# CARDIOVASCULAR RISK FACTORS IN HIV-INFECTED PATIENTS ATTENDING A HEALTH FACILITY IN SOUTHWESTERN NIGERIA

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## ABSTRACT

**Background:** The introduction of antiretroviral therapy (ART) has transformed the Human Immunodeficiency Virus and Acquired Immune Deficiency Syndrome (HIV/AIDS) pandemic from a deadly disease to a chronic disease. However, recent studies have shown that as the patients live longer, cardiovascular diseases have increasingly emerged as important complications of its treatment. The ongoing expansion of ART programs requires an assessment of patients' risk factors for cardiovascular diseases in resource-poor settings.

**Objectives:** This study assessed the prevalence of cardiovascular risk factors in HIV negative respondents and ART experienced patients with HIV attending the Wesley Guild Hospital, Ilesa.

**Methods**: A comparative cross-sectional hospital-based study was used to recruit 88 patients, grouped into 44 HIV negative respondents as control and 44 HIV positive respondents on anti retroviral therapy (ART-experienced). A standardised interviewer-administered questionnaire was used to collect data on respondents' socio-demographics, lifestyle behaviours, and co-morbid conditions. Venous blood samples were collected for lipid profiles and glucose estimations. Data were analysed using SPSS version 22. Statistical significance was set at a p-value of $< 0.05$.

**Results**: The mean age of the respondents was 39.27 years (HIV Negative) and 44.20 years (ART- experienced), respectively. The cardiovascular risk factors were Low density lipoprotein (p=0.034), dyslipidaemia (p=0.043), physical activity (p=0.015), and BMI (p=0.014). The comparative cardiovascular risk prevalence were high LDL-c (ART- experienced (22.7%) vs HIV negative group (96.8%), dyslipidaemia (ART- experienced (90.9%) vs HIV negative group (75.0%), inadequate exercise (ART- experienced (50.0%) vs HIV negative group (75.0%), and obese respondents (ART- experienced (18.2%) vs HIV negative group (6.8%).

**Conclusion**: The results support the arguments for a high prevalence of cardiovascular risk factors among patients with HIV on ART in Southwestern Nigeria. The findings call for the implementation of routine cardiovascular risk factors screening and integrated management into the HIV program in Southwestern Nigeria.

**Key Words:** Risk factors, Cardiovascular disease, ART-experienced, Southwest Nigeria.

## Introduction:

The Human Immunodeficiency Virus (HIV) remains a global health problem.[1] In 2019, an estimated 38 million people were living with HIV(PLHIV) globally.[1] Since it was first identified almost four decades ago, there have been over 60 million infections with more than 25 million deaths.[1] Sub-Saharan Africa carries most of the burden of the pandemic, and Nigeria is one of three countries accounting for about forty-eight per cent of all new HIV infections in the continent. [2]Antiretroviral Therapy (ART) is the mainstay of treatment for people living with HIV (PLHIV). [3.] Since its introduction in 1996, morbidity and mortality rates from the infection have declined considerably worldwide.[1] However, as the

patients live longer and suffer less infective complications, non-communicable conditions such as cardiovascular diseases have emerged as important complications of the disease and its treatment.[4]The PLHIV have been shown to have an increased risk of dyslipidaemia, obesity, and alcohol consumption and sedentary lifestyle behaviour compared to the general population.[4] The modelling study has indicated that 84% of HIV- infected patients will have at least one non-communicable disease (NCD) by 2030, with about one-third of HIV patients having three or more NCDs.[5]Heightened cardiovascular (CV) risk has traditionally been associated with factors such as dyslipidaemia, diabetes, hypertension, smoking, sedentary lifestyle, family history, alcohol intake, obesity, and some anthropometric measurements, including waist circumference and waist-hip ratios, in the general population.[6-8]

The risk profiles due to HIV patients on ART may vary in different countries and regions of the world because of differences in diets, genetics, and lifestyles; hence, extrapolating from one region to another is difficult.[6, 8, 9]Conventional risk factors for atherosclerosis such as cigarette smoking also vary in different populations of PLHIV.[5,6]Studies from other countries have shown a high risk of cardiovascular diseases in PLHIV, irrespective of the type of ART that could potentially modify CV risks, such as the age of the population, HIV subtypes, genetics, lifestyle and nutrition.[8,9]

Several studies on CV risk factors among non HIV individuals and ART- experienced HIV /AIDS patients have been reported in western literatures.[10-11]However, there is a paucity of data on this subject in the study area in Southwestern Nigeria. Identifying the cardiovascular risk factors and initiating appropriate intervention where necessary would allow assessment of the impact of ART on CV risk. This study compared the prevalence and risk factors for cardiovascular diseases in ART -experienced with non HIV counterparts in Southwestern Nigeria.

## Study Location

The study was conducted at the outpatient HIV clinic of the Dermato-Venereology department of Wesley Guild Hospital (WGH) in Ilesa, Osun State, Nigeria. The town has a population of 277,904 people as ofthe 2008 census.[12]The inhabitants of Ilesa are mainly of the Yoruba ethnicity, with Hausa and Igbo settlers in the minority. Their major occupations include farming and trading. Wesley Guild Hospital, Ilesa, serves as a primary, secondary and tertiary health facility for patients who come mainly from Ilesa and its surrounding towns and villages. The Hospital is one of the six constituent units of the Obafemi Awolowo University Teaching Hospitals Complex (OAUTHC) Ile-Ife, Osun State.

Every week, about 45 PLHIV are seen in this clinic. These are primarily patients on follow-up appointments, with an average of two to five new patients each week. From available medical records, there were over 400 patients on ART (experienced).

## Study Design

This was a comparative cross-sectional hospital-based study conducted between November 2016 and January 2017. The respondents were grouped into two, the non HIV respondents which served as control group and HIV patients on ART which served as ART-experienced group. A standardised interviewer-administered questionnaire was used to collect data on respondents' socio-demographics, lifestyle behaviours, and co-morbid conditions. Blood samples were also obtained to analyse fasting blood glucose and lipid profiles.

## Study Population

The study respondents were grouped into two.

i. Non HIV individuals (The control group): This group comprised HIV negative respondents as at the time of study.

ii. ART-experienced: This group comprised of HIV-seropositive respondents who had been on ART for at least one year and had a ≥ 95% level of

adherence[13]

**Inclusion Criteria:** Consented HIV-positive respondents who have been on ART for at least one year and non HIV respondents aged 18 years and above.

**Exclusion criteria:** Respondents who were acutely ill requiring admission, on a lipid-lowering drug, and with severe cognitive impairment that might not follow the study protocol. Also, those who were pregnant or lactating mothers since pregnancy may alter some of the study variables such as the body mass index (BMI), blood pressure, fasting blood glucose (FBG) and fasting lipid profile (FLP). Also, all known hypertensive and diabetes patients living with or without HIV at the time of enrolment for this study were excluded.

## Sample Size Determination

**Sample size determination:** This was determined using the formula [14], $n = Z^2 P(1-P)/d^2$

with a prevalence (P) of 2.7% [15] of adults with HIV/AIDS in Osun State, Southwestern Nigeria at 95% confidence interval (CI) and 5% margin of error. In this calculation, Z = 1.96, P = 0.027, 1-P = 0.973, and d = 0.05. This gave a minimum sample size (n) of 40. This was increased to 44 with 10% attrition to cover for dropouts. From the above, 44 was the sample size for the respondents on ART and another 44 apparently healthy individuals were also recruited as control to make 88.

## Sampling Technique

A systematic sampling technique was used to select the respondents. Data from the records department of the clinic gave a sampling frame of 400 patients on ART over the study period. Each of these respondents was seen at least one during the three months of the study, having already been previously scheduled for their routine follow-up visit in line with the National Guideline for their care. Considering the sampling frames and dividing these by the required sample size of 44 respondents gave a sampling interval of four for each of the two groups. On each clinic day, the first respondent was selected by simple random technique, thereafter every fourth respondent was selected by systematic random sampling until the sample size of 44 for each group was achieved. Each selected respondent was given a subject information sheet, and the study details were explained to them. Their right to decline participation or to withdraw from the study at any point in time without any prejudice or penalty was also established. An informed, written consent was thereafter obtained from respondents who met the inclusion criteria and were voluntarily enrolled in the study. This process was continued on subsequent clinic days until the sample size of 44 respondents was enrolled in each group. Recruited respondents had their hospital record cards tagged to prevent re-enrollment during subsequent visits.

## Instruments and Method of Data Collection

The Venereology clinic of the WGH Ilesa runs from 8.00a.m to 4.00p.m every Wednesday. The researcher was present in the clinic on Wednesdays to administer the questionnaire and on Thursdays to take Fasting blood samples during the study period. After consultations, each consecutive eligible patient was informed about the study and an interview was conducted for clients that consented. The instruments used for the study include:

A) A standardised semi-structured interviewer-administered questionnaire. A linguistic professional also translated the questionnaire into Yoruba, and back-translation into English left that version unchanged. The questionnaire had been pretested in a similar study population with adjustments made.

B) A Hana® stadiometer manufactured in Japan was used to measure the weight (in kilograms) and the height (in centimetres) of each respondent. The readings were recorded to the nearest 0.5kg and 0.1cm, respectively.

C) A non - stretchable measuring tape calibrated in centimetres was used to measure the respondent's waist circumference. The measurements were taken at

the approximate midpoint between the lower margin of the last palpable rib and the top of the iliac crest. The hip circumference was taken around the widest portion of the buttocks.

D) An Accoson® brand mercury-in-glass sphygmomanometer and a Lithman's® stethoscope were used to measure the respondents blood pressure. Blood pressures were measured after respondents were seated and rested for at least 10 minutes. The blood pressure measurements were done three times at a minimum of five minutes intervals, and an average of the readings was recorded. The instrument was standardised and rechecked for errors before each usage. After consultation, the respondents were told to fast overnight and present themselves at the hospital laboratory for estimation of their fasting lipid profiles and glucose level

## Procedure for Sample Collection

The blood samples were obtained following an overnight fast of 10 – 12. From each of the samples collected, about 2mls were emptied into a fluoride oxalate bottle for blood glucose estimation, while the remaining 3mls were emptied into a Lithium Heparin bottle for lipid profile analysis. The samples were centrifuged at 1000rpm for 10-15minutes, and the resulting supernatants (plasma) were separated into plain bottles and thereafter analysed.

## Laboratory analysis

All the forms and sample bottles were pre-labelled with the respondent's unique serial numbers. A Chemical Pathologist processed the samples and results. The plasma levels of the participant's total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), and triglycerides (TG) were measured spectro-photometrically using commercially manufactured assay kits by Randox Laboratories Ltd, 55 Diamond Road, County Antrim, BT294QY, United Kingdom. The value of low-density lipoprotein cholesterol (LDL-C) was calculated using the Friedewald formula: LDL = TC – (HDL+TG/2.2).[16] The plasma glucose was estimated using the enzymatic glucose oxidase method, with kits also manufactured by Randox Laboratories Ltd.

## Study Variables

**Alcohol intake and Cigarette smoking:** These were dichotomised based on current consumption status.

**BMI -** Body mass index (BMI) was calculated from the formula: weight (kg) / height ($m^2$). Obesity was defined as a body mass index of ≥30 kg/ $m^2$. The body mass index (BMI) was stratified into the following groups: "Underweight" (BMI <18.50kg/$m^2$), "Normal" (BMI 18.50 - 24.99kg/$m^2$), "Overweight" (BMI 25.00 - 29.99kg/$m^2$)and "Obese" (BMI ≥30.00kg/$m^2$), according to the WHO classification of nutrition.[17]

**Diabetes mellitus:** Diabetes was defined as a fasting blood glucose of ≥ 7.0mmol/l or current use of hypoglycemic medication.

**Dyslipidaemia:** Dyslipidaemia was defined according to the Third Report of the National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) as having one or more of the following: high TC, low HDL-C, high LDL-C, and high TG using the values below, or the use of lipid-lowering drugs.(20)High TC ≥6.22mmol/l (240 mg/dl); high LDL-C ≥ 4.14 mmol/l (160 mg/ dl); low HDL-C ≤ 1.03 mmol/l (40 mg/dl); high TG≥ 2.26 mmol/l (200 mg/dl).[16]

**Fruit and Vegetable Intake:** The average fruit and vegetable taken by every respondent each week were classified into one of two groups. Those whose intake was less than the group Mean ("<Mean days/week") and those whose intake was more than the group Mean ("≥ Mean days/week"), respectively.[18]

**Hypertension:** Hypertension was defined as blood pressure ≥140 mmHg systolic, or ≥90 mmHg diastolic, or current use of antihypertensive medication.

**Occupational status:** The respondents' occupational status was categorised into three. The first group comprised professionals, managers, top civil servants, business people, contractors and middle-level bureaucrats, government employees, and large-scale farmers and traders (shop owners). The second group

comprised artisans, drivers, unskilled workers, small-scale farmers and traders (non-shop owners, petty traders and hawkers), labourers and similar grades. The third group comprised the unemployed, full-time housewives and students.

**Physical Activity:** Was classified as "adequate exercise" if the respondent engages in any vigorous-intensity activity for at least 20 minutes continuously, for a minimum of 3 days a week or any moderate-intensity activity for at least 30 minutes continuously for a minimum of 5 days a week.[18]Otherwise, they were classified under the group "inadequate exercise".

**Waist Circumference -** Abdominal obesity was defined by a waist circumference (WC) greater than 102 cm in men or 88 cm in women.[19]

**Waist-Hip Ratio -** The waist-hip ratio (WHR) was calculated (waist circumference in cm divided by the hip circumference in cm). A waist-hip ratio value of > 0.9 in men and > 0.85 in women was classified as abnormal.[19]

**Ethical Consideration:** Ethical approval for the study was obtained from the Ethics and Research Committee of the institution's study centre (ERC/2016/03/10).An informed, written consent was also obtained from each respondent before recruitment into the study. In addition, assurances were given to each respondent of the highest possible level of confidentiality, privacy and anonymity. All the respondents in the study were informed about the results of the tests that were conducted. The reporting of this study conforms to the strengthening the Reporting of cross-sectional observational studies in Epidemiology (STROBE) statement.[20]

## Data Analysis

Data entry, cleaning and analysis were done using the Statistical Package for Social Sciences (SPSS) software, version 20 (SPSS, Chicago, IL, USA). Continuous variables were expressed as a mean ± standard deviation. Frequencies and percentages were calculated for categorical variables. A Chi-square test was done to assess associations between categorical variables and ART status. Findings were presented in tables and graphs. For all analyses, the level of statistical significance was set at a p-value of <0.05.

## Results:

The age of the subjects ranged from 24 years to 61 years in the HIV negative group, with a mean age of 39.27 years (S.D. 7.78 years) and 23 years to 72 years in the ART - experienced group, with a mean age of 44.20 years (S.D. 10.16 years). A higher proportion of the study respondents were females, with 54.5% and 72.7% in the HIV negative and ART - experienced groups, respectively. There was no statistically significant difference between the two groups of respondents on the basis of their age, sex, marital status, religion and ethnicity. However, the difference between the places of domicile of the two groups was statistically significant, with a larger proportion (79.5%) of the ART -experienced respondents residing in urban areas compared with (54.5%) HIV negative counterparts (p = 0.013), (Table 1).

**Table 1: Relationship between Socio-demographic Characteristics and the respondents study population**

| Socio-demographic variables | ART | | | | $X^2$ | DF | p-value |
|---|---|---|---|---|---|---|---|
| | Control | | Experienced | | | | |
| | n | (%) | n | (%) | | | |
| **Age (Years)** | | | | | | | |
| <40 | 24 | (54.5) | 18 | (40.9) | 1.640 | 1 | 0.200 |
| ≥ 40 | 20 | (45.5) | 26 | (59.1) | | | |
| **Sex** | | | | | | | |
| Male | 20 | (45.5) | 12 | (27.3) | 3.143 | 1 | 0.076 |
| Female | 24 | (54.5) | 32 | (72.7) | | | |
| **Marital Status** | | | | | | | |
| Married | 24 | (54.5) | 28 | (63.6) | 0.752 | 1 | 0.386 |
| Not Married | 20 | (45.5) | 16 | (36.4) | | | |
| **Domicile** | | | | | | | |
| Rural | 20 | (45.5) | 9 | (20.5) | 6.223 | 1 | 0.013* |
| Urban | 24 | (54.5) | 35 | (79.5) | | | |
| **Religion** | | | | | | | |
| Christianity | 37 | (84.1) | 33 | (75.0) | 1.117 | 1 | 0.290 |
| Islam | 7 | (15.9) | 11 | (25.0) | | | |
| **Ethnicity** | | | | | | | |
| Yoruba | 41 | (93.2) | 38 | (86.4) | 1.133[ǂ] | 1 | 0.287 |
| Non-Yoruba [ᵡ] | 3 | (6.8) | 6 | (13.6) | | | |

KEY: *$X^2$=Pearson's chi-square, df=degree of freedom, * = statistically significant, [ǂ] = Fisher's exact value reported, [ᵡ] = Hausa, Ibo and Others.*

The overall prevalence of dyslipidaemia in the study population was 83.0%. The prevalence of dyslipidaemia was significantly higher among the ART - experienced (90.9%) compared with the HIV negative

group (75%). However, this difference was statistically significant in only the LDL-C parameter, with 6.8% HIV negative compared to 22.7% in ART- experienced groups respectively ($p < 0.05$), (Table 2).

KEY: *$X^2$=Pearson's chi-square, df=degree of freedom, * = statistically significant, ‡= Fisher's exact value reported, †= Likelihood ratio used due to a large number of expected count less than 5 in the cells.*

**Table 2: Relationship between the Lipid Profiles and the respondents study population.**

| Lipid Profiles | ART Control n (%) | ART Experienced n (%) | $X^2$ | DF | P-value |
|---|---|---|---|---|---|
| **Total Cholesterol** | | | | | |
| Normal TC | 41 (93.2%) | 39 (88.6%) | 0.55‡ | 1 | 0.713 |
| High TC | 3 (6.8%) | 5 (11.4%) | | | |
| **Triglyceride** | | | | | |
| Normal TG | 44 (100.0%) | 42 (95.5%) | 2.819‡ | 1 | 0.093 |
| High TG | 0 (0.0%) | 2 (4.5%) | | | |
| **HDL Cholesterol** | | | | | |
| Normal HDL-C | 8 (18.2%) | 6 (13.6%) | 0.340 | 1 | 0.560 |
| Low HDL-C | 36 (81.8%) | 38 (86.4%) | | | |
| **LDL Cholesterol** | | | | | |
| Normal LDL-C | 41 (93.2%) | 34 (77.3%) | 4.423‡ | 1 | 0.034* |
| High LDL-C | 3 (6.8%) | 10 (22.7%) | | | |
| **Dyslipidaemia** | | | | | |
| Absent | 11 (25.0%) | 4 (9.1%) | 3.938‡ | 1 | 0.043* |
| Present | 33 (75.0%) | 40 (90.9%) | | | |

A significant proportion of the ART -experienced (50%) had adequate exercise compared to their HIV negative counterparts ( 25.0%), and a statistically significant difference was observed between ART status and adequate exercise in the two groups ( p = 0.015), also there was a statistically significant difference between the BMIs and the ART status in both groups (p=0.014).The results showed that underweight (29.5% in HIV negative) and (6.8% in ART experienced), and obese (6.8% in HIV negative) and (8.2% in ART experienced), (Table 3).

**Table 3: Relationship between Modifiable Risk Factors for Cardiovascular Diseases and the respondents study population**

| Modifiable risk Factors | ART Control n (%) | ART Experienced n (%) | $X^2$ | DF | P-value |
|---|---|---|---|---|---|
| **Physical Activity** | | | | | |
| Inadequate exercise | 33 (75.0) | 22 (50.0) | 5.867 | 1 | 0.015* |
| Adequate exercise | 11 (25.0) | 22 (50.0) | | | |
| **Alcohol Intake** | | | | | |
| Yes | 8 (18.2) | 3 (6.8) | 2.597 | 1 | 0.107 |
| No | 36 (81.8) | 41 (93.2) | | | |
| **Smoking** | | | | | |
| Yes | 3 (6.8) | 0 (0.0) | 4.265‡ | 1 | 0.241 |
| No | 41 (93.2) | 44 (100.0) | | | |
| **Average Fruit Intake** | | | | | |
| < 4 days/week | 22 (50.0) | 16 (36.4) | 1.667 | 1 | 0.197 |
| ≥ 4 days/week | 22 (50.0) | 28 (63.6) | | | |
| **Average Vegetable Intake** | | | | | |
| < 3 days/week | 26 (59.1) | 19 (43.2) | 2.228 | 1 | 0.135 |
| ≥ 3 days/week | 18 (40.9) | 25 (56.8) | | | |
| **BMI** | | | | | |
| Underweight | 13 (29.5) | 3 (6.8) | 10.596† | 3 | 0.014* |
| Normal range | 15 (34.2) | 22 (50.0) | | | |
| Overweight | 13 (29.5) | 11 (25.0) | | | |
| Obese | 3 (6.8) | 8 (18.2) | | | |

KEY: $X^2$=Pearson's chi-square, df=degree of freedom, * = statistically significant, ‡ = Fisher's exact value reported.

**Additional file: Treatment modalities for ART-Experienced for at least one year**

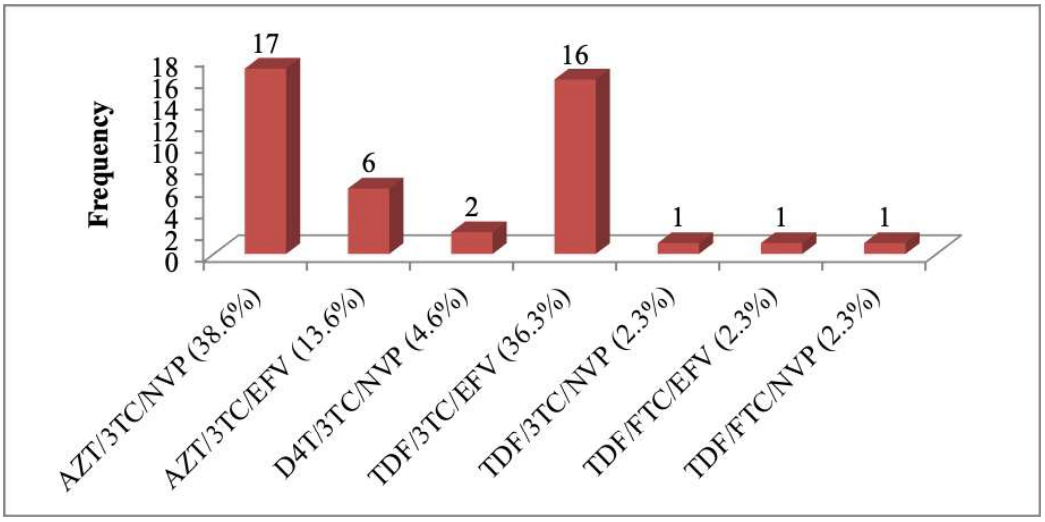


**Figure 1. Types of ART used for treatment.**

KEY: $X^2$=Pearson's chi-square, df=degree of freedom, * = statistically significant, ‡ = Fisher's exact value reported.

## Discussion:

The study explored the risk factors for cardiovascular diseases among ART-experience respondents and compared with HIV negative respondents in Wesley guild hospital, Ilesha, Osun State, Southwest Nigeria. The cardiovascular risk factors observed in the general population are also observed among HIV-infected individuals with an increased incidence of CVD.[7-8,21]The mean age of the respondents in the ART- experienced respondents was higher than the HIV negative respondents in this study. This finding was comparable to results from a similar hospital-based cross-sectional study by Eku et al., where participants had mean ages of 46.14 years and 36.15 years for ART-experienced and HIV negative respondents, respectively.[21]This observation may be due to the positive effect of ART treatment on the experienced group, which probably contributed to improved health-related quality of life and life expectancy, making them likely to be older.[21]

Analysis of the lipid profile of the respondents showed that ART- experienced patients had significantly higher LDL-c when compared to the HIV negative group. The increased prevalence of high LDL-c in the ART-experienced group suggests a link between treatment adherence and body mass index. This finding was consistent with other studies.[21,22] These studies have suggested a positive association between ART treatment and the reduction of CD4 count, improvement in BMI and increased risk of LDL-c. However, this finding was opposite to the reports by Riddler et al.. They suggested that HIV sero-conversion reduced TC and LDL-c in the experienced group compared with the HIV negative group.[23]Though not statistically significant, there was an improved HDL-c in ART experienced respondents. This should not be jettisoned, given the role of low HDL in predicting the athero-protective status of individuals.[21] An improved HDL-c in ART-experienced compared to the HIV negative group may be due to altered lipid metabolism following the initiation of treatment. This finding was consistent with the results of other studies.[21,23,24]These other studies have found that following the commencement of ART, there was a reduction in viral replication and an improvement in immunological status, resulting in raised HDLc level by non-nucleotide reverse transcriptase inhibitors (NNRTI),which provide a beneficial effect on cardiovascular risk factors.

In this study, the overall prevalence of dyslipidaemia in all the studied respondents was higher than the reports of other studies.[7,22]The exclusion of lipid-lowering drugs

in our study may account for the observed differences. The potential influence of lipid-lowering drugs cannot be discounted in study estimates since this was often not reported. Other possible factors that could account for the observed differences in the prevalence and pattern of dyslipidaemia in this study when compared with other studies include the age distribution of the subjects, the types of ART used and durations of ART.[25] Even when exposed to the same ART regimen, patients still develop varying degrees and patterns of dyslipidaemia, despite having similar demographic, immunologic and virologic characteristics.[25] The differences in the development of dyslipidaemia among this group of patients may be due partly to host genetic characteristics and eating habits.[25]The ART-experienced group had a relatively higher percentage of respondents with dyslipidaemia compared with the HIV negative group. This may be due to the observed higher LDL-cin the ART-experienced respondents in this study. Previous studies have linked increased LDL-c as the most significant contributor factor to dyslipidaemia.[21,25,26]This study's finding is consistent with the cross-sectional study in Jos by Daniyam and Iroezindu in 2013, where they described a significantly higher proportion of HDL-c in their HIV-positive subjects compared with negative controls as a contributor to higher dyslipidaemia observed in their study.[27]

In this study, the overall prevalence of physical activity in the respondents was comparable to the 66% reported in Nigeria by Edward *et al*.[28] This may be due to similarity in the study design, study population, and socioeconomic status.[4] However, our finding was higher than 36.3% reported by Edwards-Jackson *et al.* in a similar Thailand study.[29] The higher prevalence of physical activity in our study may be due to the involvement of rural dwellers compared to the other study, whose population was mainly urban residents. The previous study found rural dwellers to be involved in long trekking distances to their workplace due to poor transport systems.[4] A significant proportion of the ART-experienced respondents had adequate exercise compared to their HIV negative counterparts. This was probably a consequence of the health education and counselling the ART-experienced respondents must have received over time due to their increased interface with the health system.

Weight loss has always been a part of the natural history of HIV infection. However, many authors have recently begun to draw attention to the increasing prevalence of overweight and obesity in ART-experienced individuals.[30]The prevalence of overweight and obesity in our study population was comparable to the 32.8% reported by Edward *et al.*[28]in another study. However, it was higher than the 19.0% described by Muronya *et al*. in a study in Malawi.31The observed difference between our study and the study in Malawi may be related to the socio-demographic characteristics, study design and population. In this study, the control group were found to have a higher proportion of underweight respondents and a lower proportion with obesity compared with the ART-experienced group. This is consistent with findings in similar local studies in Nigeria.[21,28]The increased prevalence of overweight and obesity in ART-experience compared to the control group in this group may be a positive effect of the treatment.[21]The weight gain in ART-experienced in this study may be a side effect of ART. HIV infection and obesity are pro-inflammatory conditions that, when occurring together, may pose a synergistic risk for cardiovascular disease.[30]Increase in BMI, even in the short-term following ART initiation, has been shown to heighten the long-term risk of CVDs and diabetes.[30,31]Our findings suggest that weight assessment and management programs should be part of routine HIV clinical care. However, the observed prevalence of overweight and obesity in the ART- experienced respondents in our study population was higher than the 32% reported in a similar group of ART-experienced subjects in Abidjan.[31] it is imperative to remember that an individual's weight is also

influenced by other factors, including genetics, diet, as well as economic and socio-cultural factors.

The assessment and treatment of HIV-associated cardiovascular diseases should be an integral part of a general attempt to improve health in PLHIV. The findings in this study call for the inclusion of cardiovascular risk assessment as an integral part of the care element in PLHIV. These patients will require advice on a balanced diet, increased physical exercise, smoking cessation, and management of hypertension and diabetes to improve their quality of life.

**Limitations:** This study was limited in its cross-sectional design, as findings could not demonstrate any causal relationship between cardiovascular risk factors and HIV status in the two groups. Also, our study did not adjust for other potential confounding factors, such as socioeconomic status and a family history of cardiovascular risk factors. Therefore, a prospective population-based cohort study may be needed in the future to validate these findings.

## Conclusion:

The modifiable risk factors for cardiovascular diseases that were identified in the study were high LDL-c (ART-experienced - 22.7% vs control group - 96.8%), dyslipidaemia (ART- experienced - 90.9% vs control group - 75.0%), inadequate exercise (ART-experienced - 50.0% vs control group - 75.0%), and obesity (ART- experienced - 18.2% vs control group - 6.8%).The findings call for implementing routine cardiovascular risk factors screening and integrating this into the routine HIV management program in Southwestern Nigeria.

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