ORIGINAL RESEARCH ARTICLE

Prevalence of Cardiovascular Risk Factors among clients on Highly Active Anti-Retroviral Therapy in Vihiga County, Kenya

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Abstract

HIV/AIDS is a public health concern globally and especially in sub-Saharan Africa and in Kenya. All HIV positive clients are initiated on Highly Active Antiretroviral Therapy (HAART) to reduce the multiplication of the HIV and improve their immunity. These clients are at an increased cardiovascular disease risk not only because of the pathophysiological changes associated with HIV infection but also due to a complex interplay of factors including traditional cardiovascular risk factors such as smoking cigarettes, obesity due to inactivity, and diabetes. This study sought to determine the prevalence of cardiovascular disease (CVD) risk factors among people living with HIV (PLHIV) on HAART in Vihiga County, Kenya. The study employed a cross-sectional survey design to report baseline survey data for an interventional study on prevalence of CVD risk factors. The study involved a systematic sample of 211 patients on HAART in six health facilities randomly selected from Vihiga County. Data was collected using WHO stepwise questionnaire from six comprehensive care clinics (CCC) across Vihiga County from March to July 2022. The outcome measures were the prevalence of cardiovascular disease risk factors. The average age of the participants was 45.5 (Mean=45.5± 9.1). The prevalence of the cardiovascular risk factors was as follows; Obese 14.7%, overweight 17.5%, hypertension 12.32%, smoking 8.5%, diabetes 2.4%, inactivity 44.6%, alcohol consumption 14.9% and high viral load 11.9%. In Conclusion, prevalence of obesity, inactivity and hypertension was high while smoking and diabetes was low.

1.0 Introduction

HIV/AIDS is still a public health concerns globally and especially in sub-Saharan Africa, Kenya included (Moyo *et al.*, 2023; *HIV and AIDS Epidemic Global Statistics*, 2023). UNAIDS (2022) estimated that 1.7 million globally were newly infected by HIV, 37.9 million people living with HIV/AIDS whereas seven hundred and seventy thousand people died of HIV and AIDs related illnesses annualy (*UNAIDS Global AIDS Update*, 2022). Individuals who are HIV positive following HIV testing and counseling, are usually initiated on highly active antiretroviral therapy (HAART) to

ISSN 1561-7645 (online)
doi: 10.4314/jagst.v24i3.9

reduce the multiplication of the HIV and improve their immunity (Eggleton and Nagalli, 2024a; Kemnic and Gulick, 2024). Highly Active Anti-Retroviral Therapy (HAART) is the main treatment expected to prolong survival and improve quality of life in HIV-infected patients (Eggleton and Nagalli, 2024b). HAART is a combination of at least three classes of antiretroviral drugs namely protease inhibitors (PIs), non-nucleoside reverse transcriptase inhibitors (NNRTIs), and nucleoside reverse transcriptase inhibitors (NRTIs), one of which is a PI or an NNRTI or a combination of NRTI (Shin, Park and Yoon, 2021; Eggleton and Nagalli, 2024a). At the end of December 2022, 29.8 million (76% of HIV patients)people were accessing antiretroviral therapy (*UNAIDS Global AIDS Update*, 2022). Cardiovascular disease (CVD) is a significant cause of increased morbidity among persons living with the Human Immunodeficiency Virus (Appiah *et al.*, 2019; Fragkou *et al.*, 2023; Ntsekhe and Baker, 2023). These patients are at an increased risk of CVD of cardiovascular disease (Enriquez *et al.*, 2022; Ruamtawee *et al.*, 2023) due to a complex interplay of factors. Traditional cardiovascular risk factors such as smoking cigarettes, obesity due to inactivity, and diabetes are implicated. Recent evidence suggests that HIV-associated inflammation and immune activation are important mediators of cardiovascular risk (Dominick *et al.*, 2020; Ruamtawee *et al.*, 2023). Cardiovascular involvement in treatment-naïve patients is important in individuals who do not adhere to treatment or start treatment late, and in countries with limited access to ART (Kalantarzadeh *et al.*, 2022). CVD is frequent in patients with AIDS, whereby it increases the relative risk of mortality and shortens longevity compared to control patients with matched $CD4^+$ cell counts (Mueller *et al.*, 2021). While studies have confirmed that indeed HIV positive clients on HAART are at an increased risk of CVD (Ekun *et al.*, 2021; Vos and Venter, 2021; Tilahun *et al.*, 2022; Ruamtawee *et al.*, 2023) owing to a range of risk factors including smoking (Peprah *et al.*, 2021a), diabetes mellitus (Duguma *et al.*, 2020a), hypertension (Mbuthia, Magutah and McGarvey, 2021a) and obesity and overweight (Saito, Karama and Kamiya, 2020a; Touloumi *et al.*, 2020; Powell-Wiley *et al.*, 2021; Nalugga *et al.*, 2022a), there is still a gap in the interplay of these factors and the associated predictors and how they simultaneously increase the risk of HIV/AIDS. Vihiga County is one of the counties most affected by HIV (Mworia, 2023). The current study will seek to find the prevalence of the cardiovascular disease risk factors in Vihiga County. The findings will inform the academia and lead to formation of policies and tailored interventions to reduce the risk of cardiovascular disease by controlling for the associated risk factors

2.0 Methods

2.1 Study setting

Vihiga County is located in western Kenya. There are 26 facilities offering comprehensive care to HIV clients in Vihiga County and a total of eight thousand two hundred and forty-two patients on HAART as of 2019 (Health Information System office Vihiga County, 2019). The health care facilities offer a variety of services to include, inpatients services, outpatient services, comprehensive care services, maternal and child health services, radiological examinations, laboratory. Of the 26 health facilities in Vihiga County, six health facilities that offer CCC facilities were randomly

ISSN 1561-7645 (online)
doi: 10.4314/jagst.v24i3.9

selected. These were: Emuhaya Sub- County Hospital, Jumuia Hospital, Sabatia Sub-County Hospital, Serem Health Centre, Vihiga County Referral Hospital and Vihiga Health Centre.

2.2 Study design

A cross-sectional survey design was employed which served as a baseline survey for investigating the effect of a nurse-led differentiated care intervention on reduction of cardiovascular risk among clients on highly active antiretroviral therapy in Vihiga County, Kenya. This study only focused on reporting the prevalence of cardiovascular risk factors among patients on HAART in the county.

2.3 Study population:

The study population was made up of all patients on HAART care in Vihiga County. The Study comprised of persons aged above 18 years but not older than 60 years old, who have been on HAART for more than 6 months who reside in Vihiga County and who consented to participate in the study.

2.4 Sample size determination

Participants were selected using systematic random sampling to ensure equal representation.
The sample size for the study was 211 respondents. This was determined using the single population proportion formula, appropriate for a descriptive study without comparison groups. The assumptions used were:

- Confidence level: 95%
- Estimated population proportion (p):
- 0.5 (used for maximum variability)
- Margin of error (E): ±6.7%

The formula used for sample size calculation was:
n = (Z^2 * p * (1 - p)) / E^2

Where:
- Z is the Z-score corresponding to a 95% confidence level (1.96)
- p = 0.5
- E = 0.067

Substituting into the formula:
n = (1.96^2 * 0.5 * (1 - 0.5)) / (0.067^2) ≈ 211
This sample size provided a balance between statistical reliability and feasibility, considering the scope of the baseline study and fieldwork logistics. As a baseline assessment, this study does not include an end line component.

ISSN 1561-7645 (online)
doi: 10.4314/jagst.v24i3.9

A sample of 211 participants was selected for the study.

2.5 Sampling technique

Systematic sampling was used to select the study participants 211 participants were selected to ensure that they all had an equal chance of participating in the study.

2.6 Data collection

The prevalence of cardiovascular risk among patients on HAART was collected using the Stepwise WHO questionnaire. Here the prevalence of clients with obesity, those who smoke cigarette, consume alcohol, those who do not engage in physical activity, those who led sedentary lifestyles, those who are diabetic and hypertensive was collected and the prevalence determined. In addition, the socio-demographic characteristics of these patients were also collected. Additionally, height, weight, waist circumference and hip circumference were used to identify the BMI of patients. Both systolic and diastolic measurements of blood pressure were collected from the patients and recorded in the patient's data tool.

2.7 Data analysis

Descriptive data was analyzed in measures of central tendency (means, modes, medians) and measures of dispersion (standard deviation and range) for all demographic variables. Additionally, descriptive statistics were used to identify the prevalence of the risk factors for CVD. The cardiovascular risk factors under study were smoking status, alcohol consumption, hypertension, systolic pressure and BMI. In this study, a BMI of less than 18.5 kg/m2 was defined as underweight, 18.5 to 24.9 kg/m2 was defined as normal body weight, 25 to 29.9 kg/m2 was defined as overweight, and equal to or greater than 30 kg/m2 defined obesity. Abdominal obesity was defined as a waist circumference of ≥ 80 cm in females and ≥ 94 cm in males. Hypertension was defined as Systolic Blood Pressure ≥ 140 mmHg, Diastolic Blood Pressure ≥ 90 mmHg, or self-reported use of blood pressure lowering medication. Diabetes mellitus (DM) was defined as a previous diagnosis of type 1 or 2 DM, at least two random blood glucose readings of ≥ 11.1 mmol/L, fasting plasma glucose reading of ≥ 7 mmol/L, or self-reported use of a glucose-lowering agent. In inferential statistics ordinal logistic regression was used to determine the determinants of BMI category which was measured on an ordinal scale while binary logistic regression was used in finding the determinants of systolic blood pressure.

ISSN 1561-7645 (online)
doi: 10.4314/jagst.v24i3.9

3.0 Results

Table 1: Sociodemographic characteristics of study participants

Characteristics (n=211)	Freq.	Percent
Gender		
Female	148	70.14
Male	63	29.86
Education Level		
Never Been to School	5	2.37
Primary	114	54.03
Secondary	80	37.91
University/College	12	5.69
Race		
African	211	100
Marital Status		
Divorced	1	0.47
Married	117	55.45
Separated	20	9.48
Single	25	11.85
Widowed	48	22.75
Work Status (Past 12mths)		
Government Employed	30	14.22
Homemaker	21	9.95
Non-paid	6	2.84
Retired	3	1.42
Self-Employed	90	42.65
Student	3	1.42
Unemployed	55	27.49
Age (Mean [SD])	45.5 [9.1]	

Results indicate that a majority of the participants were female (70.14%). More than half had primary education (54.03%), married (55.45%). In terms of employment, the most popular employment was self-employment which was common among slightly less than half of the participants (42.65%). The average age of the participants was 45.5 (Mean=45.5± 9.1) (See Table 1)

Table 2 Prevalence of cardiovascular risks

Risk Factor (n=211)	Freq.	Percent
Smoking status		
No	193	91.47
Yes	18	8.53
Consumed Alcohol (past year)		
No	185	87.68
Yes	26	12.32
History of hypertension		
No	190	90.05
Yes	21	9.95
History of diabetes		
No	209	99.05
Yes	2	0.95
Systolic pressure		
Normal	185	87.68
Systolic hypertension	26	12.32
BMI		
Underweight	24	11.37
Normal weight	118	55.92

ISSN 1561-7645 (online)
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	Overweight	38	18.01
	Obese	31	14.69

The cardiovascular risk factors under study were smoking status, alcohol consumption, hypertension, systolic pressure and BMI. Table 2 indicates the prevalence of cardiovascular risk factors. The study findings indicate that only a small fraction of the clients were smokers (8.53%) and consumed Alcohol (12.32%). When it comes to history of hypertension, 9.95% of the clients reported a history of hypertension. However, a slightly higher percentage were in the group of those with current systolic hypertension (12.32%). A negligible proportion (0.95%) of the clients had a history of diabetes. In terms of BMI, about half of the patients had normal body weight (55.92%) with 18.01% of the clients being overweight and an additional 14.69% being obese.

Table 3 Socio-demographic determinants of body weight

	Bivariate analysis		
DV: BMI Category	OR	95% CI	p-value
Gender			
Female	REF		
Male	0.187	[0.097,0.361]	<0.001
Education Level			
Primary	REF		
None	1.089	[0.201,5.91]	0.921
Secondary	1.133	[0.652,1.968]	0.658
University/College	1.777	[0.609,5.181]	0.292
Marital Status			
Married	REF		
Divorced	0.514	[0.016,16.818]	0.708
Separated	0.891	[0.351,2.258]	0.807
Single	1.221	[0.536,2.78]	0.634
Widowed	0.965	[0.507,1.838]	0.914
Work Status (Past 12mths)			
Employed	REF		
Homemaker	2.810	[0.986,8.006]	0.053
Non-paid	0.671	[0.115,3.922]	0.658
Retired	0.070	[0.006,0.845]	0.036
Self-Employed	1.416	[0.639,3.139]	0.391
Student	0.556	[0.047,6.597]	0.642
Age (Mean [SD])	1.012	[0.984,1.042]	0.396
Income per year (Mean [SD])	1.000	[0.706,1]	0.380

Being overweight and obese is one of the risk factors for cardiovascular. The current study sought to determine the risk factors of obesity. An ordinal logistic regression was used to determine the factors associated with gaining weight (moving from category of body mass index to the other). The outcome variable was body mass index categories of underweight, normal weight, overweight and obesity. The results indicate that odds of males gaining weight and thus changing from the current BMI category to the next were 81.3% lower than that of females (OR= 0.187, 95% C.I [0.097,0.361], p<0.001). Work status was also associated with body weight category. The results revealed that those who had retired were less likely to gain weight as compared to those who were employed (OR=0.070, 95% C.I [0.006,0.845], p=0.036) [See Table 3]

ISSN 1561-7645 (online)
doi: 10.4314/jagst.v24i3.9

Table 4 Relationship between lifestyle factors and body weight

		Bivariate analysis		
DV: BMI Category		OR	95% CI	p-value
Smokes tobacco				
	Yes	REF		
	No	5.325	[2.057,13.786]	0.001
History of alcohol use				
	Yes	REF		
	No	4.394	[1.929,10.009]	<0.001
Taken alcohol in the past 1 year				
	Yes	REF		
	No	5.378	[2.257,12.815]	<0.001
Engages in exercise				
	Yes	REF		
	No	1.200	[0.549,2.621]	0.647
Regularly checks blood sugar				
	Yes	REF		
	No	0.695	[0.411,1.174]	0.174

The relationship between lifestyle and body weight was also evaluated using an ordinal logistic regression model. Table 4 indicates that those who did not smoke were five times more likely to have a higher category of body weight than those who were smokers (OR= 5.325, 95% ci [2.057,13.786], p=0.001). In the ordinal logistic regression model predicting body weight categories, the variable "History of alcohol use" was also examined as a predictor. The reference category for this predictor is "Yes," representing individuals with a history of alcohol use. The odds ratio (OR) of 4.394 indicates that individuals without a history of alcohol use were approximately 4.394 times more likely to have a higher ordinal category of body weight compared to those with a history of alcohol use (OR=4.394, 95% CI [1.929,10.009], p<0.001) and specifically, those who had not taken alcohol in the past one year were even more likely to have a higher ordinal category of body weight com (OR=5.378, 95% CI [2.257,12.815], p<0.001).

ISSN 1561-7645 (online)
doi: 10.4314/jagst.v24i3.9

Table 5 Socio-demographic predictors of systolic blood pressure

	Systolic Pressure			Bivariate analysis	
	Normal	Hypertensive	OR	95% CI	p-value
Gender					
Female	131 (70.81)	17 (65.38)	REF		
Male	54 (29.19)	9 (34.62)	1.284	[0.539,3.059]	0.572
Education Level					
Primary	103 (55.68)	2 (7.69)	REF		
None	3(1.62)	11 (42.31)	6.242	[0.939,41.492]	0.058
Secondary	71 (38.38)	9 (34.62)	1.187	[0.468,3.012]	0.718
University/College	8 (4.32)	4 (15.38)	4.682	[1.212,18.09]	0.025
Marital Status					
Married	102 (55.14)	0 (0.00)	REF		
Divorced	1 (0.54)	0 (0.00)	1.000	-	-
Separated	18 (9.73)	2 (7.69)	0.756	[0.159,3.589]	0.724
Single	25 (13.51)	0 (0.00)	1.000	-	-
Widowed	39 (21.08)	9 (34.62)	1.569	[0.635,3.879]	0.329
Work Status (Past 12mths)					
Employed	50 (27.03)	5 (19.23)	REF		
Homemaker	3 (1.62)	2 (7.69)	6.667	[0.892,49.833]	0.065
Non-paid	20 (10.81)	1 (3.85)	0.500	[0.055,4.552]	0.539
Retired	21 (11.35)	4 (15.38)	1.905	[0.465,7.803]	0.370
Self-Employed	5 (2.70)	1 (3.85)	2.000	[0.194,20.671]	0.561
Student	2 (1.08)	1 (3.85)	5.000	[0.382,65.36]	0.220
Age (Mean [SD])	44 [9.2]	51 [5.4]	1.123	[1.05,1.202]	0.001
Income per year (Mean [SD])	92616 [86411]	120340 [11375]	1.000	[1,1]	0.197

The bivariate analysis, as shown in Table 6, aimed to examine the association between systolic blood pressure as a risk factor of cardiovascular disease and various demographic and socioeconomic factors. Among the demographic factors analyzed, education level demonstrated some significant associations, with individuals having a university/college education exhibiting a higher likelihood of being hypertensive (OR: 4.682, 95% CI: [1.212, 18.09], p=0.025) compared to those with only primary education, while those with no formal education showed a marginal association (OR: 6.242, 95% CI: [0.939, 41.492], p = 0.058). Age showed a significant positive association with hypertensive status, with each one-year increase in age associated with a 12.3% increase in the odds of being hypertensive (OR: 1.123, 95% CI: [1.05, 1.202], p = 0.001).

ISSN 1561-7645 (online)
doi: 10.4314/jagst.v24i3.9

Table 6 Relationship between lifestyle factors and systolic blood pressure

	Systolic Pressure		Bivariate analysis		
	Normal	Hypertensive	OR	95% CI	p-value
Smokes tobacco					
Yes	15 (8.11)	3 (11.54)	REF		
No	170 (91.89)	23 (88.46)	0.676	[0.182,2.517]	0.560
History of alcohol use					
Yes	24 (12.97)	2 (7.69)	REF		
No	161 (87.03)	24 (92.31)	1.789	[0.397,8.056]	0.449
Taken alcohol in the past 1 year					
Yes	21 (11.35)	2 (7.69)	REF		
No	164 (88.65)	24 (92.31)	1.537	[0.339,6.972]	0.578
Engages in exercise					
Yes	161 (87.03)	24 (92.31)	REF		
No	24 (12.97)	2 (7.69)	0.559	[0.124,2.518]	0.449
Regularly checks blood sugar					
Yes	80 (43.24)	8 (30.77)			
No	105 (56.76)	18 (69.23)	1.714	[0.71,4.142]	0.231

The bivariate analysis as illustrated by Table 7 examined the relationship between systolic blood pressure and various lifestyle factors among the study participants. The analysis found no statistical significant association between smoking tobacco, history of alcohol use, recent alcohol consumption, and engagement in exercise with hypertensive status.

ISSN 1561-7645 (online)
doi: 10.4314/jagst.v24i3.9

Table 7 Relationship between HIV related factors and systolic blood pressure

	Systolic Pressure		Bivariate analysis		
	Normal	Hypertensive	OR	95% CI	p-value
Regimen Combination					
TDF/3TC/DTG	113 (61.08)	15 (57.69)	REF		
ABC/3TC/DTG	1 (0.54)	1 (3.85)	7.533	[0.447,126.848]	0.161
AFZE	7 (3.58)	0 (0.00)	1.000	-	-
AZT/3TC/ATU	1 (0.54)	0 (0.00)	1.000	-	-
TDF/3TC/ATR	2 (1.08)	0 (0.00)	1.235	-	-
TLD	61 (32.97)	10 (38.46)	1.235	[0.523,2.914]	0.630
Adherence to medication					
High	173 (93.51)	2 (7.69)	REF		
Medium	164 (88.65)	1 (3.85)	0.865	[0.104,7.212]	0.893
Low	4 (2.16)	0 (0.00)	1.000	-	-
Duration with HIV (Mean [SD])	10.5 [5.1]	11.9 [5.1]	1.054	[0.971,1.145]	0.211
Viral Load (Mean [SD])	12539.4 [139273.1]	17.1 [87.1]	0.999	[0.995,1.002]	0.477
CD4 cell count (Mean [SD])	388.5 [247.7]	356.4 [211.3]	0.999	[0.998,1.001]	0.528

The bivariate analysis examined the relationship between systolic blood pressure and several HIV-related variables, including regimen combination and adherence to medication, among participants. The study utilized individuals on the TDF/3TC/DTG regimen as the reference group. Results indicated no significant association between hypertensive status and various regimen combinations, such as ABC/3TC/DTG, AFZE, AZT/3TC/ATU, TDF/3TC/ATR, and TLD. Likewise, adherence to medication did not demonstrate a statistically significant relationship with hypertensive status, the duration of HIV, viral load, or CD4 cell count (See Table 8)

4.0 Discussion

The study sought to determine the prevalence of cardiovascular risk factors. The results indicate that slightly above half of the patients had normal body weight (55.92%) with 18.01% of the clients being overweight and an additional 14.69% being obese. A cumulative proportion of about a third (32.70%) of the clients on HAART were either overweight or obese. Comparing these findings with a study conducted in Shenzhen, China, sheds light on a potential trend of increasing prevalence of overweight and obesity among people living with HIV (PWLH) over time. The study in China showed a consistent rise in the prevalence of overweight and obesity across different age groups from 2010 to 2014. Of Particular concern is the substantial increase in the prevalence of overweight among young adults aged 15-24, indicating a shift towards earlier onset of weight-related issues among HIV patients (Li *et al.*, 2023). The findings of this study are similar to the findings of a study by (Nalugga *et al.*, 2022b) (Nalugga *et al.*, 2022a) in Uganda which found a high combined prevalence of overweight and obesity which was 46%, that of obesity being 18.2% and overweight 27.8% . In this study, being female was associated with obesity and overweight among HIV positive individuals. The current study identified sex as a significant factor of BMI category, with males being less likely to gain weight compared to females. These findings are similar to a study by (Saito, Karama and Kamiya, 2020b) (Saito, Karama and Kamiya, 2020b) which was conducted in Western Kenya and found that there was a relatively high prevalence of overweight

ISSN 1561-7645 (online)
doi: 10.4314/jagst.v24i3.9

and obesity among HIV patients on ART with female patients having an increased likelihood of being overweight or obese. However, the findings contrast those of (Belete *et al.*, 2023) (Belete *et al.*, 2023) in Ethiopia which found out that the prevalence of overweight and obesity was higher in males that in females.

Work status also played a role, as retirees were less likely to gain weight compared to those who were employed. This could suggest that lifestyle factors associated with employment, such as increased payment and thus possibility of eating junk food or sedentary behavior, contribute to weight gain. In comparison with a study conducted by (Anekwe *et al.*, 2020) (Anekwe *et al.*, 2020) which found out that persons with low income had less odds of being overweight, implying the connection to work status to BMI category. Other lifestyle habits strongly linked to body weight were being non-smoker and no history of alcohol use. Notably, those who had not consumed alcohol in the past year showed even higher odds of being in a higher BMI category, indicating a potentially pronounced effect of recent alcohol abstinence on weight status. The finding that non-smokers and individuals without a history of alcohol use were more likely to be in a higher BMI category suggests a counterintuitive relationship between lifestyle habits and weight status in this population. It's essential to acknowledge that while non-smokers and those abstaining from alcohol may have higher BMI categories, this does not necessarily indicate that these lifestyle choices are directly protective against weight gain. One potential interpretation could be that smoking and alcohol use may affect appetite or nutrient absorption differently in individuals with HIV. It's possible that these behaviors contribute to a higher risk of underweight status rather than overweight or obesity. The study agrees with that of (Real *et al.*, 2021) with reference to smoking; HIV patients having lower weight, but disagrees with its findings that alcohol consumption is associated with weight gain among HIV patients on HAART. Relationship between alcohol and weight gain surrounding its consumption is still unclear and some studies have also indicated that high consumption of alcohol, may instead lead to loss of weight due to a loss of desire in eating as it may cause a feeling of being full (DeBenedictis *et al.*, 2020) and others indicating that it leads to weight gain (Eggleton and Nagalli, 2024b)

Regarding medication regimens, individuals on the "TLD" regimen were more likely to be in a higher BMI category compared to those on the reference regimen. TLD typically consists of tenofovir, lamivudine, and dolutegravir, while TDF/3TC/DTG comprises tenofovir disoproxil fumarate, lamivudine, and dolutegravir. While both regimens contain the same antiretroviral agent, dolutegravir, they differ in their other components. Tenofovir disoproxil fumarate (TDF) in the TDF/3TC/DTG regimen is associated with potential renal and bone toxicity, whereas tenofovir in the TLD regimen is the newer tenofovir alafenamide (TAF), which is believed to have fewer side effects on renal and bone health (Mtisi *et al.*, 2019; Turner *et al.*, 2019). Therefore, the observed difference in BMI categories between the two regimens could potentially be attributed to the differential side effect profiles of the components.

ISSN 1561-7645 (online)
doi: 10.4314/jagst.v24i3.9

Dolutegravir-based regimens, including TLD, are generally favored for their potency, high barrier to resistance, and favorable tolerability compared to other antiretroviral agents (Semengue *et al.*, 2022). Therefore, individuals on the TLD regimen may experience better virologic control and overall health status, which could indirectly influence weight gain. In addition, differences in treatment adherence or duration on specific regimens could also contribute to variations in weight status among individuals. The findings indicated that the clients on the TLD regimen had a better adherence to drugs than those on TDF/3TC/DTG regimen, which positively impacted their weight status compared to individuals on the TDF/3TC/DTG regimen. The use of dolutegravir-based regimen is associated with weight gain (Maartens, Sinxadi and Venter, 2023). The high adherence to TLD coupled with its propensity to lead to weight gain (Hirigo *et al.*, 2023) is a possible reason to the observed difference in the regimen. The findings contrast that of a study done in Botswana (Tshikuka *et al.*, 2020) which found no association between the regimen type and overweight and obesity. However, adherence levels and other clinical variables like duration with HIV, viral load, and CD4 cell count did not show significant associations with BMI category. This is likely due to an overwhelming majority of the individual's showing adherence to medication and thus was not significantly associated with BMI.

When it comes to history of hypertension 9.95% of the clients reported a history of hypertension. However, a slightly higher percentage were in the group of those with current systolic hypertension (12.32%). The study reports that nearly 10% of the clients had a history of hypertension, indicating a notable proportion of individuals with a pre-existing condition predisposing them to cardiovascular complications. However, the prevalence of current systolic hypertension, which directly assesses elevated blood pressure at the time of the study, was slightly higher at 12.32%. This suggests that there may be undiagnosed or poorly controlled hypertension among this population, potentially exacerbating their cardiovascular risk. The current study revealed a current lower risk of hypertension among HIV patients. This was lower than that reported in Burundi (Harimenshi *et al.*, 2022), Nigeria (Aina *et al.*, 2022), South Africa (Gonah, Moodley and Hlongwana, 2020), Uganda (Lubega *et al.*, 2021), Cameroon (Dzudie *et al.*, 2021). The findings of the prevalence of hypertension of about 10%-12% are comparable to a study conducted in Western Kenya (Saito, Karama and Kamiya, 2020b), but lower than the prevalence for a study conducted in Central Kenya (Mbuthia, Magutah and McGarvey, 2021b).

The study aimed to identify prevalence of systolic blood pressure as a risk factor for cardiovascular disease among HIV clients on HAART in Vihiga County, Kenya. The bivariate analysis examined associations between systolic blood pressure and various demographic, socioeconomic, lifestyle, and HIV-related factors. Among demographic factors, education level and age showed significant associations with hypertensive status. Interestingly, individuals with a university/college education exhibited a higher likelihood of being hypertensive compared to those with only primary

ISSN 1561-7645 (online)
doi: 10.4314/jagst.v24i3.9

education, while older age was positively associated with hypertensive status. The unexpected finding that individuals with a university/college education exhibited a higher likelihood of being hypertensive compared to those with only primary education may stem from several factors. Higher education levels may correlate with higher socioeconomic status, which can influence dietary habits, access to healthcare, and stress levels. Additionally, individuals with higher education may lead more sedentary lifestyles due to desk-bound jobs or academic pressures.
The findings are similar to those of a study conducted in Burundi which revealed that old age was associated with increase in likelihood of hypertension (Harimenshi *et al.*, 2022). This is also the case in Ghana (Dai *et al.*, 2022), Uganda (Majumdar *et al.*, 2022), Zimbabwe (Sabapathy *et al.*, 2024) and Rwanda (Uwanyirigira *et al.*, 2023) where increase in age is associated with increase in the risk of systolic blood pressure and consequently the risk in developing cardiovascular disease.

The study found a small prevalence of smoking (8.53%) among patients on HAART. Smoking is estimated to cause 10% of CVD and its prevalence is estimated to be lowest in the WHO African Region (Peprah *et al.*, 2021b) . The relatively low prevalence of smoking among HIV patients on HAART in Vihiga County is notable and could potentially have positive implications for cardiovascular health in this population. Smoking cessation has been shown to lead to significant reductions in CVD risk, including decreased rates of coronary artery disease, stroke, and peripheral vascular disease (van den Berg *et al.*, 2019; Gallucci *et al.*, 2020). Therefore, the low prevalence of smoking observed in this study suggests that a smaller proportion of HIV patients on HAART in Vihiga County may be at risk of developing smoking-related CVD compared to populations with higher smoking prevalence.

A negligible proportion (0.95%) of the clients on HAART had a history of diabetes implying that diabetes is not a threat among people on HAART in Vihiga. However, there is a need for regular monitoring of blood sugar levels since diabetes can develop based on lifestyle factors and family history of diabetes which were no directly assessed during the study. According to other studies, the prevalence of DM in HIV-infected patients varies depending on the makeup of the cohort analyzed, how the diagnosis of DM is made, and how DM risk variables are taken into consideration in the study (Umar and Naidoo, 2021). The prevalence of diabetes in the current study is comparable to that of a study conducted in British Columbia (Bratu *et al.*, 2021). The prevalence of diabetes among clients on HAART in the current study was generally lower than that found in most studies. It was lower than that those of studies in Taiwan (Lin *et al.*, 2018), Ethiopia (Duguma *et al.*, 2020b; Gebrie *et al.*, 2020), Zimbabwe (Chireshe, Manyangadze and Naidoo, 2024), and South Africa (Rajagopaul and Naidoo, 2021). According to (Duguma *et al.*, 2020a) (Duguma *et al.*, 2020b), HAART is associated with increased risk of diabetes mellitus among PLWHIV which was not the case in this study.

ISSN 1561-7645 (online)
doi: 10.4314/jagst.v24i3.9

5.0 Conclusion

The study provides valuable insights into the prevalence of cardiovascular risk factors among HIV clients on HAART in Vihiga County, Kenya. The findings reveal a considerable burden of overweight and obesity among the study population, with a substantial proportion falling into the overweight and obese categories. Socio-demographic factors such as gender and work status, as well as lifestyle habits including smoking and alcohol consumption, were identified as significant determinants of BMI category. Additionally, certain medication regimens, specifically the TLD regimen, were associated with a higher BMI category compared to the reference regimen. However, adherence levels and clinical variables such as duration with HIV, viral load, and CD4 cell count did not show significant associations with BMI category. Moreover, hypertension was prevalent among the study participants, with age emerging as a significant determinant. Conversely, smoking prevalence was relatively low among HIV patients on HAART in Vihiga County, which could potentially have positive implications for cardiovascular health in this population. Similarly, there was a low prevalence of diabetes mellitus among clients on HAART in Vihiga County. The study highlights the importance of addressing modifiable risk factors and optimizing treatment strategies to mitigate cardiovascular risk among HIV clients on HAART in resource-limited settings.

What is already known on this topic?

- All clients who test positive for HIV virus are initiated on HAART
- HAART and pathogenesis of HIV predisposes clients to cardiovascular disease

What this study adds?

- This study finding gives a snapshot of the prevalence of clients at risk of cardiovascular disease who are on highly active antiretroviral drugs in Vihiga County.
- These study findings inform the policy makers on importance of including cardiovascular risk prevention strategies in management of clients on HAART.

6.0 Acknowledgments

6.1 Competing interests

The authors declare no competing interest.

6.2 Ethical consideration

Permission to conduct the study was granted upon reviewing the proposal by Masinde Muliro University of Science and Technology ethics and research committee and National Commission for Science, Technology and Innovation (NACOSTI) Reference number: 120458/132219. Participants voluntarily signed informed consents prior to participation in the study. The principles of beneficence and non-maleficence were ensured by informing participants of the potential benefits and risks of the study before they signed consents to participate in the study.

ISSN 1561-7645 (online)
doi: 10.4314/jagst.v24i3.9

Questionnaires were serialized to ensure anonymity. No other form of identification was required from participants. All research tools were only accessed by the researcher. They were stored under lock and key and research information in computers under passwords.

6.3 Acknowledgements (if any)

I acknowledge all research assistants and clients who participated in the study.

7.0 References

Aina, T.S. *et al.* (2022) 'Critical evaluation of waterfall project management methodology: A case study of digital management conference project'.

Anekwe, C.V. *et al.* (2020) 'Socioeconomics of Obesity', *Current obesity reports*, 9(3), pp. 272–279. Available at: https://doi.org/10.1007/s13679-020-00398-7.

Appiah, L.T. *et al.* (2019) 'Cardiovascular risk factors among Ghanaian patients with HIV: a cross-sectional study', *Clinical Cardiology*, 42(12), pp. 1195–1201. https://doi.org/10.1002/clc.23273

Belete, N.K. *et al.* (2023) 'Association Between Overweight/Obesity and ART Drug Regimen Among Adult HIV Patients in Gamo Zone Public Health Facilities Southern Ethiopia', *HIV/AIDS - Research and Palliative Care*, 15, pp. 349–360. Available at: https://doi.org/10.2147/HIV.S412586.

van den Berg, M.J. *et al.* (2019) 'Smoking cessation and risk of recurrent cardiovascular events and mortality after a first manifestation of arterial disease', *American Heart Journal*, 213, pp. 112–122. Available at: https://doi.org/10.1016/j.ahj.2019.03.019.

Bratu, A. *et al.* (2021) 'Incidence of diabetes mellitus among people living with and without HIV in British Columbia, Canada between 2001 and 2013: a longitudinal population-based cohort study', *BMJ Open*, 11(5), p. e048744. Available at: https://doi.org/10.1136/bmjopen-2021-048744.

Chireshe, R., Manyangadze, T. and Naidoo, K. (2024) 'Diabetes mellitus and associated factors among HIV-positive patients at primary health care facilities in Harare, Zimbabwe: a descriptive cross-sectional study', *BMC Primary Care*, 25(1), p. 28. Available at: https://doi.org/10.1186/s12875-024-02261-3.

Dai, B. *et al.* (2022) 'The prevalence of hypertension and its associated risk factors among older adults in Ghana', *Frontiers in Cardiovascular Medicine*, 9, p. 990616. Available at: https://doi.org/10.3389/fcvm.2022.990616.

DeBenedictis, J.N. *et al.* (2020) 'Changes in the Homeostatic Appetite System After Weight Loss Reflect a Normalization Toward a Lower Body Weight', *The Journal of Clinical Endocrinology and Metabolism*, 105(7), pp. e2538–e2546. Available at: https://doi.org/10.1210/clinem/dgaa202.

ISSN 1561-7645 (online)
doi: 10.4314/jagst.v24i3.9

Dominick, L. *et al.* (2020) 'HIV-related cardiovascular diseases: the search for a unifying hypothesis', *American Journal of Physiology-Heart and Circulatory Physiology*, 318(4), pp. H731–H746. Available at: https://doi.org/10.1152/ajpheart.00549.2019.

Duguma, F. *et al.* (2020a) 'Diabetes Mellitus and Associated Factors Among Adult HIV Patients on Highly Active Anti-Retroviral Treatment', *HIV/AIDS (Auckland, N.Z.)*, 12, pp. 657–665. Available at: https://doi.org/10.2147/HIV.S279732.

Duguma, F. *et al.* (2020b) 'Diabetes Mellitus and Associated Factors Among Adult HIV Patients on Highly Active Anti-Retroviral Treatment', *HIV/AIDS (Auckland, N.Z.)*, 12, pp. 657–665. Available at: https://doi.org/10.2147/HIV.S279732.

Dzudie, A. *et al.* (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), p. e0253742. Available at: https://doi.org/10.1371/journal.pone.0253742.

Eggleton, J.S. and Nagalli, S. (2024a) 'Highly Active Antiretroviral Therapy (HAART)', in *StatPearls*. Treasure Island (FL): StatPearls Publishing. Available at: http://www.ncbi.nlm.nih.gov/books/NBK554533/ (Accessed: 17 March 2024).

Eggleton, J.S. and Nagalli, S. (2024b) 'Highly Active Antiretroviral Therapy (HAART)', in *StatPearls*. Treasure Island (FL): StatPearls Publishing. Available at: http://www.ncbi.nlm.nih.gov/books/NBK554533/ (Accessed: 17 March 2024).

Ekun, O.A. *et al.* (2021) 'Risks of cardio-vascular diseases among highly active antiretroviral therapy (HAART) treated HIV seropositive volunteers at a treatment centre in Lagos, Nigeria', *The Pan African Medical Journal*, 38, p. 206. Available at: https://doi.org/10.11604/pamj.2021.38.206.26791.

Enriquez, R. *et al.* (2022) 'Prevalence of cardiovascular risk factors by HIV status in a population-based cohort in South Central Uganda: a cross-sectional survey', *Journal of the International AIDS Society*, 25(4), p. e25901. Available at: https://doi.org/10.1002/jia2.25901.

Fragkou, P.C. *et al.* (2023) 'Cardiovascular disease and risk assessment in people living with HIV: Current practices and novel perspectives', *Hellenic Journal of Cardiology*, 71, pp. 42–54. Available at: https://doi.org/10.1016/j.hjc.2022.12.013.

Gallucci, G. *et al.* (2020) 'Cardiovascular risk of smoking and benefits of smoking cessation', *Journal of Thoracic Disease*, 12(7), pp. 3866–3876. Available at: https://doi.org/10.21037/jtd.2020.02.47.

ISSN 1561-7645 (online)
doi: 10.4314/jagst.v24i3.9

Gebrie, A. *et al.* (2020) 'Diabetes mellitus and its associated risk factors in patients with human immunodeficiency virus on anti-retroviral therapy at referral hospitals of Northwest Ethiopia', *Diabetology & Metabolic Syndrome*, 12(1), p. 20. Available at: https://doi.org/10.1186/s13098-020-00527-1.

Gonah, L., Moodley, I. and Hlongwana, K. (2020) 'Prevalence, healthcare costs and management of non-communicable diseases in people living with human immunodeficiency virus: A scoping review', *African Journal of Primary Health Care & Family Medicine*, 12(1), p. 8. Available at: https://doi.org/10.4102/phcfm.v12i1.2474.

Harimenshi, D. *et al.* (2022) 'Hypertension and associated factors in HIV-infected patients receiving antiretroviral treatment in Burundi: a cross-sectional study', *Scientific Reports*, 12(1), p. 20509. Available at: https://doi.org/10.1038/s41598-022-24997-7.

Hirigo, A.T. *et al.* (2023) 'Effect of dolutegravir-based first-line antiretroviral therapy on weight and body mass index among adult people living with HIV on follow up at health facilities in Hawassa city administration, Southern Ethiopia: a retrospective cohort study', *Annals of Medicine*, 55(2), p. 2242250. Available at: https://doi.org/10.1080/07853890.2023.2242250.

HIV and AIDS Epidemic Global Statistics (2023) *HIV.gov*. Available at: https://www.hiv.gov/hiv-basics/overview/data-and-trends/global-statistics (Accessed: 17 March 2024).

Kalantarzadeh, M. *et al.* (2022) 'Adherence Barriers to Treatment of Patients with Cardiovascular Diseases: A Qualitative Study', *Iranian Journal of Nursing and Midwifery Research*, 27(4), pp. 317–324. Available at: https://doi.org/10.4103/ijnmr.ijnmr_307_21.

Kemnic, T.R. and Gulick, P.G. (2024) 'HIV Antiretroviral Therapy', in *StatPearls*. Treasure Island (FL): StatPearls Publishing. Available at: http://www.ncbi.nlm.nih.gov/books/NBK513308/ (Accessed: 17 March 2024).

Li, T. *et al.* (2023) 'Increasing trends of overweight and obesity in treatment-naive people living with HIV in Shenzhen from 2014 to 2020: an emerging health concern', *Frontiers in Public Health*, 11. Available at: https://doi.org/10.3389/fpubh.2023.1186838.

Lin, S.P. *et al.* (2018) 'Risk of diabetes mellitus in HIV-infected patients receiving highly active antiretroviral therapy: A nationwide population-based study', *Medicine*, 97(36), p. e12268. Available at: https://doi.org/10.1097/MD.0000000000012268.

Lubega, G. *et al.* (2021) 'Prevalence and factors associated with hypertension among people living with HIV/AIDS on antiretroviral therapy in Uganda', *The Pan African Medical Journal*, 38(216). Available at: https://doi.org/10.11604/pamj.2021.38.216.28034.

ISSN 1561-7645 (online)
doi: 10.4314/jagst.v24i3.9

Maartens, G., Sinxadi, P. and Venter, W.D.F. (2023) 'Weight gain on dolutegravir: Association is not the same as causation', *Southern African Journal of HIV Medicine*, 24(1), p. 1500. Available at: https://doi.org/10.4102/sajhivmed.v24i1.1500.

Majumdar, U. *et al.* (2022) 'Hypertension screening, prevalence, treatment, and control at a large private hospital in Kampala, Uganda: A retrospective analysis', *PLOS Global Public Health*, 2(5), p. e0000386. Available at: https://doi.org/10.1371/journal.pgph.0000386.

Mbuthia, G.W., Magutah, K. and McGarvey, S.T. (2021a) 'The Prevalence and Associated Factors of Hypertension among HIV Patients', *International Journal of Hypertension*, 2021, p. 5544916. Available at: https://doi.org/10.1155/2021/5544916.

Mbuthia, G.W., Magutah, K. and McGarvey, S.T. (2021b) 'The Prevalence and Associated Factors of Hypertension among HIV Patients', *International Journal of Hypertension*, 2021, p. 5544916. Available at: https://doi.org/10.1155/2021/5544916.

Moyo, E. *et al.* (2023) 'Key populations and Sub-Saharan Africa's HIV response', *Frontiers in Public Health*, 11, p. 1079990. Available at: https://doi.org/10.3389/fpubh.2023.1079990.

Mtisi, T.J. *et al.* (2019) 'Tenofovir-associated kidney disease in Africans: a systematic review', *AIDS Research and Therapy*, 16(1), p. 12. Available at: https://doi.org/10.1186/s12981-019-0227-1.

Mueller, M.C. *et al.* (2021) 'Assessing the differential impact of chronic CMV and treated HIV infection on CD8+ T-cell differentiation in a matched cohort study: is CMV the key?', *AIDS Research and Therapy*, 18(1), p. 37. Available at: https://doi.org/10.1186/s12981-021-00361-z.

Mworia, J.G. (2023) *Management Skills and Performance of Kipepeo HIV/AIDS Project in Vihiga County, Kenya*. University of Nairobi.

Nalugga, E.A. *et al.* (2022a) 'Prevalence of overweight and obesity and associated factors among people living with HIV attending a tertiary care clinic in Uganda', *BMC Nutrition*, 8, p. 107. Available at: https://doi.org/10.1186/s40795-022-00604-w.

Nalugga, E.A. *et al.* (2022b) 'Prevalence of overweight and obesity and associated factors among people living with HIV attending a tertiary care clinic in Uganda', *BMC Nutrition*, 8, p. 107. Available at: https://doi.org/10.1186/s40795-022-00604-w.

Ntsekhe, M. and Baker, J.V. (2023) 'Cardiovascular Disease Among Persons Living With HIV: New Insights Into Pathogenesis and Clinical Manifestations in a Global Context', *Circulation*, 147(1), pp. 83–100. Available at: https://doi.org/10.1161/CIRCULATIONAHA.122.057443.

ISSN 1561-7645 (online)
doi: 10.4314/jagst.v24i3.9

Peprah, E. *et al.* (2021a) 'An Emerging Syndemic of Smoking and Cardiopulmonary Diseases in People Living with HIV in Africa', *International Journal of Environmental Research and Public Health*, 18(6), p. 3111. Available at: https://doi.org/10.3390/ijerph18063111.

Peprah, E. *et al.* (2021b) 'An Emerging Syndemic of Smoking and Cardiopulmonary Diseases in People Living with HIV in Africa', *International Journal of Environmental Research and Public Health*, 18(6), p. 3111. Available at: https://doi.org/10.3390/ijerph18063111.

Powell-Wiley, T.M. *et al.* (2021) 'Obesity and Cardiovascular Disease: A Scientific Statement From the American Heart Association', *Circulation*, 143(21), pp. e984–e1010. Available at: https://doi.org/10.1161/CIR.0000000000000973.

Rajagopaul, A. and Naidoo, M. (2021) 'Prevalence of diabetes mellitus and hypertension amongst the HIV-positive population at a district hospital in eThekwini, South Africa', *African Journal of Primary Health Care & Family Medicine*, 13(1), p. 6.

Real, L.H.G. *et al.* (2021) 'Tobacco smoking and body composition in persons living with HIV/AIDS', *Ciência & Saúde Coletiva*, 26, pp. 1923–1930. Available at: https://doi.org/10.1590/1413-81232021265.19532019.

Ruamtawee, W. *et al.* (2023) 'Prevalence and risk factors of cardiovascular disease among people living with HIV in the Asia-Pacific region: a systematic review', *BMC Public Health*, 23(1), p. 477. Available at: https://doi.org/10.1186/s12889-023-15321-7.

Sabapathy, K. *et al.* (2024) 'Prevalence of hypertension and high-normal blood pressure among young adults in Zimbabwe: findings from a large, cross-sectional population-based survey', *The Lancet Child & Adolescent Health*, 8(2), pp. 101–111. Available at: https://doi.org/10.1016/S2352-4642(23)00287-0.

Saito, A., Karama, M. and Kamiya, Y. (2020a) 'HIV infection, and overweight and hypertension: a cross-sectional study of HIV-infected adults in Western Kenya', *Tropical Medicine and Health*, 48(1), p. 31. Available at: https://doi.org/10.1186/s41182-020-00215-w.

Saito, A., Karama, M. and Kamiya, Y. (2020b) 'HIV infection, and overweight and hypertension: a cross-sectional study of HIV-infected adults in Western Kenya', *Tropical Medicine and Health*, 48(1), p. 31. Available at: https://doi.org/10.1186/s41182-020-00215-w.

Semengue, E.N.J. *et al.* (2022) 'Dolutegravir-Based Regimen Ensures High Virological Success despite Prior Exposure to Efavirenz-Based First-LINE ART in Cameroon: An Evidence of a Successful Transition Model', *Viruses*, 15(1), p. 18. Available at: https://doi.org/10.3390/v15010018.

ISSN 1561-7645 (online)
doi: 10.4314/jagst.v24i3.9

Shin, Y.H., Park, C.M. and Yoon, C.-H. (2021) 'An Overview of Human Immunodeficiency Virus-1 Antiretroviral Drugs: General Principles and Current Status', *Infection & Chemotherapy*, 53(1), pp. 29–45. Available at: https://doi.org/10.3947/ic.2020.0100.

Tilahun, A. *et al.* (2022) 'Prevalence and predictors of dyslipidemia among HAART treated and HAART naive HIV positive clients attending Debre Tabor Hospital, Debre Tabor, Ethiopia', *Heliyon*, 8(11), p. e11342. Available at: https://doi.org/10.1016/j.heliyon.2022.e11342.

Touloumi, G. *et al.* (2020) 'Cardiovascular risk factors in HIV infected individuals: Comparison with general adult control population in Greece', *PLOS ONE*, 15(3), p. e0230730. Available at: https://doi.org/10.1371/journal.pone.0230730.

Tshikuka, J.G. *et al.* (2020) 'Overweight and Obesity among Recipients of Antiretroviral Therapy at HIV Clinics in Gaborone, Botswana: Factors Associated with Change in Body Mass Index', *AIDS Research and Treatment*, 2020, p. e8016791. Available at: https://doi.org/10.1155/2020/8016791.

Turner, D. *et al.* (2019) 'Renal function change after switching tenofovir disoproxil fumarate for tenofovir alafenamide in the HIV-positive patients of a metropolitan sexual health service', *AIDS Research and Therapy*, 16(1), p. 40. Available at: https://doi.org/10.1186/s12981-019-0256-9.

Umar, D.M. and Naidoo, P. (2021) 'Prevalence and predictors of diabetes mellitus among persons living with HIV: a retrospective cohort study conducted in 4 public healthcare facilities in KwaZulu-Natal', *BMC Public Health*, 21, p. 288. Available at: https://doi.org/10.1186/s12889-021-10318-6.

UNAIDS Global AIDS Update (2022). Available at: https://www.unaids.org/en/resources/documents/2022/in-danger-global-aids-update (Accessed: 7 March 2024).

Uwanyirigira, D. *et al.* (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*, 19, pp. 857–870. Available at: https://doi.org/10.2147/VHRM.S442108.

Vos, A.G. and Venter, W.D.F. (2021) 'Cardiovascular toxicity of contemporary antiretroviral therapy', *Current Opinion in HIV and AIDS*, 16(6), p. 286. Available at: https://doi.org/10.1097/COH.0000000000000702.

ISSN 1561-7645 (online)
doi: 10.4314/jagst.v24i3.9