Original Research Article

JRSM Cardiovascular Disease
Volume 11: 1–13

DOI: 10.1177/20480040221114651
journals.sagepub.com/home/cvd
SAGE

Dyslipidemia and associated cardiovascular risk factors in HIV-positive and HIV-negative patients visiting ambulatory clinics: A hospital-based study

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Abstract

Background: Dyslipidemia is a well-known risk factor for cardiovascular disease (CVD), accounting for more than half of all instances of coronary artery disease globally (CAD).

Purpose: The purpose of this study was to determine lipid-related cardiovascular risks in HIV-positive and HIV-negative individuals by evaluating lipid profiles, ratios, and other related parameters.

Methods: A hospital-based study was carried out from January 2019 to February 2021 in both HIV + and HIV- ambulatory patients.

Results: High TG ($p = .003$), high TC ($p = .025$), and low HDL ($p < .001$) were all associated with a two-fold increased risk of CVD in people aged 45 and up. Due to higher TG ($p < .001$) and lower HDL ($p < .001$), males were found to have a higher risk of atherogenic dyslipidemia. A twofold increase in the likelihood of higher TG levels has been associated with smoking ($p = .032$) and alcohol intake ($p = .022$). A twofold increase in a high TC/HDL ratio and an elevated TG/HDL ratio was observed with an increase in waist-to-height ratio ($p = .030$) and a high level of FBS (126 mg/dl) and/or validated diabetes ($p = .017$), respectively. In HIV + participants, central obesity ($p < .001$), diabetes ($p < .001$), and high blood pressure ($p < .001$) were all less common than in HIV- participants.

Conclusions: Dyslipidemia is linked to advanced age, male gender, diabetes, smoking, alcohol consumption, and increased waist circumference, all of which could lead to an increased risk of CVD, according to the study. The study also revealed that the risks are less common in HIV + people than in HIV-negative ambulatory patients.

Keywords

Dyslipidemia, Cardiovascular risks, Ambulatory patients

Received: 25 December 2021; Revised: 29 June 2022; accepted: 3 July 2022

Introduction

Dyslipidemia is a well-known risk factor for cardiovascular disease (CVD), accounting for more than half of all instances of coronary artery disease (CAD) globally.[1] The mechanism of atherosclerosis that leads to CVD is difficult to diagnose before the appearance of serious clinical outcomes such as CVD-related death, myocardial infarction (MI), or stroke.[2] Several studies have found a wide number of CVD risk variables, which can be split into non-modifiable risk factors like age and gender and modifiable risk factors including smoking, blood pressure (BP), and diabetes mellitus (DM).[3] Because low-density lipoprotein cholesterol (LDL-C) is the principal cholesterol-carrying lipoprotein and is believed to be the main atherogenic lipoprotein,[4] its levels are optimized in primary and secondary prevention measures to minimize cardiovascular risks.[5] Other lipoproteins, such as high-density lipoprotein cholesterol (HDL-C) or very-low-density lipoprotein (VLDL), have also been found to have a role in atherogenesis on multiple occasions.[6–8]

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Excessive weight gain, such as for overweight & obesity, has emerged as a major global health concern,[9] increasing the risk of DM and CVD.[10,11] Despite this link, there are obese patients without metabolic abnormalities known as "metabolically healthy obese" (MHO), as well as normal-weight patients with metabolic abnormalities known as "metabolically unhealthy normal weight" (MUH-NW).[12–15] Individuals of normal weight who are at an increased risk of metabolic illnesses such as type 2 diabetes (T2DM) are classified as MUH-NW. MHO is usually diagnosed based on normal glucose and lipid metabolism indicators, as well as the absence of hypertension (HTN), whereas MUH-NW are individuals of normal weight who are at an elevated risk of metabolic illnesses such as DM and HTN.[16,17]

Waist circumference (WC) and waist-to-height ratio (WHtR), in addition to BMI, can be utilized as surrogate biomarkers of body fat centralization and cardiovascular risks.[18] Finding risk variables to target to avoid or minimize mortality risk has thus become vital, even in people of normal weight.[15,19,20] However, there are no universally accepted standards for establishing whether or not someone is metabolically healthy.[20]

In clinical investigations, hyperinsulinemia or insulin resistance (IR) and carotid intima-media thickness (CIMT) are widely utilized biomarkers for predicting lipid-associated cardiovascular risk.[21,22] Nonalcoholic fatty liver disease (NAFLD) is also connected to IR, hyperglycemia, and T2DM.[23,24] To predict and diagnose a wide range of lipid-related risks, a variety of biomarkers, both specific and non-specific, can be utilized and are available.[25,26] For many patients, reliable measurement of several techniques in clinical practice is difficult or impossible due to a variety of factors.[27] The use of simple rapid tests to establish lipid profiles is gaining popularity due to its cost-effectiveness and time-saving capabilities.[15,28,29] Even if disparities in discriminating power among populations, as well as variations in rapid test cut-off points, remained an issue.[15]

HIV-positive people are known to have an increased risk of cardiovascular disease (CVD) for a variety of reasons, including pathophysiology and the use of antiretroviral therapy (ART). However, this risk, which is prevalent in people living with HIV/AIDS (PLWHA), must be compared to other people with chronic conditions and who are not using ART drugs. As a result, the goal of this study was to determine lipid-related cardiovascular risks in HIV-positive compared to HIV-negative individuals by evaluating lipid profile patterns, ratios, and other related parameters.

Methods

Study design, period, and setting

Patients visiting the HIV and adult ambulatory clinics of Zewditu Memorial Hospital (ZMH), Addis Ababa, Ethiopia, were studied in a hospital-based observational study from January 25, 2019, to February 25, 2021. This institution has been at the forefront of establishing and launching ART therapy services in Ethiopia since 2003.[30] In addition to HIV counseling and testing, sexually transmitted infection services, and post-exposure prophylaxis treatments, it offers various clinical services and palliative care to the general public. As a general hospital, it provides a wide range of services through its clinics, departments, and wards. Every month, ZMH serves approximately 1163 HIV-positive patients and over 3000 HIV-negative patients.

Study population

The source population consisted of patients who came to ZMH for treatment of HIV and other chronic illnesses. Patients who met the study's inclusion criteria made up the study's population.

Inclusion and exclusion criteria

Inclusion criteria. The study included all patients who were 18 years or older, had at least three appointments completed, and were willing to participate.

Exclusion criteria. During the cohort period, severely unwell patients, and pregnant and breastfeeding women were excluded. Patients with HIV who went to ambulatory clinics for reasons other than ART were also excluded so as to avoid double entry.

Sample size determination and sampling technique

The following sample size estimation of independent cohort studies was used to calculate the sample size for the study population.[31]

$$n = \frac{\left[Z_{1-\alpha/2}\sqrt{(1+1/m)p^*(1-p)} + Z_{1-\beta}\sqrt{p_0^*(1-p_0/m)p_1(1-p_1)}\right]^2}{(p_0-p_1)^2}$$

The sample size was calculated using a two-sided significance criterion (1-alpha) of 95%, a power (1-beta, percent probability of detecting) of 80%, a ratio of Unexposed/Exposed = 1, and a percentage of Exposed with Outcome of 11.3%.[32] A sample size of (n = 620) determined with 10% contingency for (n = 320) HIV-positive and the rest (n = 300) HIV-negative group. The baseline sample size was complete for (n = 510) participants comprising 288 HIV + and 222 HIV-negative patients. To enroll study participants, a systematic random sampling technique was adopted.

Data collection

Laboratory testing, clinical examinations and measurements, patient interviews, and chart reviews were used to gather detailed information about the participants. The structured questionnaire employed by the WHO stepwise method for non-communicable disease risk factor surveillance was adapted for a face-to-face interview (STEPS-2014).[33] The questionnaire asks about age, religion, civil status, address, educational level, occupation, monthly income, substance use (tobacco, alcohol, coffee, Khat plant use), and use of any prescription and non-prescription medications. Height and weight (body mass index/ BMI), waist circumferences (WC), blood pressure (BP), fasting blood sugar (FBS), and lipid profile were determined through a physical examination and laboratory tests.

Study procedure

All participants in this study were classified as HIV + if they were registered at an ART clinic for follow-up treatment, and HIV-negative if they were registered at an adult ambulatory clinic for follow-up care and tested negative for HIV within the last 6 months.

Borderline, high, and very high cholesterol values were frequently used to mark severity and classify treatment options considering bad cholesterol.[34] Low and very low were terms that were used to describe good cholesterol, and high-density lipoprotein (HDL).[35,36]

Dyslipidemia[37] is defined when one or more of the following are present in both males and females aged 19 and up. 1. Total cholesterol (TC) $\geq$ 240 mg/dl; 2. non-high-density lipoprotein (non-HDL-C) $\geq$ 130; 3. Low density lipoprotein (LDL) $\geq$ 160 mg/dl; 4. TG $\geq$ 201 mg/dL in both males (M) and females (F) aged 19 and up, and 5. When HDL-C <40 mg/dL (M) or <50 mg/dL (F).

The following Cholesterol Ratios to Predict CVD were employed. 38 1. Waist circumference: Overweight: >94 cm (M); >80 cm (F); Obesity: >102 cm (M); >88 cm (F). 2. Waist to height ratio: Overweight: 0.53 to 0.89 (M) & 0.49 to 0.84 (F); Obesity: ≥0.90 cm (M); ≥0.85 cm (F). 3. TC/HDL-C ratio: Ideal: Less than 3.5 (M) < 3.0 (F); Moderate: 3.5 to 5.0 (M) 3.0 to 4.4 (F); High: More than 5.0 (M) > 4.4 (F). 4. LDL-C/HDL-C ratio: Ideal, less than 2.5; Moderate, 2.5 to 3.3; High, more than 3.3. 5. HDL/LDL ratio: Ideal, more than 0.4; Moderate, 0.4 to 0.3; High, less than 0.3. 6. TG/HDL ratio: Ideal: Less than 3.5 (M) < 3.0 (F); Moderate: 3.5 to 5.0 (M) 3.0 to 4.4 (F); High: More than 5.0 (M) > 4.4 (F).

Instruments

Omron HEM 7203 was used to measure BP (Omron Healthcare Co. Ltd, Kyoto, Japan). The devices were calibrated regularly to ensure correct validation. The accuracy of the devices was also tested using a Mercury sphygmomanometer. Before taking measurements, an appropriate BP arm cuff in suitable sizes was applied. Before BP measures, participants were allowed to sit and relax for 5 min without talking, with their legs uncrossed and their arms supported at heart level. The mean of three BP readings taken from the right arm with a 5-min interval was used for analysis.[38,39] SIEMENS (Dimension EXL 200 Integrated Chemistry System), Omnia Health (CS-T240 Auto-Chemistry Analyzer), and LipidPlus® were used to examine lipid profiles and glucose levels.

Data analysis

IBM statistics software version 25 for Windows was used to code, double-enter, and analyze the data. All categorical characteristics were categorized as 0 or 2 (for females with no responses and HIV-negative) or 1 (for males with yes responses and HIV +). The dependent variables were coded as dichotomous measurements (low-risk was coded as '0 or 2' and 'Moderate to high-risk' was coded as '1').

To present sociodemographic data, incidence, and prevalence data, descriptive statistics were used. The connections of predictors with the outcome variables were determined using logistic regression analysis. To control the effect of confounders, independent variables with a p-value of 0.20 in the bivariate logistic regression were incorporated into multivariate logistic regression. Statistical significance was defined as a 95% confidence interval and a p-value of less than 0.05.

Results

General characteristics of study participants

When compared to participants younger than 45 years old, those aged 45 and more were twice as likely to have high TG ($p = .003$), high TC ($p = .025$), and low HDL ($p < .001$). Males were 2 times as likely as females to have high TG ($p < .001$) and 6 times as likely to have low HDL-C ($p < .001$).

Table 1. The socio-demographic characteristics of participants based on triglycerides, total cholesterol, and high-density lipoprotein cholesterol distribution at the zewditu memorial hospital in Addis Ababa, Ethiopia, 2021.

Characteristics		Triglycerides (mg/dl)		OR (95%CI)	P. value	Total cholesterol (mg/dl)		OR (95%CI)	P. value	HDL-C (mg/dl)		OR (95%CI)	P. value
		≥ 201 n (%)	<201			≥ 240 n (%)	Else n (%)			<40 (M) or <50 (F) n (%)	Else n (%)		
Age	≥45	103 (81.7)	259 (67.4)	2.161 (1.311, 3.563)	.003	63 (81.8)	299 (69.1)	2.017 (1.092, 3.726)	.025	158 (81.4)	204 (64.6)	2.410 (1.569, 3.701)	<.001
	<45	23 (18.3)	125 (32.6)			14 (18.2)	134 (30.9)			36 (18.6)	112 (35.4)		
Gender	Male	70 (55.6)	143 (37.2)	2.107 (1.401, 3.167)	<.001	32 (41.6)	181 (41.8)	.990 (.605, 1.619)	.968	135 (69.6)	78 (24.7)	6.982 (4.686, 10.402)	<.001
	Female	56 (44.4)	241 (62.8)			45 (58.4)	252 (58.2)			59 (30.4)	238 (75.3)		
Civil status	Married	64 (50.8)	191 (49.7)	1.043 (.697, 1.560)	.873	37 (48.1)	218 (50.3)	.912 (.562, 1.482)	.711	106 (54.6)	149 (47.2)	1.350 (.943, 1.933)	.101
	Else[a]	62 (49.2)	193 (50.3)			40 (51.9)	215 (49.7)			88 (45.4)	167 (52.8)		
Edu. status	College & above	48 (38.1)	128 (33.3)	1.231 (.811, 1.868)	.330	31 (40.3)	145 (33.5)	1.339 (.814, 2.201)	.520	77 (39.7)	99 (31.3)	1.443 (.993, 2.095)	.054
	Else[b]	78 (61.9)	256 (66.7)			46 (59.7)	288 (66.5)			117 (60.3)	217 (68.7)		
Address	Kirkos	49 (39.2)	141 (37.0)	1.097 (.725, 1.662)	.661	31 (40.8)	159 (37.0)	1.174 (.714, 1.931)	.527	79 (41.1)	111 (35.4)	1.279 (.884, 1.849)	.192
	Else[c]	76 (60.8)	240 (63.0)			45 (59.2)	271 (63.0)			113 (58.9)	203 (64.6)		
Income	≥50USD	68 (54.0)	204 (53.1)	1.034 (.691, 1.549)	.869	40 (51.9)	232 (53.6)	.937 (.576, 1.522)	.791	107 (55.2)	165 (52.2)	1.126 (.786, 1.611)	.518
	<50USD	58 (46.0)	180 (46.9)			37 (48.1)	201 (46.4)			87 (44.8)	151 (47.8)		
FH	Yes	29 (23.0)	81 (21.1)	1.115 (.688, 1.805)	.659	18 (23.4)	92 (21.3)	1.127 (.634, 2.005)	.683	42 (21.6)	68 (21.6)	1.004 (.650, 1.550)	.987
	No	97 (77.0)	302 (78.9)			59 (76.6)	340 (78.7)			152 (78.4)	247 (78.4)		
TM	Yes	17 (13.5)	37 (9.7)	1.458 (.790, 2.693)	.285	12 (15.6)	42 (9.7)	1.714 (.857, 3.429)	.128	19 (9.8)	35 (11.1)	.869 (.482, 1.566)	.639
	No	109 (86.5)	346 (90.3)			65 (84.4)	390 (90.3)			175 (90.2)	280 (88.9)		
Smoker	Yes	15 (11.9)	23 (6.0)	2.115 (1.067, 4.193)	.032	3 (3.9)	35 (8.1)	.460 (.138, 1.534)	.206	20 (10.3)	18 (5.7)	1.903 (.980, 3.695)	.057
	No	111 (88.1)	361 (94.0)			74 (96.1)	397 (91.9)			174 (89.7)	298 (94.3)		
Alcohol	Yes	28 (22.2)	52 (13.6)	1.819 (1.090, 3.034)	.022	6 (7.8)	74 (17.1)	.409 (.171,.976)	.044	38 (19.6)	42 (13.3)	1.583 (.979, 2.561)	.061
	No	98 (77.8)	331 (86.4)			71 (92.2)	358 (82.9)			156 (80.4)	273 (86.7)		
Coffee consumption	Yes	85 (67.5)	240 (62.7)	1.235 (.807, 1.892)	.331	48 (62.3)	277 (64.1)	.926 (.561, 1.529)	.764	125 (64.4)	200 (63.5)	1.042 (.717, 1.512)	.830
	No	41 (32.5)	143 (37.3)			29 (37.7)	155 (35.9)			69 (35.6)	115 (36.5)		
Khat chewing	Yes	8 (6.3)	20 (5.2)	1.231 (.528, 2.867)	.631	3 (3.9)	25 (5.8)	.660 (.194, 2.242)	.505	11 (5.7)	17 (5.4)	1.054 (.483, 2.300)	.896
	No	118 (93.7)	363 (94.8)			74 (96.1)	407 (94.2)			183 (94.3)	298 (94.6)		
HIV-status	HIV +	69 (54.8)	219 (57.0)	.912 (.608, 1.367)	.656	41 (53.2)	247 (57.0)	.858 (.527, 1.395)	.536	107 (55.2)	181 (57.3)	.917(.640, 1.315)	.639
	HIV-	57 (45.2)	165 (43.0)			36 (46.8)	186 (43.0)			87 (44.8)	135 (42.7)		

n = 510 (288 (HIV +), 222 (HIV-)); a: includes Widowed/er, divorced, and never married; b: includes illiterate, primary, secondary, and high schoolers; c: includes Gulelle, Arada, Kolfe, Addis Ketema, Nefas Silk Lafto, Lidetea, Yeka, Bole, and Akaki Kality; OR: is according to Mantel-Haenszel OR estimate (95%CI). FH, family history of cardiometabolic diseases.

Smokers (p = .032) and alcoholics (p = .022) had twice the amount of high TG as non-smokers and non-alcoholics, respectively. Those who consumed alcohol, on the other hand, were less likely to have high TC (p = .044) than those who were not. Other factors like civil status, family history, and HIV status had no significant impact on the specific dyslipidemias. Details are shown in Table 1.

When it came to the TC/HDL-C ratio, the male gender was less likely to be associated with a moderate to a high level of TC/HDL ratio (p < .001), whereas WHtR (p = .030), and high FBS and/or confirmed DM (p = .017) were two-fold more likely to be associated with an elevated TC/HDL ratio after correcting for the confounders. Other variables such as MUH-NW and

Table 2. Total cholesterol to high-density lipoprotein cholesterol ratio among participants at the zewditu memorial hospital in Addis Ababa, Ethiopia, 2021.

	TC/HDL ratio					
Description	Moderate to high	Normal	COR (95% CI)	*P*. value	AOR (95% CI)	P value
Age ≥45 years						
>/ = 40	264 (73.7)	98 (64.5)	1.548 (1.030, 2.325)	.036	1.345 (.842, 2.148)	.215
<45	94 (26.3)	54 (35.5)				
Gender (M)						
Male	131 (36.6)	82 (53.9)	.493 (.335,.724)	<.001	.468 (.304,.720)	.001
Female	227 (63.4)	70 (46.1)				
Civil status						
Married	171 (47.8)	84 (55.3)	.740 (.506, 1.084)	.122	.690 (.459, 1.037)	.074
Else	187 (52.2)	68 (44.7)				
Edu						
College & above	120 (33.5)	56 (36.8)	.864 (.582, 1.284)	.471		
Else	238 |(66.5)	96 (63.2)				
Monthly income						
>/ = 50 USD	193 (53.9)	79c (52.0)	1.081 (.739, 1.581)	.688		
<50 USD	165 (46.1)	73 (48.0)				
Family history						
Yes	81 (22.7)	29 (19.1)	1.963 (1.256, 2.000)	.366		
No	235 (65.6)	120 (78.9)				
Central Obesity						
WC >35′ (F) 0r ≤ 40' (M)	125 (34.9)	22 (14.5)	3.170 (1.920, 5.234)	<.001	1.478 (.803, 2.723)	.210
WC ≤ 35′ (F) 0r >40′ (M)	233 (65.1)	130 (85.5)				
BMI						
Over-weight & Obesity	113 (31.6)	27 (17.8)	2.135 (1.332, 3.423)	.002	1.283 (.764, 2.154)	.346
Normal-BMI	245 (68.4)	125 (82.2)	1			
High FBS or Confirmed DM						
FBS ≥ 126 mg/dl or DM	113 (31.6)	27 (17.8)	2.135 (1.332, 3.423)	.002	1.739 (1.052, 2.875)	.031
FBS < 126 mg/dl or No DM	245 (68.4)	125 (82.2)				
SBP >120 & DBP>80 or HTN						
Pre-HTN and HTN	214 (59.9)	71 (46.7)	1.707 (1.165, 2.503)	.006	1.473 (.960, 2.261)	.076
Normal BP	143 (40.1)	81 (53.3)				
MUH_NW						
Yes	224 (62.6)	100 (65.8)	.869 (.584, 1.294)	.490		
Else	134 (37.4)	52 (34.2)				
MHO						
Yes	87 (24.3)	30 (19.7)	1.306 (.819, 2.082)	.263		
Else	271 (75.7)	122 (80.3)				
WHtR						
>.50	248 (69.3)	74 (48.7)	2.376 (1.610, 3.508)	<.001	1.676 (1.052, 2.669)	.030
Else	110 (30.7)	78 (51.3)				
HIV status						
HIV +	202 (70.1)	86 (29.9)	.994 (.678, 1.457)	.974		
HIV-	156 (70.3)	66 (29.7)				

Moderate to high, >/ = 3. 5 (M) & >/ = 3.0 (F); Normal, <3.5 (M) & <3.0 (F) .

Table 3. Low-density lipoprotein cholesterol to high-density lipoprotein cholesterol ratio among study participants at the zewditu memorial hospital in Addis Ababa, Ethiopia, 2021.

	LDL/HDL ratio					
Characteristics	Moderate to high	Normal	COR (95% CI)	*P* value	AOR (95% CI)	*P* value
Age ≥45 years						
>/ = 40	177 (74.4)	185 (68.0)	1.365 (.927, 2.009)	.115	1.229 (.810, 1.864)	.332
<45	61 (25.6)	87 (32.0)				
Gender (M)						
Male	98 (41.2)	115 (42.3)	.956 (.672, 1.360)	.801		
Female	140 (58.8)	157 (57.7)				
Civil status						
Married	118 (49.6)	137 (50.4)	.969 (.684, 1.372)	.859		
Else	120 (50.40	135 (49.6)				
Address						
Kirkos	94 (39.8)	96 (35.6)	1.200 (.837, 1.721)	.322		
Else	142 (60.2)	174 (64.4)				
Educational status						
College & above	36.6%	32.7%	1.185 (.822, 1.708)	.364		
Else	63.4%	67.3%				
Monthly income						
>/ = 50 USD	137 (57.6)	135 (49.6)	1.377 (.970, 1.954)	.074	1.385 (.965, 1.987)	.077
<50 USD	101 (42.4)	137 (50.4)				
Family history						
Yes	54 (22.8)	56 (20.6)	1.138 (.746,.1737)	.548		
No	183 (77.2)	216 (79.4)				
Central Obesity						
WC >35′ (F) 0r ≤ 40′ (M)	78 (32.8)	69 (25.4)	1.434 (.976, 2.107)	.066	1.207 (.769, 1.894)	.413
WC ≤ 35′ (F) 0r >40′ (M)	160 (67.2)	203 (74.6)				
BMI						
Over-weight & Obesity	76 (31.9)	79 (29.0)	1.146 (.785, 1.672)	.479		
Normal-BMI	162 (68.1)	193 (71.0)				
High FBS or DM						
FBS ≥126 or confirmed DM	31.9 (76)	64 (23.5)	1.525 (1.031, 2.254)	.034	1.306 (.868, 1.963)	.200
FBS <126 or confirmed DM	162 (68.1)	208 (76.5)				
High BP or confirmed HTN						
SBP>120 mmHg and DBP> 80mmHg	141 (59.5)	144 (52.9)	1.306 (.918, 1.856)	.138	1.126 (.774, 1.638)	.535
Else	96 (40.5)	128 (47.1)				
MUH_NM						
BMI <125 Kg/m^2 but with DM/HTN	149 (62.6)	175 (64.3)	.928 (.647, 1.332)	.685		
Else	89 (37.4)	97 (35.7)				
MHO						
BMI ≥125 Kg/m^2 but without DM/HTN	51 (21.4)	66 (24.3)	.851 (.562, 1.290)	.448		
Else	187 (78.6)	206 (75.7)				
WHtR						
>.50	161 (67.6)	161 (59.2)	1.442 (1.002, 2.074)	.049	1.221 (.801, 1.860)	.354
Else	77 (32.4)	111 (40.8)				
HIV-status						
HIV +	137 (47.6)	151 (52.4)	1.087 (.765, 1.544)	.642		
HIV-	101 945.5)	121 (54.5)				

Moderate to high, ≥ 2.5; Central obesity is according to the NCEP definition (waist circumference >35 inches in Women and >40 inches in men).

MHO showed no significant association with TC/HDL-C ratio (Table 2).

Before and after adjusting for confounders, none of the covariates were shown to have a significant link with increasing LDL/HDL-C ratio (Table 3).

Age, central obesity, BMI, DM, HTN, and WHtR were all found to be linked with higher TG/HDL-C ratios, but after controlling for variables, only DM (hyperglycemia) was shown to be substantially associated with high TG/HDL-C ratio (AOR = 1.597, 95 percent CI (1.061, 2.404; p = .025). Details are shown in Table 4.

Discussion

Only a few studies have been found in the scholarly literature that compares HIV-negative ambulatory patients with chronic illnesses to HIV-positive patients.[40,41] Dyslipidemia has been linked to a higher risk of CVD in

Table 4. Triglyceride to high-density lipoprotein cholesterol ratio among study participants at the zewditu memorial hospital in Addis Ababa, Ethiopia, 2021.

Characteristics	TG/HDL ratio		COR (95% CI)	*P* value	AOR (95% CI)	*P* value
	Moderate to high	Normal				
Age ≥45 years						
>/ = 40	165 (76.7)	197 (66.8)	1.642 (1.102, 2.445)	.015	1.284 (.839, 1.965)	.249
<45	50 (23.3)	98 (33.2)				
Gender (M)						
Male	96 (44.7)	117 (39.7)	1.227 (.860, 1.752)	.259		
Female	119 (55.3)	178 (60.3)				
Civil status						
Married	113 (52.6)	142 (48.1)	1.194 (.840, 1.697)	.324		
Else	102 (47.4)	153 9 (51.9)				
Address						
Kirkos	83 (39.2)	107 (36.4)	1.124 (.781, 1.618)	.528		
Else	129 (60.8)	187 (63.6)				
Educational status						
College & above	70 (32.6)	106 (35.9)	.861 (.594, 1.248)	.429		
Else	145 (67.4)	189 (64.1)				
Monthly income						
>/ = 50 USD	119 (55.3)	153 (51.9)	1.150 (.808, 1.637)	.436		
<50 USD	96 (44.7)	142 (48.1)				
Family history						
Yes	51 (23.7)	59 (20.1)	1.239 (.810, 1.894)	.323		
No	164 (76.3)	235 (79.9)				
Central Obesity						
WC >35′ (F) 0r ≤ 40′ (M)	75 (34.9)	72 (24.4)	1.659 (1.128, 2.442)	.010	1.204 (.726, 1.996)	.473
WC ≤ 35′ (F) 0r > 40′ (M)	140 (65.1)	223 (75.6)				
BMI						
Over-weight & Obesity	75 (34.9)	80 (27.1)	1.440 (.984, 2.106)	.060	1.077 (.696, 1.667)	.740
Normal-BMI	140 (65.1)	215 (72.9)				
High FBS or DM						
FBS ≥126 or confirmed DM	74 (34.4)	66 (22.4)	1.821 (1.230, 2.697)	.003	1.597 (1.061, 2.404	.025
FBS <126 or confirmed DM	141 (65.6)	229 (77.6)				
High BP or confirmed HTN						
SBP>120 mmHg and DBP> 80mmHg	136 (63.3)	149 (50.7)	1.675 (1.170, 2.400)	.005	1.422 (.967, 2.092)	.073
Else	79 (36.7)	145 (49.3)				
MUH_NM						
BMI <125 Kg/m^2 but with DM/HTN	140 (65.1)	184 (62.4)	1.126 (.781, 1.624)	.525		
Else	75 (34.9)	111 (37.6)				
MHO						
BMI ≥125 Kg/m^2 but without DM/ HTN	52 (24.2)	65 (22.0)	1.129 (.745, 1.712)	.568		
Else	163 (75.8)	230 (78.0)				
WHtR						
>.50	152 (70.7)	170 (57.6)	1.774 (1.221, 2.578)	.003	2.975 (.317, 27.967)	.340
Else	63 (29.3)	125 (42.4)				
HIV status						
HIV +	123 (42.7)	165 (57.3)	.994 (.678, 1.457)	.974		
HIV-	92 9(41.4)	130 (58.6)				

Central obesity (AOR = .316, 95 percent CI (.186,.538), p < .001), diabetes (AOR = .330, 95 percent CI (.203,.535), p < .001), and high blood pressure (AOR = .339 (.227,.507), p < .001) were all less common in HIV + participants than in HIV- participants. WHtR (AOR = 2.973 (1.831, 4.828), p < .001) was the only type of dyslipidemia factor that was substantially linked with HIV + subjects.

ambulatory diabetic patients,[42,43] and it is also seen often in HIV-positive patients on protease inhibitors.[44] In clinical settings, assessing and quantifying risk in these populations through comparative research could be highly useful for optimal drug therapy management. The purpose of this study was to use data from ambulatory individuals' lipid profiles to predict the risk of CVD.

Table 1 shows that people aged 45 and up had a two-fold increased risk of CVD in the form of elevated TG (AOR = 2.161, 95% CI (1.311, 3.563), p = .003), elevated TC (AOR = 2.017, 95% CI (1.092, 3.726), p = .025), and a decline in HDL (AOR = 2.410, 95% CI (1.569, 3.701), regardless of the HIV status. Several studies have found a link between age and dyslipidemia, albeit the specific

Table 5. Dyslipidemia based on HIV status of the participants at the zewditu memorial hospital in Addis Ababa, Ethiopia, 2021.

	HIV-positive	HIV-negative	COR (95% CI)	P value	AOR (95% CI)	P value
BMI						
Over-weight and obesity (≥ 25 kg/m^2)	92 (31.9)	63 (28.4)	1.185 (.808, 1.737)	.386		
Normal (<25 kg/m^2)	196 (68.1)	159 (71.6)				
Obesity (NCEP)						
WC >35 inch in Women and >40 inch in men	68 (23.6)	79 (35.6)	.559 (.380,.824)	.003	.316 (.186,.538)	<.001
WC </ = 35 inch in Women and </ = 40 inch in men	220 (76.4)	143 (64.4)				
High FBS or DM						
FBS ≥126 or confirmed DM	50 (17.4)	90 (40.5)	.308 (.205,.462)	<.001	.330 (.203,.535)	<.001
Else (<126)	238 (82.6)	132 (59.5)				
High BP or confirmed HTN						
SBP>120 mmHg and DBP> 80mmHg	129 (44.9)	156 (70.3)	.345 (.345,.500)	<.001	.339 (.227,.507)	<.001
Else	158 (55.1)	66 (29.7)				
MUH_NM						
BMI <125 Kg/m^2 but with DM/HTN	168 (58.3)	156 (70.3)	.592 (.409,.858)	.006	.583 (.317, 1.074)	.084
Else	120 (41.7)	66 (29.7)				
MHO						
BMI ≥125 Kg/m^2 but without DM/HTN	80 (27.8)	37 (16.7)	1.923 (1.242, 2.977)	.003	1.206 (.563, 2.582)	.630
Else	208 (72.2)	185 (83.3)				
High TC						
≥240 mg/dl	41 (14.2)	36 (16.2)	.536 (.527, 1.395)	.858		
< 240 mg/dl	247 (85.8)	186 (83.8)				
High Non-HDL-C						
≥130 mg/dl	163 (56.6)	131 (59.0)	.906 (.635, 1.292)	.585		
<130 mg/dl	125 (43.4)	91 (41.0)				
High LDL-C						
≥160 mg/dl	42 (14.6)	31 (14.0)	1.052 (.637, 1.736)	.843		
<160 mg/dl	246 (85.4)	191 (86.0)				
LDL/HDL ratio						
>/ = 2.5 moderate to high	137 (47.6)	101 (45.5)	1.087 (.765, 1.544)	.642		
<2.5 normal	151 (52.4)	121 (54.5)				
TC/HDL ratio						
>/ = 3. 5 (M) & >/ = 3.0 (F) Moderate to high	202 (70.1)	156 (70.3)	.994 (.678, 1.457)	.974		
<3.5 (M) & <3.0 (F) Normal	86 (29.9)	66 (29.7)				
TG/HDL ratio						
>/ = 3. 5 (M) & >/ = 3.0 (F) Moderate to high	123 (42.7)	92 (41.4)	1.053 (.739, 1.502)	.774		
<3.5 (M) & <3.0 (F) Normal	165 (57.3)	130 (58.6)				
WHtR						
>.50	193 (67.0)	199 (58.1)	1.465 (1.019, 2.105)	.039	2.973 (1.831, 4.828)	<.001
Else	95 (33.0)	93 (41.9)				

cut-off age differs depending on the scientific literature.[45,46] According to one study, the prevalence of dyslipidemia rises in tandem with the progression of diabetes mellitus as people get older.[47] As liver and kidney function deteriorates with age, it is also possible that this will affect lipid metabolism, leading to dyslipidemia.[48,49]

Males were found to have a greater risk of dyslipidemia due to higher TG (AOR = 2.107, 95% CI (1.401, 3.167), p < .001), and lower HDL (AOR = 6.982, 95% CI (4.686, 10,402), p < .001). A high TG and low HDL describe atherogenic dyslipidemia and insulin resistance, which is also a risk factor for CAD and stroke.[50,51] Atherogenic dyslipidemia was more common in men than in women, which could be because most men smoke and are genetically predisposed to lipid-related CVD. This finding was supported by several other investigations.[52,53]

As stated above concerning gender, smoking has been linked to a higher TG level (p = .032), with smokers being two times more likely than non-smokers.[54] The likely explanation is that smoking impairs the function of lipoprotein lipase and hormone-sensitive lipase, both of which are regulated by insulin and catecholamines, causing dysregulation and an increase in TG levels.[55] This finding was consistent with prior research that linked cigarette smoking to an increased risk of atherosclerosis,[56] and also several other studies.[57–59]

Alcohol consumption was also linked to higher TG levels, with the odds being doubled in alcoholics compared to non-alcoholics (p = .022). Epidemiologic data generally demonstrate an inverse relationship between CAD risk and moderate alcohol consumption, which is characterized in various ways but roughly equates to 1 to 2 pints of beer per day.[60] The influence of fasting TG level arising from the effect of alcohol in liver cells can be explained in connection with the involvement of underlying genetic disorders of TG metabolism in increasing TG with alcohol consumption.[60,61] This finding is in agreement with several other studies.[58,59,62]

Lipoprotein ratios can provide information on risk variables that are difficult to measure using traditional methods, and they may be a better reflection of metabolic and clinical interactions between lipid fractions.[63,64] Because lipoprotein ratios are underutilized in cardiovascular prevention but can help with risk assessment,[65] we used the three most frequent types of ratios to predict the risks in this investigation as shown in table 2.

An increase in WHtR resulted in a twofold rise in a high-Tc/HDL ratio (AOR = 1.676, 95% CI (1.052, 2.669), p = .030). Because the population's height remains constant over time, the only element that influences this could become the WC. According to the findings, utilizing WHtR as an indicator of 'early health risk' is easier and more accurate than using a matrix based on BMI or waist circumference alone.[66] Hence, the measurement could be used to track the risk of CAD and NAFLD.

A high level of FBS (≥ 126 mg/dl) and/or verified DM (p = .017) were also connected to a two-fold greater risk of having an elevated TC/HDL ratio. The association between a high WHtR and DM is best explained by the fact that these individuals are prone to metabolic disturbances that can lead to central obesity. This is well addressed in various scientific findings.[66,67] Individuals who have increased WHtR could also be prone to develop, CAD, NAFLD, or stroke.[68–72] This ratio determination has also been shown to be a better predictor of CIMT advancement than HDL-C or LDL-C alone in a prospective investigation.[73,74]

Table 4 shows the other lipoprotein ratio, TG/HDL-C, and only DM (hyperglycemia) was shown to be significantly linked with it (AOR = 1.597, 95% CI (1.061, 2.404; p = .025), indicating metabolic dysregulation in this population and its contribution to dyslipidemia once again. The TG/HDL-C ratio can be used to detect IR, cardiometabolic risk, and CVD (9, 10). As a result, a widely available and standardized measurement of the TG/HDL-C ratio is expected to aid clinicians in identifying individuals who are not just IR but also have dyslipidemia.[15] A high TG/HDL-C ratio has also been revealed to be a strong predictor of major adverse cardiac events (MACE) such as cardiac death, nonfatal MI, or reintervention, as well as an independent predictor of long-term all-cause mortality.[75] Several studies have also used the TG/HDL-C ratio to determine childhood obesity-related CVD.[76,77]

As shown in table 5, dyslipidemias and related factors were compared based on HIV status, and variables like central obesity (AOR = .316, 95% CI (.186,.538), p < .001), diabetes (AOR = .330, 95% CI (.203,.535), p < .001), and high blood pressure (AOR = .339 (.227,.507), p < .001) were all less common in the HIV + participants than in the HIV-negatives. The most plausible explanation is that two-thirds of HIV-negative participants had diabetes mellitus (DM), and the rest had other conditions that contributed to the disparities. Diabetes mellitus, as previously noted, is the leading cause of dyslipidemia and CVD in persons aged 45 and up.[78,79]

Limitation of the study

Because the data was only obtained from a single hospital, the study cannot be considered a representative of all HIV + and HIV− ambulatory patients. Again, since clinical events or surrogate evidence such as coronary plaque was not determined using computed CT, the lipid-related CVD risk calculated in this study may not represent a genuine CVD. During the follow-up phase, good application of preventive clinical guidelines and a healthy lifestyle modification can also help to reduce the risk of CVD.

Operational definitions

Terms	Interpretations
Alcohol-consumption	defined as the use of any form of alcohol-based beverages whether locally produced or manufactured in industries, and used regularly in any interval ranging from days to month by the participant/s at present in any amount. Occasional intakes for holidays, ceremonies, a greater than monthly interval intakes were neglected.
Cigarette smoking	defined as the active use of tobacco whether locally produced or manufactured in industries, and is being used regularly by the participant/s at present in any form or amount on a daily, weekly basis, or monthly intervals.
Coffee- consumption	defined as the use of coffee whether locally produced or manufactured in industries, and is being used regularly by the participant/s at present in any amount on a daily or weekly basis.
Family history of cardiometabolic disease	defined concerning the positive history of cardiovascular diseases (diabetes, hypertension, heart failure, coronary heart disease, or dyslipidemia) in a first-degree relative.
HIV- negative	An individual on follow-up care of adult ambulatory clinics for other chronic diseases management such as diabetes, hypertension, etc., and have no HIV during enrollment.
HIV- positive	An individual confirmed HIV + by either antigen or antibody tests and has already initiated combination ART (cART) by attending the ART follow-up service.
Khat-chewing	defined as the regular use of Khat leaves by the participant/s at present in any form or amount on a daily, weekly basis, or monthly intervals.
MHO	Defined as metabolically healthy obese patients[16] and they are overweight/ obesity patients ($\geq$25 Kg/m^2) but without dyslipidemia, T2DM, or HTN.
MUH-NW	Defined as metabolically unhealthy normal weight[16] and participants within the normal BMI (<25 Kg/m^2) but having a T2DM or FBS>126 mg/dl or HTN will be considered MUH-NW
Normal-weight	Defined as BMI 18.5–24.9 kg/m^2
Obesity	defined as a BMI of $\geq$ 30 kg/m^2
Overweight	defined as a body mass index or BMI of 25 to 29.9 kg/m^2
Traditional medicine	defined as the use of any non-conventional medicine that was prescribed in any form of remedies to be administered to any part of the body and that is being used at present in any amount and any interval.
WHtR	Defined as Waist to Height Ratio and if it is greater than 0.5 in adults are considered to be a risk for cardiometabolic disorders.[80]

Conclusion

Dyslipidemia is linked to advanced age, male gender, diabetes, smoking, alcohol consumption, and increased waist circumference, all of which could lead to an increased risk of CVD, according to the study. The study also revealed that the risks are less common in HIV + people than in HIV-negative ambulatory patients. Diabetes mellitus was the most common cause of dyslipidemia and cardiovascular disease in people aged 45 and up.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This work was supported by the Deutscher Akademischer Austauschdienst,

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Annexes

Annex 1. Target cholesterol levels by age and sex [39]

Age and sex	Total cholesterol	Non-HDL cholesterol	LDL cholesterol
People aged 19 years and younger (children and teens)	Borderline: 170-199 mg/dL High: Greater than or equal to 200 mg/dL	Borderline: 120-144 mg/dL High: Greater than or equal to 145 mg/dL	Borderline: 110-129 mg/dL High: Greater than or equal to 130 mg/dL
Men aged 20 years and older	Borderline: 200-239 mg/dL High: Greater than or equal to 239 mg/dL	High: Greater than 130 mg/dL	Near optimal or above optimal: 100-129 mg/dL Borderline high: 130-159 mg/dL High: 160-189 mg/dL Very high: Greater than 189 mg/dL
Women aged 20 years and older	Borderline: 200-239 mg/dL High: Greater than or equal to 239 mg/dL	High: Greater than 130 mg/dL	Near optimal or above optimal: 100-129 mg/dL Borderline high: 130-159 mg/dL High: 160-189 mg/dL

Annex 2. High total, non-HDL, and LDL cholesterol levels by age and sex[39]

Age and sex	Total cholesterol	Non-HDL cholesterol	LDL cholesterol
People aged 19 years and younger (children and teens)	Borderline: 170-199 mg/dL High: Greater than or equal to 200 mg/dL	Borderline: 120-144 mg/dL High: Greater than or equal to 145 mg/dL	Borderline: 110-129 mg/dL High: Greater than or equal to 130 mg/dL
Men aged 20 years and older	Borderline: 200-239 mg/dL High: Greater than or equal to 239 mg/dL	High: Greater than 130 mg/dL	Near optimal or above optimal: 100-129 mg/dL Borderline high: 130-159 mg/dL High: 160-189 mg/dL Very high: Greater than 189 mg/dL
Women aged 20 years and older	Borderline: 200-239 mg/dL High: Greater than or equal to 239 mg/dL	High: Greater than 130 mg/dL	Near optimal or above optimal: 100-129 mg/dL Borderline high: 130-159 mg/dL High: 160-189 mg/dL Very high: Greater than 189 mg/dL