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FACTORS ASSOCIATED WITH HYPERTENSION AMONG HIV POSITIVE PATIENTS USING ANTIRETROVIRAL THERAPY AT DISTRICT HOSPITAL, RWANDA

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Abstract:

Background: Hypertension is a public health problem globally, largely not diagnosed at an early stage, during the year 2019 this disease accounted for 17.9 million (32%) death globally. Worldwide the number people living with HIV are 37.6 million. The principal aim of this study was to find out the associated factors of hypertension in HIV-positive patients using ART and thus was guided by the following specific objectives: To determine the prevalence and factors associated with hypertension at Kigeme District Hospital. The findings from this study will be useful in early diagnoses of hypertension in HIV-positive patients using antiretroviral drugs.

Methods and Materials: A cross-section study design was used at Kigeme District Hospital in HIV service. A total of 207 study participants were selected with simple random sampling respecting inclusion and exclusion criteria. Data on social-demographic, hypertension, clinical and lifestyle factors were collected using standardized questionnaire. Data were analyzed through SPSS V21 where binary and Multivariate logistic regression model was used to determine the factors association with hypertension in HIV-positive patients using ART.

Results: Results are resented in odds ratio with its corresponding confidence interval. Mount Kenya University ethical committee and Kigeme District Hospital provided the ethical clearance for an approval. A total of 207 HIV-positive patients using ART attending Kigeme District Hospital from Southern Province of Rwanda were recruited in this study where mean age of participants was 52.76 years and majority of participants were female (61.8%). 87% of study participants had been on antiretroviral medications for < 10 years. The prevalence of hypertension was 15.9%. Being male was associated with higher odds of hypertension (AoR: 5.09, 95%CI 1.3-21.2, p-value: 0.025). Being hypertensive before diagnosis of HIV was associated with this health event with AoR: 0.1, 95%CI: 0.021-0.466,P=0.003. Diabetes mellitus has a negative association (AoR: O.O62, 95%CI:0.005-0.7,p=0.027). In addition overweight or obese is statically significant associated of hypertension (AoR: 34.5, 95%CI: 8.9-134.2, p-value: 0.0001). Age, occupation,

level of education, CKD, physical exercises, alcohol consumption, smoking and HIV-related health factors are not significantly associated with hypertension.

Conclusion: In conclusion hypertension is common for patient using ART at Kigeme District Hospital where the findings indicated that 15.9% of these people are hypertensive .The factors like being male ,diabetes mellitus, being overweight or obese , history of hypertension before HIV are likely associated with the increase of hypertension. This research study recommends that there be early detection of hypertension and further researches to find out the causality of this health condition in HIV-positive patients using ART.

Key words: Hypertension, Hiv Positive Patients, Antiretroviral Therapy, District Hospital, Rwanda

Introduction

Hypertension continues to be a local regional and global community concern and largely not diagnosed at early stage and the persons having HIV are 37.6 million (Vos et al., 2020) .The global percentage of hypertension in persons having HIV is 23.6% with 95% CI 21.6-25.5% where, Western Europe and Northern American is 28.1%, Latin American 22% (CI; 17.8 -25.5%). Hypertension is higher in developed regions than in ongoing incomes countries (Bigna et al., 2020) ,Marcus et al., 2020). Heart diseases are still the main leading cause of premature fatal and morbidity globally (Vos et al., 2020). During 2019 cardiovascular diseases have killed around 17.9 million people where 32% worldwide death and 75% from low-income countries (Masenga et al., 2019).

From the meta-analysis research done in United State .Europe ,Asia and Africa , it has shown that the overall prevalence of hypertension is 25.2% where people living with HIV was 34.7% whereas in no HIV patients were 12.7% (Xu et al., 2017). North America and sub-Saharan Africa the prevalence of hypertension in HIV-infected people is importantly higher than those negative HIV people in contrast to South American and European people where there is no differences (Bigna et al., 2020). In East Africa country , the prevalence of hypertension is 17.4% and around 47.25% of HIV individuals with elevated blood pressure were newly identified (Harimenshi et al., 2022).

The prevalence of hypertension in West and central Africa is 23.5% (CI; 16.6-31.0) and in southern Africa is 22.0% (CI; 17.8-26.5) with P =0.0007. The prevalence is still bigger in developed nations compared to low developed (Bigna et al., 2020 ,Marcus et al., 2020). In Rwanda heterogeneous studies have found that the prevalence of hypertension in people using antiretroviral drugs is 15.6% (Bakesha N. et al ., 2020) and 16.0% (Bernard et al., 2023).

Different studies have found that cardiovascular diseases associated factors are often greater in HIV patients than those none HIV people (Marcus et al., 2020). The use of antiretroviral drugs has importantly improved the health of persons having HIV where in study conducted from February1996 to December 2004 whose aim was to describe the mortality rate and the cause in HIV people under ART it has shown that in 6945 HIV infected people mortality rate went down

from 7.0 death/100 person years 1996 to 1.3 deaths/100 person years in 2004(Palella et al., 2006). Even if the life of HIV -infected people was improved there is a still a challenge with ART-associated chronic complications of comorbidities and mortality; among these emerging problems cardiovascular diseases as hypertension take a major part.

Even though the combination of anti-HIV drugs has increased the quality of life in HIV positive people and their life expectancy has increased ; they have expressed the complications in the form of hypertension (Marcus et al., 2020). These drugs do this function by suppressing the HIV multiplication mitigation of AIDS (Carr, 2002) but HIV infection with other diseases showed an increase in non-communicable diseases including heart diseases (Sherer et al., 2014, Bain & Gwain, 2019). The enzyme protease of human immunodeficiency virus plays a major role for virally encoded enzyme which cut the gag and gag genes that generate a new virus and is the site for Anti-HIV drugs.

HIV protease inhibitors drugs play a major role in metabolic events and cardiac disease and the main issue came from protease inhibitor which is linked with increase blood cholesterol and triglycerides relates to the factors that trigger atherosclerosis (Behrens et al., 1998). The previous researches demonstrated that the associated factors of hypertension in people living with HIV are smoking ,alcohol consumption ,and antiretroviral drugs that cause malfunction of the blood vessels and metabolic properties of ART such as dyslipidemias or insulin resistance (Vos et al., 2020). The associated factors for hypertension in HIV living patients were overweight, obesity, long duration of HIV infection for greater than 10 years ,diabetes and age (Harimenshi et al., 2022). The main objective of this study was to determine factors associated with hypertension in people having HIV using antiretroviral therapy at Kigeme District Hospital, Southern Province of Rwanda. It was guided by the following specific objectives:

i. To determine the prevalence of hypertension among HIV-positive patients using antiretroviral therapy at Kigeme District Hospital, Southern Province of Rwanda.
ii. To determine social and demographic factors associated with hypertension among HIV-positive patients using antiretroviral treatment in Kigeme District Hospital, Southern Province of Rwanda.
iii. To determine biomedical factors associated with hypertension among HIV-positive patients using antiretroviral therapy in Kigeme District Hospital, Southern Province of Rwanda.

ii. Theoretical Framework

The current study has used Health Believe Model which is a theoretical model that states about the believes of people that influence their health-related behavior and give guidance for health promotion and disease prevention (Siddiqui et al., 2016). Health Belief Model consists of the perception of susceptibility about the probability of getting hypertension but not enough alone to cause behavior change (Tan et al., 2022 and Green et al., 2020), perceived severity where seriousness of the hypertension is highly considered (Siddiqui et al., 2016), perceived benefits in which the person's opinion take into account the usefulness the new behavior to minimize the causation of high blood pressure (Zewdie et al., 2022), perceived barrier that involves the person's

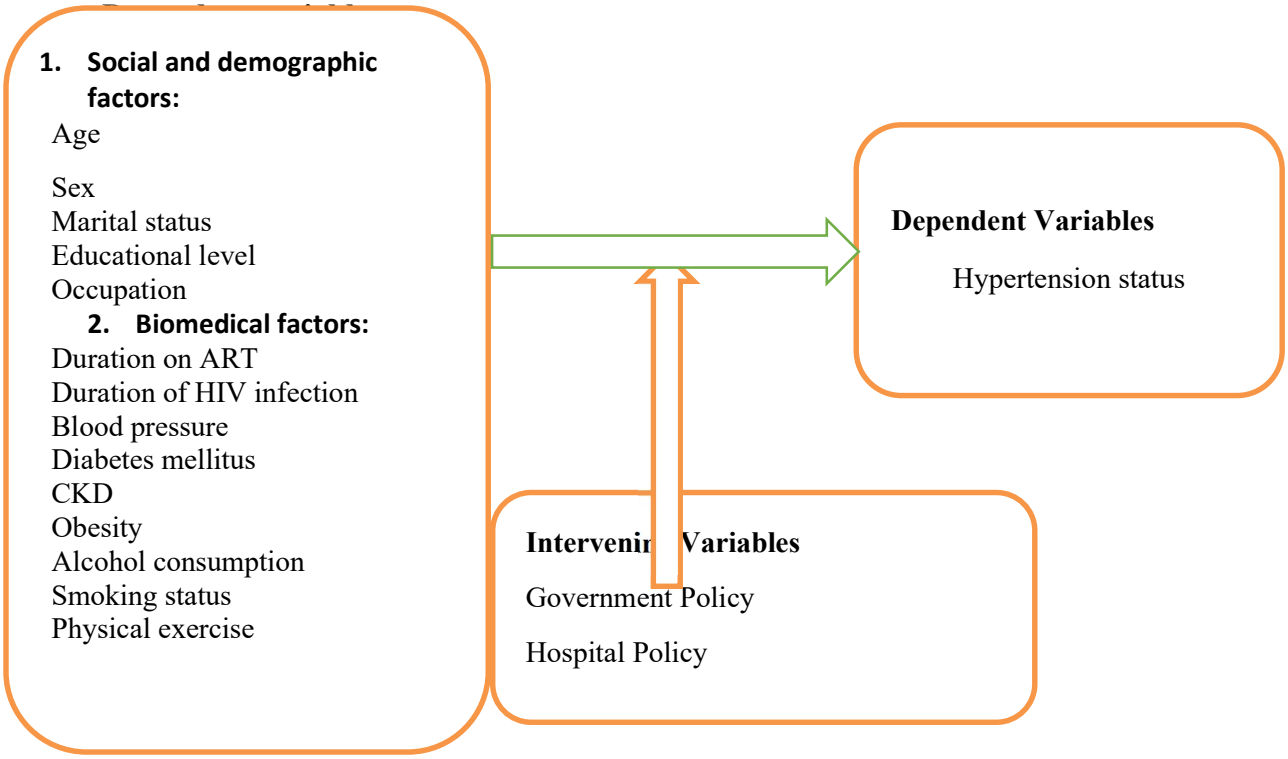
view on the challenges of behavior change, the signals to action that indicates the conditions, people and things that can cause people to change their behavior ,finally this model focus on the self -efficacy which indicates the confidence and belief to take action on personal behavior (Siddiqui et al., 2016 and Alphonce Joho, 2021).

iii. Conceptual Framework

Conceptual framework represents the relationship the researcher expects to see between variables to study and can be written or visual. Based on research specific objectives on the prevalence and factors associated with hypertension in people taking antiretroviral drugs, independent and dependent variables are formulated.

Figure1: Conceptual Framework

Independent Variables



Source : Bernard et al., 2023

The age is the one of important associated factor for development of hypertension that has been found to be a problem in old HIV people taking ART whereas the age advance the risk of having high blood pressure increase too (Dzudie et al., 2021). So this experience calls for early detection for hypertension at all ages in people using ART.

Different studies have found that Sex can play a key role as associated factor for having hypertension where male is 2 time more likely to have hypertension than female (Mbuthia et al., 2021)in contrast with the study conducted in (Bernard et al., 2023). Previous studies have demonstrated that the people with education attainment at the middle or higher school are at lower risk to develop high blood pressure compare to those with or without primary school (Sun et al., 2022).

The heterogeneous studies have indicated that history of alcohol consumption and being obese are associated with the development of hypertension (Bernard et al., 2023 ,Mogaka et al., 2022 and Mbuthia et al., 2021). Being diabetes can play a major role risk in development of high blood pressure as it has been demonstrated by different studies that call for care on blood sugar monitoring (Ekrikpo et al., 2018 and Divala et al., 2016). Previous studies have found that physical activities can prevent hypertension and controlling blood pressure among those having hypertension(Huai et al., 2013). Smoking causes acute blood pressure elevation (Primatesta et al., 2001). Long duration taking antiretroviral drugs can trigger the elevation of blood pressure as it has been found in the study conducted at Kabutare District Hospital in Rwanda (Bernard et al., 2023).

iv. Research Methodology

Hospital based cross section study design was undertaken to conduct this current study among HIV-positive patients using antiretroviral treatment at Kigeme District Hospital to determine the prevalence of and factors associated with hypertension in this group of people from August 2023 to June 2024. Both outcome and associated factors were measured at the same time and the participants were selected respecting inclusion and exclusion criteria. The study allowed the investigator to estimate the odd ratios for the association of the hypertension and associated factors variables.

Target Population

The targeted population were the HIV-positive patients using anti-HIV medicines attending Kigeme District Hospital HIV service. The target population was 1070 HIV-positive patients using ART in Kigeme District catchment area HMIS (HMIS, 2023). Both male and female were involved. HIV infected people on ART who completed the criteria for the study were requested to participate.

Inclusion Criteria

All HIV patients > 18 years old on ART and who have accepted to participant were included in the study. Male and female who have accepted to sign consent form.

Exclusion Criteria

All HIV negative patients.

HIV positive patient not on ART were not participate in this study

People who came before or after data collection period.

Pregnant women whose known effects of pregnancy on blood pressure on physiological measures of their body.

Sample Size

The sample size was determined by using Fisher formula and referring to the previous studies done in Rwanda where the prevalence of hypertension in PLHIV was 16.0 %(Bernard et al., 2023). So Fisher formula sample size was utilized to calculate the sample size (Charan & Biswas, 2013)

$$n = p\left(1 - p\right)\left(\frac{Z}{E}\right)^2$$

Where **Z**: The value obtained in the standard normal distribution showing the confidence level to use where :

Z = 1.96 for 95% confidence interval

E: Desired margin of error: 0.05

p :Proportion of hypertension in PLHIV: 16%

n is sample size

After using this formula, the simple was:

n= 0.16(1-0.16) (1.96^2/ (0.05^2) = 207 participants.

Sampling Technique

Purposively a simple random sampling was applied on patients attending Kigeme District Hospital from the list of clients who benefit from the HIV service where the random number was generated by excel software. Two well-trained nurses have used the standardized data collection tools to get participants information on demographic factors (age, sex, marital status, occupation and educational level) , biomedical (blood pressure, duration on ART, duration of HIV infection and diabetes mellitus status, chronic kidney disease and obesity , anthropometric measurements (height and weight), lifestyle (smoking, alcohol consumption and physical exercise). Before measuring blood pressure, participants have provided consent form and prior to participate.

Data Collection Methods

Data Collection Instruments

Data was collected once on each participant and the established questionnaire was translated in mother tongue Kinyarwanda to facilitate data collection then interviewed for answering the questions. Research investigators completed the questionnaire after the response of participants.

The questionnaire questions were related to demographic, clinic and lifestyle factors in association with hypertension.
Well calibrated electronic blood pressure machine sphygmomanometer (Omron M1basic (HEM-71121J-AF) was used to measure blood pressure focusing on systolic and diastolic measurements; weight was measured using calibrated weighting scale in kilograms after removal of shoes and heavy clothing. Referring to European Society of Cardiology (ESC) 2018 guidelines was referred on to interpreted the results whereby defining hypertension as specified systolic blood pressure of ≥140 and or diastolic BP ≥90 mmHg (Bergler-Klein, 2019).

Height and weight were measured then after body Mass Index was calculate as weight (kg) divided by the square of the height (m^2). According to Body mass index : Normal weight: BMI = 18.5–24.9 kg/m^2, overweight : BMI= 25–29.9 kg/m^2 and obese: BMI ≥ 30 kg/m^2 (Aronne, 2002).

v. Research Findings and Discussion

Demographic Characteristics of Respondents

A 207 total HIV-positive patients using ART attending Kigeme District Hospital are recruited in this study of >18 years old including 79 males and 128 females. The median age is 54-year-old.

Social and Demographic Characteristics of Study Participants

Table 1: Social and Demographic Characteristics of Study Participants

Variable	Frequency(n=207)	Percentage (%)
Age (Median/SD)	54(12.151)	
Age Group		
>60 years old	134	64.7
<=60 years old	73	35.3
Gender		
Male	79	38.2
Female	128	61.8
Marital status		
Single	17	8.2
Married	99	47.8
Others	91	44

Occupation		
Farmers	175	84.5
Public employees	13	6.3
Drivers	3	1.4
Private employees	16	7.7
Level of education		
Informal education	90	43.5
Primary education	91	44
Secondary and above	21	12.6

Source: Primary data (2024)

Table 1 presents the study population primarily consists of older people (n=207). Among the respondents 134 (64.7%) are over 60 years old, while less than 60 years old are 73 (35.3%) . Gender distribution shows a higher number of females 128 (61.8%) compared to males 79 (38.2%). Marital status reveals that almost half of the participants are married 99 (47.8%), single 17 (8.2%) and another category 91 (44%). Occupation status , the vast majority are farmers175 (84.5%), followed by private employees 16 (7.7%), public employees 13(6.3%), and a very small percentage are drivers 3 (1.4%). In terms of education level , most participants have received primary education 91 (44%) , informal 90 (43.5%) and 21 (12.6%) have secondary education or higher.

Descriptive Biomedical Characteristics of Study Participants

Table 2: Descriptive Statistics of Biomedical Characteristics of Study Participants

Variable	Frequency (n=207)	Percentage(%)
Currently on antihypertensive treatment		
Yes	27	13
No	180	87
Diabetes mellitus		
Yes	6	2.9
No	201	97.1

CKD status		
Yes	9	4.3
No	198	95.7
Duration of HIV/AIDS		
>10 years	27	13
<=10 years	180	87
Diagnosed with hypertension		
Yes	33	15.9
No	174	84.1
New cases of hypertension during research		
Yes	24	11.6
No	183	88.4
Body mass index		
Overweight/obese (BMI>25)	55	26.6
Normal Weight (BMI:18-24.9)	152	88.4
Physical exercise		
Yes	44	21.3
No	163	78.7
Smoking		
Yes	23	11.1
No	184	88.9
Alcohol consumption		
Yes	188	90.8
No	19	9.2

Source : Primary data (2024)

Table 2 reveals that currently, 27 (13%) are on antihypertensive treatment, with the remaining 180 (87%) not receiving such treatment. The duration of HIV/AIDS infection shows that 27 (13%)

people have been living with the condition for more than 10 years, whereas 180 (87%) have had it for 10 years or less. Concerning hypertension diagnosis, 33 (15.9%) participants have been diagnosed with hypertension, while 174 (84.1%) have not. New cases of hypertension identified during the research accounted for 24 (11.6%). In terms of body mass index (BMI), 55 (26.6%) participants are classified as overweight or obese (BMI >25kg/m^2), and 152 (73.4%) have a normal weight (BMI of 18-24.925kg/m^2).

Regarding lifestyle habits, a significant majority163 (78.7%) do not engage in physical exercise, with only 44 (21.3%) reporting they do. Smoking is relatively uncommon among the participants, where 184 (88.9%) being non-smokers and 23 (11.1%) are smokers or smoked. However, alcohol consumption is notably high, with 188 (90.8%) of the participants consuming or consumed alcohol while 19 (9.2%) did not.

2. Presentation of Findings

Prevalence Of Hypertension Among Patients Using ART Regimen Attending Kigeme District Hospital

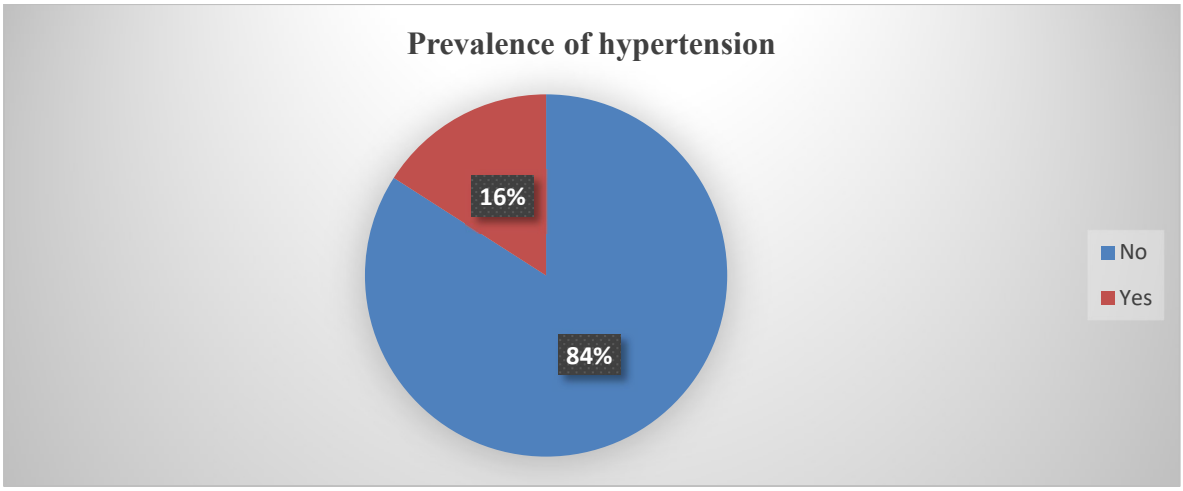


Figure 1: Prevalence of Hypertension At Kigeme District Hospital

The pie chart illustrates the prevalence of hypertension among HIV patients undergoing antiretroviral therapy (ART). The chart is divided into two segments. The first segment shows that 174 (84%) of the patients do not have hypertension, indicating that a significant proportion of the study population is not affected by hypertension despite being on ART. The second segment reveals that 33 (15.9)% of the patients have been diagnosed with hypertension, highlighting that a minority are managing both hypertension and HIV concurrently.

Table 3: Bivariate Analysis of Factors Associated With Hypertension Among People Having HIV Using ART At Kigeme District Hospital

Variable	Yes n (%)	No n(%)	Chi-square/Fisher test	P-value
Age group				
<=60 years old	7 (9.6)	66 (90.4)	2.104	0.10
>60 years old	26(19.4)	108(80.6)		
Gender				
Male	16(20.3)	63(79.7)	1.772	**0.045***
Female	17(13.3)	111(86.7)		
Level of education				
Informal education	11(12.2)	79(87.8)	20.305	**0.0001***
Primary education	10(11.0)	81(89.0)		
Secondary and above	12(46.2)	14(53.8)		
Marital status				
Single	0(0)	17(100)	5.119	0.077
Married	14(14.1)	85(85.9)		
Other	19(20.9)	72(79.1)		
Occupation				
Farmer	20(11.4)	155(88.6)	20.073	**0.0001***
Public employee	7(53.8)	6(46.2)		
Driver	1(33.3)	2(66.7)		
Private employee	5(31.3)	11(68.8)		
Alcohol consumption				
Yes	32(17.0)	156(83.0)	1.780	0.321
No	1(5.3)	18(97.4)		
Smoking				
Yes	5(21.7)	18(78.3)	0.649	0.379

No	28(15.2)	156(84.8)		
Physical exercise				
Yes	2(4.5)	42(95.5)	5.416	**0.020***
No	31(19.0)	132(81.0)		
BMI				
Normal weight	7(4.6)	145(95.4)	54.866	**0.0001***
Overweight/obese	26(47.3)	29(52.7)		
Being hypertensive before diagnosis of HIV				
Yes	12(46.2)	14(53.8)	20.253	**0.0001***
No	21(11.6)	160(88.4		
Diabetes mellitus status				
Yes	5(83.3)	1(16.7)	20.942	**0.0001***
No	28(13.9)	173(86.1)		
CKD status				
Yes	7(77.8)	2(22.2)	26.848	**0.0001***
No	26(13.1)	172(86.9)		
Duration of HIV/AIDS				
>10years	30(16.7)	150(83.3)	0.541	0.582
<=10years	3(11.1)	24(88.9)		
Duration on ART regime				
>10years	30(16.7)	150(83.3)	0.541	0.582
<=10years	3(11.1)	24(88.9)		

Source: Primary data (2024)

Data analysis process for the factors associated with hypertension in HIV-positive patients using ART was conducted through SPSS 21. 2x2 table is used and shows those factors with or without association with hypertension. The bivariate analysis showed that out of 14 factors assessed during

the study , 8 factors are significantly associated with hypertension namely gender(p=0.045),level of education (p=0.0001),Occupation (p=0.0001), physical exercises (p=0.020), MBI (P=0.0001), Being hypertensive before diagnosis of HIV (p=0.0001) and diabetes mellitus (0.0001), CKD (p=0.0001) however age, marital status smoking, alcohol consumption , duration of HIV infection and duration on ART are not significantly associated with hypertension in patient taking ART at Kigeme District hospital.

Table 4 Multivariate analysis of factors associated with hypertension in people having HIV using ART at Kigeme District Hospital

Variable	Adjusted Odd ratio(AoR)	95% Confidence Interval	P-value
Age group			
<=60 years old	**Ref**		
>60 years old	0.67	[0.20-2.22]	0.52
Gender			
Male	5.09	[1.3-21.2]	**0.025***
Female	**Ref**		
Level of education			
Informal education	0.103	[0.06-1.92]	0.12
Primary education	**Ref**		
Secondary and above	0.75	[0.05-1.12]	0.06
Marital status			
Single	0.001	0.001	0.998
Married	**Ref**		
Other	0.376	[0.11-1.3]	0.119
Occupation status			
Farmer	0.489	[0.92-2.603]	0.402
Public employee	2.019	[0.311-13.090]	0.461
Driver	0.438	[0.014-14.07]	0.641
Private employee	**Ref**		
Alcohol consumption			
Yes	5.5	[0.29-10.35]	0.25
No	**Ref**		

Smoking			
Yes	0.22	[0.41-1.2]	0.78
No	**Ref**		
Physical exercise			
No	0.87	[0.23—3.280]	0.846
Yes	**Ref**		
BMI			
Overweight/obese	34.5	[8.9-134.2]	**0.0001***
Normal weight	**Ref**		
Being hypertensive before diagnosis of HIV			
Yes	0.1	[0.021-0.466]	**0.003***
No	**Ref**		
CKD status			
Yes	0	[0.001-1.1]	0.999
No	**Ref**		
Diabetes mellitus status			
Yes	0.062	[0.005-0.7]	**0.027***
No	**Ref**		

Source: Primary data (2024)

Table 4 presents the analysis after bivariate analysis step. Multivariate logistic regression analysis is done to assess the factors significantly associated to hypertension in ART users . While initial findings hinted at age as a factor, further analysis found it insignificant. However, gender played a significant role, with males at higher risk (AoR: 5.09, 95% CI: [1.3-21.2], P-value: 0.025). Education level, marital status, alcohol consumption, smoking, physical exercise and CKD status showed no significant associations. Not having diabetes mellitus reduce the chance of having hypertension (AoR: 0.062, 95% CI: 0.005-0.7, p:0.027) and being overweight or obese strongly correlated with hypertension (AoR: 34.5, 95% CI: 8.9-134.2, p: 0.0001). Being hypertensive before diagnosis of HIV was associated with this health event (AoR: 0.1, 95%CI: 0.021-0.466,p=0.003).

Discussion

The purpose of the study was to determine the prevalence and factors associated with hypertension among people having HIV using ART at Kigeme District Hospital in Southern Province of Rwanda. The study found that the prevalence of hypertension in people using antiretroviral therapy is 15.9% (33/207) at this hospital that is the same as the findings from the study conducted in Rwanda by Bernard .et al ., 2023 of 16% at Kabutare District Hospital-Rwanda .In addition the report from Kigali City at Kibagabaga Level II Teaching Hospital has shown a slight lower prevalence rate of 15.6% by Bakesha N. 2020.(Bakesha & Nicholas NjauNgomi, 2020). Contrarily, the magnitude of Hypertension in people using ART in this study was lower compared to the findings obtained in the studies done in Uganda and Burundi which found 29% (Lubega et al., 2021) and 17.4% (Kasoma Mutebi et al., 2023 ,Dechasa et al., 2023) respectively, Ondo State of Nigeria where the magnitude is 20.3% (Ekrikpo et al., 2018) .

These findings showed that being male is 5.09 times more likely to have hypertension than female among people using ART as the same findings from the study done in Kenya in 2021 (Mbuthia et al., 2021). These findings were not similar to the study done in South Africa, which showed that being female were more likely associated with hypertension than male [OR = 5.5; 95%CI = 2.67-11.12]. The difference in this finding is attributed to the sample size used and they used a retrospective cross-sectional study which used data for WHO SAGE(Okyere et al., 2022).

In the present study, the odds of having hypertension also increased with the increase of body mass index where being overweight or obese is statistically associated with hypertension among HIV-positive patients using ART at Kigeme District Hospital p= 0.0001(AoR: 34.5 , 95% C.I: [8.9-134. 2]which similar to the findings from the study conducted by Ekrikpo et al., 2018, Divala et al., 2016 , Ataro et al., 2018 and the study from Burundi done by Harimenshi et al., 2022. In addition the same results were found in Kenya where being overweight and obesity are 2-3 fold greater odds of having hypertension(Mbuthia et al., 2021). In Uganda the same result was found where being overweight or obesite are associated with hypertension in people recieving ART (Lubega et al., 2021). Moreover in East Ethiopia the researchers have found the same results where being overweight or obese increase the likehood of development of hypertension (Dechasa et al., 2023) and (Ekrikpo et al., 2018)in Nigeria .

In the present study the factor of not having diabetes mellitus increases the odds of not having hypertension that agrees with study done in Rwanda at Kabuatare Diatrict Hospital by Bernard et al., 2023, South Africa (Chiwandire et al., 2021), Burundi (AoR : 2.1, 95% CI : 1.37–3.32)(Harimenshi et al., 2022) and in systemic review conducted in East Africa by Tegegne et al., 2023. During the study, age factor was not statistically associated with the odds of the elevation of high blood pressure while other studies are not getting well with this finding. Age > 50 years was associated with higher odds of hypertension (AoR: 3.75, 95%CI 1.68, 8.55, p-value: 0.002) (Denu et al., 2024) and aged 50–59, those aged 60–69 [OR = 2.2; CI = 1.30,3.84], 70–79 years [OR = 2.8; CI = 1.37,5.82], and 80 + [OR = 4.9; CI = 1.68,14.05] had higher risk of

hypertension(Okyere et al., 2022). Having >60 years old is strongly associate with the increase of odd of having hypertension 5 times more (Belay et al., 2022).The results were different because of the sample size used and sampling strategies.

The results of this study showed that there is no significance association of marital status ,occupation and alcohol consumption with the odds of increase of high blood pressure that lines closely to the findings of the adult HIV clinic at Korle Bu Teaching Hospital (Denu et al., 2024) ,in Tanzania (Rodríguez-Arbolí et al., 2017), (Okyere et al., 2022) and (Dimala et al., 2016). However the findings from the findings form Mbuthia et al., 2021indicated that alcohol consumption is statistically associated to predict the hypertension development in ART-people users AoR =0.81, 95% CI=1.49-4.84 ,p=0.001.

Having chronic kidney disease (CKD), being hypertensive before acquiring HIV, alcohol consumption, marital status, age, smoking factor, Physical exercise and educational level all these factors were found not to be significantly associated with hypertension in people taking ART at Kigeme District Hospital after multivariate analysis of the collected data.

It has been found that smoking factor is not associated with hypertension among HIV people taking ART through multivariate analysis [AoR: 0.78 , 95%CI=0.41-1.2] which look similar to the studies done by Dechasa et al., 2023 in Ethiopia and Okonkwo et al., 2024 in Nasarawa State, Nigeria , that from Spain (AoR: 0.79, 95% CI: 0.46–1.33, P=0.37)(Jerico et al., 2005) and in Tanzania (Rodríguez-Arbolí et al., 2017). The study brought the same findings with AoR =1.45, 95%CI=0.6-3.46 with p=0.65(Denu et al., 2024). But it is different from the study in Rwanda where alcohol consumption were nearly six times more likely to experience hypertension [AOR = 5.5; 95% CI = 2.75–10.9, p < 0.001] than non-consumers of alcohol (Uwanyirigira et al., 2023). They are different may be because of simple size where the later study is twice more the present study.

Physical exercise was found to be not significantly associated after analysis via multivariate analysis [AoR: 0.87, 95%CI=0.23-3.280] with the development of hypertension in this study that look like to the result from the research conducted by Dechasa et al., 2023. Contrarily Nahimana et al., 2018 , Uwanyirigira et al., 2023 and Bernard et al., 2023 where there is strong association with practicing physical exercise reduce the likehood of development of hypertension. Educational level was associated with hypertension with binary logistic regression where p=0.001 in people receiving ART however after analysis of the data in multivariate analysis output indicated that there is no significance association which is the same as the findings from Korle-Bu Teaching Hospital(T. Nartey et al., 2023) and (Denu et al., 2024).

The findings of the present study highlighted that duration of HIV infection doesn't predict high blood pressure in HIV-positive patients using ART (AoR = 1.077 , 95% CI=0.245-4.743) with p=0.922 as it was found in study Ghana in 2023 (AoR: 1.05, 95% CI: 0.97-1.130) with p=0.194 (T. Nartey et al., 2023) and the results from among attendants of the adult HIV clinic at Korle Bu

Teaching Hospital between June and August 2020(Denu et al., 2024). The result of this study indicated that having kidney diseases do not increase the of odds of having hypertension with p=0.999 which is different from other studies conducted in Tanzania p=0.001(Peck et al., 2014) . This contrast is due to the big number simple size 454 people and sampling strategy used in Tanzania.

vi. Conclusion

This research aimed to determine the factors associated with hypertension in HIV-positive patients using antiretroviral therapy at Kigeme District hospital. It has been found that the prevalence of high blood pressure in this group of people is 15.9%. 11.6% (24/207) people were new diagnosed with hypertension during the research period that bring call for early detection of high blood pressure. The findings indicated that being male, having hypertensive before diagnosis of HIV, diabetes mellitus and overweight or obesity are the factors that are likely associated with hypertension in this population. These findings reveal why it important for early diagnosis of hypertension in HIV patients taking ART. The results highlight the need of incorporation of blood pressure screening and management into routine HIV care to prevent adverse outcomes and to improve cardiovascular health in HIV-positive patients using ART regimens.

vii. References

Alphonce Joho, A. (2021). Using the Health Belief Model to Explain the Patient's Compliance to Anti-hypertensive Treatment in Three District Hospitals - Dar Es Salaam, Tanzania: A Cross Section Study. *East African Health Research Journal*, *5*(1), 50–58. https://doi.org/10.24248/eahrj.v5i1.651

Ataro, Z., Ashenafi, W., Fayera, J., & Abdosh, T. (2018). Magnitude and associated factors of diabetes mellitus and hypertension among adult HIV-positive individuals receiving highly active antiretroviral therapy at Jugal Hospital, Harar, Ethiopia. *HIV/AIDS - Research and Palliative Care*, *Volume 10*, 181–192. https://doi.org/10.2147/HIV.S176877

Bain, L. E., & Gwain, G. C. (2019). Cardiovascular Disease and HIV Infection in Sub-Saharan Africa: Misplaced Priorities in the Public Health and Research Agendas? *Frontiers in Cardiovascular Medicine*, *6*, 35. https://doi.org/10.3389/fcvm.2019.00035

Balt, C. A. (2013). Hypertension and HIV Infection. *Journal of the Association of Nurses in AIDS Care*, *24*(Supplement 1), S127–S134. https://doi.org/10.1016/j.jana.2012.06.012

Bärnighausen, T., Welz, T., Hosegood, V., Bätzing-Feigenbaum, J., Tanser, F., Herbst, K., Hill, C., & Newell, M.-L. (2008). Hiding in the shadows of the HIV epidemic: Obesity and hypertension in a rural population with very high HIV prevalence in South Africa. *Journal of Human Hypertension*, *22*(3), 236–239. https://doi.org/10.1038/sj.jhh.1002308

Bergler-Klein, J. (2019). What's new in the ESC 2018 guidelines for arterial hypertension: The ten most important messages. *Wiener Klinische Wochenschrift*, *131*(7–8), 180–185. https://doi.org/10.1007/s00508-018-1435-8

Bigna, J. J., Ndoadoumgue, A. L., Nansseu, J. R., Tochie, J. N., Nyaga, U. F., Nkeck, J. R., Foka, A. J., Kaze, A. D., & Noubiap, J. J. (2020). Global burden of hypertension among people living with HIV in the era of increased life expectancy: A systematic review and meta-analysis. *Journal of Hypertension*, *38*(9), 1659–1668. https://doi.org/10.1097/HJH.0000000000002446

Bolarinwa, O. (2015). Principles and methods of validity and reliability testing of questionnaires used in social and health science researches. *Nigerian Postgraduate Medical Journal*, *22*(4), 195. https://doi.org/10.4103/1117-1936.173959

Carey, R. M., Muntner, P., Bosworth, H. B., & Whelton, P. K. (2018). Prevention and Control of Hypertension. *Journal of the American College of Cardiology*, *72*(11), 1278–1293. https://doi.org/10.1016/j.jacc.2018.07.008

Chiwandire, N., Zungu, N., Mabaso, M., & Chasela, C. (2021). Trends, prevalence and factors associated with hypertension and diabetes among South African adults living with HIV, 2005–2017. *BMC Public Health*, *21*(1), 462. https://doi.org/10.1186/s12889-021-10502-8

Correale, M., Palmiotti, G. A., Lo Storto, M. M., Montrone, D., Foschino Barbaro, M. P., Di Biase, M., & Lacedonia, D. (2015). HIV-associated pulmonary arterial hypertension: From bedside to the future. *European Journal of Clinical Investigation*, *45*(5), 515–528. https://doi.org/10.1111/eci.12427

Dechasa, M., Nigussie, S., Jambo, A., Sime, M. L., Tamire, A., Kitessa, M., Degefu, N., Dereje, J., Demeke, H., & Legese, N. (2023). The Magnitude of Hypertension and Its Contributing Factors Among Patients Receiving Antiretroviral Therapy in Public Hospitals in Harar City, Eastern Ethiopia: A Cross-Sectional Study. *Integrated Blood Pressure Control*, *Volume 16*, 81–93. https://doi.org/10.2147/IBPC.S433907

Denu, M. K. I., Revoori, R., Buadu, M. A. E., Oladele, O., & Berko, K. P. (2024). Hypertension among persons living with HIV/AIDS and its association with HIV-related health factors. *AIDS Research and Therapy*, *21*(1), 5. https://doi.org/10.1186/s12981-023-00576-2

Dimala, C. A., Atashili, J., Mbuagbaw, J. C., Wilfred, A., & Monekosso, G. L. (2016). Prevalence of Hypertension in HIV/AIDS Patients on Highly Active Antiretroviral Therapy (HAART) Compared with HAART-Naïve Patients at the Limbe Regional Hospital, Cameroon. *PLOS ONE*, *11*(2), e0148100. https://doi.org/10.1371/journal.pone.0148100

Dukunde, A., Ntaganda, J. M., Kasozi, J., & Nzabanita, J. (2023). Prediction of the Prevalence of Hypertension and Associated Risk Factors in Rwanda Using Gibbs Sampling Method. *Diseases*, *11*(2), 87. https://doi.org/10.3390/diseases11020087

Dzudie, A., Hoover, D., Kim, H.-Y., Ajeh, R., Adedimeji, A., Shi, Q., Pefura Yone, W., Nsame Nforniwe, D., Thompson Njie, K., Pascal Kengne, A., Ebasone, P. V., Barche, B., Bissek Anne Cecile, Z.-K., Nash, D., Yotebieng, M., & Anastos, K. (2021). Hypertension among people living with HIV/AIDS in Cameroon: A cross-sectional analysis from Central Africa International Epidemiology Databases to Evaluate AIDS. *PLOS ONE*, *16*(7), e0253742. https://doi.org/10.1371/journal.pone.0253742

Ebasone, P. V., Dzudie, A., Peer, N., & Kengne, A. P. (2023). GLOBAL PREVALENCE OF HYPERTENSION AMONG ART-NAÏVE ADULTS LIVING WITH HIV: A SYSTEMATIC REVIEW AND META-ANALYSIS. *Journal of Hypertension*, *41*(Suppl 3), e219–e220. https://doi.org/10.1097/01.hjh.0000941208.81281.4b

Ekrikpo, U. E., Akpan, E. E., Ekott, J. U., Bello, A. K., Okpechi, I. G., & Kengne, A. P. (2018). Prevalence and correlates of traditional risk factors for cardiovascular disease in a Nigerian ART-naive HIV population: A cross-sectional study. *BMJ Open*, *8*(7), e019664. https://doi.org/10.1136/bmjopen-2017-019664

Green, E. C., Murphy, E. M., & Gryboski, K. (2020). The Health Belief Model. In K. Sweeny, M. L. Robbins, & L. M. Cohen (Eds.), *The Wiley Encyclopedia of Health Psychology* (1st ed., pp. 211–214). Wiley. https://doi.org/10.1002/9781119057840.ch68

Harimenshi, D., Niyongabo, T., Preux, P.-M., Aboyans, V., & Desormais, I. (2022). Hypertension and associated factors in HIV-infected patients receiving antiretroviral treatment in Burundi: A cross-sectional study. *Scientific Reports*, *12*(1), 20509. https://doi.org/10.1038/s41598-022-24997-7

HMIS. (2023). *Health Management Information System* (Kigeme District Hospital) [Dataset].

Hofman, F. M., Wright, A. D., Dohadwala, M. M., Wong-Staal, F., & Walker, S. M. (1993). Exogenous tat protein activates human endothelial cells. *Blood*, *82*(9), 2774–2780.

Huai, P., Xun, H., Reilly, K. H., Wang, Y., Ma, W., & Xi, B. (2013). Physical Activity and Risk of Hypertension: A Meta-Analysis of Prospective Cohort Studies. *Hypertension*, *62*(6), 1021–1026. https://doi.org/10.1161/HYPERTENSIONAHA.113.01965

Lubega, G., Mayanja, B., Lutaakome, J., Abaasa, A., Thomson, R., & Lindan, C. (2021). Prevalence and factors associated with hypertension among people living with HIV/AIDS on antiretroviral therapy in Uganda. *Pan African Medical Journal*, *38*. https://doi.org/10.11604/pamj.2021.38.216.28034

Marcus, J. L., Leyden, W. A., Alexeeff, S. E., Anderson, A. N., Hechter, R. C., Hu, H., Lam, J. O., Towner, W. J., Yuan, Q., Horberg, M. A., & Silverberg, M. J. (2020). Comparison of Overall and Comorbidity-Free Life Expectancy Between Insured Adults With and Without HIV Infection, 2000-2016. *JAMA Network Open*, *3*(6), e207954. https://doi.org/10.1001/jamanetworkopen.2020.7954

Masenga, S. K., Hamooya, B. M., Nzala, S., Kwenda, G., Heimburger, D. C., Mutale, W., Munsaka, S. M., Koethe, J. R., & Kirabo, A. (2019). Patho-immune Mechanisms of Hypertension in HIV: A Systematic and Thematic Review. *Current Hypertension Reports*, *21*(7), 56. https://doi.org/10.1007/s11906-019-0956-5

Mbuthia, G. W., Magutah, K., & McGarvey, S. T. (2021). The Prevalence and Associated Factors of Hypertension among HIV Patients. *International Journal of Hypertension*, *2021*, 1–8. https://doi.org/10.1155/2021/5544916

Mikolajczyk, T. P., & Guzik, T. J. (2019). Adaptive Immunity in Hypertension. *Current Hypertension Reports*, *21*(9), 68. https://doi.org/10.1007/s11906-019-0971-6

Mills, K. T., Stefanescu, A., & He, J. (2020). The global epidemiology of hypertension. *Nature Reviews Nephrology*, *16*(4), 223–237. https://doi.org/10.1038/s41581-019-0244-2

Mogaka, J. N., Sharma, M., Temu, T., Masyuko, S., Kinuthia, J., Osoti, A., Zifodya, J., Nakanjako, D., Njoroge, A., Otedo, A., Page, S., & Farquhar, C. (2022). Prevalence and factors associated with hypertension among adults with and without HIV in Western Kenya. *PLOS ONE*, *17*(1), e0262400. https://doi.org/10.1371/journal.pone.0262400

Mulugeta, H., Afenigus, A. D., Haile, D., Amha, H., Kassa, G. M., Wubetu, M., Abebaw, E., & Jara, D. (2021). Incidence and Predictors of Hypertension Among HIV Patients Receiving ART at Public Health Facilities, Northwest Ethiopia: A One-Year Multicenter Prospective Follow-Up Study. *HIV/AIDS - Research and Palliative Care*, *Volume 13*, 889–901. https://doi.org/10.2147/HIV.S329838

Niiranen, T. J., Kalesan, B., Hamburg, N. M., Benjamin, E. J., Mitchell, G. F., & Vasan, R. S. (2016). Relative Contributions of Arterial Stiffness and Hypertension to Cardiovascular Disease: The Framingham Heart Study. *Journal of the American Heart Association*, *5*(11), e004271. https://doi.org/10.1161/JAHA.116.004271

Okonkwo, P., Ajayi, O., Babatunde, D., & Ezekiel, D. M. (2024). Prevalence and Factors Associated with Hypertension among People Living with HIV Receiving Care in Three Large HIV Clinics in Nasarawa State, Nigeria. *World Journal of AIDS*, *14*(01), 1–17. https://doi.org/10.4236/wja.2024.141001

Okyere, J., Ayebeng, C., Owusu, B. A., & Dickson, K. S. (2022). Prevalence and factors associated with hypertension among older people living with HIV in South Africa. *BMC Public Health*, *22*(1), 1684. https://doi.org/10.1186/s12889-022-14091-y

Parikh, N. I., Gerschenson, M., Bennett, K., Gangcuangco, L. M. M., Lopez, M. S., Mehta, N. N., Playford, M. P., Nakamoto, B. K., Seto, T. B., Chow, D. C., & Shikuma, C. M. (2015). Lipoprotein concentration, particle number, size and cholesterol efflux capacity are associated with mitochondrial oxidative stress and function in an HIV positive cohort. *Atherosclerosis*, *239*(1), 50–54. https://doi.org/10.1016/j.atherosclerosis.2014.12.005

Peck, R. N., Shedafa, R., Kalluvya, S., Downs, J. A., Todd, J., Suthanthiran, M., Fitzgerald, D. W., & Kataraihya, J. B. (2014). Hypertension, kidney disease, HIV and antiretroviral therapy among Tanzanian adults: A cross-sectional study. *BMC Medicine*, *12*(1), 125. https://doi.org/10.1186/s12916-014-0125-2

Rodríguez-Arbolí, E., Mwamelo, K., Kalinjuma, A. V., Furrer, H., Hatz, C., Tanner, M., Battegay, M., Letang, E., & on behalf of the KIULARCO Study Group. (2017). Incidence and risk factors for hypertension among HIV patients in rural Tanzania – A prospective cohort study. *PLOS ONE*, *12*(3), e0172089. https://doi.org/10.1371/journal.pone.0172089

Sarathy, H., Salman, L. A., Lee, C., & Cohen, J. B. (2022). Evaluation and Management of Secondary Hypertension. *Medical Clinics of North America*, *106*(2), 269–283. https://doi.org/10.1016/j.mcna.2021.11.004

Sinha, A., & Feinstein, M. J. (2019). Coronary Artery Disease Manifestations in HIV: What, How, and Why. *Canadian Journal of Cardiology*, *35*(3), 270–279. https://doi.org/10.1016/j.cjca.2018.11.029

Sun, K., Lin, D., Li, M., Mu, Y., Zhao, J., Liu, C., Bi, Y., Chen, L., Shi, L., Li, Q., Yang, T., Wan, Q., Wu, S., Wang, G., Luo, Z., Qin, Y., Tang, X., Chen, G., Huo, Y., … Yan, L. (2022). Association of education levels with the risk of hypertension and hypertension control: A nationwide cohort study in Chinese adults. *Journal of Epidemiology and Community Health*, *76*(5), 451–457. https://doi.org/10.1136/jech-2021-217006

T. Nartey, E., A. Tetteh, R., Anto, F., Sarfo, B., Kudzi, W., & M. Adanu, R. (2023). Hypertension and associated factors among patients attending HIV clinic at Korle-Bu Teaching Hospital. *Ghana Medical Journal*, *57*(1), 19–27. https://doi.org/10.4314/gmj.v57i1.4

Tan, P. P. S., Sandhu, R. S., Zain, S. M., Hall, D., Tan, N. C., Lim, H. M., Daud, F., & Pung, Y.-F. (2022). Health motivations and perceived barriers are determinants of self-care behaviour for the prevention of hypertension in a Malaysian community. *PLOS ONE*, *17*(12), e0278761. https://doi.org/10.1371/journal.pone.0278761

Tenorio, A. R., Zheng, Y., Bosch, R. J., Krishnan, S., Rodriguez, B., Hunt, P. W., Plants, J., Seth, A., Wilson, C. C., Deeks, S. G., Lederman, M. M., & Landay, A. L. (2014). Soluble Markers of Inflammation and Coagulation but Not T-Cell Activation Predict Non–AIDS-Defining Morbid Events During Suppressive Antiretroviral Treatment. *The Journal of Infectious Diseases*, *210*(8), 1248–1259. https://doi.org/10.1093/infdis/jiu254

Uwanyirigira, D., Biracyaza, E., Uzabakiriho, I., Omolo, J., Hakizayezu, F., & Nzayirambaho, M. (2023). Prevalence and Factors Associated with Hypertension Among HIV Positive Patients on Antiretroviral Therapy: A Hospital-Based Cross-Sectional Study in Rwanda. *Vascular Health and Risk Management*, *Volume 19*, 857–870. https://doi.org/10.2147/VHRM.S442108

Xu, Y., Chen, X., & Wang, K. (2017). Global prevalence of hypertension among people living with HIV: A systematic review and meta-analysis. *Journal of the American Society of Hypertension*, *11*(8), 530–540. https://doi.org/10.1016/j.jash.2017.06.004

Zewdie, A., Mose, A., Sahle, T., Bedewi, J., Gashu, M., Kebede, N., & Yimer, A. (2022). The health belief model's ability to predict COVID-19 preventive behavior: A systematic review. *SAGE Open Medicine*, *10*, 205031212211136. https://doi.org/10.1177/20503121221113668

Zhou, B., Perel, P., Mensah, G. A., & Ezzati, M. (2021). Global epidemiology, health burden and effective interventions for elevated blood pressure and hypertension. *Nature Reviews Cardiology*, *18*(11), 785–802. https://doi.org/10.1038/s41569-021-00559-8