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Dyslipidaemia and Its Correlates Among People Living with Human Immunodeficiency Virus in Yenagoa, Southern Nigeria

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Abstract: People living with HIV/AIDS (PLWHA) are at risk of cardiovascular disease (CVD) morbidity and mortality linked to dyslipidaemia because of plasma lipids alterations. Understanding the magnitude of dyslipidaemia and its correlates is essential for the CVD risk reduction in this population. We conducted this study to determine the prevalence and types of dyslipidaemia, sociodemographic, lifestyle characteristics and selected comorbidities among PLWHA in Yenagoa, Southern Nigeria. This is a cross-sectional study among 278 PLWHA, aged 18 years and above receiving the HIV-laboratory services of the Federal Medical Centre, Yenagoa from March through April 2017. We collected respondents' sociodemographic data, lifestyle characteristics and selected comorbidities using an interviewer-administered, semi-structured questionnaire adapted from the WHO STEPS instrument. We collected venous blood and assayed for Total Cholesterol (TC), Triglycerides (TG), and High-Density Lipoprotein Cholesterol (HDL-C) using Selectra ProS Chemistry Analyzer and calculated Low-Density Lipoprotein Cholesterol (LDL-C) with Friedewald formula. We measured height and weight and calculated for body mass index, and retrieved CD4+ T-cell count results from the HIV-laboratory workbook. We analyzed the data with Epi Info 7.2 and did a multivariable logistic regression analysis to identify factors associated with dyslipidaemia at 95% confidence level. Respondents mean age was 40.0±8.8 years, 104 (37.4%) were aged 35-44 years, 192 (69.1%) were females and 152 (54.7%) were married or living with a partner. The prevalence of dyslipidaemia was 48.6%. Seventy-six (27.3%) of the respondents had decreased HDL-C as the most prevalent type of dyslipidaemia. Those engaged in harmful alcohol intake were 26 (9.4%), smokers 28 (10.1%), hypertensive 52 (18.7%) while 244 (87.8%) were on antiretroviral therapy. Predictors of dyslipidaemia were age 45-64 years [AOR=2.43 (95%CI: 1.20-4.92)], being married or living with a partner [AOR=1.72 (95%CI: 1.01-2.91)] and being physically inactive and overweight or obese [POR=5.71 (95%CI: 1.76-18.51)]. This study showed that dyslipidaemia was common among the PLWHA in Yenagoa, Nigeria, with decreased HDL-C as the most prevalent type. Being older than 45 years, married or living with a partner or being physically inactive and overweight or obese appears to be the major predictors of dyslipidaemia. There is a need to sustain the lifestyle counselling and laboratory monitoring of lipids among the PLWHA in Yenagoa, Southern Nigeria.

Keywords: Dyslipidaemia, Hypercholesterolaemia, Hypertriglyceridaemia, Low-density Lipoprotein Cholesterol, High-Density Lipoprotein Cholesterol, HIV/AIDS

1. Introduction

Human immunodeficiency virus (HIV) infection and acquired immune deficiency syndrome (AIDS) is a problem of public health concern worldwide. In 2017, of the 36.9 million people who lived with HIV/AIDS worldwide, Western and Central Africa accounted for 6.1 million, of which about 280,000 died from AIDS-related illnesses [1]. In Nigeria, about 3.2 million persons lived with HIV/AIDS in 2017 and close to 150,000 died from AIDS-related illness [2]. The HIV prevalence was highest in the South-South zone (5.5%) [2], with Bayelsa State accounting 2.7% [3]. In developing countries including Nigeria, the daily HIV/AIDS-related mortalities of about 20.0% were connected to cardiovascular diseases (CVD) [4]. According to the 2001 to 2012 HIV data examined in New York City, 10.0% of the 29,326 deaths reported among the PLWHA were connected to CVD [5]. The increased risk of CVD morbidity and mortality among PLWHA were in turn connected to dyslipidaemia [6–8] and other metabolic factors. HIV infection increases liver lipogenesis [9] and the metabolic changes from the disturbance in the metabolism of lipids lead to dyslipidaemia, which may promote atherogenesis and increase the risk of CVD [10].

The increased severity of dyslipidaemia was connected to different classes of antiretroviral drugs [11] and the mechanisms responsible for the dyslipidaemia been described. However, the pathogenesis of dyslipidaemia connected with antiretroviral therapy (ART) is multifaceted and not fully understood [12]. Though the new generation of antiretroviral drugs was reported to decrease these adverse effects [13], dyslipidaemia still exists among PLWHA as was demonstrated by the Spanish cohort study which showed hypercholesterolaemia in 27.8%, decreased high-density lipoprotein cholesterol (HDL-C) in 36.1%, and hypertriglyceridaemia in 19.0% of the participants [14]. A hospital-based survey of adult PLWHA and recruited HIV-negative controls in Jos, Nigeria showed dyslipidaemia of 63.7% and 6.0% as one of the prevalent CVD risk factors of the subjects against controls [15]. In addition, a study among PLWHA in Cameroun reported a dyslipidaemia prevalence of 70.2%, hypercholesterolaemia in 29.8%, elevated low-density lipoprotein cholesterol (LDL-C) in 33.3%, hypertriglyceridaemia in 51.8% and decreased HDL-C in 18.4% of the respondents. On the basis of these findings, the authors concluded that a high prevalence of dyslipidaemia exists among the PLWHA who are on ART and suggested the need for laboratory monitoring of lipids for patients in their third year of the first-line ART [8]. Nevertheless, dyslipidaemia does not show in everyone who takes these drugs [16]. This suggests the contribution of patient factors to its development, for the magnitude of dyslipidaemia induced by the use of antiretroviral drugs, could vary across populations and settings [7, 17]. But to what extent the dyslipidaemia is associated with specific patient factors is unclear [18]. In addition, the mechanisms responsible for it are complex and not fully understood [19]. Determination of the magnitude of dyslipidaemia and its correlates in a population is essential for planning of strategies for effective prevention and reduction of the risk of CVD morbidity and mortality connected to dyslipidaemia [20]. However, there is a paucity of data on the magnitude of dyslipidaemia and its correlates among the HIV-infected population of Yenagoa, Southern Nigeria. In view of the contribution of dyslipidaemia to the increased risk of CVD morbidity and mortality among PLWHA, we conducted this study to determine the prevalence and types of dyslipidaemia, and the associated sociodemographic, lifestyle characteristics and selected comorbidities among the PLWHA in Yenagoa, Bayelsa State. Findings from this study will help to guide in the counselling and the laboratory monitoring of lipids to the prevention and control of dyslipidaemia, CVD morbidity and mortality among the PLWHA in Yenagoa, Southern Nigeria.

Operational Definitions

Physical inactivity was regarded as less than five times of 30 minutes of moderate activity per week, or less than three times 20 minutes of vigorous activity per week [21].

A family history of CVD was defined as having a first-degree relative (mother, father, brother or sister) who had a heart attack or stroke before 60 years [22].

Harmful alcohol consumption was defined as binge drinking of ≥3 units or drinks of alcohol in males and ≥2 drinks in females in one day [23] within one year.

Tobacco use was defined as current or previous use of cigarettes for the past five years [5].

Insufficient intake of fruits and/or vegetables was regarded as less than five servings/portions of fruits or dish of vegetables in the diet of the participant per day [24].

2. Materials and Methods

2.1. Study Setting

We conducted this study in the HIV-laboratory of the Federal Medical Centre (FMC) Yenagoa, Bayelsa State, Nigeria. It is the major health facility in Bayelsa State and renders healthcare services to clients from within and neighbouring states. The HIV-laboratory is supported by Family Health International (FHI 360) technically and materially. The analysis of blood samples for the routine cluster of differentiation (CD4+) T-cell count and viral load of PLWHA are in the HIV-laboratory. PLWHA come for laboratory services on Mondays through Fridays of the week with an average of 140 patients per month. The laboratory renders services to both old and new cases of HIV infection including adults and children.

2.2. Study Design and Population

This was a cross-sectional study among PLWHA receiving laboratory service of FMC, Yenagoa, Bayelsa State Nigeria.

2.2.1. Inclusion Criteria

Both old and newly diagnosed PLWHA, aged 18 years and above who came for the routine CD4+ T-cell count monitoring at the HIV-Laboratory of FMC, Yenagoa in Bayelsa State.

2.2.2. Exclusion Criteria

Those who were pregnant, critically ill, diagnosed with coronary heart disease and physically or mentally challenged due to ethical concerns.

2.3. Sample Size Determination and Sampling Techniques

The sample size (n=278) was estimated with the assumption of an expected LDL-C prevalence of 19.2% from a previous study in Nigeria [25], the precision of 5%, a standard normal deviate of 1.96 at 95% confidence level and compensated for a non-response rate of 10%. We then consecutively recruited respondents who met the inclusion criteria into the study from March through April 2017.

2.4. Training of Research Assistants and Pretesting of Questionnaire

Prior to the survey, we trained three Medical Laboratory Scientists for two days as research assistants on the collection of the sociodemographic data, lifestyle characteristics, and selected co-morbidities. The training was centred on the measurement of height and weight, administration of the questionnaire, interpretation of the questions, translation of the questions using Pidgin English, and confidentiality. The questionnaire was pretested on 28 PLWHA at the Diete Koki Memorial Hospital, Opolo in Yenagoa, Bayelsa State by those trained under the supervision of the principal investigator. This was to detect ambiguities and duration of administering the questionnaire. All ambiguous questions were corrected in order to obtain the right response from the respondents.

2.5. Data Collection Methods

2.5.1. Respondents Characteristics

An interviewer-administered semi-structured questionnaire adapted from the World Health Organization (WHO) STEPS instrument [26] was used to collect respondents' sociodemographic data, lifestyle characteristics, and selected comorbidities.

2.5.2. Blood Sample Collection and Laboratory Investigations

After the administration of the questionnaire, 3.0 mL of venous blood was aseptically collected from the respondents using Tri-potassium Ethylene Diamine Tetra-acetic Acid (K_3EDTA) anticoagulated vacutainers. The plasma was then separated and stored at -20°C before analysis. We assayed the plasma for HDL-C, Triglycerides (TG) and Total Cholesterol (TC) using Selectra ProS Chemistry Analyzer (Elitech Group, Italy). The procedures were as described by the manufacturer of the kit (Elitech). LDL-C was calculated using the Friedewald formula [LDL-C (mmol/L)=TC-(TG/2.2 + HDL-C)] for respondents with a TG<4.50 mmol/L [27].

2.5.3. Physical Measurements

The measuring tape (Komelon PG85 8m by 25mm Metric Gripper Tape, USA) was used to measure height without shoes with the respondent standing upright and recorded to the nearest 0.5 centimetres. Weight was measured with a calibrated weighing scale (Camry Personal Scale, Model: BR9015A, Colombo). The readings were measured to the nearest 0.5 kilograms. We calculated the body mass index (BMI) for each respondent by dividing weight (kilogrammes) with height (metres squared). Overweight or obesity was defined as a BMI>24.9kg/m^2.

2.6. Study Variables

2.6.1. Dependent Variables

The dependent variable was dyslipidaemia. It was defined as the presence of one or more of the following conditions: hypercholesterolaemia (plasma TC≥5.18mmol/L); hypertriglyceridaemia (TG≥1.70mmol/L); decreased HDL-C (HDL-C≤1.04mmol/L) or elevated LDL-C (LDL-C≥3.44mmol/L) in accordance with the United States National Cholesterol Education Programme, Adult Treatment Panel III (NCEP-ATP III) [28].

2.6.2. Independent Variables

These were the sociodemographic data (age, sex, marital status, employment, education, monthly income), lifestyle characteristics (tobacco use, alcohol intake, physical activity, consumption of fruits and/or vegetables in the daily diet) and the selected comorbidities (hypertension, diabetes mellitus, overweight or obesity, use of ART, CD4+ T-cell counts results, family history of CVD).

2.7. Data Analysis

We analyzed the data with Epi Info version 7.2 (CDC, Atlanta, USA). Descriptive statistics of the continuous variable (age) was summarized as mean and standard deviation while categorical variables were summarized as frequencies, proportions, and presented as tables and a chart. Prevalence Odds Ratio (POR) from the bivariate analysis was used to assess the association between the dependent categorical variable (dyslipidaemia) and the independent categorical variables (sociodemographic data, lifestyle characteristics and selected comorbidities). After stratification to check for interaction and to protect against residual confounding, all variables of known clinical importance and p<0.25 during the bivariate analysis were selected and entered into a multivariable logistic regression analysis to adjust for confounding at 95% confidence level.

2.8. Ethical Considerations

Ethical approval for this study was obtained from the FMC, Yenagoa, Bayelsa State Ethics Review Committee, number: FMCY/REC/ECC/2017/JAN/013. We obtained written and verbal informed consent from the respondents ensuring

confidentiality and anonymity. We gave the respondents a study identification number and used this number on the forms and the laboratory specimens.

3. Results

3.1. Characteristics of the PLWHA in Yenagoa, Southern Nigeria

Of the 278 respondents with a mean age of 40.0±8.8 years, 192 (69.1%) were females while 152 (54.7%) were currently married or living with a partner. Two hundred and fourteen (77.0%) had at least a secondary school education while 207 (74.5%) were unemployed. Twenty-eight (10.1%) were current tobacco users while 26 (9.4%) were involved in harmful alcohol intake. Nineteen (6.8%) of the respondents were diabetic while 52 (18.7%) were hypertensive (Table 1).

3.2. Prevalence and Types of Dyslipidaemia Among the PLWHA in Yenagoa, Southern Nigeria

Dyslipidaemia occurred in 135 (48.6%) of the respondents. Seventy-six (27.3%) of the respondents had decreased HDL-C as the most prevalent type of dyslipidaemia, 47 (16.9%) had hypercholesterolaemia (TC≥5.18mmol/L) while 59 (21.2%) had hypertriglyceridaemia (TG≥1.70mmol/L) (Figure 1).

3.3. Association Between Dyslipidaemia and Characteristics of the PLWHA in Yenagoa, Southern Nigeria

Of the 95 respondents between 45 and 64 years, 56 (59.0%) had dyslipidaemia. Of those who had at most a primary school education, 37 (57.8%) had dyslipidaemia while 41 (57.8%) of those who were gainfully employed had dyslipidaemia. Eighty-three (54.6%) of those who were married or living with a partner and 70 (42.7%) of those with monthly income less than N18,000.00 presented with dyslipidaemia. Those in the age group 45-64 years had 2.77 times the odds of having dyslipidaemia (POR=2.77, 95%CI: 1.49-5.14) compared to those of the age group 25-34 years. Also, those who were currently married or living with a partner had 1.71 times the odds of having dyslipidaemia (POR=1.71, 95%CI: 1.06–2.76) compared to those who were not currently married or living with a partner. Similarly, those who were physically inactive and overweight or obese had 5.71 times the odds of having dyslipidaemia (POR=5.71, 95%CI: 1.76-18.51) compared to those were physically active and were overweight or obese. But those with a monthly income<N18,000.00 had a 44% reduction in the odds of having dyslipidaemia (POR=0.56, 95%CI: 0.35–0.91) compared to those with monthly income≥N18,000.00 (Table 2).

Table 1. *Characteristics of the PLWHA in Yenagoa, Southern Nigeria (N=278).*

Characteristics	Frequency	Percent
Age-group (years)		
25-34	78	28.0
35-44	105	37.8
45-54	77	27.7
55-64	18	6.5
Sex		
Female	192	69.1
Male	86	30.9
Education		
≤Primary	64	23.0
≥Secondary	214	77.0
Employment		
Unemployed	206	74.1
Employed	72	25.9
Marital Status		
Currently Married/ Partner	153	55.0
Not Currently Married	125	45.0
Monthly Income		
<₦18,000.00	163	58.6
≥₦18,000.00	115	41.4
Alcohol Use		
Harmful	26	9.4
Not Harmful	252	90.6
Tobacco Use		
Yes	28	10.1
No	250	89.9
Physical Activity		
Inactive	53	19.1
Active	225	80.9
Intake of Fruits &/or Vegetables		
Inadequate	174	62.6
Adequate	104	37.4
Diabetes Mellitus		
Yes	19	6.8
No	259	93.2
Hypertensive		
Yes	52	18.7
No	226	81.3
Overweight or Obese		
BMI>24.9Kg/m^2	95	34.2
BMI≤24.9Kg/m^2	183	65.8
CD4+ Count Result		
<350 Cells/μL	92	33.1
≥350 Cells/μL	186	66.9
Use of ART		
Yes	244	87.8
No	34	12.2
Family History of CVD		
Yes	18	6.5
No	260	93.5

ART=Antiretroviral Therapy, BMI=Body Mass Index, CVD=Cardiovascular Diseases, CD=Cluster of differentiation.

3.4. Predictors of Dyslipidaemia among the PLWHA in Yenagoa, Southern Nigeria

Among the PLWHA, age group 45-64 years (AOR=2.43, 95%CI: 1.20–4.92), being married or living with a partner (AOR=1.72, 95%CI: 1.01–2.91) and being physically inactive and overweight or obese (AOR=5.71. 95%CI: 1.76-18.51) were predictors of dyslipidaemia (Table 2).

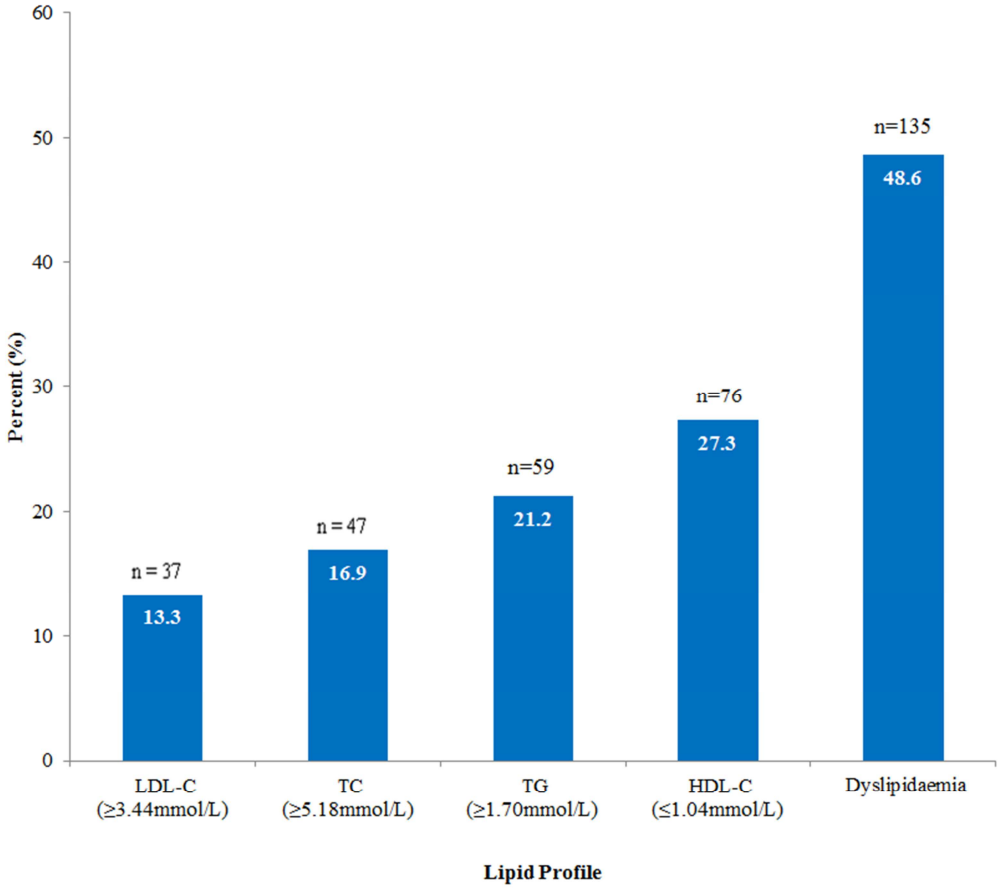

Figure 1. *Prevalence and types of dyslipidaemia among the PLWHA in Yenagoa, Southern Nigeria.*

Table 2. *Association between Dyslipidaemia and Characteristics of the PLWHA in Yenagoa, Southern Nigeria.*

Characteristics	Total	Dyslipidaemia	Bivariate Analysis	Multivariable Analysis
	N=278	N (%)	POR (95%CI)	AOR (95%CI)
Age-group (years)				
25-34	79	27 (34.2)	1	1
35-44	104	52 (50.0)	1.93 (1.05–3.52)	1.73 (0.91–3.32)
45-64	95	56 (59.0)	2.77 (1.49-5.14)	2.43 (1.20-4.92)*
Sex				
Female	192	89 (46.4)	1	1
Male	86	46 (53.5)	1.33 (0.80–2.22)	1.06 (0.57-1.97)
Education				
≥Secondary School	214	98 (45.8)	1	1
≤Primary School	64	37 (57.8)	1.62 (0.92–2.85)	1.69 (0.88–3.22)
Employment				
Employed	71	41 (57.8)	1	1
Unemployed	207	94 (45.4)	0.61 (0.35–1.05)	0.72 (0.37-1.44)
Marital Status				
Not Married	126	52 (41.3)	1	1
Married/Partner	152	83 (54.6)	1.71 (1.06–2.76)	1.72 (1.01–2.91)*
Monthly Income				
≥₦18000.00	114	65 (57.0)	1	1
<₦18000.00	164	70 (42.7)	0.56 (0.35–0.91)	0.70 (0.38–1.28)
Alcohol Use				
Not Harmful	252	125 (49.6)	1	1
Harmful	26	10 (38.5)	0.64 (0.28–1.45)	0.69 (0.27–1.76)
Tobacco Use				
No	250	121 (48.2)	1	1
Yes	28	14 (48.2)	1.07 (0.49–2.33)	1.13 (0.45–2.85)
Fruits/Vegetables				
Adequate	103	49 (47.6)	1	1

Characteristics	Total	Dyslipidaemia	Bivariate Analysis	Multivariable Analysis
	N=278	N (%)	POR (95%CI)	AOR (95%CI)
Inadequate	175	86 (49.1)	1.07 (0.65–1.73)	1.05 (0.61–1.79)
Diabetes Mellitus				
No	259	126 (48.7)	1	1
Yes	19	9 (47.4)	0.95 (0.37–2.42)	0.95 (0.35–2.55)
Hypertensive				
No	226	109 (48.2)	1	1
Yes	52	26 (50.0)	1.07 (0.59–1.96)	0.84 (0.43–1.65)
Physically Active				
BMI≤24.9Kg/m^2	154	73 (47.4)	1	-
BMI>24.9Kg/m^2	70	35 (50.0)	1.11 (0.63–1.95)	-
Physically Inactive				
BMI≤24.9Kg/m^2	29	9 (31.0)	1	-
BMI>24.9Kg/m^2	25	18 (72.0)	5.71 (1.76-18.51)	-
CD4+T-cell Count				
≥350cells/μL	186	86 (46.2)	1	1
<350cells/μL	92	49 (53.3)	1.33 (0.80–2.19)	1.15 (0.67-1.98)
Use of ART				
No	34	19 (55.9)	1	1
Yes	244	116 (47.5)	0.72 (0.35–1.47)	0.61 (0.28–1.35)
Fam. Hist. of CVD				
No	260	127 (48.9)	1	1
Yes	18	8 (44.4)	0.84 (0.32–2.19)	0.79 (0.28-2.24)

*Statistically significant at p<0.05, POR=Prevalence Odds Ratio, AOR=Adjusted Odds Ratio, BMI=Body Mass Index, CD4+=Cluster of Differentiation, ART=Antiretroviral Therapy, CVD=Cardiovascular Disease.

4. Discussion

This study has demonstrated dyslipidaemia of 48.6% among the PLWHA in Yenagoa, Bayelsa State, Southern Nigeria. The magnitude of dyslipidaemia was different from the 63.7% reported by Amusa and colleagues in 2012 among PLWHA in Jos, Nigeria [15] and the 70.2% reported in Cameroun [8]. This difference may be attributed to the difference in populations and settings, as the magnitude of dyslipidaemia induced by ART could vary across populations and settings [17]. In this study, a decreased HDL-C level was the most prevalent type of dyslipidaemia reported as an important risk factor for CVD. The observed decrease in HDL-C reported in this study is lower than the decreased HDL-C reported among PLWHA in Osun State, Nigeria [6]. The decreased HDL-C may be as a result of the HIV infection directly affecting the metabolism of HDL-C by up-regulating the activity of cholesteryl ester transfer protein, which facilitates the transfer of cholesterol to apolipoprotein B that promotes atherogenesis, thus placing PLWHA at risk of CVD [29]. On the basis of the anti-inflammatory and antioxidant effects of HDL-C [30], the decreased HDL-C level reported in this study may be a pointer that PLWHA in Yenagoa, Bayelsa State is at risk of CVD in the future.

The hypercholesterolaemia in 16.9% of the PLWHA in this study is higher when compared with a previous work which reported hypercholesterolaemia in 6.0% among PLWHA [31]. However, the finding from this report is lower when compared with Edward and colleagues, which reported hypercholesterolaemia of 33.6% in a similar population [6]. This difference may be because of the slight difference in cut-off points used in these studies as this may affect the outcome. But the hypertriglyceridaemia in 21.2% of the respondents in this study was similar to the 19.5% reported among PLWHA in Cameroun [17]. This similarity may suggest that levels of TG are not likely influenced by differences in geographical location among blacks and people of African descent, as they are observed to have normal levels of TG even in the presence of decreased HDL-C compared to non-African descent, a phenomenon referred to as "triglyceride paradox"[32]. The similarities of triglyceridaemia among people of African descent could be attributed to the expression of higher lipoprotein lipase (LPL) activity, LPL activity uninhibited by insulin resistance and lower levels of apolipoprotein C III activity which inhibits LPL activity in blacks compared to Caucasians [32]. The finding from this report corroborates a previous study which evaluated the lipid profile pattern of PLWHA in Nigeria [33]. The authors observed that the most prevalent dyslipidaemia was decreased HDL-C and normal TG level. This observation showed that even though the level of TG is similar or normal among blacks, a decreased HDL-C level may be a pointer to a potential risk of developing CVD in the future in this population of this study. Decreased HDL-C is atherogenic. The inductive effect of HIV infection on the function of HDL-C and transportation of cholesterol may contribute to high rates of CVD among PLWHA [18], this is because HDL-C has an anti-inflammatory and antioxidant effect [30].

This study showed that older age (45-64 years) was one of the predictors of dyslipidaemia. This finding is similar to the study conducted in Addis Ababa, Ethiopia where PLWHA older than age 40 years were more likely to have dyslipidaemia [34]. This was further supported by the association between hypercholesterolaemia and advanced age among PLWHA in rural south-western Uganda [32], for the association of hypercholesterolaemia with increased age is well-known. In addition, this finding is consistent with the known fact that increase in age leads to CVD due to the

subtle physiologic changes the heart undergoes even in the absence of disease [21]. Studies have shown that as the individual age advances, pro-atherogenic lipid profile also increases [35] predisposing those with advancing age to CVD. However, this finding contradicts a previous study that reported no association between abnormal lipid profile and age. This discrepancy may be attributed to the poor categorization of age as stated by the authors [8].

Results from this study show that being married or living with a partner is a predictor of dyslipidaemia. This observation is supported by a community-based survey of PLWHA in Uganda which found an association between being married and hypercholesterolaemia [30]. This may be due to a subtle difference in physical activities and lifestyle between those who were married or living with a partner and unmarried individuals. In addition, findings from this study showed that being physically inactive and overweight or obese is a predictor of dyslipidaemia. This finding is consistent with known knowledge that a sedentary lifestyle and overweight or obesity are risk factors of dyslipidaemia [21]. Though poverty is a well-known CVD risk factor, findings from this study, showed no significant association between monthly income (<N18,000.00) and dyslipidaemia after adjusting for other factors. The absence of a significant association between monthly income and dyslipidaemia agrees with a previous study in Cameroon [8]. This suggests that its association with dyslipidaemia is not significant in this setting. This may be that despite the low monthly income below the country's minimum wage by the majority of the respondents, they are not in abject poverty. This is as shown by the initial protective association the low monthly income had on dyslipidaemia. They engaged in activities like small-scale business, subsistence farming, and fishing to improve their livelihood to reduce the impact of monthly income below the country's minimum wage.

This study is not without its limitations. Some respondents might not have been in the fasting state before sample collection and this might have slightly affected the plasma TG level. The duration of ART was not part of the data collected hence; the association with dyslipidaemia in terms of duration could not be analyzed. More so, this is a cross-sectional study, consequently, the association cannot establish causality. In addition, the self-reported data obtained from the questionnaire may be inaccurate.

5. Conclusion

This study showed that dyslipidaemia was common among the PLWHA in Yenagoa, Bayelsa State, Southern Nigeria with decreased HDL-C as the most prevalent type. Being older than 45 years, married or living with a partner or being overweight or obese and physically inactive appears to be the major predictors of dyslipidaemia. There is a need to sustain the lifestyle counselling and laboratory monitoring of lipids among PLWHA in Yenagoa, Bayelsa State.

Author Contributions

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Project Administration	Bountain W. Tebeda
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Conflict of Interest

The Authors has no conflict of interest.

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References

[1] Sheet F, Day WA, People V. 2017 Global HIV Statistics. 2018: 1-6.

[2] AVERT. HIV and AIDS in Nigeria. 2017.

[3] National Agency for the Control of AIDS, Federal Republic of Nigeria. Global AIDS Response Country Progress Report.

[4] Kengne A. P., June-Rose Mchiza Z., Amoah A. G. B., Mbanya J. C. Cardiovascular Diseases and Diabetes as Economic and Developmental Challenges in Africa. Progress in Cardiovascular Diseases. 2013; 56 (3): 302-313.

[5] Hanna D. B., Ramaswamy C., Kaplan RC, et al. Trends in Cardiovascular Disease Mortality among Persons with HIV in New York City, 2001-2012. Clinical Infectious Diseases. 2016; 63 (8): 1122-1129.

[6] Edward A. O., Oladayo A. A., Omolola A. S., Adetiloye A. A., Adedayo P. A. Prevalence of Traditional Cardiovascular Risk Factors and Evaluation of Cardiovascular Risk using three Risk Equations in Nigerians Living with Human Immunodeficiency Virus. North American Journal of Medical Sciences. 2013; 5 (12): 680-688.

[7] Nsagha D. S., Assob J. C. N., Njunda A. L., Tanue E. A., Kibu O. D., Ayima C. W., Ngowe M. N. Risk Factors of Cardiovascular Diseases in HIV/AIDS Patients on HAART. Open AIDS Journal. 2015; 9 (June 2012): 51-59.

[8] Bekolo C. E., Nguena M. B., Ewane L, Bekoule P. S., Kollo B. The Lipid Profile of HIV-Infected Patients Receiving Antiretroviral Therapy in a Rural Cameroonian Population. BMC Public Health. 2014; 14 (1): 236-239.

[9] Francesco F., Noemi B., Massimo M. Cardiovascular Risk Factors and HIV Disease. AIDS Rev. 2011; 13: 119-129.

[10] Melzi S., Carenzi L., Cossu M. V., Passerini S., Capetti A., Rizzardini G. Lipid Metabolism and Cardiovascular Risk in HIV-1 Infection and HAART: Present and future problems. Cholesterol. 2010.

[11] Fontas E., van Leth F., Sabin C., Friis-Moller N., Rickenbach M., d'Arminio Monforte A., Reiss P. Lipid Profiles in HIV-infected patients receiving combination antiretroviral therapy: are different antiretroviral drugs associated with different lipid profiles? Journal of Infectious Diseases. 2004; 189 (6): 1056-1074.

[12] Estrada V. and Portilla J. Dyslipidemia related to antiretroviral therapy. AIDS Reviews. 2011; 13 (1): 49-56.

[13] Hemkens L. G. and Bucher H. Infection and cardiovascular disease. European Heart Journal. 2014; 35 (21): 1373–1381.

[14] Masiá M., Pérez-Cachafeiro S., Leyes M, et al. Riesgo cardiovascular en pacientes con infección por el virus de la inmunodeficiencia humana en España. Cohorte CoRIS, 2011. Enferm Infecc Microbiol Clin. 2012; 30 (9): 517-527.

[15] Amusa G. A., Awokola B. I., Akanbi M. O., Onuh J. A., Uguru S. U., Oke D. A., Okeahialam B. N. Burden Of Cardiovascular Disease Risk Factors In HIV-Infected Adults in North-Central Nigeria. 2012; (October): 2-3.

[16] Tungsiripat M. and Aberg J. Dyslipidemia in HIV patients. Cleveland Clinic Journal of Medicine. 2006; 72: 1113-1120.

[17] Nsagha D. S., Weledji E. P., Jules N., Jules N., Assob C., Njunda L. A., Tanue E. A., Ngowe M. N. Highly active antiretroviral therapy and dyslipidemia in people living with HIV/ AIDS in Fako Division, South West Region of Cameroon. BMC Cardiovascular Disorders. 2015; 15 (95): 1-8.

[18] Kelesidis T., and Currier J. S. Dyslipidemia and cardiovascular risk in human immunodeficiency virus infection. Endocrinology and Metabolism Clinic of North America. 2014; 43 (3): 665-684.

[19] Boccara F., Lang S., Meuleman C, Ederhy S., Mary-Krause M., Costagliola D., Cohen A. HIV and coronary heart disease: Time for a better understanding. Journal of the American College of Cardiology. 2013; 61 (5): 511-523.

[20] Trevillyan J. M. and Hoy J. F. Managing Cardiovascular Risk in People Living with HIV. Current Treatment Options in Infectious Diseases. 2016; 8 (2): 139-151.

[21] World Heart Federation. Cardiovascular Disease Risk Factors. Cardiology Journal. 2012; (April 2012): 6-9.

[22] Hippisley-cox J., Coupland C., Vinogradova Y, Robson J., Minhas R., Sheikh A. Brindle P. Predicting cardiovascular risk in England and Wales: Prospective derivation and validation of QRISK2. British Medical Journal. 2008; (April).

[23] U.S. Department of Health and Human Services, U.S. Department of Agriculture. Dietary Guidelines for Americans, 2005.; 2005.

[24] Agudo A. Joint FAO. Measuring intake of fruit and vegetables. World Health Organization 2005: 40.

[25] Iwuala S. O., Lesi O. A., Olamoyegun M. A., Sabir A. A., Fasanmade O. A. Lipoatrophy among patients on antiretroviral therapy in Lagos, Nigeria: Prevalence, pattern and association with cardiovascular risk factors. Nigeria Journal of Clinical Practice. 2015; 18 (5): 626-632.

[26] World Health Organization. WHO STEPS Instrument for Chronic Disease. 2009: 12.

[27] Friedewald W. T., Levy R. I., Fredrickson D. S. Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without the use of the preparative ultracentrifuge. Clinical Chemistry. 1972; 18 (6): 499-502.

[28] Expert Panel on Detection, Evaluation and Treatment of High Blood Cholesterol in Adults. Executive Summary of the Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). JAMA: Journal of the American Medical Association. 2001; 285 (19): 2486-2497.

[29] Rose H., Hoy J. and Wooley I. HIV infection and high-density lipoprotein metabolism. Atherosclerosis. 2008; 199 (1): 79-86.

[30] Asiki G., Murphy G. A. V., Baisley K., Nsubuga R. N., Karabarinde A., Newton R., Sandhu M. S. Prevalence of dyslipidemia and associated risk factors in a rural population in South Western Uganda: A community-based survey. PLoS One. 2015; 10 (5): 1-17.

[31] Yu S. S. K., Castillo D. C., Courville A. B., Sumner A. E. The Triglyceride Paradox in People of African Descent. Metabolic Syndrome and Related Disorders. 2012; 10 (2): 77-82.

[32] Ayodele O. A. and Akinboro O. E. Triglycerides paradox in Nigerians living with HIV. Research Journal of Health Sciences. 2014; 2 (4). 37-38.

[33] Bayenes H. W. Prevalence and Predictors of Dyslipidemia on HAART and HAART-Naïve HIV-Positive Persons in Defense Hospital, Addis Ababa, Ethiopia. American Journal of Health Research. 2014; 2 (5): 303-305.

[34] Armstrong C., Liu E., Okuma J., Spiegelman D., Guerino C., Njelekela M., Hawkins C., Dyslipidemia in an HIV-positive antiretroviral treatment-naive population in Dar es Salaam, Tanzania. Journal of Acquired Immune Deficiency Syndrome. 2011; 57 (2): 141-145.