

Lipid profile of people living with HIV on antiretroviral therapy monitored in a hospital setting in Kinshasa, Democratic Republic of the Congo

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ABSTRACT

Introduction

HIV/AIDS is a global epidemic and remains a major public health concern. Although there is no cure, HIV infection has become a chronic condition thanks to effective treatment and care. Despite the beneficial effects of antiretroviral therapy (ART), metabolic abnormalities such as dyslipidaemia are increasingly reported. To date, no studies have been conducted in the Democratic Republic of the Congo on the lipid profile of people living with HIV (PLHIV).

Purpose

This study aimed to describe the lipid profile of PLHIV on antiretroviral therapy monitored in a hospital setting in Kinshasa.

Methods

A cross-sectional, descriptive, and analytical study was conducted. The study population comprised PLHIV on antiretroviral therapy, followed in a hospital setting in Kinshasa. Data were collected using a structured data collection form from eligible individuals who had provided informed consent. Lipid profile assessment was conducted on fasting samples.

Results

A total of 407 patients were included in the study, with a predominance of women (70.3%). The mean age was 50.2 ± 12.3 years. Total hypercholesterolaemia was observed in 51 patients (25.2%), LDL hypercholesterolaemia in 20 patients (9.9%), HDL hypocholesterolaemia in 68 patients (27.87%), and hypertriglyceridaemia in 29 patients (14.4%).

Conclusion

The lipid profile of patients on antiretroviral therapy in this study was marked by the presence of dyslipidaemia. Male sex, age over 50 years, hypertension, and alcohol consumption were associated factors in the development of lipid abnormalities among PLHIV.

INTRODUCTION

HIV/AIDS remains a global epidemic and a major public health concern. To date, HIV has caused over 40.1 million deaths and continues to be transmitted worldwide (World Health Organization [WHO], 2022). As of the end of 2023, it is estimated that 39.9 million people [36.1–44.6 million] are living with HIV (PLHIV), with more than two-thirds (25 million) residing in the WHO African Region (WHO, 2022). The Democratic Republic of Congo (DRC) is among the 22 countries with a high HIV/AIDS burden. According to the National Multisectoral AIDS Control Program (PNMLS), more than 94,000 people are living with HIV in the DRC, with a prevalence rate of approximately 1.2% in the general population (Edwards et al., 2022).

Although HIV has no cure, prevention, early detection, and appropriate treatment—including the management of opportunistic infections—can help individuals live long and healthy lives. HIV treatment is based on lifelong use of antiretroviral therapy (ART) (Lac & Currier, 2013). However, long-term use of ART is associated with a range of metabolic complications, including lipodystrophy, insulin resistance, and dyslipidemia (Patterson et al., 2015). Even with the use of the most lipid-friendly ART regimens, alterations in lipid concentration and composition are frequently reported (Lac & Currier, 2013). Despite the therapeutic benefits of ART, metabolic abnormalities such as dyslipidemia are increasingly being observed (Kouakou-Siransy et al., 2015). Dyslipidemia is typically characterised by elevated total cholesterol, LDL cholesterol, and triglycerides, along with reduced HDL cholesterol (Habtamu et al., 2014; Marino et al., 2015).

The pathogenesis of dyslipidemia among PLHIV on ART is not fully understood. Several contributing factors have been identified, including ART regimens, HIV infection itself, genetic predisposition, patient lifestyle, and environmental influences (da Cunha et al., 2015; Bekolo et al., 2014).

While other aspects of HIV/AIDS have been studied in the DRC, there is a lack of specific data on the lipid profiles of PLHIV. This study aims to assess the lipid profile of PLHIV in Kinshasa to better understand the risks and improve comprehensive care in hospital settings.

METHODS

Nature and Period of Study

This is a prospective, analytical, and descriptive study conducted from 19 June 2020 to 18 July 2021.

Study Setting

The study was carried out at multiple health facilities in Kinshasa, including the University Clinics of Kinshasa (CUK), Saint Joseph Hospital, Bondeko Hospital, Kingasani Hospital Center, and Lisungi Center. The University Clinics Laboratory of Kinshasa served as the facility for the measurement of biochemical parameters.

Sample Size

The sample size was calculated using the following formula:

$$n = Z^2 \cdot P(1 - P)/m^2$$

Where:

- n = sample size
- Z = value from the normal distribution (1.96 for 95% confidence)
- P = estimated prevalence of HIV (1%)
- m = margin of error (5%)

Using this formula, the minimum sample size required was 152 participants.

Inclusion Criteria

Participants included in the study were PLHIV:

- Aged 18 years and above
- Residing in Kinshasa
- On ART for at least one year
- Demonstrating good treatment adherence
- Without a prior history of dyslipidemia and/or diabetes mellitus
- Providing signed informed consent

Data Collection Technique

During recruitment, physicians conducted medical histories and routine clinical examinations to assess eligibility based on the inclusion criteria. After obtaining informed consent, eligible participants completed a data collection form documenting relevant parameters.

Four millilitres (ml) of blood were drawn from each participant into a dry tube. Samples were stored in

isothermal containers at the collection site and transported within four hours to the Clinical Biology Laboratory of the University Clinics of Kinshasa. The samples were centrifuged at 3,000 rpm for five minutes. Serum was then aliquoted into two cryotubes and stored at -80°C until analysis at the Clinical Chemistry Laboratory of CUK.

All analyses were conducted using the Mindray BS-240 analyser, which employs molecular absorption spectrophotometry, turbidimetry, and selective potentiometry.

Dyslipidemia was defined as any abnormality in the lipid profile, including elevated plasma cholesterol or triglycerides and/or low HDL cholesterol.

Lipid Profile Reference Values

- **Total cholesterol:** 0–200 mg/dL
- **HDL cholesterol:** 35–45 mg/dL
- **LDL cholesterol:** 0–160 mg/dL
- **Triglycerides (TG):** 0–150 mg/dL

ART Combinations Used in the Study

- Nucleoside reverse transcriptase inhibitor (NRTI) + protease inhibitor (PI)
- NRTI + non-nucleoside reverse transcriptase inhibitor (NNRTI)
- NRTI + integrase inhibitor (INI)

ART Regimens

- **PI:** Lopinavir (LPV)
- **INI:** Dolutegravir (DTP)
- **NRTIs:** Zidovudine (AZT), Lamivudine (3TC), Tenofovir (TDF)
- **NNRTI:** Efavirenz (EFV)

Statistical Analyses

Data was analysed using SPSS version 26. Continuous quantitative variables with a Gaussian distribution are presented as medians and ranges. Qualitative variables are expressed as relative frequencies (%). Proportions were compared using Pearson's chi-square test. Means between groups with normal or symmetric distributions were compared using the ANOVA test.

Ethical Considerations

Anonymity and respect for human dignity were maintained throughout the study. The study protocol was

reviewed and approved by the Ethics Committee of the School of Public Health, University of Kinshasa.

RESULTS

Study Population

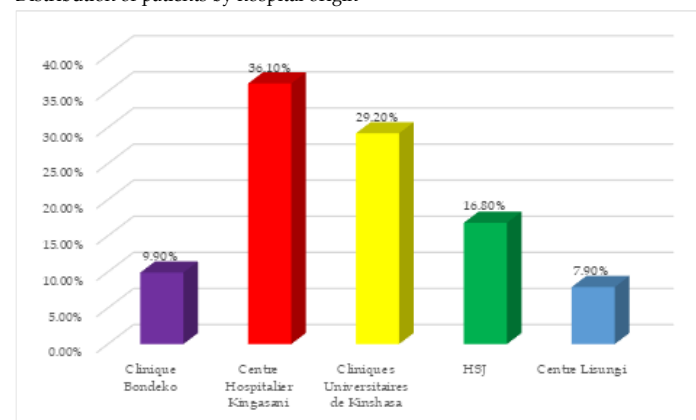
During this study, we enrolled a total of 202 patients who tested positive for HIV serology and were undergoing antiretroviral therapy (ART).

Sociodemographic Characteristics of the Study Population

Hospital Origin of Patients

Of the 202 patients included in the study, 73 (36.1%) were from the Kingasani Hospital Centre; 59 (29.2%) from the University Clinics of Kinshasa; 34 (16.8%) from the Saint Joseph Hospital (HSJ); 20 (9.9%) from the Bondeko Clinic; and 16 (7.9%) from the Lisungi Centre.

Figure 1:
Distribution of patients by hospital origin



Distribution of patients according to age and sex

Table 1:
Distribution of patients according to age and sex

Variables	Frequency (n = 202)	Percentage (%)
Sex		
Male	60	29.7
Female	142	70.3
Age (years)		
Mean \pm SD	50.2 \pm 12.3	-
<30	11	5.4
30–39	33	16.3
40–49	55	27.2
50–59	50	24.8
60–69	45	22.3
>69	8	4.0

Among the 202 patients, 142 were female (70.3%) and 60 were male (29.7%). The mean age was 50.2 ± 12.3 years, with the majority aged between 40 and 49 years (27.2%), followed by those aged 50 to 59 years (24.8%)

Clinical Characteristics of the Study Population

Medical History of the Study Population

Table 2:
Distribution according to medical history

Condition	Frequency (n = 202)	Percentage (%)
Hypertension (HTN)	62	30.7
Chronic kidney disease	8	4.0
Diabetes mellitus	12	5.9
Obesity	7	3.5
Heart failure	2	1.0
Stroke	6	3.0
Myocardial infarction	2	1.0
Smoking	14	6.9
Alcoholism	57	28.2

Hypertension (30.7%) and alcoholism (28.2%) were the most frequently reported medical histories among participants (*Author, Year*).

Therapeutic Profile of the Study Population

Table 3:
Distribution by antiretroviral regimen

ART Regimen	Frequency	Percentage (%)
AZT + 3TC + LPV/r	4	2.0
AZT + 3TC + NVP	7	3.5
TDF + 3TC + DTG	41	20.3
TDF + 3TC + EFV	140	69.3
TDF + 3TC + LPV/r	10	5.0

The majority of patients (69.3%) were treated with the TDF + 3TC + EFV regimen, followed by TDF + 3TC + DTG (20.3%) (*Author, Year*).

Lipid Profile of the Study Population

Table 4:
Lipid Profile Distribution

Lipid Variable	Mean ± SD	Normal (n, %)	Pathological (n, %)
Total cholesterol	178.1 ± 56.9	151 (74.8%)	51 (25.2%)
LDL cholesterol	114.5 ± 54.2	182 (90.1%)	20 (9.9%)
HDL cholesterol	43.8 ± 15.5	84 (41.6%)	118 (58.4%)
Triglycerides	101.5 ± 55.4	173 (85.6%)	29 (14.4%)

A considerable proportion of the patients exhibited abnormal lipid profiles: 25.2% had elevated total cholesterol, 58.4% had low HDL cholesterol, and 14.4% had elevated triglyceride levels (*Author, Year*).

Correlation Between Dyslipidaemia, WHO Stage, and ART Regimens

Table 5:
Correlation analysis

Variables	n=202	Dyslipidemia		p value
		No	Yes	
ART regimens				
AZT+3TC+LPV/R	4	2(50)	2(50)	0.412
AZT + 3TC + NVP	7	5(71.4)	(28.6)	0.879
TDF + 3TC + DTG	41	30(73.2)	11(26.8)	0.001
TDF + 3TC + EFV	140	98(70)	42(30)	0.024
TDF + 3TC + LPV/R	10	4(40)	6(60)	0.044
WHO Stage				
1 and 2	106	71(67)	35(33)	0.555
3 and 4	96	68(70.8)	28(29.2)	

Significant associations were found between dyslipidaemia and the following ART regimens:

- TDF + 3TC + DTG (p = 0.001)
- TDF + 3TC + EFV (p = 0.024)
- TDF + 3TC + LPV/r (p = 0.044)

No significant correlation was found between dyslipidaemia and WHO clinical stage (p = 0.555).

Factors Associated with Lipid Disorders in PLHIV on ART

Table 6:
Determinants of lipid disorders

Factor	Univariate p	OR (95% CI)	Multivariate p	Adjusted OR (95% CI)
Sex (Male)	<0.001	2.1 (1.4-3.2)	0.001	3.0 (2.0-5.7)
Age ≥50 yrs	0.001	2.8 (1.5-5.3)	0.232	1.3 (1.1-1.6)
Hypertension	0.002	2.1 (1.5-3.5)	0.033	3.6 (2.1-7.8)
Alcoholism	0.010	3.5 (1.6-6.3)	0.021	3.1 (2.3-6.9)

The analysis indicates that male sex, age ≥50 years, hypertension, and alcoholism were significantly associated with lipid disorders in people living with HIV (PLHIV) on ART.

DISCUSSION

This study focused on people living with HIV (PLWHIV) under antiretroviral therapy (ART) followed in hospital settings in Kinshasa. The patients included in the study were mainly adults, with a mean age of 50.2 ± 12.3 years.

Most were between 40 and 49 years, representing 27.2% of cases. The mean age in our study was higher than that found by Djagadou et al. (2019) in Lomé, Togo (38.84 years), and that reported by Zouiten et al. (2007) in Tunisia (35.7 years). This difference may be explained by the fact that our study population was recruited from consultation and hospitalisation units dedicated to adult infectious diseases. In our study, a female predominance was noted (70.3%). This result is similar to findings from Djagadou et al. (2019) and Okome Nkoumou et al. (2007). The predominance of females may be linked, on one hand, to the anatomy of the female genital tract, which is more susceptible to HIV infection, and on the other hand, to higher HIV testing rates among women (Todd et al., 2007). Women are generally more willing to undergo testing; additionally, routine HIV screening during pregnancy as part of the prevention of mother-to-child transmission (PMTCT) programmes also increases testing among women (Kaul et al., 2008). Our results contrast with those of Zouiten et al. (2007), who reported a male predominance.

Immunological Aspects

The mean CD4 lymphocyte count in our study was 385 cells/mm³ (normal range: 500–1200 cells/mm³). This result aligns with the findings of Carr et al. (2023) in Australia and Djagadou et al. (2019). The relatively high CD4 count in our cohort may be due to the majority of patients being at stage I of the disease, as well as immune restoration following ART initiation.

Lipid Profile of the Study Population

Total Cholesterol

Hypercholesterolaemia was observed in 25.2% of patients. Friis-Møller et al. (2007) reported a prevalence of 21.1%, while Djagadou et al. (2019) found a higher prevalence of 41.4%. This discrepancy could be attributed to differences in the duration of ART exposure.

Triglyceridemia

Hypertriglyceridaemia was noted in 14.4% of participants, similar to the 12.7% observed by Djagadou et al. (2019). This similarity may be explained by the use of identical treatment regimens. However, Bekolo et al. (2014) found a much higher prevalence (51.8%) among patients on ART.

HDL Cholesterol

HDL hypocholesterolaemia was observed in 17.4% of our patients, whereas Friis-Møller et al. (2003) reported a prevalence of 26.1%. This difference could be explained by several factors, including duration of exposure, specific ARV regimens, and genetic predispositions (Djagadou et al., 2019).

LDL Cholesterol

LDL hypercholesterolaemia was found in 9.9% of patients in our study, a result that differs from that of Bekolo et al. (2014), who reported higher prevalence rates.

Treatment Plan

Approximately 70% of PLWHIV in our study were treated with the TDF + 3TC + EFV regimen. This finding has been reported in several other studies, including Binta et al. (2022), Doumbia (2022), and Eliza (2007), and is consistent with the use of this regimen as a first-line treatment option. Factors Associated with Lipid Disorders in PLWHIV on ART

In our study, male gender, age over 50 years, hypertension, and alcohol consumption were significantly associated with lipid disorders. In contrast, Alassani et al. (2019) found overweight to be the only factor associated with dyslipidaemia. This discrepancy may be explained by the age distribution of the study populations—our patients were mostly over 50 years, while the majority in Alassani's study were under 40.

Correlation Between Dyslipidaemia and Different ART Regimens

Dyslipidaemia was significantly associated ($p < 0.05$) with the regimens TDF + 3TC + DTC, TDF + 3TC + EFV, and TDF + 3TC + LPV/r. This finding may be due to the fact that over 80% of our patients were on these regimens.

Potential Confounding Factors

Several potential confounding factors must be considered when interpreting the results. These may independently influence the lipid abnormalities observed, possibly masking or exaggerating the true effects of ART (Vittinghoff et al., 2012). Age is an important variable, as lipid metabolism changes with advancing age (Estrada et al., 2006). Body mass index (BMI) also affects lipid profiles, particularly triglyceride and LDL cholesterol levels (Lake et al., 2011; Koethe et al., 2012). Additionally, physical activity

(Hand et al., 2008), dietary habits (Koethe et al., 2010), smoking and alcohol use (Feldman et al., 2006; Freiberg & Kraemer, 2010), and family history of dyslipidaemia (Goff et al., 2006) may act as significant confounders. To reduce these biases, we employed multivariate statistical analysis, notably analysis of covariance (ANCOVA).

CONCLUSION

This study focused on the lipid profile of PLWHIV receiving antiretroviral treatment in hospital settings in Kinshasa.

Our findings reveal a notable prevalence of lipid disorders among these patients, underscoring the metabolic effects of ART. These lipid abnormalities represent significant cardiovascular risk factors that could compromise long-term patient outcomes.

The results underscore the importance of regular biological monitoring for HIV-positive individuals on ART to identify and manage lipid imbalances early. Comprehensive clinical surveillance and integrated care approaches are vital to reduce complications and enhance patient quality of life.

Limitations of the Study and Perspectives

This study presents several limitations:

- Its observational nature does not allow for the establishment of causal links between ART and lipid profile abnormalities.
- Its monocentric design, limited to a few hospital centres in Kinshasa, may restrict the generalisability of findings to broader populations, including those in rural or private care settings.
- Some confounding variables could not be systematically measured or adjusted for.
- The study did not permit in-depth analysis by ART regimen type.

Prospects for Future Research

To strengthen understanding in this area, we recommend:

- Multicentre studies involving diverse healthcare structures (urban, rural, private) to enhance generalisability.
- Longitudinal studies to track lipid profile changes over time and evaluate the delayed effects of ART.

- Randomised controlled trials (RCTs) comparing various ART regimens (e.g., older vs. newer ARVs) to determine those with lower metabolic risks.

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Ethical Approval: The study protocol was reviewed and approved by the Ethics Committee of the School of Public Health, University of Kinshasa, DRC.

Conflicts of Interest: None declared.

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