ORIGINAL RESEARCH

Prevalence of Clinical Cardiovascular Disease Risk Factors Among HIV Infected Patients on Anti-Retroviral Treatment in a Tertiary Hospital in Ethiopia

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Background: Anti-retroviral treatment has improved mortality of human immunodeficiency virus (HIV) infected patients, which is offset by an increasing burden of cardiovascular diseases (CVD). Data regarding prevalence of cardiovascular disease risk factors in HIV infected patients in Ethiopia are very scarce. The aim of this study was to determine the prevalence of CVD risks and associated factors in patients with HIV.

Methods: A cross-sectional study was conducted on 333 patients with HIV infection, using a modified World Health Organization's stepwise approach to surveillance questionnaire. Anthropometric and blood pressure measurement was done along with biochemical studies. Cardiovascular risk was estimated using Framingham risk score. Multivariate logistic regression was used to examine the association between cardiovascular risks and associated factors, with a p-value of <0.05 considered statistically significant.

Results: The mean age of the participants was 45 years, and 69.2% were females. Most (80.9%) of the participants had viral load below 50 copies/mL and the mean CD4 count was 579 cells/mm^3. Dyslipidemia was the most common risk factor identified in 69.4%, followed by abnormal fasting blood glucose (≥100 mg/dL) in 36.8%. Hypertension was diagnosed in 23.8%, while 22.8% and 11.1% had metabolic syndrome and obesity, respectively. Framingham risk score was low in 95.9%. Male gender, increasing age, high body mass index and previous ART regimen being tenofovir disoproxil fumarate, lamivudine and nevirapine increased CVD risk factors.

Conclusion: Traditional cardiovascular risk factors were high in the population studied. There is a need to raise awareness about the risk factors, and patients should have timely follow-up and care.

Keywords: human immunodeficiency virus, cardiovascular disease, risk factors

Introduction

Non-communicable diseases (NCDs) are showing an epidemic increase in sub-Saharan Africa (SSA). These NCDs include cardiovascular diseases (CVD), cancer and metabolic diseases. Much of the focus in SSA has traditionally been on infectious diseases, maternal and child health, with less focus on NCDs.[1] Evidences show that low-income countries are now facing challenges from both NCDs and infectious diseases.[1,2]

Human immunodeficiency virus (HIV) is a global pandemic affecting more than 34 million people of which 69% (23.5 million) live in sub-Saharan Africa.[3] HIV infected patients on antiretroviral therapy (ART) face a new group of complications and challenges.[4] These include chronic diseases such as hypertension, diabetes, dyslipidemia, lipodystrophy and cardiovascular diseases that need their own treatment options, different from the usual infectious problems.[4–6] The improved mortality of patients as a result of widespread use of ART is being offset by increasing death from CVD, cancer and liver diseases.[7]

A systematic review and meta-analysis showed the relative risk of CVDs to be 61% higher compared to non-infected individuals. This cardiovascular risk persisted even when patients are on ART.[8] With increasing life expectancy of patients, their prolonged exposure to environmental and behavioral risks, along with prolonged exposure to ART can contribute to developing CVDs.[8–10] Limited data on assessment of CVD risk factors in HIV infected people on ART from low-income countries exist.[7,11,12] The incidence of NCDs brings significant adverse economic impact and strains the fragile healthcare system.[13]

Data regarding prevalence of cardiovascular risk factors in HIV infected patients in Ethiopia are very scanty. Available evidence suggests hypertension to be a major challenge along with diabetes, lipodystrophy and metabolic syndrome (MetS) with possible contribution of type and duration of ART to CVD risks.[14–17] The prevalence of HIV in Ethiopia has shown a decline to 0.9%. However, this progress is being hampered by complacency towards preventative strategies.[18] According to a recent systematic review and meta-analysis, the pooled prevalence of CVD in the general Ethiopian population was 5%.[19] Therefore, it is imperative to assess the burden of CVD risk factors and determine their causes. This study aimed to fill the data gap regarding the prevalence and associated risk factors of cardiovascular risk factors in patients with HIV on ART in Ethiopian patients.

Methods
Study Design, Setting and Participants
A cross-sectional study was conducted on patients with HIV infection on ART at St. Paul's hospital millennium medical college (SPHMMC) HIV treatment clinic in Addis Ababa, Ethiopia. Patients from urban and rural communities have follow-up in the clinic. There is no integration of HIV follow-up with CVD care services. There are a total of 4685 patients on active follow-up at adult HIV treatment clinic, with average daily patients of 70. There are 2520 patients that are expected to visit the clinic over the data collection period of 6 weeks from January 6, 2020 to February 15, 2020. As to the authors' knowledge, despite previous studies reporting components of CVD risk factors, comprehensive assessment of CVD risk in HIV infected patients has not been reported.[5,14–17] Therefore, assuming a 50% of prevalence of cardiovascular risk factors, 5% margin of error and 95% confidence interval, a sample size of 384 was calculated. Adjusting for the finite size of the population using population correction formula, the final calculated sample size was 333 patients. To minimize sampling bias, selection of participants was done using systematic random sampling from routine ART clinic visit, with every seventh patient coming in the morning for follow-up invited to participate in the study. All patients above 18 years of age who were on ART for at least 6 months and gave written consent to participate were included and pregnant patients were excluded. Patients were considered to be on ART if they were taking medications for at least 6 months, which was used in the pervious studies.

Data Collection
Data was collected using an interview based on a structured questionnaire modified from the STEP wise approach of the World Health Organization (WHO) for NCD surveillance in developing countries.[20] The data collection had three parts. The first was interviewer administered questionnaires on socio-demographic characteristics and life style factors including tobacco and alcohol consumption, diet, prior history of CVD or risks, current ART regimen and previous ART regimen, if regimen was changed; followed by the second part consisting of anthropometric and blood pressure measurement. Data were collected by trained general practitioners. Finally, biochemical analysis was done to determine serum cholesterol and fasting blood glucose (FBG). Blood samples were collected after a 12-hour overnight fasting and analyzed with COBAS 6000 chemistry machine. CD4 count and viral load done in the previous 6 months were retrieved from patient follow-up charts.

Blood pressure was measured with patients sitting on a chair, relaxed for at 30 minutes and without recent ingestion of stimulants like caffeine using a manual sphygmomanometer. Measurement was repeated after at least 5 minutes and the average blood pressure measurement was taken. The diagnosis of hypertension was made in accordance with International Society of Hypertension Global Hypertension Practice 2020 Guidelines. High normal blood pressure was considered to be systolic blood pressure (SBP) 130–139 and/or diastolic blood pressure (DBP) 85–89 mm Hg, grade 1 hypertension was considered to be SBP 140–159 and/or DBP 90–99 and grade 2 was considered to be SBP ≥160 and/or DBP ≥100 mm Hg.[21] Individuals taking anti-hypertensive medications were also considered to have hypertension.

Body Mass Index (BMI) was considered normal if it was 18.5–24.9 kg/m^2, 25–29.9 kg/m^2 was considered overweight, 30–34.9 kg/m^2 was considered class I obesity, 35–39.9 kg/m^2 was considered class II obesity and above 40 was considered class III obesity. BMI <18.5 kg/m^2 was considered underweight.[22]

Waist circumference was measured in centimeters at the midpoint between the lower margin of the lowest palpable rib and top of iliac crest. Hip circumference was measured in centimeters at the widest portion of the buttocks with the tape being held snug around the body. Waist circumference of >94/80 cm (males/females) increased risk of metabolic complications, as did waist-hip ratio of ≥0.9/0.85 (males/females) and was the cutoff used in this study.[23]

Metabolic syndrome was defined according to National Cholesterol Education Program Adult Treatment Panel-III (NCEP-ATP III) that includes any three of: waist circumference >102 cm (Male), >88 cm (Female); triglyceride level ≥150 mg/dL or specific medications; low High density lipoprotein-cholesterol (HDL-C)<40 mg/dL and <50 mg/dL for men and women, respectively, or specific medications; blood pressure ≥130 mmHg systolic or ≥85 mmHg diastolic or specific medications; or FBG ≥100 mg/dL or previously diagnosed type 2 diabetes or specific medications.[24]

Cardiovascular risk was estimated using Framingham risk score (FRS). FRS is used to estimate projections of 10-year absolute CVD risk in patients above 20 years of age to identify patients who need intensive treatment and will benefit from it. Risk factors used in the score include age, total cholesterol, HDL cholesterol, blood pressure, and cigarette smoking. It divides patients into high, moderate and low risk based on 10-year risk of >20%, 10–20%, and <10%, respectively.[24] FRS is among the most commonly used scoring systems and has shown good agreement with other scoring systems. It has been studied in patients with HIV infection and hence used in this study.[6,7]

Data Analysis

Data were analyzed using Statistical Package for Social Sciences version 25. Data were summarized using percentages, mean, standard deviation (SD) and presented in tables and text. The independent Student's *t*-test was used to compare continuous variables and the Chi square and Fisher's exact test, when assumptions of chi-square test were not met, were used to compare categorical variables. These tests were used to make subgroup comparisons. Logistic regression was used to examine the association between cardiovascular risk and associated factors. Variables with P-value <0.2 in the univariate analysis were included in the multivariate logistic regression model. All variables with a p-value of <0.05 in the multivariate model were considered statistically significant. Little's test was done and missing data were missing completely at random. In addition, data with less than 80% response was not included as a covariate in the regression analysis. Pairwise exclusion of missing data was used during analysis to maximize available data. Furthermore, for logistic regression analysis, the minimum required responses to determine differences with 80% power, medium effect size (0.15), alpha significance level of 5% and use of up to 15 predictors calculated using G*Power was 139 responses.[25] This response was attained for variables considered in the regression analysis and therefore, pairwise exclusion of missing data did not affect adequacy of responses of the regression analysis.

Ethical Approval

This study was approved by the Institutional Review Board of SPHMMC with protocol number PM23/264. Written informed consent was obtained from all participants. Each participant's information was collected using anonymous questionnaire and the study was conducted according to the principles expressed in the Declaration of Helsinki.

Results

Demographics and Clinical Characteristics

A total of 333 HIV infected patients on ART participated in the study, out of which, 230 (69.1%) were female. The mean age (SD) of study participants was 45 (10.4) years, with the youngest participant being 19 and the oldest 83 years old. Male participants were relatively older than females with 87.2% of males compared to 61.2% of females being above 40 years (P < 0.001). The mean duration on ART was 10.07 (3.9) years with males being on ART for longer mean years than females (P = 0.012). The mean CD4 count (SD) was 579 cells/mm^3 (351) and ranged from 55 to 1477 cells/mm^3. Viral load was available in 75.4% of the

Table 1 Sociodemographic and Clinical Characteristics of Patients, SPHMMC, Addis Ababa, 2020

	Total	Male N (%)	Female N (%)
Age group			
≤39 years	98 (30.6%)	13 (12.9%)	85 (38.8%)
40–59 years	191 (59.7%)	74 (73.3%)	117 (53.4%)
≥60	31 (9.7%)	14 (13.9%)	17 (7.8%)
Missing	13 (3.9%)		
Marital status			
Never married	25 (8%)	13 (13.4%)	12 (5.6%)
Married	140 (44.7%)	64 (66%)	76 (35.2%)
Separated/divorced	67 (21.4%)	11 (11.4%)	56 (25.9%)
Widowed	81 (25.9%)	9 (9.3%)	72 (33.3%)
Missing	20 (6%)		
Education			
No education	54 (16.4%)	10 (9.8%)	44 (19.3%)
Primary school	138 (41.8%)	41 (40.2%)	97 (42.5%)
Secondary school	98 (29.7%)	32 (31.3%)	66 (29%)
College or higher	40 (12.1%)	19 (18.7%)	21 (9.2%)
Missing	3 (0.9%)		
CD4 count (cells/mm^3)			
< 200	18 (6.5%)	7 (8.3%)	11 (5.7%)
200–349	43 (15.5%)	9 (10.7%)	34 (17.6%)
350–499	61 (22%)	21 (25%)	40 (20.7%)
≥ 500	155 (56%)	47 (56%)	108 (56%)
Missing	56 (16.8%)		
Viral load (copies/mL)			
< 50	202 (80.8%)	64 (84.2%)	138 (79.3%)
≥ 50	48 (19.2%)	12 (15.8%)	36 (20.7%)
Missing	83 (24.9%)		
Current regimen			
TDF/3TC/EFV OR NVP	228 (69.3%)	68 (67.3%)	160 (70.2%)
AZT/3TC/EFV OR NVP	69 (21%)	22 (21.8%)	47 (20.7%)
TDF OR AZT/3TC/LPV/R	6 (1.8%)	4 (4%)	2 (0.9%)
Other	26 (7.9%)	7 (6.9%)	19 (8.3%)
Missing	4 (1.2%)		
Mean years since diagnosis	10.58 ± 3.9	11.18 ± 3.8	10.3 ± 3.8
Mean years on ART	10.07 ± 3.9	10.86 ± 3.8	9.69 ± 3.86

Abbreviations: 3TC, Lamivudine; ART, Anti-Retroviral Treatment; AZT, Zidovudine; EFV, Efavirenz; LPV, Lopinavir/ritonavir; NVP, Nevirapine; TDF, Tenofovir Disoproxil Fumarate.

participants and the mean of the most recent result was 4757 copies/mL (undetectable-272,719) with 74.5% having undetectable viral load and 80.9% having viral load below 50 copies/mL (Table 1).

Cardiovascular Risk Factors

Among the participants 31 (9.3%) have ever smoked cigarettes, out of which only 6 (1.8%) were still actively smoking. Participants were asked about their intakes of alcohol and 7 participants (2.1%) consumed alcohol in the last month. Only 3 individuals (0.9%) consumed WHO recommendations of five or more servings of fruits and/or vegetables per day on average.

Hypertension was more common in males (34.3%) compared to females (19.4%) (P = 0.004). Participants above the age of 40 years had hypertension records (29.5%) compared to those below 40 years of age (10%) (P = 0.001). Obese participants also had higher records of BP in the hypertensive range (P = 0.012). Patients on Zidovudine, Lamivudine and Nevirapine ART regimen had higher BP recording (P = 0.045) (Table 2).

Participants were asked if they had ever been told to have raised blood glucose or diabetes and 15 (4.5%) responded yes. Out the 15 patients, 5 patients were on Insulin, 5 were on oral anti-hyperglycemic agent and 8 responded that they were given lifestyle advice regarding their raised blood glucose. More participants, age 40 and older (41.9%) had FBG measurements ≥100 mg/dL compared to younger ones (25%) (P = 0.013). Patients on Efavirenz containing ART regimen had higher FBG compared to individuals on Nevirapine containing ART regimen (P < 0.001) (Table 2).

The mean (SD) BMI was 24.3 kg/m^2 (4.5) ranging from 13.3 to 40.5 kg/m^2. A total of 11.1% had obesity with 9.9% in class I, 0.9% in class II and 0.3% in class III range. Patients on Tenofovir Disoproxil Fumarate, lamivudine and Nevirapine regimen had higher proportion of obese participants (P < 0.001). Waist and hip circumference was measured in 32.1% of participants, out of which 10 (27.8%) of the males had waist circumference >94 cm and 2 (5.6%) had waist circumference above 102 cm. Female participants had higher waist circumference compared to males (P < 0.001) (Table 2).

Derangement of at least one of the four cholesterols was seen in 69.4% with individuals age 40 and older and obese participants having higher levels of abnormal lipid profile (P < 0.001 and P = 0.024, respectively). Patients on Atazanavir containing ART regimen (67.2%) had higher total cholesterol levels above 200 mg/dL compared to other regimens (48%) (P = 0.029). Out of the 82.6% of participants investigated for metabolic syndrome, older individuals >60 years had higher

Table 2 Anthropometric and Biochemical Characteristics of Patients, SPHMMC, Addis Ababa, 2020

	Total Mean ± SD	Male, Mean ± SD	Female, Mean ± SD
Weight (Kg)	62.9 ± 13.2	67.1 ± 14.1	61 ± 12.5
Height (cm)	161 ± 8.8	169 ± 8.4	157.4 ± 6.3
BMI (Kg/m^2)	24.3 ± 4.5	23.7 ± 4.3	24.6 ± 4.5
Waist circumference (cm)	91.7 ± 11.7	89.1 ± 10	93 ± 12.4
Hip circumference (cm)	98.2 ± 12.1	97.7 ± 10.5	98.4 ± 12.8
Waist to hip ratio	0.94 ± 0.1	0.94 ± 0.1	0.94 ± 0.1
Mean SBP (mmHg)	121.9 ± 19.1	126.3 ± 19.7	120.1 ± 18.6
Mean DBP (mmHg)	79.6 ± 11.1	81.7 ± 11	78.7 ± 11
Fasting blood glucose (mg/dl)	102.7 ± 57.1	104.9 ± 36	101.9 ± 64.4
Total cholesterol (mg/dl)	206.8 ± 45.8	204.2 ± 47.3	208 ± 45.2
Triglyceride (mg/dl)	152.3 ± 76.8	179.3 ± 97.7	141.1 ± 63.5
HDL-C (mg/dl)	58.4 ± 17.3	54.6 ± 18.5	60.3 ± 16.6
LDL-C (mg/dl)	127.9 ± 37.6	123.8 ± 39	129.6 ± 37

Abbreviations: DBP, Diastolic blood pressure; HDL-C, High density lipoprotein-cholesterol; LDL-C, Low density lipoprotein-cholesterol; SBP, Systolic blood pressure.

Table 3 Cardiovascular Risk Factors of Patients, SPHMMC, Addis Ababa, 2020

	Total	Male N (%)	Female N (%)
Blood pressure (mmHg)			
SBP <130 and/or DBP <85	210 (64.4%)	51 (51.5%)	159 (70%)
SBP 130–139 and/or DBP 85–89	38 (11.7%)	14 (14.1%)	24 (10.6%)
SBP 140–159 and/or DBP 90–99	55 (16.9%)	24 (24.2%)	31 (13.7%)
SBP ≥160 and/or DBP ≥100	23 (7.1%)	10 (10.1%)	13 (5.7%)
Missing	7 (2.1%)		
Current tobacco use			
Yes	6 (1.8%)	4 (3.9%)	2 (0.9%)
No	328 (98.2%)	99 (96.1%)	228 (99.1%)
Current Alcohol use			
Yes	7 (2.1%)	3 (2.9%)	4 (1.7%)
No	326 (97.9%)	100 (97.1)	226 (98.3%)
BMI (Kg/m^2)			
Underweight	28 (8.7%)	10 (10.1%)	18 (8.1%)
Normal	156 (48.4%)	57 (57.6%)	99 (44.4%)
Overweight	102 (31.7%)	22 (22.2%)	80 (35.9%)
Obese	36 (11.1%)	10 (10.1%)	26 (11.6%)
Missing	11 (3.3%)		
Waist circumference >94/80 in males/females (cm)			
Yes	68 (63.6%)	10 (27.8%)	58 (81.7%)
No	39 (36.4%)	26 (72.2%)	13 (18.3%)
Missing	226 (67.9%)		
Waist to hip ratio >0.9/0.85 in males/females			
Yes	85 (80.2%)	27 (77.1%)	58 (81.7%)
No	21 (19.8%)	8 (22.9%)	13 (18.3%)
Missing	227 (68.2%)		
Fasting blood glucose (mg/dl)			
Less than 100	199 (63.2%)	57 (60%)	142 (64.5%)
100–125	87 (27.6%)	27 (28.4%)	60 (27.3%)
≥126	29 (9.2%)	11 (11.6%)	18 (8.2%)
Missing	18 (5.4%)		
Total cholesterol >200 (mg/dl)			
Yes	166 (52.4%)	51 (51.5%)	115 (52.8%)

(*Continued*)

Table 3 (Continued).

	Total	Male N (%)	Female N (%)
No	151 (47.6%)	48 (48.5%)	103 (47.2%)
Missing	16 (4.8%)		
Triglyceride >150 (mg/dl)			
Yes	120 (37.3%)	50 (50.5%)	70 (31.4%)
No	202 (62.7%)	49 (49.5%)	153 (68.6%)
Missing	11 (3.3%)		
HDL-cholesterol <40 (mg/dl)			
Yes	34 (10.7%)	17 (17.2%)	17 (7.7%)
No	285 (89.3%)	82 (82.8%)	203 (92.3%)
Missing	14 (4.2%)		
LDL-cholesterol >130 (mg/dl)			
Yes	140 (44.4%)	35 (35.7%)	105 (48.4%)
No	175 (55.6%)	63 (64.3%)	112 (51.6%)
Missing	18 (5.4%)		
Metabolic syndrome			
Yes	63 (22.9%)	20 (25.6%)	43 (21.8%)
No	212 (77.1%)	58 (74.4%)	114 (78.2%)
Missing	58 (17.4)		
Framingham risk score			
<10%	281 (95.9%)	82 (87.2%)	199 (100%)
10–20%	11 (3.8%)	11 (11.7%)	-
>20%	1 (0.3%)	1 (1.1%)	-
Missing	40 (12%)		

Abbreviations: BMI, Body mass index; DBP, Diastolic blood pressure; HDL-C, High density lipoprotein-cholesterol; LDL-C, Low density lipoprotein-cholesterol; SBP, Systolic blood pressure; WHO, World health organization.

prevalence (P = 0.034). It was also seen more frequently in obese individuals (P = 0.016). FRS was able to be calculated in 293 of the participants and was in the low risk in 95.9% (Table 3).

Cardiovascular risk factors had no difference among patients with different groups of CD4 counts and viral load. No change in the risk factors was seen with increasing duration of diagnosis.

Predictors of CVD Risk Factors

After controlling for other variables, being a male increased the odds of having hypertension by 2.7 times (95% CI, 1.37–5.59). Being in the higher age group (≥40) increased the odds of having hypertension and dyslipidemia by 2.5 times (95% CI, 1.11–5.68) and 3.61 times (95% CI, 1.95–6.72), respectively. Being obese increased the risk of having hypertension and metabolic syndrome by 13.8 (95% CI, 2.29–83.17) times and 12 times (95% CI, 1.28–115.5), respectively, while being overweight increased the risk of having dyslipidemia by 3.67 fold (95% CI, 1.3–10.1). Previous ART regimen being Tenofovir Disoproxil Fumarate, lamivudine and Nevirapine increased the odds

Table 4 Multivariate Logistic Regression Analysis of Factors Associated with CVD Risk Factors, SPHMMC, Addis Ababa, 2020

	Crude OR	95% CI	P-value	Adjusted OR	95% CI	P-value
Hypertension						
Age group			0.006			0.049*
<40	1 (R)			1 (R)		
40–59	3.63	1.62–8.13	0.002	2.52	1.11–5.68	0.027*
≥60	3.64	1.17–11.28	0.025	3.59	1.08–11.95	0.037*
Male gender	0.41	0.23–0.73	0.003	2.767	1.37–5.59	0.005*
BMI			0.091			0.022*
Underweight	1 (R)			1 (R)		
Normal	3.12	0.69–14	0.138	4.06	0.84–19.72	0.082
Overweight	3.53	0.77–16.24	0.105	5.26	1.02–27.05	0.047*
Obese	6.95	1.15–31.23	0.019	13.79	2.29–83.17	0.004*
Previous ART regimen	4.13	1.71–9.93	0.005	1.14	0.23–5.76	0.538
Current ART regimen	2.46	1.11–5.44	0.144	1.21	0.33–4.4	0.436
Elevated blood glucose						
Age			0.015			0.056
<40	1 (R)			1 (R)		
40–59 years	2.08	1.2–3.6	0.009	2.34	1.16–4.7	0.017
≥60	2.79	1.15–6.75	0.023	2.13	0.71–6.4	0.179
Elevated LDL cholesterol	1.79	1.08–2.98	0.024	0.85	0.4–1.83	0.683
Elevated total cholesterol	2.07	1.24–3.46	0.006	2.15	0.97–4.77	0.061
Current ART regimen	0.25	0.11–0.6	0.001	0.32	0.11–0.96	0.092
Previous ART regimen	0.49	0.2–1.21	0.194	0.37	0.6–2.24	0.68
CD4 count	0.32	0.08–1.25	0.09			0.148
<200	1 (R)			1 (R)		
200–349	0.44	0.13–1.47	0.183	0.28	0.07–1.2	0.087
350–499	1.41	0.48–4.17	0.53	0.86	0.23–3.2	0.819
≥ 500	1.06	0.39–2.89	0.91	0.68	0.19–2.4	0.550
Dyslipidemia						
Age group			<0.001			<0.001*
<40	1 (R)			1 (R)		
40–59 years	3.08	1.76–5.38	<0.001	3.61	1.95–6.72	<0.001*
≥60	2.4	0.91–6.33	0.077	2.45	0.86–7.01	0.094
Hypertension	1.54	0.8–2.95	0.193	1.06	0.5–2.28	0.873

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Table 4 (Continued).

	Crude OR	95% CI	P-value	Adjusted OR	95% CI	P-value
BMI			0.031			0.044*
Underweight	1 (R)			1 (R)		
Normal	1.29	0.54–3.06	0.565	1.53	0.6–3.9	0.375
Overweight	3.06	1.19–7.86	0.02	3.67	1.3–10.1	0.014*
Obese	1.75	0.57–5.32	0.327	2	0.58–6.86	0.277
Elevated blood glucose	1.2	0.66–2.17	0.036	1.13	0.59–2.17	0.097
Obesity						
Age			0.761			0.941
<40	1 (R)			1 (R)		
40–59 years	1.34	0.62–2.94	0.998	1.18	0.47–2.98	0.727
Hypertension	2.32	1.03–5.18	0.041	2.1	0.85–5.23	0.11
Previous ART regimen (TDF + 3TC + NVP)	9.05	3.01–27.23	<0.01	7.88	2.55–24.32	<0.001*
Metabolic syndrome						
Age			0.039			0.051
<40	1 (R)			1 (R)		
40–59 years	2.43	1.2–4.91	0.013	2.04	0.87–4.78	0.101
≥60	2.61	0.89–7.61	0.079	5	1.31–19.03	0.018
CD4 count			0.199			0.187
<200	1 (R)			1 (R)		
200–349	0.2	0.04–0.99	0.049	0.15	0.03–0.85	0.032
350–499	0.76	0.21–2.72	0.672	0.53	0.13–2.12	0.372
≥ 500	0.64	0.2–2.04	0.455	0.53	0.15–1.83	0.315
BMI			0.05			0.029*
Underweight	1 (R)			1 (R)		
Normal	4.55	0.58–35.7	0.15	4.02	0.49–32.68	0.194
Overweight	8.24	1.04–65.37	0.046	9.35	1.13–77.54	0.038*
Obese	11.2	1.26–99.26	0.03	12.17	1.28–115.5	0.03*

Note: *P-value <0.05.
Abbreviations: 3TC, Lamivudine; BMI, Body mass index; CD4, Cluster of differentiation 4; NVP, Nevirapine; OR, odds ratio; R, Reference; TDF, Tenofovir Disoproxil Fumarate.

of being obese by 7.9 times (95% CI, 2.55–24.32) compared to other regimens. Elevated FBG had no relation with sociodemographic or clinical characteristics. The severity of infection did not contribute significantly to CVD risk factors (Table 4).

Discussion

The prevalence of CVD risks was high in the studied population with 69.4% having dyslipidemia, 36.8% abnormal fasting blood glucose, 23.8% hypertension, 22.8% metabolic syndrome and 11.1% having obesity.

Active smoking among our participants was seen in only 1.8%, with similar rates from studies in different parts of Ethiopia, Nigeria and Malawi.[7,15,26–29] The low prevalence of smoking in general Ethiopian population of 3.21%, the lower smoking habit of females in the country and inclusion of more females in this study can justify why only a handful of current smokers participated.[30] A study from Malawi reported that very low number of participants consumed the WHO recommended amount of fruits and vegetables similar to our study possibly resulting from resource limitation.[29]

The prevalence of hypertension was 23.8%. Previous studies done in SSA countries showed prevalence ranging from as low as 8.7% in Kenya to as high as 45.9% in Malawi.[31–34] There is also a wide range of findings in previous studies in Ethiopia from 12.7% to 34.3%.[5,15,16,26–28,35] Advancing age seems to be a risk for developing hypertension.[5,26,28,31–33] Although not consistent in all studies, males and obese individuals tend to have hypertension more frequently.[5,26,28,32,33] The difference in prevalence could be explained by the differences in criteria for defining hypertension, socio-economic status, age, life style habits, duration of HIV infection, race, type of ART and study methodology. Awareness regarding hypertension needs to be increased and future studies that evaluate the effectiveness and feasibility of screening and life style modification in HIV infected population should be done.

Our study showed higher magnitude of elevated FBG of >125 mg/dL of 9.2% compared with previous studies, which ranged from 5% in Thailand to 8.8% from Ethiopia.[5,13,16,17,27,28,35–37] Studies from Senegal and Tanzania showed higher rates of 14.5% and 18%, respectively.[38,39] Impaired fasting glucose (IFG) was seen in 27.6% which was also higher than previous findings of 14% to 19.6% in Ethiopia and Tanzania.[16,17,39] Our study included only a one-time measurement of FBG. In addition, Glycated hemoglobin testing was not used due to unavailability of the test in the hospital at the time of data collection. In addition, the variation in the populations studied, differences in age, lifestyle habits and ART could explain the varying findings. The high magnitude of IFG is a potential precursor to diabetes and indicates the risk of having diabetes and CVD in the future. Patients were not aware of their abnormal FBG tests and screening asymptomatic patients is recommended to prevent adverse outcomes.[17,35]

Obesity in our study was seen in 11.1%. There is a large variation in obesity prevalence in HIV infected population, with as high as 16.6% in Botswana to 17.5% in United States have been seen.[40,41] Studies from SSA, France and Brazil show prevalence of 2% to 13.1%.[13,15,32,35,36,42–44] The studies were done in different countries on different population groups with different prevalence of obesity. Our study revealed Tenofovir Disoproxil Fumarate, lamivudine and Nevirapine regimen to be a risk for obesity, which needs to be substantiated in future studies. Weight gain is a possible occurrence after initiation of ART and is potentially associated with reduced mortality in underweight individuals. It, however, is offset by the associated increase in diabetes and CVD, and therefore needs follow-up and advice.[45,46]

Dyslipidemia was seen in 69.4%. Studies from Nigeria, Brazil, Greece have reported prevalence of 29.1% to 46.3% while other studies from Ethiopia have reported higher rates ranging from 48.2% to 90.2%.[13,14,35,47–50] There is a difference regarding the cutoffs for abnormal values, differences in gender, age and proportion of patients taking protease inhibitor (PI) containing regimen. Increasing BMI along with advancing age were found to be predictors of dyslipidemia, which is supported by previous studies.[13,49,50] Our study revealed more dyslipidemia than some comparative studies which show that risk of future cardiovascular disease with increasing age and longevity is high and needs urgent preventative measures.[49]

Metabolic syndrome was seen in 22.9%, higher prevalence compared to previous findings ranging from 6.2% to 21.1%.[6,9,14,41] Studies from Democratic Republic of Congo and Uganda found it to be a high burden problem with prevalence of 27%, and 58%, respectively.[51,52] Higher BMI was the main driver behind MetS in this study, also supported by previous reports.[9,41] The differences in the prevalence could have resulted from differences in study design, patient populations, criteria used to define MetS, variation of ART regimen, particularly PIs, and variation in the prevalence of components of MetS.

Almost all of our participants were having FRS of either low or moderate risk. Previous studies also found patients in high-risk group to be low. For instance, studies from Uganda and Malawi showed high or moderate FRS risk of 2.4% and 3.6%, respectively.[29,52] CVD risk profiles have good estimation of risk of likelihood of development of stroke and myocardial infarction in HIV patients in Europe and North America.[52] However, translating those findings into SSA still remains unproven, as the available data are mainly cross-sectional studies.[52] It is yet to be confirmed if risk scores determine the likelihood of developing CVD morbidity or mortality accurately in HIV infection, as HIV specific factors such as immunity status and lipodystrophy are not taken into account.[52,53]

Integrating HIV care to NCD has been recommended to be a solution to avert the burden of CVDs, including adding NCD care to HIV clinics. This can help with disease prevention and health promotion. It can lead to increased detection of CVDs which need timely care, potentially improving patient outcome. This could potentially be one solution to the growing problem of NCDs in developing countries and its benefits need to be studied further.[13]

There are certain limitations to our study. The cross-sectional nature of the study makes it difficult to draw definitive conclusions between CVD risks and contributing factors. Only a single record of blood glucose was done and glycated hemoglobin was not assessed, which made the diagnosis of diabetes difficult. In addition, accuracy of FRS in SSA is uncertain and future studies that validate appropriate risk scores in similar settings are needed. Regardless of these limitations, our study provided a comprehensive assessment of CVD risk factors with a large number of participants.

Conclusions

High burden of CVD risk factors was seen. CVD risk factors were independently associated with male gender, increasing age, obesity, and the type of ART patient was taking previously. The high prevalence of these risks should be recognized as it can lead to future development of cardiovascular disease. Patients should have timely follow-up and care. Health-care workers and policy makers should be aware of the high burden of these risk factors. Future well-controlled and prospective studies need to be done to further determine the effect of HIV on cardiovascular disease. The benefits and feasibility of screening and lifestyle modifications should be assessed in HIV infected population in future studies.

Supplementary Materials

Supplementary Material including the data collection questionnaire are available from the corresponding author on reasonable request.

Data Sharing Statement

The datasets used in this study are available from the corresponding author on reasonable request.

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Disclosure

All authors declare that they have no conflicts of interest regarding this work.

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