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Major Article

Metabolic disorders and cardiovascular risk in people living with HIV/AIDS without the use of antiretroviral therapy

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Abstract

Introduction: Metabolic disorders in people living with HIV/AIDS (PLH) have been described even before the introduction of antiretroviral (ARV) drugs in the treatment of HIV infection and are risk factors for cardiovascular diseases. Based on this, the purpose of this study was to assess metabolic disorders and cardiovascular risk in PLH before the initiation of antiretroviral treatment (ART). **Methods:** This was a cross-sectional descriptive study of 87 PLH without the use of ART, which was carried out between January and September 2012 at a specialized infectious diseases center in Minas Gerais, Brazil. **Results:** The main metabolic disorders in the population were low serum levels of HDL-cholesterol, hypertriglyceridemia and abdominal obesity. Dyslipidemia was prevalent in 62.6% of the study population, whereas metabolic syndrome (MS) was prevalent in 11.5% of patients assessed by the International Diabetes Federation (IDF) criteria and 10.8% assessed by the National Cholesterol Education Program-Adult Treatment Panel (NCEP-ATPIII) criteria. Regarding cardiovascular risk, 89.7% of the population presented a low coronary risk according to the Framingham Risk Score. A greater proportion of patients diagnosed with MS presented low cardiovascular risk (80% assessed by IDF criteria and 77.8% assessed by NCEP-ATPIII criteria). **Conclusions:** Metabolic disorders in this population may be due to HIV infection or lifestyle (smoking, sedentary lifestyle and inadequate diet). The introduction of ART can enhance dyslipidemia, increasing cardiovascular risk, especially among those who have classic risks of cardiovascular disease.

Keywords: HIV/AIDS. Metabolic disorders. Cardiovascular risk.

INTRODUCTION

Metabolic disorders in people living with HIV/AIDS (PLH) have been described even before the introduction of antiretroviral (ARV) drugs in the treatment of the infection caused by HIV[1]. Among those for whom antiretroviral therapy (ART) has not been initiated, low-density lipoprotein-cholesterol (LDL-c) and high-density lipoprotein-cholesterol (HDL-c) levels are frequently found, prior to hypertriglyceridemia which is associated with an increase in very low-density lipoprotein-cholesterol (VLDL-c) levels and normal LDL-c and HDL-c levels[2].

Lipid and glycemic metabolic disorders, such as dyslipidemia, hypertension, glucose intolerance, insulin resistance, diabetes mellitus (DM) and alterations in body fat distribution can be characterized as metabolic syndromes (MS)[1]. Brazilian studies that assessed the MS prevalence in PLH with and without the use of ART have reported prevalence between 12% and 38.2%, respectively[3-6]. In PLH with the use of ART, metabolic disorders are more frequent and severe. Dyslipidemia amounts to about 70% of PLH who use ART and cardiovascular events in these patients are more common than in the general population[7].

The Strategies for Management of Antiretroviral Therapy (SMART) study was an important clinical study which demonstrated the role of non-infectious complications in PLH, comparing patients in continuous use of ART and PLH on intermittent ART monitored by cluster of differentiation 4 (CD4) cell count, which refer to CD4+ T lymphocytes count, essential cells of the human immune system. This study showed that mortality in the group with use of intermittent ART was higher[8]. The vast majority of the population deaths were related to cardiovascular diseases (CVD). Yet, one of the hypotheses for this outcome was that the events were related to the increase in the inflammation process due to viral replication with subsequent vascular damage[9].

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The clinical management of PLH has shown some complications related to the increase in survival rate, the aging process of this population, chronic inflammation and its consequences as well as the medium or long-term ART toxicity, besides the classic risk factors of CVD (smoking, sedentary lifestyle, etc.)[10]. Based on this, the aim of this study was to assess the main metabolic disorders and cardiovascular risk in PLH before the initiation of ART.

METHODS

Study design

This descriptive cross-sectional study was carried out in a specialized infectious diseases center in Belo Horizonte - Minas Gerais, Brazil. The participants of this study comprised 87 PLH without the use of ART, older than 18 years, of both sexes, who have had medical indication for the beginning of ART in the period between January and September 2012 and had biochemical tests results nearing the study inclusion appointment, have been added by convenience.

Ethical considerations

The Research Ethics Committee of the Federal University of Minas Gerais approved the present study, under protocol number 0251.0.203.000-11, and all participants gave written informed consent.

Data collection

The data were collected during clinical evaluation (before the initiation of ART) and review of the medical records. During the clinical evaluation, anthropometric data were collected using standardized procedures by the World Health Organization[11] [weight, height and abdominal circumference (AC)] and filling out questionnaires to evaluate the physical activity level of patients who were categorized in two groups: sedentary individuals and those who undertook at least one physical activity (bodybuilding, aerobics, hiking, running, or pedaling).

The review of medical records was performed after the inclusion consultation and the information registered in specific forms. Demographic data were collected (sex, age and schooling), comorbidity (cardiac disease, DM and hypertension), lifestyle (smoking and alcoholism), and laboratory tests [glycemia, total cholesterol (TC), HDL-c, LDL-c, triglycerides (TG), CD4 count and viral load].

Metabolic profile

The evaluation of the metabolic profile of the population was conducted by biochemical tests of glucose, TC and fractions (LDL-c and HDL-c), and TG in accordance with the values of the V Brazilian Guidelines on Dyslipidemia and Prevention of Atherosclerosis[12]. The patients were categorized as dyslipidemic when TC ≥ 200mg/dl, HDL-c < 40mg/dl for men and < 50mg/dl for women, LDL-c ≥ 160mg/dl and/or TG ≥ 150mg/dl[12].

Metabolic syndrome

The patients were classified according to the criteria of the International Diabetes Federation (IDF)[13] and the National Cholesterol Education Program-Adult Treatment Panel (NCEP-ATPIII)[14].

The IDF classifies patients with MS according to the presence of abdominal obesity (AC > 94cm for men and > 80cm for women), as a condition sine qua non, and two or more criteria, such as: TG > 150mg/dl, HDL-c < 40mg/dl for men and < 50mg/dl for women, systolic arterial pressure > 130mmHg or treatment for hypertension and diastolic arterial pressure > 85mmHg or treatment for hypertension.

The NCEP-ATP III, on the other hand, proposes that the individual has MS if there is the presence of at least three of the following criteria: AC > 102 cm for men or > 88cm for women, HDL-c < 40mg/dl for men and < 50mg/dl for women, TG > 150mg/dl, arterial pressure with cut-off values of 130/85mmHg and fasting glucose > 110mg/dl.

Cardiovascular risk

A Framingham Risk Score was calculated to evaluate the cardiovascular risk, as proposed by the American Heart Association and the American College of Cardiology according to the results of Framingham Heart Study[15].

Statistical analyses

The data collected were recorded in a database, which was built in Excel software (Microsoft Office 2013). Statistical analyses were carried out using the Statistical Package for the Social Sciences (SPSS) software, version 22.0 (SPSS Inc., Chicago, IL, USA).

The data were described as frequencies and percentages for categorical variables, by measures of central tendency (mean or medians) and measures of dispersion [standard deviation (SD) or 25^{th}-75^{th} percentiles] for numerical variables. To check data normality, the Shapiro-Wilk test was applied.

Continuous variables were compared using the t-test (normal distribution) or the Wilcoxon test (asymmetrical distribution), and frequencies were compared using the chi-square test or Fisher's exact test, where appropriate. For all tests, were considered as level of statistical significance a value of 5%.

RESULTS

Prevalence of dyslipidemia

The patients were categorized as dyslipidemic if they presented with abnormalities in biochemical tests, in accordance with the values of the V Brazilian Guidelines on Dyslipidemia and Prevention of Atherosclerosis[12]. The prevalence of dyslipidemia in the study population was 62.6%. The variations in the serum levels of each lipid fraction are shown in **Table 1.**

Demographic, clinical and laboratorial characteristics

Seventy-six percent of the patients analyzed (75.9%) were men. The mean (SD) age of the studied population was 36.57 (9.38) years. There was no significant difference between both sexes and the most frequent level of schooling was high school (49.4%).

The mean body mass index (BMI) among the male patients was 24.09kg/m^2 and 23kg/m^2 for females, with no significant

TABLE 1

Serum levels of TC, HDL-c, LDL-c and TG in PLH without the use of ART.

Baseline (N=87)	Number	Percentage
TC ≥ 200mg/dl	14	16.1
LDL-c ≥ 160mg/dl	2	2.3
HDL-c < 40mg/dl for men and < 50mg/dl for women	47	54.0
TG ≥ 150mg/dl	25	26.4

TC: total cholesterol; **HDL-c:** high-density lipoprotein-cholesterol; **LDL-c:** low-density lipoprotein-cholesterol; **TG:** triglycerides**; PLH**: people living with HIV/AIDS; **ART:** antiretroviral therapy; **HIV/AIDS:** human immunodeficiency virus/acquired immunodeficiency syndrome.

TABLE 2

Demographic and clinical characteristics of PLH without the use of ART according to sex and diagnosis of dyslipidemia

Characteristic	Total n (%)	Men n (%)	Women n (%)	*p-value*	Patients with dyslipidemia n (%)	Patients without dyslipidemia n (%)	*p-value*
Sex		-	-				
female	21 (24.1)	-	-		7 (23.3)	14 (24.6)	**0.89[a]**
male	66 (75.9)	-	-		23 (76.7)	43 (75.4)	
total	87 (100.0)	-	-		30 (100.0)	57 (100.0)	
Age (years)							
mean SD	36.57 (9.38)	35.58 (9.70)	39.71 (7.63)	**0.05[b]**	33.63 (9.04)	38.12 (9.25)	**0.03[b]**
Schooling							
illiterate	3 (3.5)	1 (1.5)	2 (9.5)	**0.05[c]**	1 (3.3)	2 (3.5)	**0.26[c]**
elementary school	16 (18.4)	10 (15.2)	6 (28.6)		2 (6.7)	14 (24.6)	
high school	43 (49.4)	32 (48.5)	11 (52.4)		18 (60)	25 (43.9)	
higher education	25 (28.7)	23 (34.8)	2 (9.5)		9 (30)	16 (28.0)	
Hypertension							
yes	13 (14.9)	10 (15.2)	3 (14.3)	**0.20[c]**	6 (20)	7 (12.3)	**0.22[a]**
no	74 (85.1)	56 (84.8)	18 (85.7)		24 (80)	50 (87.7)	
DM							
yes	2 (2.3)	1 (1.5)	1 (4.8)	**0.38[c]**	0 (0)	2 (3.5)	**0.29[c]**
no	85 (97.7)	65 (98.5)	20 (95.2)		30 (100)	55 (96.5)	
Fasting glycemia							
yes	7 (8)	3 (4.5)	4 (19)	**0.03[c]**	1 (3.3)	6 (10.5)	**0.24[c]**
no	80 (92)	63 (95.5)	17 (81)		29 (96.7)	51 (89.5)	
Smoking							
yes	26 (29.9)	20 (30.3)	6 (28.6)	**0.88[a]**	5 (16.7)	21 (36.8)	**0.05[a]**
no	61 (70.1)	46 (69.7)	15 (71.4)		25 (83.3)	36 (63.2)	
Alcoholism							
yes	56 (64.4)	45 (68.2)	11 (52.4)	**0.18[a]**	21 (70)	35 (61.4)	**0.42[a]**
no	31 (35.6)	21 (31.8)	10 (47.6)		9 (30)	22 (38.6)	

PLH: people living with HIV; **ART:** antiretroviral therapy; **SD:** standard deviation; **DM:** diabetes mellitus; **HIV:** human immunodeficiency virus. [a]Chi-square test. [b]Students t-test. [c]Fisher's exact test.

difference; 31% of the patients of this study presented abdominal obesity according to the NCEP-ATPIII, that classifies the patient with abdominal obesity if there AC > 94cm for men and > 80cm for women.

The mean TC level was 168.47 (31.60) mg/dl, HDL-c 40.67 (31.60) mg/dl, and TG 120.93 (66.60) mg/dl.

Of the total, 31% of the patients studied presented CD4 cell counts less than or equal to 200 cells/ml and men presented viral load significantly higher than women (p-value=0.04). Regarding lifestyle, 29.9% were smokers, 64.4% consumed alcoholic beverages, and 58.6% were sedentary.

Regarding the previous medical history, 3.4% of the participants had heart disease and 4.6% had a history of cancer, and 2.3% of them had Kaposi's sarcoma diagnosed in the same year of human immunodeficiency virus (HIV) diagnosis. The prevalence of hypertension and DM were 14.9% and 2.3%, respectively.

Table 2 and **Table 3** present the demographic, clinical, anthropometric, and laboratorial characteristics according to sex and diagnosis of dyslipidemia.

Prevalence of metabolic syndrome

According to the criteria defined by the IDF, 11.5% of the population were classified with MS. In relation to the criteria established by NCEP-ATPIII, this classification occurred in 10.8% of the population. Each MS component (AC, systolic and diastolic arterial pressure, TG, glucose and HDL-c) was significantly associated with the presence of MS (p-value <0,05).

Table 4 presents the baseline demographic, clinical and laboratorial characteristics of the participants according to the two definitions of MS (NCEP-ATP III and IDF).

Cardiovascular risk according to Framingham Score

Regarding the evaluation of the risk of developing cardiovascular events in 10 years, 6.4% of the population of this study presented intermediate risk and 3.9% were classified as having high risk. Only increases in age and AC were significantly associated with high risk (p-value <0.05).

Table 5 presents the demographic, clinical and laboratorial characteristics of the participants according to the Framingham Score.

TABLE 3

Anthropometric and laboratorial characteristics of PLH without the use of ART according to sex and diagnosis of dyslipidemia.

Characteristic	Total	Men	Women	*p-value*	Patients without dyslipidemia	Patients with dyslipidemia	*p-value*
Physical activity [n (%)]							
practice	36 (41.4)	31 (47)	5 (23.8)	**0.06[a]**	12 (40)	24 (42.1)	**0.85[a]**
not practice	51 (58.6)	35 (53)	16 (76.2)		18 (60)	33 (57.9)	
BMI (kg/m²)							
mean SD	23.90 (4,30)	24,09 (4,34)	23,66 (4,24)	**0.69[b]**	23,27 (3,06)	24,37 (4,81)	**0.26[b]**
BMI per category[n (%)]							
< 18.5	5 (5.8)	3 (4.5)	2 (9.5)	**0.82[c]**	0 (0)	5 (8.8)	**0.02[c]**
18.5-24.9	51 (58.6)	40 (60.6)	11 (53.4)		23 (76.7)	28 (49.1)	
25 – 29.9	23 (26.4)	17 (25.8)	6 (28.6)		7 (23.3)	16 (28.1)	
> 30	8 (9.2)	6 (9.1)	2 (9.5)		0 (0)	8 (14)	
CD4-cell count (cells/mm³)							
Mean SD	264.93 (152.12)	263.60 (151.39)	269.09 (158.09)	**0.65[b]**	309.90 (142.25)	241.26 (152.99)	**0.04[b]**
CD4-cell count per category [n (%)]							
≤ 200 cells/ml	27 (31)	22 (33.3)	5 (23.8)	**0.54[c]**	6 (20)	21 (36.8)	**0.27[c]**
201-499 cells/ml	55 (63.2)	41 (62.1)	14(66.7)		22 (73.3)	33 (57.9)	
≥ 500 cells/ml	5 (5.8)	3 (4.6)	2(9.5)		2 (6.7)	3 (5.3)	
Last viral load (copies/ml) median							
25th-75th percentiles	19,767 7,416-63,515	21,282 10,297-77,628	12,449 4,162-28,799	**0.03[b]**	18,219 6,754-68,973	24,775 13,794-51,326	**0.68[b]**

PLH: people living with HIV; **ART:** antiretroviral therapy; **BMI:** body mass index; **SD:** standard deviation; **DM:** diabetes mellitus; **HIV:** human immunodeficiency virus. **[a]**Chi-square test. **[b]**Wilcoxon test. **[c]**Fisher's exact test.

TABLE 4

Demographic, clinical and laboratorial characteristics of PLH without the use of ART with regard to MS.

Characteristic	MS (NCEP-ATPIII)			MS (IDF)		
	no	yes	*p-value*	no	yes	*p-value*
Men [n (%)]	58 (90.6)	6 (9.4)	**0.43**[a]	55 (85.9)	9 (14.1)	**0.69**[a]
Age (years*)	36.01 (9.69)	38.56 (7.26)	**0.36**[b]	35.99 (9.65)	38.27 (8.21)	**0.41**[b]
BMI (kg/m²*)	22.86 (2.93)	30.09 (3.78)	**<0.01**[b]	23.26 (3.29)	30.78 (3.81)	**<0.01**[c]
Smoking [n (%)]						
no	48 (80)	12 (20)	**0.78**[c]	50 (83.3)	10 (16.7)	**0.13**[c]
yes	19 (82.6)	4 (17.4)		22 (95.7)	1 (4.3)	
CD4 cells count (cells/mm*)	278.17 (149.36)	251.33 (139.90)	**0.61**[b]	275.69 (149.60)	272.45 (142.09)	**0.94**[b]
Viral load (copies/ml)**	20,020 (6,754-61,848)	13,285 (10,416-19,515)	**0.38**[d]	18,219 (6,131.5-9,146.5)	19,515 (11,850.5-39,562)	**0.89**[d]
TC (mg/dl*)	167.13 (31.78)	169.78 (25.32)	**0.81**[b]	167.07 (31.92)	169.72 (25.54)	**0.79**[b]
MS components						
AC (cm*)	85.20 (8.60)	109.35 (6.84)	**0.01**[b]	85.03; 8.81	106.08; 8.39	**<0.01**[b]
systolic AP (mmHg*)	117.58 (12.47)	134.45 (18.78)	**<0.01**[b]	117.71; 12.54	132; 19.32	**<0.01**[b]
diastolic AP (mmHg*)	76.67 (7.74)	90 (15)	**<0.01**[b]	76.61 (7.79)	89 (14.49)	**<0.01**[b]
TG (mg/dl*)	111.37 (53.28)	187.88 (107.51)	**<0.01**[b]	105.43 (44.07)	212.91 (99.25)	**<0.01**[b]
glucose (mg/dl**)	85 (79-90.75)	90 (86.5-185.5)	**0.01**[d]	85 (80-93)	87 (82-99)	**<0.01**[b]
HDL-c (mg/dl*)	41.5 (13.41)	33.89 (8.40)	**0.03**[b]	41.94 (13.42)	32.36 (7.07)	**0.02**[b]

PLH: people living with HIV; **ART:** antiretroviral therapy; **MS:** metabolic syndrome; **NCEP-ATP-III**: National Cholesterol Education Program-Adult Treatment Panel III; **IDF**: International Diabetes Federation; **BMI:** body mass index; **CD4**: *cluster of differentiation*; **TC:** total cholesterol; **AC:** abdominal circumference; **AP**: arterial pressure; **TG**: triglycerides; **HDL-c:** HDL-cholesterol; **HIV:** human immunodeficiency virus; **SD:** standard deviation. [a]Chi-square test. [b]Student t-test. [c]Fisher's exact test. [d]Wilcoxon test. *Rate (SD). **median (25^{th}-75^{th} percentiles).

DISCUSSION

The IDF and NCEP-ATPIII are the main criteria utilized for the diagnosis of MS because of their simple clinical and epidemiologic application[16]. The prevalence of MS identified in this study agreed with Wand *et al.*[17] who evaluated the prevalence of MS (8.5% and 7.8% by the IDF and NCEP-ATPIII criteria, respectively) in PLH without the use of ART, but did not agree with the prevalence of Nguyen *et al.*[18], who reported the prevalence of MS (26.5% and 24.1% by the IDF and NCEP-ATPIII criteria, respectively) in PLH 93% of whom were on ART.

The prevalent components of MS in this study were low HDL-c (54%), abdominal obesity (31%) and hypertriglyceridemia (26.4%). Similar results were obtained in other studies conducted among PLH, such as the study by Vidigal *et al.*[19], who demonstrated a higher prevalence of low HDL-c and hypertriglyceridemia between MS components.

In the dyslipidemic group, the CD4 cell count was significantly lower than that in patients without dyslipidemia, which is not in accordance with the study by Farhi *et al.*[20]. CD4 cell count is a strong predictor of opportunistic infections, as well as non-infectious diseases[8].

Garcez *et al.*[21] found a prevalence of 59.74% of dyslipidemia in a population-based study in São Paulo - Brazil. Farhi *et al.*[20] observed a prevalence of 77.5% in dyslipidemia among PLH; such prevalence has been associated mainly with the use of ART, more specifically patients taking protease inhibitors. These patients without the use of ART, explained the Farhi[20] *et al.*'s finding, as the introduction of ART is associated with the development of metabolic disorders.

According to Lazzaretti *et al.*[22], the risk of development of dyslipidemia in PLH with the use of ART in Brazil may be 70%. A Brazilian study evaluated PLH with and without the use of ART and observed significantly higher values of TC, LDL-c and TG in the population with the use of ART, illustrating the importance of identification of metabolic disorders before the initiation of ART, and adopting a multidisciplinary approach in this population with the aim of lifestyle modification[23].

The mean age of this population is representative of the prevalence of HIV/AIDS cases notified in Brazil[24], and lower compared to other studies that assessed the frequency of metabolic disorders in PLH[10,20]. The patients with dyslipidemia were significantly older than those without this comorbidity. HIV infection is a chronic condition and the aging of this

TABLE 5

Demographic, clinical and laboratorial characteristics of PLH without the use of ART with regard to Framingham Risk Score.

Characteristic	Cardiovascular risk according to Framingham risk score		
	low	intermediary and high	*p-value*
MS/NCEP ATP-III [n (%)]	7 (77.8)	2 (22.2)	0.16[a]
MS/IDF [n (%)]	8 (80)	2 (20)	0.22[b]
Age (years)*	34.87 (8.15)	51.25 (8.05)	<0.01[b]
BMI (kg/m²)*	23.83 (4.42)	25.45 (4.41)	0.33[b]
Smoking [n (%)]			
no	52 (94.5)	3 (5.5)	0.02[a]
yes	17 (77.3)	5 (21.7)	
CD4-cell count (cells/mm³)*	277.42 (150.19)	175.77 (164.02)	0.06[b]
Viral load (copies/ml)**	19,047.5 (6,055.75-55,165.25)	37,431.5 (15,399-65,410.5)	0.29[c]
TC (mg/dl)*	168.52 (30.88)	172.50 (46.65)	0.74[b]
MS components			
AC (cm)*	86.99 (11.25)	96.20 (13.63)	0.04[b]
systolic AP (mmHg)*	118.11 (12.83)	135.71 (22.25)	0.08[b]
diastolic AP (mmHg)*	77.27 (9.53)	84.29 (12.72)	0.20[b]
TG (mg/dl)*	115.42 (53.66)	164.37 (108.90)	0.24[b]
glucose (mg/dl)**	85 (79-90)	86.5 (83.5-88.5)	0.52[c]
HDL-c (mg/dl)*	42.62 (12.76)	32.75 (12.84)	0.04[b]

PLH: people living with HIV; **ART:** antiretroviral therapy; **MS:** metabolic syndrome; **NCEP-ATP-III**: National Cholesterol Education Program-Adult Treatment Panel III; **IDF**: International Diabetes Federation; **BMI:** body mass index; **CD4**: *cluster of differentiation*; **TC:** total cholesterol; **AC:** abdominal circumference; **AP**: arterial pressure; **TG**: triglycerides; **HDL-c:** HDL-cholesterol; **HIV/AIDS:** human immunodeficiency virus/acquired immunodeficiency syndrome; **SD:** standard deviation. [a]Fisher's exact test. [b]Student t-test. [c]Wilcoxon test. *Rate (SD). **median (25th-75th percentiles).

population increases the risk of non-infectious diseases and can affect the quality of life[20].

The population of this study, in general, demonstrated a low risk to the development of cardiovascular events, which can be explained by the mean age. The increase in age correlated with an increase in cardiovascular risk. The patients with intermediary and high risk were significantly older than patients with low risk. Other studies have also found out a correlation in their analyses, pointing out that the cardiovascular risk in patients infected by HIV after they are 45 seem to have increased whenever compared to populations without this infection[25].

The increase in cardiovascular risk among PLH is due to a number of factors, including lipid disorders. The first few years of using ARV constitute the period of greatest vulnerability. The rapid recuperation of the immune system during this period may be responsible for atherogenic alterations in the arterial walls[26].

The results of this study are in accordance with the Data collection on Adverse events of Anti-HIV Drugs (DAD) study[27], in terms of the median age (37.1 in DAD *vs.* 36.6 years), proportion of men (75.9% *vs.*75.9%), presence of DM (2.8% *vs.* 2.3%), and mean BMI (23 *vs.* 23.9kg/m²). In the base population, the prevalence of dyslipidemia in the DAD study was 45.9%, which was lower (62.6%) than that of this study. In addition, there were higher proportions of smokers (56.2%) and hypertensive patients (14.9%) compared to this study (29.9% and 7.2%, respectively). This difference could be due to the difference in localities in which the studies were conducted (the DAD study was carried in 21 clinics in Europe, United States of America and Australia). In addition, the disparity in the prevalence of dyslipidemia can be explained, partly, by culture, eating habits and differences in physical activity level.

A Brazilian study has shown that obesity is the most important nutritional abnormality among PLH[28]. All the participants of this study who were considered obese by the classification of BMI had some sort of dyslipidemia. The excess of corporal fat is a predisposing factor for hypertension and a risk factor for the development of other chronic degenerative diseases, such as CVD. When BMI reaches levels higher than 25kg/m², the risk of DM can also increase progressively[29].

The participants of the study who were diagnosed with MS had higher BMI compared to other participants without this diagnosis, in agreement with the results of Wand *et al.*[17]. Excess weight was correlated with increased AC, exhibiting increased visceral fat. Android-type obesity, defined as the accumulation of visceral fat with predominant central or abdominal distribution, has a strong correlation with metabolic disorders and consequently better discriminatory cardiovascular risk results when compared to BMI[30]. Beraldo *et al.*[31] demonstrated that AC attained the best performance in comparing the anthropometric indicators for the identification of MS among PLH.

The prevalence of fasting glycemia in this study has been greater in women than men. In 2013, the prevalence of DM in the Brazilian population older than 18 years was 6.2%, and was higher in women[32]. The number of diabetic patients has increased due to the growth and aging of the population, the acceleration of urbanization, the progressive prevalence of obesity and sedentary lifestyle, as well as the improved survival of patients with DM[33]. The introduction of ART can even improve the occurrence of glycemic alterations, suggesting a relation between HIV infection and increased glycemia, probably through the virus acting in the function of β pancreatic cells, as well as in the mechanisms of secretion and action of insulin[33]. Studies evaluating insulin resistance in PLH showed that this connection may be aggravated in patients on ART, especially those in the IP class, which may occur by inhibiting the activity of GLUT1 and GLUT4 glucose transporters in the plasma membrane, inhibiting the differentiation of preadipocytes into adipocytes and the induction of mature adipocyte apoptosis[34,35].

Among the scores that assess the risk for CVD, the most popularized was originated in the Framingham Heart Study[15]. However, the Framingham Risk Score has limitations for analysis in HIV-positive populations since it does not consider in its calculation the inflammatory process that occurs throughout the course of HIV infection. In addition, a third of the population in this study had CD4 cell counts below 200 cells/ml, indicating late diagnoses of infection. When the CD4 cell count is less than 350 cells/ml, the risk of severe complications increases considerably[36].

For the evaluation of cardiovascular risk, some studies have focused on the research of subclinical data, such as thickening of the intimal layers of the coronary arteries and aorta. In the studies analyzed by Currier *et al.*[37], the mean cardiovascular risk of PLH from the United States, Canada and Europe was 1.5 times higher than that of uninfected patients. Significant thickening of the coronary intimal layer and the presence of atherosclerotic plaques was prevalent in 50% of the HIV-positive population, compared to 23% of the uninfected population. Thus, the analysis of subclinical data points to a higher cardiovascular risk in PLH showing, together with the data mentioned above, that the Framingham Risk Score could have been underestimated in these patients[37].

A model of cardiac risk assessment created in a study for longitudinal assessment of cardiac risk in PLH performed better than the Framingham Risk Score but did not have its validity extended to other out-of-study populations[38]. Although the Framingham Risk Score is not the ideal tool for assessing cardiovascular risk in PLH, it is still the most widely used tool in studies evaluating cardiovascular risk[39].

There was a greater prevalence of patients diagnosed with MS who presented low cardiovascular risk (80% assessed by the IDF criteria and 77.8% by the NCEP-ATPIII criteria), but these patients were significantly younger. Among patients with MS who have low cardiovascular risk, the introduction of ART may worsen dyslipidemia, conferring an increase in cardiovascular risk, since lipid risk factors preceded the initiation of treatment with these drugs.

This study presents limitations mainly regarding the non-exclusion of patients who reported to have used drugs to control dyslipidemia (5%) and other medications that could interfere with the analysis of metabolic disorders. This study used an HIV-positive cohort without the use of ART representative of the population of a specialized infectious diseases center in Southeastern Brazil, so the results of this study may not be generalizable to other PLHs without the use of ART that receive care outside this health system. In addition, the population was predominantly male (75.9%) and statistical difference was observed between the sexes only related to viral load, which was higher among males (21,282 copies/mL *vs.* 12,449 copies/mL; p-value=0.04).

Future studies will explore the impact of metabolic disorders on the initiation of ART and its role as a cardiovascular risk factor, aiming at a better understanding of how these drugs affect patients' lipid metabolism and their impact on the evolution and prognosis of HIV infection.

In our study, it was possible to identify metabolic disorders in the population evidenced mainly by low serum levels of HDL-c, increased triglycerides and abdominal obesity. Disorders in the metabolic profile in this population may be due to HIV infection or lifestyles such as smoking, sedentary lifestyle and inadequate diets, which may be aggravated by exposure to ART.

Based on the data presented, it is concluded that the majority of patients have a low risk of coronary event in 10 years, however, with a high prevalence of dyslipidemia before the initiation of ART. Lipid and glycemic control and the stratification of cardiovascular risk are mandatory in the follow up of these patients, especially amongst patients with MS who have low cardiovascular risk, since the introduction of ART may potentiate dyslipidemia, conferring an increase in the cardiovascular risk.

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Conflict of interest

The authors declare there is no conflict of interest.

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Erratum

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TABLE 2

Demographic and clinical characteristics of PLH without the use of ART according to sex and diagnosis of dyslipidemia

Characteristic	Total n (%)	Men n (%)	Women n (%)	*p-value*	Patients with dyslipidemia n (%)	Patients without dyslipidemia n (%)	*p-value*
Sex		-	-				
female	21 (24.1)	-	-		7 (23.3)	14 (24.6)	**0.89[a]**
male	66 (75.9)	-	-		23 (76.7)	43 (75.4)	
total	87 (100.0)	-	-		30 (100.0)	57 (100.0)	
Age (years)							
mean SD	36.57 (9.38)	35.58 (9.70)	39.71 (7.63)	**0.05[b]**	33.63 (9.04)	38.12 (9.25)	**0.03[b]**
Schooling							
illiterate	3 (3.5)	1 (1.5)	2 (9.5)	**0.05[c]**	1 (3.3)	2 (3.5)	**0.26[c]**
elementary school	16 (18.4)	10 (15.2)	6 (28.6)		2 (6.7)	14 (24.6)	
high school	43 (49.4)	32 (48.5)	11 (52.4)		18 (60)	25 (43.9)	
higher education	25 (28.7)	23 (34.8)	2 (9.5)		9 (30)	16 (28.0)	
Hypertension							
yes	13 (14.9)	10 (15.2)	3 (14.3)	**0.20[c]**	6 (20)	7 (12.3)	**0.22[a]**
no	74 (85.1)	56 (84.8)	18 (85.7)		24 (80)	50 (87.7)	
DM							
yes	2 (2.3)	1 (1.5)	1 (4.8)	**0.38[c]**	0 (0)	2 (3.5)	**0.29[c]**
no	85 (97.7)	65 (98.5)	20 (95.2)		30 (100)	55 (96.5)	
Fasting glycemia							
yes	7 (8)	3 (4.5)	4 (19)	**0.03[c]**	1 (3.3)	6 (10.5)	**0.24[c]**
no	80 (92)	63 (95.5)	17 (81)		29 (96.7)	51 (89.5)	
Smoking							
yes	26 (29.9)	20 (30.3)	6 (28.6)	**0.88[a]**	5 (16.7)	21 (36.8)	**0.05[a]**
no	61 (70.1)	46 (69.7)	15 (71.4)		25 (83.3)	36 (63.2)	
Alcoholism							
yes	56 (64.4)	45 (68.2)	11 (52.4)	**0.18[a]**	21 (70)	35 (61.4)	**0.42[a]**
no	31 (35.6)	21 (31.8)	10 (47.6)		9 (30)	22 (38.6)	

PLH: people living with HIV; **ART:** antiretroviral therapy; **SD:** standard deviation; **DM:** diabetes mellitus; **HIV:** human immunodeficiency virus. [a]Chi-square test. [b]Students t-test. [c]Fisher's exact test.

Should read:

TABLE 2

Demographic and clinical characteristics of PLH without the use of ART according to sex and diagnosis of dyslipidemia

Characteristic	Total n (%)	Men n (%)	Women n (%)	*p-value*	Patients without dyslipidemia n (%)	Patients with dyslipidemia n (%)	*p-value*
Sex		-	-				
female	21 (24.1)	-	-		7 (23.3)	14 (24.6)	**0.89[a]**
male	66 (75.9)	-	-		23 (76.7)	43 (75.4)	
total	87 (100.0)	-	-		30 (100.0)	57 (100.0)	
Age (years)							
mean SD	36.57 (9.38)	35.58 (9.70)	39.71 (7.63)	**0.05[b]**	33.63 (9.04)	38.12 (9.25)	**0.03[b]**
Schooling							
illiterate	3 (3.5)	1 (1.5)	2 (9.5)	**0.05[c]**	1 (3.3)	2 (3.5)	**0.26[c]**
elementary school	16 (18.4)	10 (15.2)	6 (28.6)		2 (6.7)	14 (24.6)	
high school	43 (49.4)	32 (48.5)	11 (52.4)		18 (60)	25 (43.9)	
higher education	25 (28.7)	23 (34.8)	2 (9.5)		9 (30)	16 (28.0)	
Hypertension							
yes	13 (14.9)	10 (15.2)	3 (14.3)	**0.20[c]**	6 (20)	7 (12.3)	**0.22[a]**
no	74 (85.1)	56 (84.8)	18 (85.7)		24 (80)	50 (87.7)	
DM							
yes	2 (2.3)	1 (1.5)	1 (4.8)	**0.38[c]**	0 (0)	2 (3.5)	**0.29[c]**
no	85 (97.7)	65 (98.5)	20 (95.2)		30 (100)	55 (96.5)	
Fasting glycemia							
yes	7 (8)	3 (4.5)	4 (19)	**0.03[c]**	1 (3.3)	6 (10.5)	**0.24[c]**
no	80 (92)	63 (95.5)	17 (81)		29 (96.7)	51 (89.5)	
Smoking							
yes	26 (29.9)	20 (30.3)	6 (28.6)	**0.88[a]**	5 (16.7)	21 (36.8)	**0.05[a]**
no	61 (70.1)	46 (69.7)	15 (71.4)		25 (83.3)	36 (63.2)	
Alcoholism							
yes	56 (64.4)	45 (68.2)	11 (52.4)	**0.18[a]**	21 (70)	35 (61.4)	**0.42[a]**
no	31 (35.6)	21 (31.8)	10 (47.6)		9 (30)	22 (38.6)	

PLH: people living with HIV; **ART:** antiretroviral therapy; **SD:** standard deviation; **DM:** diabetes mellitus; **HIV:** human immunodeficiency virus. [a]Chi-square test. [b]Students t-test. [c]Fisher's exact test.