	69 (26)	Ref	-	-
Smoke tobacco	Yes	34 (12)	1.31	0.59, 2.78	0.491
	No	247 (88)	Ref	-	-
Consume alcoholic drink	Yes	59 (21)	0.69	0.34, 1.34	0.292
	No	221 (79)	Ref	-	-
Alcohol consumption frequency/ times	2-5 times	25 (42)	Ref	-	-
	Once	34 (58)	0.82	0.24, 2.92	0.755
Often check blood glucose weekly	2-5 times	16 (29)	Ref	-	-
	Once	40 (71)	0.62	0.13, 3.36	0.549
Physically active weekly	Yes	67 (24)	0.63	0.32, 1.19	0.174
	No	214 (76)	Ref	-	-
Take physical activity	Daily	43 (64)	Ref	-	-
	Once week, month	24 (36)	0.23	0.03, 0.97	0.075.
	No	228 (0.811)	Ref	-	-
Add salt in daily	>2 times	175 (63)	Ref	-	-

Continued.

Variables		All PLWH, n (%)	OR	OR 95% CI	P value
servings	never	106 (37)	1.89	0.91, 3.83	0.079
Daily fatty meal serving	<2 times	180 (64)	Ref	-	-
	>2 times	101 (35)	1.88	1.10, 3.21	0.021
Daily fruit and vegetable serving	<2 times	216 (77)	Ref	-	-
	>2 times	65 (23)	1.85	0.93, 3.94	0.093
Weekly processed food servings	>2 times	261 (94)	Ref	-	-
	<2 times	18 (4)	1.39	0.47, 3.73	0.525
Missed HIV care appointment	Yes	149 (53)	2.69	1.55, 4.79	0.0005
	No	132 (47)	Ref	-	-
Family history of diabetes	Yes	162 (58)	1.31	0.77, 2.25	0.329
	No	119 (42)	Ref	-	-

Table 3: Characteristics of PLWHIV (n=281) and those with NCD, (n=77).

Variables		All (%)	NCD (%)	Prevalence (%)	95% CI
Sex	Female	192 (68)	52 (68)	18.5	16.2, 20.8
	Male	89 (32)	25 (32)	8.9	7.2, 10.6
Age^a (in years)	≤35	25 (9)	9 (12)	3.2	2.2, 4.3
	>35	256 (91)	68 (88)	24.2	21.6, 26.8
Marital status	Married	180 (64)	49 (64)	17.4	15.2, 19.7
	Separated divorced	52 (19)	13 (17)	4.6	3.4, 5.9
	Single, widow	49 (17)	15 (19)	5.3	4.0, 6.7
Marriage type	Monogamous	162 (90)	47 (96)	26.1	22.8, 29.4
	Polygamous	18 (10)	2 (4)	1.1	0.3, 1.9
Education level	Post-secondary ^b	110 (40)	22 (29)	7.9	6.3, 9.5
	Primary	18 (6)	7 (9)	2.5	21.6, 3.5
	Secondary	150 (54)	48 (62)	17.3	15.0, 19.5
Religion	Christians	238 (85)	64 (83)	22.8	20.3, 25.3
	Muslims	43 (15)	13 (17)	4.6	3.4, 5.96
Occupation type	Formal sector	70 (25)	21 (27)	7.5	5.9, 9.1
	Informal sector	172 (61)	42 (55)	15.0	12.9, 17.1
	Student, unemployed	38 (14)	14 (18)	5.0	3.7, 6.36
Income in shillings	≤10,000	82 (29)	26 (34)	9.3	7.5, 11.0
	>10,000	199 (71)	51 (66)	18.1	15.9, 20.4
Hypertensive	Yes (≤140/95 mm/hg)	77(27)	77	27.4	24.7, 30.1
	No (<140/95 mm/hg)	204 (73)	0	0.0	0.0, 0.0
Diabetic	Yes (>11 mmol/dl)	0 (0)	0	0.0	0.0,0.0
	No (≤11 mmol/dl)	281 (100)	0	0.0	0.0,0.0
Pre-diabetic	Yes (7-11 mmol/dl)	154 (55)	42 (54)	14.9	12.8, 17.1
	No (≤7 mmol/dl)	127 (45)	35 (46)	12.5	10.5, 14.4
BMI (kg/m²)	Healthy weight (18-24)	29 (10)	2 (3)	0.7	0.2,1.2
	Overweight (25-30)	130 (46)	25 (33)	1.7	7.2,10.6
	Obese (>30)	122 (43)	50 (65)	2.3	15.5, 20.1
Prediabetic and hypertensive	Yes	56 (20)	42 (54)	14.9	12.8, 17.1
	No	225 (80)	35 (46)	12.5	10.5, 14.4

^aMinimum and maximum age was 21 and 65 years, respectively; ^bPost-secondary included diploma, certificate, bachelor.

Table 4: Healthcare-seeking behaviour among the PLWH (n=281) and those with NCD, (n=77).

Variances		All (%)	NCD (%)	Prevalence (%)	95% CI
Medical insurance cover	Yes	35 (13)	10 (13)	3.6	2.5, 4.7
	No	245 (88)	67 (87)	23.9	21.4, 26.5
Transport to PHC	Cycle, car, walk, other	34 (12)	9 (12)	3.2	2.2, 4.3
	Public taxi	247 (88)	68 (88)	24.2	21.6, 26.8
Family history of diabetes	Yes	162 (58)	48 (71)	17.1	14.8, 19.3
	No	119 (42)	29 (29)	10.3	8.5, 12.1
Queries on NCD	Yes	73 (78)	7 (70)	7.5	4.8, 10.3

Continued.

Variances		All (%)	NCD (%)	Prevalence (%)	95% CI
Responded	No	20 (22)	3 (30)	3.2	1.4, 5.1
Satisfied with NCD services	Yes	24 (26)	2 (20)	2.2	0.6, 3.7
	No	69 (74)	8 (80)	8.6	5.7, 11.5
Health providers professional	Yes	84 (91)	9 (90)	9.8	6.7, 12.9
	No	8 (9)	1 (10)	1.1	0.0, 2.2
Family support to a clinical appointment	Yes	35 (80)	5 (100)	11.4	0.0, 16.1
	No	9 (20)	0 (0)	0.0	0.0, 0.0
Missed HIV care appointment	Yes	149 (53)	54 (70)	19.2	16.9, 21.6
	No	132 (47)	23 (30)	8.2	6.5, 9.8

Table 5: Behavioural risk factors among PLWHIV (n=281) and those with NCD, (n=77).

Variance		All (%)	NCD (%)	Prevalence (%)	95% CI
Smoking tobacco	Yes	34 (12)	11 (14)	3.9	2.8, 5.1
	No	247 (88)	66 (86)	23.5	21.0, 26.0
Smoking frequency	Once	8 (24)	1 (9)	2.9	0.0, 5.8
	More than once	26 (76)	10 (91)	29.4	21.6, 37.2
Consume alcohol	Yes	59 (21)	13 (17)	4.6	3.4, 5.9
	No	221 (79)	64 (83)	22.9	20.3, 25.4
Alcohol consumption times	Once	34 (58)	7 (54)	11.9	7.7, 16.1
	2-5 times	25 (42)	6 (46)	10.2	6.2, 14.1
Often check blood glucose weekly	Once	40 (71)	5 (63)	8.9	5.1, 12.7
	2-5 times	16 (29)	3 (38)	5.4	2.3, 8.4
Physically active weekly	Yes	67 (24)	14 (18)	5.0	3.7, 6.3
	No	214 (76)	63 (82)	22.4	19.9, 24.9
Vigorous exercise	None	67 (96)	14 (93)	20.9	15.9, 25.9
Moderate exercise	Cycling	3 (4)	1 (7)	1.5	0.0, 3.0
	None	64 (96)	13 (93)	19.4	14.6, 24.2
Daily balanced diet intake	Yes	53 (19)	17 (22)	6.0	4.6, 7.5
	No	228 (81)	60 (78)	21.4	18.9, 23.8
Add salt in daily servings	Never	2 (1)	2 (3)	0.7	0.2, 1.2
	Once	36 (63)	13 (56)	4.6	3.4, 5.9
	2 times	175 (63)	43 (56)	62.5	59.6, 65.4
	3 times	67 (24)	19 (25)	6.8	5.3, 8.3
Daily fatty meal serving	At least once	10 (4)	0 (0)	0.0	0.0, 0.0
	2 times	170 (60)	41 (53)	60.5	57.6, 63.4
	3 times	99 (35)	34 (44)	12.1	10.2, 14.0
	≥4 times	2 (60)	2 (53)	0.7	0.2, 1.2
Daily fruit and vegetable serving	Never	6 (2)	2 (3)	0.7	0.2, 1.2
	At least once	216 (77)	64 (83)	22.8	20.3, 25.3
	2 times	55 (20)	10 (13)	3.6	2.5, 4.7
	3 times	3 (1)	1 (1)	0.4	0.0, 0.7
	≥4 times	1 (0)	0 (0)	0.0	0.0, 0.0
Weekly processed food servings	At least once	18 (56)	6 (47)	2.2	1.3, 3.0
	2 times	156 (56)	35 (47)	55.9	52.9, 58.9
	3 times	95 (34)	30 (40)	10.8	8.9, 12.6
	≥4 times	10 (4)	4 (5)	1.4	0.7, 2.1

Table 6: Factors associated with NCDs among PLWHIV.

Variables		OR	CI	P value
Missing HIV care appointment	Yes	2.12	1.23, 3.95	0.008
	No	Ref	-	-
BMI (kg/m²)		1.15	1.06, 1.24	<0.000

DISCUSSION

This study determined the risk factors associated with NCDs among PLWHIV attending a referral health facility in central Kenya. The frequently diagnosed NCD among the PLWHIV was hypertension in women compared to their male counterparts. Additionally, although none of the PLWHIV was diagnosed with diabetes, more than half (55%) were prediabetic. Missing HIV care appointments and higher BMI predicted the risk of NCDs among PLWHIV. Consistent with other studies, regular HIV care appointments among PLWHIV, including those for NCD care, delayed complications, and risk of hospitalization.¹⁷

Increasing BMI among PLWHIV predicted a 15% increased risk of hypertension, suggesting a possible risk associated with heavy weight. Indeed, most (89%) of the PLWHIV, irrespective of sex, were obese or overweight (BMI ≥ 25). Consistent with our findings, a study in South Africa reveals an increasing risks of chronic diseases including hypertension co-morbidities are associated with obesity among the PLWH.¹⁸ Additionally, hypertension increases the risk of diabetes occurrences due to hyperglycaemic conditions from the prolonged blood sugar build-up linked with obesity, weight gain, or high BMI among the PLWHIV.¹⁹ Further, ART initiation in the presence of obesogenic environment risks predisposes PLWHIV to overweight and the ultimate risk of NCD, including hypertension.²⁰ Behavioural interventions promoting lifestyle changes such as routine body weight screening, increasing physical exercise, consuming adequate fruits or vegetables, and caloric restrictions effectively maintain normal BMI for healthy body weight among PLWHIV.²¹

PLWHIV missing HIV care appointments were twice as at risk of hypertension compared to those attending these appointments suggesting the likelihood of poor adherence to proper care and management. Indeed, 70% of the PLWHIV missed HIV care appointments, with a majority (99%) linking their reasons to associated costs and the unavailability of ART drugs in the facility. Consistent with our findings, a study in Ethiopia associated HIV care appointments with additional care costs, quality of services received, and psychosocial support. This study did not assess healthcare workers' attitudes and related persistent HIV stigma and discrimination among the PLWHIV. However, these factors are among the major barriers to access and uptake of care services.²² Moreover, similar to our findings, missed appointments are common among PLWHIV in low-income families unable to cover transport to health facilities and associated costs, resulting in delayed or missed care likely to worsen their health outcomes.²³ Adherence to HIV care appointments by PLWHIV promotes better HIV-NCD care, including treatment and management, thus warranting strategic approaches to promoting hospital attendance, such as eliminating transport costs, encouraging familial support, and good doctor-patient relationships.^{24,25} Further,

adopting technological reminder systems could support PLWHs in adhering to scheduled doctor appointments for care services and continuity.²⁶ To contribute to global health, identifying and understanding determinants of missed HIV care appointments will help to re-engage defaulters while promoting regular screening for NCD profiles.

Prediabetes was common among older PLWHIV aged >35 years (55%), suggesting a likelihood of progression to diabetes if left untreated or unchecked and an ultimate co-occurrence with hypertension. Additionally, our hypertension (17%) prevalence estimates among these PLWHIV were almost similar in proportions to that of the South Africa study, with increasing age among these PLWHIV being an indication of prolonged life, perhaps due to the ART treatment.^{18,27} These hypertensive and risky pre-diabetes conditions we studied among PLWHIV warrants the need for the integration of HIV treatment and NCD screening services to reduce the progression and identification of undiagnosed hypertensive-related complication.^{28,29} Further, these services can leverage the existing overlapping services to improve the development and delivery of quality chronic care services and reduce service duplication, fragmentation, associated costs, and inconveniences.^{27,29,30}

More than 22% of PLWHIV with hypertension took alcohol and smoked tobacco weekly while also missing their HIV care appointments, suggesting likely NCD behavioural risk exposure. In addition, these PLWHIV consumed an unbalanced diet and were physically inactive. Consistent with our findings, a study in Uganda and Kenya associated alcohol consumption with antiretroviral medication non-adherence and delayed initiation, and reduced retention of PLWHIV to care, contributing to HIV/AIDS complications.³¹ Further, alcohol consumption impacts decision-making, promoting riskier sexual behaviours, including engaging in unprotected sex among PLWHIV, ultimately increasing HIV incidence.³² Conversely, repeated alcohol and smoking are risk factors for hypertension and diabetic complications and risks among PLWHIV.³³ In our study area, alcohol consumption is a major public health concern that needs to be addressed using established means.³⁴ Smoking cessation improves health outcomes increasing life expectancy and risks of NCD and HIV infection itself.³⁵

Fewer (24%) PLWHIV participated in physical activities, including moderate exercises suggesting a reduced sedentary behaviour. Indeed, PLWHIV engaging in physical activities was associated with reduced systolic and/or diastolic blood pressure and blood glucose levels ($p > 0.05$). Earlier findings in Sub-Saharan Africa link physical activities to improving blood glucose and blood pressure levels which are common non-communicable disease risks.³⁶ On the other hand, PLWH (76%) reporting not participating in any physical activities indicated sedentary lifestyle habits warranting more

insights into health promotion covering physical inactivity given the longer ART treatment duration, especially among females.³⁷ Existing HIV and NCD care models can integrate PLWHIV physical activity interventions to include hospital-based training and a home-based exercise program to improve their fitness strengths, body composition, and quality of life.^{36,38} Further, expanding national and community health education interventions promoting awareness on physical activity and healthy feeding practices would immensely benefit PLWHIV in tackling their greater risk of weight gain in BMI and obesity, among other associated risks.³⁹

Limitation and strengths

This study is limited to an institutional setting with a study population from a specific region. Our study did not explore the effects of ARVs on the potential build-up of blood sugar, and its contribution to hypertension among PLWHIV. In addition, the adopted cross-sectional study design is not designed to show temporal relationships, so the observed associations might not necessarily be causal. However, this study assessed factors associated with hypertension and diabetes among PLWHIV, thus providing insights for improving HIV-NCD integrated care model.

CONCLUSION

We established risks associated with higher BMI levels and missing HIV care appointments among PLWHIV by predicting the risk of hypertension at diagnosis. Regular medical appointments among PLWHIV, including those for NCD care increase patient engagement and are associated with preventing and delaying related complications. Understanding factors promoting missed or delayed appointments is essential in designing patient-centred support interventions and reducing their associated risks linked to NCDs.

ACKNOWLEDGEMENTS

Author would like to thank the study participants, data collectors for their support and participation. Also, to Muranga health facility staff for the institutional and administrative support for making the study a success.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Nxasana N, Oladimeji KE, Pulido-Estrada GA, Apalata TR. Prevalence of HIV and Selected Disease Burden in Outpatients of Primary Health Care (PHC) Facilities in Rural Districts of the Eastern Cape Province, South Africa. *Int J Environ Res Publ Heal*. 2022;19(13):8003.

2. Shayo EH, Kivuyo S, Seeley J, Dominic B, Peter K, Sayoki GM, et al. The acceptability of integrated healthcare services for HIV and non-communicable diseases: experiences from patients and healthcare workers in Tanzania. *BMC Health Serv Res*. 2022;22(1):1-12.
3. Ciccacci F, Tolno VT, Doro Altan AM, Giuseppe L, Stefano O, Sandro M, et al. Noncommunicable Diseases Burden and Risk Factors in a Cohort of HIV+ Elderly Patients in Malawi. *AIDS Res Hum Retroviruses*. 2019;35(11-12):1106-11.
4. Moyo M, Musekiwa A. Protocol for updated systematic review and meta-analysis on the burden of non-communicable diseases among people living with HIV in sub-Saharan Africa. *BMJ Open*. 2022;12(5):e055895.
5. Smit M, Perez-Guzman PN, Mutai KK, Rachel C, Joseph K, Nduku K, et al. Mapping the Current and Future Noncommunicable Disease Burden in Kenya by Human Immunodeficiency Virus Status: A Modeling Study. *Clin Infect Dis*. 2020;71(8):1864-73.
6. Achwoka D, Waruru A, Chen TH, Kenneth M, Evelyn N, Maureen K, et al. Noncommunicable disease burden among HIV patients in care: A national retrospective longitudinal analysis of HIV-treatment outcomes in Kenya, 2003-2013. *BMC Public Health*. 2019;19(1):1-10.
7. Mutagonda RF, Siril H, Kaaya S, Theresia A, Tausi H, Aisa M, et al. Prevalence and determinants of non-communicable diseases including depression among HIV patients on antiretroviral therapy in Dar es Salaam, Tanzania. *Trop Med Int Health*. 2022;27(8):742-51.
8. Chalker JC, Wagner AK, Tomson G, Keith J, Rolf W, Dennis R-D, et al. Appointment systems are essential for improving chronic disease care in resource-poor settings: learning from experiences with HIV patients in Africa. *Int Health*. 2013;5(3):163-5.
9. Magadzire BP, Mathole T, Ward K. Reasons for missed appointments linked to a public-sector intervention targeting patients with stable chronic conditions in South Africa: results from in-depth interviews and a retrospective review of medical records. *BMC Fam Pract*. 2017;18(1).
10. Etoori D, Wringe A, Renju J, Chodziwadziwa WK, Francesc XG-O, Georges R. Challenges with tracing patients on antiretroviral therapy who are late for clinic appointments in rural South Africa and recommendations for future practice. *Glob Health Action*. 2020;13(1):1755115.
11. Koethe JR, Jenkins CA, Turner M, Bebawy S, Shepherd BE, Wester CW, et al. Body mass index and the risk of incident noncommunicable diseases after starting antiretroviral therapy. *HIV Med*. 2015;16(1):67-72.
12. Hema A, Poda A, Zoungrana J, Jean Baptiste T, Clément M, Euloges K, et al. Body mass index trends and overweight/obesity risk among patients initiating

- antiretroviral therapy in Bobo-Dioulasso Day Hospital, Burkina Faso: a cohort study from 2002 to 2019. *PAMJ-CM*. 2022;9(28):1-15.
13. Kagaruki GB, Mayige MT, Ngadaya ES, Godfather DK, Akili KK, Andrew MK, et al. Magnitude and risk factors of non-communicable diseases among people living with HIV in Tanzania: A cross sectional study from Mbeya and Dar es Salaam regions. *BMC Public Health*. 2014;14(1):1-9.
14. KNBS. Distribution of Population by Administrative Units. 2019;251.
15. Unger T, Borghi C, Charchar F, Nadia AK, Neil RP, Dorairaj P, et al. 2020 International Society of Hypertension Global Hypertension Practice Guidelines. *Hypertension*. 2020;75(6):1334-57.
16. Committee ADAPP. 2. Classification and Diagnosis of Diabetes: Standards of Medical Care in Diabetes-2022. *Diabetes Care*. 2022;45(1):S17-38.
17. Majumdar A, Mitra A, Parthibane S, Revadi G. Young, obese, and underweight patients show up inadequately at scheduled appointments: Findings from a record-based study on diabetic, hypertensive diabetic, and hypertensive patients attending a primary care clinic of Puducherry. *J Family Med Prim Care*. 2019;8(3):1090-7.
18. Rajagopaul A, Naidoo M. Prevalence of diabetes mellitus and hypertension amongst the HIV-positive population at a district hospital in eThekweni, South Africa. *Afr J Prim Health Care Fam Med*. 2021;13(1):1-6.
19. Mouri Mi, Badireddy M. Hyperglycemia. *Mader's Reptile and Amphibian Medicine and Surgery*. In: StatPearls. Treasure Island (FL): StatPearls Publishing. 2023;1314-5.e1.
20. Kumar S, Samaras K. The Impact of Weight Gain During HIV Treatment on Risk of Pre-diabetes, Diabetes Mellitus, Cardiovascular Disease, and Mortality. *Front Endocrinol (Lausanne)*. 2018;9:705.
21. Duncan AD, Goff LM, Peters BS. Type 2 diabetes prevalence and its risk factors in HIV: A cross-sectional study. *PLoS One*. 2018;13(3):e0194199.
22. Asrade AA, Moges NA, Meseret M, Kasaye DA, Tilahun DT, Pammla P, et al. Uptake of appointment spacing model of care and associated factors among stable adult HIV clients on antiretroviral treatment Northwest Ethiopia. *PLoS One*. 2022;17(12):e0279760.
23. Chapman KA, Machado SS, Van der Merwe K, Ashley B, Dwight S. Exploring Primary Care Non-Attendance: A Study of Low-Income Patients. *J Prim Care Community Health*. 2022;13:21501319221082352.
24. Rachlis B, Naanyu V, Wachira J, Becky G, Beatrice K, Regina K, et al. Identifying common barriers and facilitators to linkage and retention in chronic disease care in western Kenya. *BMC Public Health*. 2016;16(1):1-15.
25. Atkins DL, Violette L, Neimann L, Mary T, Karen H, Deepa R, et al. Provider perspectives on the use of motivational interviewing and problem-solving counseling paired with the point-of-care nucleic acid test for HIV care. *PLoS One*. 2022;17(6):e0270302.
26. Akinniyi AA, Olamide OO. Missed medical appointment among hypertensive and diabetic outpatients in a tertiary healthcare facility in Ibadan, Nigeria. *Trop J Pharmaceutical Res*. 2017;16(6):1417-24.
27. McCombe G, Murtagh S, Lazarus JV, Marie CVH, Max B, Shabbar J, et al. Integrating diabetes, hypertension and HIV care in sub-Saharan Africa: a Delphi consensus study on international best practice. *BMC Health Serv Res*. 2021;21(1):1-9.
28. Kasaie P, Weir B, Schnure M, Chen D, Jeff P, Yu T, et al. Integrated screening and treatment services for HIV, hypertension and diabetes in Kenya: assessing the epidemiological impact and cost-effectiveness from a national and regional perspective. *J Int AIDS Soc*. 2020;23(1):e25499.
29. Adeyemi O, Lyons M, Njim T, Joseph O, Josephine B, Kevin N, et al. Integration of non-communicable disease and HIV/AIDS management: a review of healthcare policies and plans in East Africa. *BMJ Glob Health*. 2021;6(5):4669.
30. Manne-Goehler J, Siedner MJ, Montana L, Guy H, Pascal G, Julia R, et al. Hypertension and diabetes control along the HIV care cascade in rural South Africa. *J Int AIDS Soc*. 2019;22(3):e25213.
31. Patsis I, Goodrich S, Yiannoutsos CT, Steven AB, Beverly SM, Lameck D, et al. Lower rates of ART initiation and decreased retention among ART-naïve patients who consume alcohol enrolling in HIV care and treatment programs in Kenya and Uganda. *PLoS One*. 2020;15(10):e0240654.
32. Rehm J, Probst C, Shield KD, Shuper PA. Does alcohol use have a causal effect on HIV incidence and disease progression? A review of the literature and a modeling strategy for quantifying the effect. *Popul Health Metr*. 2017;15(1):4.
33. Parry CD, Patra J, Rehm J. Alcohol consumption and non-communicable diseases: epidemiology and policy implications. *Addiction (Abingdon, England)*. 2011;106(10):1718.
34. Conroy AA, McKenna SA, Ruark A. Couple interdependence impacts alcohol use and adherence to antiretroviral therapy in Malawi. *AIDS Behav*. 2019;23(1):201.
35. Reddy KP, Parker RA, Losina E, Travis PB, David AP, Nancy AR, et al. Impact of Cigarette Smoking and Smoking Cessation on Life Expectancy Among People With HIV: A US-Based Modeling Study. *J Infect Dis*. 2016;214(11):1672-81.
36. Kitilya B, PrayGod G, Peck R, John C, Kidola J, Bazil BK, et al. Levels and correlates of physical activity and capacity among HIV-infected compared to HIV-uninfected individuals. *PLoS One*. 2022;17(1):e0262298.
37. John B, Todd J, Mboya I, Mary M, Mark U, Tara M, et al. Physical activity and associated factors from a cross-sectional survey among adults in northern Tanzania. *BMC Public Health*. 2017;17(1):1-8.

38. Ndirangu-Mugo E, Shumba CS, Gatiti P, Benard DM, Amina A, Anne T. Interventions for Prevention of Non-Communicable Diseases among Adolescents Living with HIV: A Systematic Review. *SN Comprehensive Clin Med*. 2022;4(1):1-12.
39. Hyle EP, Martey EB, Bekker LG, Ai X, Robert AP, Rochelle PW, et al. Diet, physical activity, and obesity among ART-experienced people with HIV in South Africa. *AIDS Care-Psychological and Socio-Medical Aspects of AIDS/HIV*. *AIDS Care*. 2021;35(1):71-7.
40. Kuipers SJ, Cramm JM, Nieboer AP. The importance of patient-centered care and co-creation of care for satisfaction with care and physical and social well-being of patients with multi-morbidity in the primary care setting. *BMC Health Serv Res*. 2019;19(1):1-9.

Cite this article as: Ngugi S, Mutie C, Wanjiku V, Chweya R, Gachohi J, Ngure K. Missed HIV care appointments and high body mass index predict hypertension risks at diagnosis: a risk identifying opportunity among people living with HIV for global health. *Int J Community Med Public Health* 2024;11:1107-17.