ORIGINAL ARTICLE

Correlates of Hypertension among Persons Living with HIV at Livingstone Central Hospital: A Cross-sectional study

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ABSTRACT

Background: Persons living with HIV (PLWH) are more likely to develop hypertension and cardiovascular disease than the HIV-negative population. The new hypertension guidelines by the American Heart Association (AHA) and the American College of Cardiology (ACC) lowered the definition of hypertension from systolic and diastolic blood pressure (BP) of ≥140/90mmHg to ≥ 130/80, respectively. This study was aimed at determining the prevalence and factors associated with hypertension in PLWH in Livingstone using the new hypertension diagnostic criteria.

Methods: This was a cross-sectional study. We recruited 226 antiretroviral treated PLWH attending routine visits. Socio-demographic, health and clinical data including BP readings were collected. Interviewer-structured questionnaires adapted from the World Health Organization Stepwise approach to Surveillance (WHO STEPs) and the international physical activity questionnaire (IPAQ) were used to collect data. Statistical evaluations were employed to elucidate relationships between hypertension and all response variables.

Results: The prevalence of hypertension using the old and new guidelines was 16% and 42%, respectively. Factors significantly associated with increased and reduced odds of developing hypertension after adjustments in multivariate logistic regression were age, body mass index (BMI), employment status, fasting blood sugar (FBS) and table salt consumption, respectively ($p<0.05$ for all). Using the new AHA/ACC criteria for hypertension shifted the prevalence from 16% (old criteria) to 42%.

Conclusion: The prevalence of hypertension in PLH in Livingstone was 42% and the major risk factors associated with hypertension in PLWH wereincreasing age, BMI and FBS. We recommend the inclusion of FBS in routine measurements in PLWH. The AHA/ACC new guidelines should be re-enforced in low-cost settings to increase the treatment of hypertension among PLWH.

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INTRODUCTION

Susceptibility to non-communicable diseases (NCDs), such as hypertension, is a rising challenge facing persons living with HIV (PLWH), especially in low-income countries[1]. Collection of comprehensive baseline information that elucidates the underlying health risk factors associated with hypertension is critical for patient quality care, identification, and management of associated cardiovascular risk factors[1,2]. Many of the risk factors can be measured during routine clinic visits. This is of particular importance in sub-Saharan Africa where the burden of NCDs is high in PLWH[3].

In 2017, a report on clinical practice guidelines from the American College of Cardiology (ACC) and the American Heart Association (AHA) Task Force was released to aid in hypertension diagnosis and management[4]. For many years, systolic and diastolic blood pressure (SBP/DBP) categories of below 120/80 mmHg, 120-139/80-89 mmHg and 140/90 mmHg or higher defined normal, pre-hypertension and hypertension, respectively[5]. However, according to the new classification, the SBP/DBP reading categories of below 120/80 mmHg, 120-129/<80 mmHg and 130/80 mmHg or higher define normal, elevated blood pressure (BP) and hypertension[4]. Furthermore, the new guidelines also provide new treatment recommendations, including lifestyle changes to manage elevated blood pressure and hypertension[4]. Among lifestyle and social-economic factors pertinent to hypertension, management are diet, smoking, physical inactivity, being divorced/widowed, and lower education[6-8]. However, data based on new hypertension guidelines that report on the prevalence and factors associated with hypertension among PLWH living in sub-Saharan Africa is scarce.

We conducted a cross-sectional analytical study to determine the prevalence and risk factors associated with hypertension in PLWH. Furthermore, focusing on Zambia's health care, we were seeking to provide epidemiological data and compare these data to those collected in other countries. The study aimed: 1. to determine the prevalence of hypertension in PLWH in Livingstone, Zambia using the new AHA/ACC guidelines; 2. to determine routinely- and non-routinely collected factors associated with hypertension in PLWH.

METHODS

Study design and Setting

We conducted a cross-sectional analytical study at Livingstone Central Hospital (LCH), the largest referral hospital (and hosting the largest ART clinic) in the Southern Province of Zambia. The antiretroviral therapy (ART) Clinic offers ART and general medical services to the community, with approximately 3,800 PLWH enrolled in ART.

Participants

Participants were enrolled from the ART clinic during their regular attendance to these services.

Eligibility criteria

We included all adults aged 18 years and above living with HIV. Study participants were only recruited after verbally consenting and signing a consent form. We excluded patients seeking healthcare due to an acute illness rather than routine ART clinic reviews and participants who were currently taking antihypertensive medication for purposes of BP classification. Participants with a history of antihypertensive medication but who had not taken their medication for ≥ 2 weeks were included in the study and classified as hypertensive.

Sample size estimation

We used OpenEpi online software (sample size for a proportion or descriptive study) to compute a total sample size of 226 using an estimated prevalence of hypertension of 19.3% (local quarterly monthly records) at 95% significance level and 80% power in an ART population of 3776. The formula is stipulated below:

Sample size (n) = [DEFF*Np(1-p)]/ [(d2/Z21-α/2*(N-1)+p*(1-p)]; where N is the population size;

p is hypothesized % frequency of outcome factor in the population; d is Confidence limits as % of 100 (absolute +/- %, which is 5%); DEFF is the design effect.

Study variables

The primary response variable was hypertension. The diagnosis of hypertension for participants was initially based on the history of antihypertensive usage and BP readings of 140/90 mmHg or higher according to the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7)[5]. However, in this study, we used the new AHA/ACC criteria for hypertension as a BP reading of 130/80 mmHg or higher[4].

Explanatory variables included:

Social demographic characteristics such as age, gender, marital status, employment status, and highest education attained.

Physical activities and dietary lifestyle: daily physical activity, minutes of weekly vigorous and moderate activity, minutes of weekly walking activity, minutes spent seated every weekend and weekday, days per week with fruit intake, days per week with vegetable intake, the addition of salt at the table and while cooking, processed salt intake (intake of salt from processed foods), current alcohol consumption, current or past smoker.

Clinical factors: BMI (weight in kg/height in meters^2), waist circumference, duration on ART, ART regimen, use of antihypertensive medication, pulse, pulse pressure [defined as systolic BP (SBP) minus diastolic BP (DBP)], mean arterial pressure (MAP) (defined as DBP plus one third pulse pressure), mid-BP (sum of SBP and DBP, divided by 2), CD4 counts, HIV RNA viral load, fasting blood sugar (FBS), diabetes risk scores, diabetes risk category. Diabetes risk scores were calculated using the International Diabetes Federation (IDF) risk assessment form as previously described elsewhere .

BP measurements

We used the WGNBPA 730 (USA) and SBM 67 (Germany) BP monitors for measurements. For standard measurements, we adapted the new AHA/ACC guidelines : The patients had not been exercising, smoking, or drinking caffeine, their bladders were empty, and they were seated for more than 30 minutes before measurements were taken in a still position. The limb used to measure BP was supported ensuring that the BP cuff was at heart level. During the measurements, the participants were asked to sit upright, back straight, with feet flat on the floor without legs crossing each other. Three readings were taken and averaged. The average BP was used to reflect the person's BP. Routine BPs taken by attending nurses did not take into account the consideration explained above. Furthermore, our measured BP values were compared to the BP measurements taken by attending nurses during routine visits as reported in the patients' health records[25].

Hypertension diagnosis wasbased on the history of antihypertensive drugs (where hypertensive patients did not take antihypertensive drugs for ≥ 2 weeks to satisfy the eligibility criteria) except for four participants where we used BP readings taken on 2 or more occasions (from records) which were consistent with the standard measure news we took. The new diagnosis of hypertension using the AHA criteria for participants with no history of antihypertensive medication usage was based on BP readings taken on 2 occasions.

Antihypertensives

Most participants with a history (≥ 2 weeks) of using antihypertensive medication were using two antihypertensive drugs, a calcium channel blocker (Amlodipine or Nifedipine) and an Angiotensin-converting enzyme inhibitor (ACE) (Enalapril or Losartan) or a Diuretic (Furosemide or Moduretic).

Data sources/ measurement

For data collection, we used the interviewer structured questionnaire adapted from the WHO STEPs (World Health organization's STEPwise Approach to Surveillance), the international physical activity questionnaire (IPAQ), and the IDF type 2 diabetes risk assessment forms described in our previous study[9]. These were translated into the local language (Tonga) for participants that could not speak English.

Data analysis

Since data were not normally distributed (p-value <0.05, Shapiro-Wilk's test for all continuous variables categorized by hypertension status), we used the non-parametric test Mann-Whitney to compare medians (interquartile range) of continuous variables between normotensives and hypertensives. For categorical variables, we used Chi-Square or Fishers' exact test where appropriate. We selected known risk factors for developing hypertension and variables significant in univariate logistic regression were included in the multivariate logistic regression model. We reported odds ratios (OR), adjusted odds ratios (AOR), and confidence limits at 95%. We used descriptive statistics to compare the proportion of participants in each BP category and hypertension status between JNC 7 and the new AHA/ACC criteria. To compare routine BP measurements taken by attending nurses and standard BP measurements, we used Mann-Whitney and non-parametric Spearman correlation coefficient to assess the strength of association. We also reported median differences and their confidence limits (95%).

Age, WC, BMI, and diabetes risk were also categorized to ease interpretation.P values less than 0.05 were considered significant and are shown in bold. We used SPSS statistical software for data analysis.

RESULTS

General characteristics of participants

We found that the prevalence of hypertension in the study population was 42% as determined using the new AHA/ACC criteria and 16% as determined using the JNC 7 criteria (Table 1). The age range was 18 to 88 years old and 66% were female (n, 149)

Table 1; Social-demographic characteristics associated with hypertension

Variables	Normotensive n(%) 131 (58.0)	Hypertensive, 95 (42.0%)	P value
Hypertension status based on old criteria			
Normotensive, *n/total (%) 191/226 (85.5%)*	131 (100)	60 (63.2)	**<0.001**
Hypertensive, *n/total (%) 35/226 (15.5%)*	0 (0.0)	35 (36.8)	
Age,*median years (IQR)*	40 (30, 46)	50 (42, 57)	**<0.001**
Age category (years)			
18 - 35	49 (37.4)	8 (8.4)	**<0.001**
36 - 45	45 (34.4)	28 (29.5)	
	30 (22.9)	30 (31.6)	
56 – 65	6 (4.6)	25 (26.3)	
66 - 90	1 (0.8)	4 (4.2)	
Gender, n (%)			
Female	89 (67.9)	60 (63.2)	0.454
Male	42 (32.1)	35 (36.8)	
Marital status			
Married	57 (43.5)	44 (46.3)	**0.001**
Widowed	26 (19.8)	37 (38.9)	
Single	38 (29.0)	11 (11.6)	
Divorced	10 (7.6)	3 (3.2)	
Employment Status			
GRZ/Private	28 (21.4)	30 (31.6)	**<0.001**
Self employed	51 (38.9)	24 (25.3)	
Retired	3 (2.3)	17 (17.9)	
Unemployed	49 (37.4)	24 (25.3)	
Highest Education attained			
No formal education	5 (3.8)	4 (4.2)	0.339
Primary	28 (21.4)	20 (21.1)	
Secondary	76 (58.0)	46 (48.4)	
Tertiary	22 (16.8)	25 (26.3)	

IQR, interquartile range; GRZ, government; n, number of participants; %, percentage

Socio-demographic variables associated with hypertension

Age (Fig 1A), Age category (Fig 1B), marital (Fig 2A) and employment status (Fig 2B) were associated with hypertension (p<0.01) as shown in Table 1.

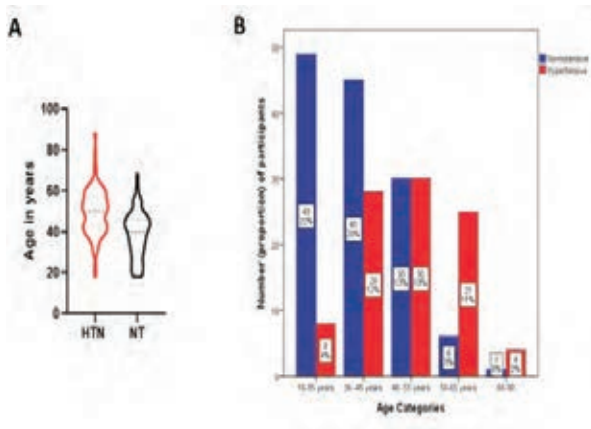

Fig 1: Median age and age category proportions between hypertensive and normotensive participants

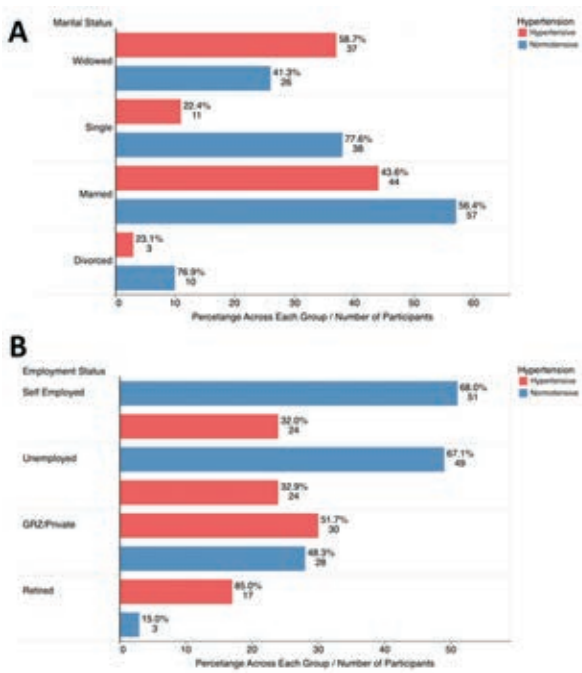

Fig 2. Comparison of marital proportions status proportions between hypertensive and normotensive participants

Lifestyle factors associated with hypertension

Minutes of weekly walking activity (p=0.006) and addition of salt while cooking (p=0.001) were the only factors associated with hypertension, Table 2.

Table 2. Dietary and lifestyle factors associated with Hypertension

Variables	**Normotensive** n(%) 131 (58.0)	**Hypertensive** n (%), 95 (42.0%)	**P value**
Daily physical activity			
Yes	69 (52.7)	35 (36.8)	**0.018**
No	62 (47.3)	60 (63.2)	
Minutes of Weekly vigor ous activity, *median (IQR)*	0 (0, 120)	0 (0, 120)	0.893
Minutes of Weekly moderate activity, *median (IQR)*	60 (30, 180)	20 (0, 120)	0.172
Minutes of Weekly walking activity, *median (IQR)*	55 (23, 120)	60 (20, 120)	0.221
Minutes spent seated every weekend, *median (IQR)*	300 (120, 383)	300 (180, 420)	0.327
Minutes spend seated every weekday, *median (IQR)*	180 (120, 360)	240 (120, 360)	0.257
Days per week with fruit intake, *median (IQR)*	1 (0, 2)	1 (0, 3)	0.490
Days per week with vegetable intake, *median (IQR)*	7 (5, 7)	7 (7, 7)	0.429
Addition of salt at the table			
Never or rarely	42 (32.1)	11 (11.6)	**<0.001**
Sometimes or always	89 (67.9)	84 (88.4)	
Addition of salt while cooking			
Never	0 (0.0)	1 (1.1)	0.108
Sometimes	1 (0.8)	4 (4.2)	
always	130 (99.2)	90 (94.7)	
Processed salt intake			
Never	21 (16.0)	26 (27.4)	**0.027**
Rarely	26 (19.8)	25 (26.3)	
Sometimes	74 (56.5)	42 (44.2)	
always	10 (7.6)	2 (2.1)	
Alcohol consumption			

IQR, interquartile range

Clinical factors associated with hypertension

BMI (Fig 3A), BMI category (Fig 3B), WC (Fig 4A), WC category (Fig 4B), duration on ART (Fig 5A), fasting blood sugar (Fig 5B), diabetes risk scores (Fig 5C), diabetes risk category (Fig 6), pulse pressure, mean arterial pressure, and mid-BP, were associated with hypertension, $p<0.05$ (Table 3). There was no specific ART regimen that was associated with hypertension. Pulse, CD4 count, and HIV RNA viral load were analogous between hypertensives and normotensive, $p>0.05$.

Table 3. Clinical factors associated with Hypertension

Variables	**Normotensive** n(%) 131 (58.0)	**Hypertensive** n(%), 95 (42.0%)	**P value**
Body mass index, *kg/m²*	20.3 (18.2, 23.8)	24.2 (21.1, 27.7)	**0.002**
Body mass index, *kg/m²*			
<18.5	24 (18.3)	7 (7.4)	**0.001**
	78 (59.5)	45 (47.4)	
25.0 – 29.9	18 (13.7)	25 (26.3)	
	11 (8.4)	18	
Waist circumference, *cm*	73 (69, 83)	85 (76, 95)	**<0.001**
Waist circumference category, *cm*			
<94 men or < 80 women	94 (71.8)	43 (45.3)	**<0.001**
94-102 men or 80-88 women	20 (15.3)	19 (20.0)	
>102 men or >88 women	17 (13.0)	33 (34.7)	
Duration on ART, *months*	102 (51, 129)	108 (72, 144)	**0.008**
ART regimen (n, %)	115 (57.5)	85 (42.5)	
TDF/3TC/EFV	83 (72.2)	59 (69.4)	0.420
TDF/3TC/NVP	8 (7.0)	11 (12.9)	
TDF/3TC/LPV/r	8 (7.0)	7 (8.2)	
ABC/3TC/NVP	1 (0.9)	0 (0.0)	
ABC/3TC/EFV	2 (1.7)	3 (3.5)	
AZT/3TC/LPV/r	4 (3.5)	3 (3.5)	
AZT/3TC/NVP	9 (7.8)	2 (2.4)	
Using Antihypertensive	*Not applicable*	31 (32.6%)	
Pulse, *beats per minute*	73 (63, 79)	70 (60, 80)	0.300
Pulse pressure, *mmHg*	42 (38, 46)	55 (45, 67)	**<0.001**
Mean arterial pressure. *mmHg*	88 (82, 93)	110 (102, 115)	**<0.001**
Mid BP, *mmHg*	94 (90, 101)	120 (108, 127)	**<0.001**
CD4 Count, *cells/μL*	487 (387, 672)	447 (305, 630)	0.678
HIV RNA Viral Load, *copies per ml*	48 (20, 445)	20 (20, 290)	0.143
Fasting blood sugar, mmol/l	4.9 (4.4, 5.3)	5.2 (4.8, 6.0)	**0.007**
Diabetes Risk scores	3 (1, 7)	7 (4, 10)	**<0.001**
Diabetes risk category			

ART, antiretroviral therapy; BP, blood pressure; TDF, tenofovir disoproxil fumarate ; 3TC, Lamivudine ; EFV, efavirenz ; NVP, nevirapine ; LPV/r, lopinavir/ritonavir ; ABC, abacavir ; AZT, azidothymidine, also called zidovudine; Antihypertensive drugs used: Calcium channel blockers (Amlodipine, nifedipine); Angiotensin converting enzyme inhibitors (ACE) (Enalapril, Losartan); Diuretics (Furosemide, moduretic).

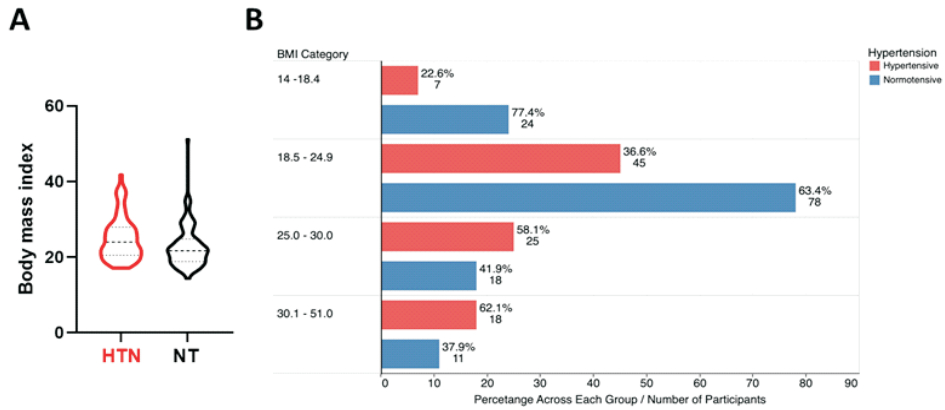

Fig 3. Distribution of body mass index between hypertensive and normotensive participants. Median body mass index (BMI) (panel A) and BMI categories (panel B) compared between hypertensive and normotensive participants

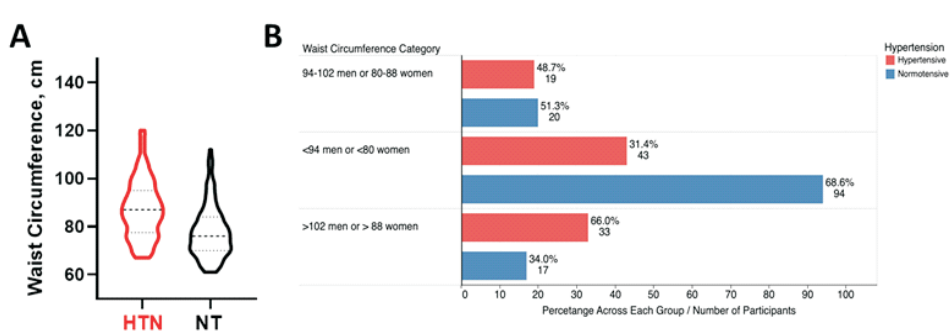

Fig 4. Distribution of waist circumference between hypertensive and normotensive participants. Median waist circumference (WC) (panel A) and WC categories (panel B) compared between hypertensive and normotensive participants

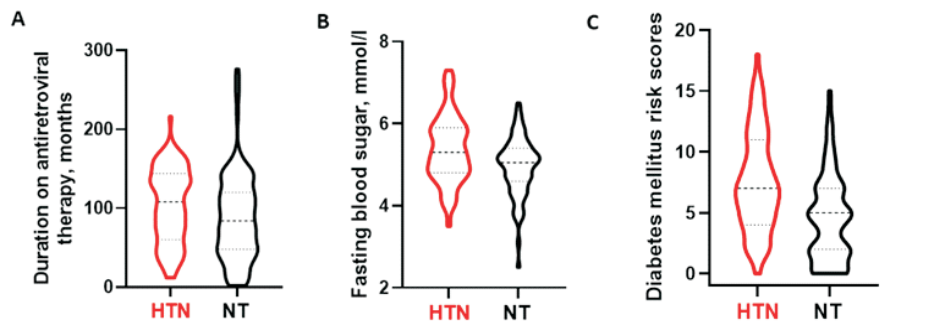

Fig 5. Duration on antiretroviral therapy, fasting blood sugar and diabetes risk scores between hypertensive and normotensive participants

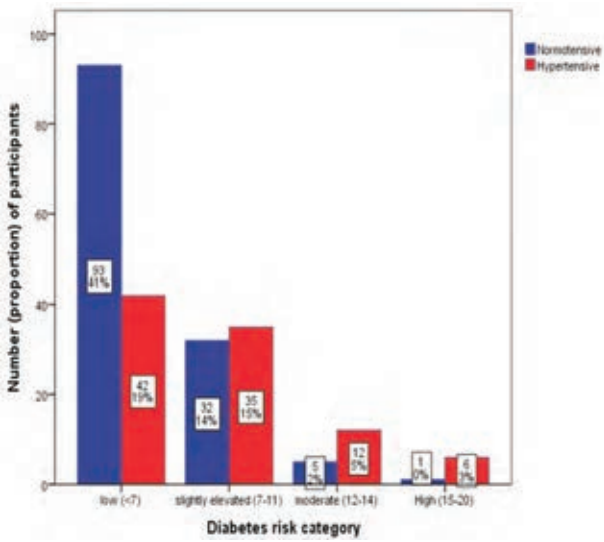

Fig 6. Hypertension distribution by diabetes category

Multivariate analysis of factors associated with hypertension

We included all factors associated with hypertension in logistic regression in multivariate analysis. Age, BMI, employment status, table salt consumption (inversely association), and fasting blood sugar remained significantly associated with hypertension after adjustments, as shown in Table 4.

Table 4. Factors associated with hypertension in logistic regression

Variable	Odds Ratio (OR) (95%CI)	p-value	Adjusted Odds Ratio AOR (95%CI)	p-value
Sex				
Female	1		1	
Male	1.24 (0.71, 2.15)	**0.454**	1.14 (0.29, 4.48)	0.850
Age, *Years*	1.09 (1.06, 1.13)	**<0.001**	1.08 (1.03, 1.15)	**0.004**
Body mass index, kg/m^2				
<18.5	1		1	
. . .	1.97 (0.79, 4.95)	**0.145**	5.17 (0.96, 27.91)	0.056
25.0 – 29.9	4.76 (1.68, 13.43)	**0.003**	8.60 (1.07, 69.35)	**0.043**
.	5.61 (1.81, 17.32)	**0.003**	23.36 (1.44, 446.46)	**0.027**
Waist circumference category, *cm*				
<94 men or < 80 women	1		1	
94-102 men or 80 -88 women	2.07 (1.01, 4.28)	**0.048**	0.56 (0.13, 2.48)	0.443
>102 men or >88 women	4.24 (2.13, 8.44)	**<0.001**	1.99 (0.27, 14.81)	0.503
Employment Status				
GRZ/Private	1		1	
Self employed	0.44 (0.22, 0.89)	**0.023**	0.33 (0.09, 1.23)	0.100
Retired	5.28 (1.39, 20.01)	**0.014**	2.37 (0.26, 21.18)	0.442
Unemployed	0.45 (0.22, 0.93)	**0.031**	0.19 (0.04, 0.95)	**0.043**
Minutes of moderate physical activity	1.00 (0.99, 1.00)	0.973	0.99 (0.99, 1.00)	0.218
Sedentary hours (sitting)	1.00 (1.00, 1.01)	**0.129**	1.00 (0.99, 1.00)	0.148
Smoking status				
No	1		1	
Yes	0.92 (0.43, 1.96)	**0.832**	1.99 (0.43, 9.30)	0.382
Table salt consumption				
Never or rarely	1		1	
Sometimes or always	0.27 (0.13, 0.57)	**0.001**	0.17 (0.04, 0.95)	**0.022**

Comparison of the JNC 7 and AHA/ACC diagnostic criteria for hypertension

We compared the classification of the patients in our study using the JNC 7 and AHA criteria. We found that by using the new AHA/ACC criteria, 26% more normotensive individuals (based on the JNC 7 criteria) were classified as hypertensive (Table 5).

Table 5. Comparison of Blood pressure categories and status between JNC 7 and new AHA/ACC criteria

Category BP with JNC 7 criteria	n (%)	Category BP with New ACC/AHA criteria	n (%)	Difference
BP categories		**BP categories**		
Normal	94 (41.6)	Normal	84 (37.2)	10 (4.4)
Prehypertension	45 (19.9)	Elevated	47 (20.8)	-2 (-0.9)
Stage 1 hypertension	25 (11.1)	Stage 1 hypertension	31 (13.7)	-6 (-2.6)
Stage 2 hypertension	62 (27.4)	Stage 2 hypertension	64 (28.3)	-2 (-0.9)
Hypertension Status		**Hypertension Status**		
Normotensive	191 (84.5)	Normotensive	131 (58)	60 (26.5)
Hypertensive	35 (15.5)	Hypertensive	95 (42)	-60 (-26.5)
Total	226 (100)	Total	226 (100)	

AHA, American heart association; ACC, American college of cardiology; BP, blood pressure; JNC 7, Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure

DISCUSSION

Prevalence of hypertension

While using the JNC 7 criteria puts the prevalence of hypertension in our study at 16%, the new AHA/ACC criterion shifts the prevalence to 42% representing a 26% shift of those previously considered normotensive into the hypertensive category. The reported prevalence of hypertension in PLWH in low- and middle-income countries ranges from 4 to 54%[10-11]. In ART-treated PLWH, a prevalence of hypertension of between 17 to 38% has been reported[12-15] using the JNC 7 criteria, lower than what we reported. However, with the new AHA/ACC criteria, our results indicate an urgent need for intervention. However, further investigations are required to understand the outcomes of hypertension in PLWH when using the new hypertension guidelines as previous studies of cardiovascular events, stroke, etc. relied on different definitions of hypertension. So, we do not know whether the new guidelines will improve the prior epidemiological models.

Factors associated with hypertension in PLWH

Among the social-demographic data collected, three were positively associated with hypertension, including the age of participants, employment status and marital status. In the Zambian setting, the patients' age is always recorded, while the rest are non-routine data. The new AHA/ACC does not recommend consideration for employment status, marital status, or level of education when assessing risk for hypertension or treatment. However, most hypertensives in this study were married (46% hypertensive versus 43% normotensive), and in formal employment (31% hypertensive versus 21% normotensive). Furthermore, the JNC 7 and AHA/ACC does not consider the influence of these factors on blood pressure. Here, we suggest that further studies are needed to determine how an individual's employment status, marital status, and level of education are related to hypertension in low-income countries.

Among dietary and lifestyle non-routinely collected variables, factors such as daily physical activity, the addition of salt at the table, and processed salt intake (negative association) were all positively associated with hypertension (Table 2), and this is in tandem with the recent hypertension report guidelines[4].

The clinical factors associated with hypertension included BMI, WC, and duration on ART, pulse pressure, MAP, mid-BP, FBS, diabetes risk scores, and risk category (Table 3). Among these, only BMI is routinely collected in Zambian hospitals. While BP components such as pulse pressure, MAP, and mid-BP are expected to be different between hypertensive and normotensive, we only included these variables in the analysis to indirectly assess the effect of antihypertensive drugs. It is expected that hypertensive patients taking antihypertensives will present with BP readings similar to r lower than those of normotensive individuals except when either the patient has hypertension that does not respond to the current treatment or dues to poor adherence to the hypertension medication. We found in our study that PP, MAP, and mid-BPs were higher in hypertensive patients. This is because all hypertensives in the study had not taken their medication for more than two weeks. Since we did not collect data on adherence to antihypertensive drugs and cannot ascertain the cause for this.

Hypertensive patients had high diabetes risk scores and FBS (Table 3). Often the factors associated with hypertension are likely related to diabetes risk too[16]. Hence, we employed a diabetes risk assessment tool to assess if hypertensive patients were at risk of developing diabetes mellitus type 2 in 10 years. The value for diabetes risk assessment scores has been describing our recent previous study conducted in PLWH. Conducting diabetes risk assessment would be cardinal among PLWH[9] let alone hypertensive.

We performed a multivariate logistic regression to assess each variable's contribution toward hypertension status (Table 4). Being older [1.0 (1.03, 1.15); AOR 95%CI] was positively associated with hypertension in HIV while those who were overweight (BMI =25-29.9) and obese (BMI equal

to or greater than 30) were eight (p=0.043) and twenty-three (p=0.027) times more likely to be hypertensive, respectively. These findings are consistent with another study conducted locally in Zambia[17] and other studies reviewed[4]. Fasting blood sugar was positively associated with hypertension (p=0.038) as those with higher fasting blood sugars were twice more likely to be hypertensive (1.0, 4.1, 95% CI). Being unemployed had reduced effect on hypertension [0.19 (0.04, 0.95); AOR 95% CI]. Unexpectedly, those who added salt onto the table had reduced odds [0.17 (0.04, 0.95; AOR, 95%)] for the development of hypertension compared to those who rarely or never add salt on the table. These results were contrary to a study conducted in neighbouring Zimbabwe, where adding salt to food at the table (AOR 2.77, 95% CI 1.41-5.43) was an independent risk factor for uncontrolled hypertension. However, the study population was not PLWH. In our study, we did not quantify the amount of salt the participants consumed. Hence, further studies are needed to ascertain the role of table salt as a risk factor for hypertension in PLWH. Several studies consistently report that higher salt intake is positively associated with BP and hypertension[18-20], albeit not in PLWH. A previous study reported that among the Zambian population, salt consumption was more than twice that recommended by WHO[19]. There is a general paucity of studies and no study known to us that has addressed salt intake and its relation to BP and hypertension in HIV. There is also the issue of salt sensitivity which varies among individuals[21,22]. However, our study was beyond the scope of assessing actual salt quantities and sensitivity.

Compared to those with normal WC (<94 cm men; <88 cm women), individuals with a WC between 94-102 for men and 80 to 88 for females and those with a WC above 102 for men and above 88 for females were sixteen times (1.2, 198.9; 95% CI) and 290 times respectively, more likely to be hypertensive (p<0.05). Individuals with more extended sedentary lifestyles, which is the amount of time spent seated, were more likely to be hypertensive [1.0 (1.00, 1.01); AOR, 95%CI, p=0.021] while minutes of moderate physical activity were associated with a lowerrisk of being hypertensive [0.98 (0.97, 1.00) 95%CI, p=0.048]. These results are consistent with previous studies and the AHA/ACC report on hypertension[4]. Our results provide evidence that several non-routinely collected variables should be incorporated into routine ART services and care to prevent hypertension and its attendant adverse outcomes.

Contextualizing the usage of new AHA/ACC guidelines in low-cost settings in PLWH

The treatment and care of PLWH previously overlooked the burden of NCD comorbidity such as hypertension. Recently (2018), the Zambian Government, through the Ministry of Health integrated hypertension management in PLWH (see www.hivst.org). However, the guidelines are not detailed and lack the most critical hypertension diagnosis, treatment, and care emphasized in the new AHA/ACC criteria.

Using the new AHA/ACC criteria to diagnose hypertension shifted 26% of normotensives into hypertension (Table 5). This is consistent with the AHA/ACC report[4]. The advantage of this is that most the patients can prevent hypertension-related health complications through lifestyle changes alone, such as reducing salt intake, increasing physical activity, reducing sedentary time, and eating more plant-based diets[4,23,24]. These changes are feasible in low-cost settings and can potentially reduce the burden and complications of hypertension.

The 10-year risk for heart disease and stroke using the atherosclerotic cardiovascular disease (ASCVD) risk calculator elaborated in the new AHA/ACC guidelines is uncommon in Zambia and SSA countries. ASCVD risk components include age, sex, race, SBP, DBP, total cholesterol, high-density lipoprotein (HDL) cholesterol, low-density lipoprotein (LDL) cholesterol, history of diabetes, smoking status, antihypertensive drug history, history of statin use, and aspirin use. Screening for ASCVD in low-cost settings is feasible, although testing for LDL and HDL is not yet routine at Livingstone Central Hospital.

Our study shows that the new AHA/ACC guidelines are needed. We would, therefore, encourage integrating the guidelines into routine care for PLWH[25].

LIMITATIONS

We did not collect data on drug adherence to antihypertensive medications to ascertain the cause of uncontrolled BPs in hypertensive patients. Further, we did not have a comparison group (HIV negative) to ascertain the effect of HIV and ART on hypertension and factors related to hypertension.

CONCLUSION

The prevalence of hypertension in PLWH using the previous JNC 7 and new AHA/ACC criteria was 16% and 42%, respectively. A significant number of non-routinely collected variables (employment status, dietary salt, fasting blood sugar, physical activity, sedentary hours) were associated with hypertension; hence, there is much need for intensifying monitoring and incorporating additional modifiable non-routine risk factors for hypertension in HIV care. The new AHA/ACC guidelines are indispensable and critical for care, hence the urgent need to integrate them in managing hypertension, especially among PLWH.

ABBREVIATIONS

3TC, Lamivudine; ABC, abacavir; ACC, American college of cardiology; AHA, American heart association; ACE, Angiotensin converting enzyme inhibitors; AOR, adjusted odds ratio; ART, antiretroviral therapy; ASCVD, atherosclerotic cardiovascular disease; AZT, azidothymidine, also called zidovudine; BMI, body mass index; BP, blood pressure; DBP, diastolic blood pressure; EFV, efavirenz ; FBS, fasting blood sugar; GRZ, government; HDL, high-density lipoprotein; HIV, human immunodeficiency virus; IDF, international diabetes federation; IPAQ, international physical activity questionnaire; IQR, interquartile range; JNC 7, Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure; LCH, Livingstone Central Hospital; LDL, low-density lipoprotein; LPV/r, lopinavir/ritonavir ; MAP, mean arterial pressure; NCD, non-communicable disease; NVP, nevirapine ; OR, odds ratio; PLWH, persons with HIV; PP, pulse pressure; SBP, systolic blood pressure; TDF, tenofovir disoproxil fumarate ; WC, waist circumference; WHO STEPS, World health organization stepwise approach to surveillance; WHO, World Health Organizations;

DECLARATIONS

Ethics approval and consent to participate

Ethical approval was obtained from the University of Zambia Biomedical Research Ethics Committee (UNZABREC) (Assurance No. FWA00000338 IRB00001131 of IORG0000774) on 24th May 2017. Permission to conduct the study was granted by the Livingstone Central Hospital Administration. All participants were asked to consent by signing a consent form before being included in the study. All data collected were de-identified and used for research purposes only.

What the study adds

1. The prevalence of hypertension in people living with HIV may be twice higher using AHA/ACC guidelines
2. People living with HIV attending routine antiretroviral treatment clinics should be screened for risk factors associated with the development of hypertension. Such risk factors may include: dietary salt intake, fasting blood sugar, physical activity, and sedentary hours.

Consent for publication

Not applicable

Availability of data and materials

All data generated or analyzed during this study are included in this published article. For other data, these may be requested through the corresponding author.

Competing interests

The authors declare that they have no competing interests

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Author's contributions

SKM and SM conceived the study. SKM, BMH, MS, MM and SM contributed to the writing of the manuscript. SM is the principal investigator. SKM is the senior author and guarantor. All authors read, provided feedback, and approved the final manuscript.

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