

PATTERN OF DYSLIPIDEMIA IN PEOPLE LIVING WITH HIV/AIDS ON ANTIRETROVIRAL THERAPY: A CROSS-SECTIONAL STUDY CONCERNING BMI, SMOKING, AND ALCOHOL CONSUMPTION

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ABSTRACT

Background: The widespread use of antiretroviral therapy (ART) has significantly improved the life expectancy of people living with HIV/AIDS (PLWHA). However, ART is associated with long-term metabolic complications, particularly dyslipidemia, which increases the risk of cardiovascular disease. Lifestyle factors such as body mass index (BMI), tobacco use, and alcohol consumption may further influence lipid metabolism in this population. The aim and objective is to assess the pattern and prevalence of dyslipidemia in PLWHA on ART and evaluate its association with BMI, smoking, and alcohol consumption. **Materials and Methods:** This cross-sectional study was conducted over 18 months at Gajra Raja Medical College and JA Group of Hospitals, Gwalior. A total of 110 clinically stable HIV-positive patients aged ≥ 18 years receiving ART with good compliance were included. Data were collected using a pre-tested proforma, which included demographic details, clinical history, anthropometric measurements, and lifestyle habits. Fasting lipid profile, blood glucose, blood pressure, and CD4 count were recorded. Lipid parameters were analyzed for associations with gender, BMI, smoking, and alcohol use. Statistical analysis was performed using SPSS v25, with $p < 0.05$ considered significant. **Result:** Dyslipidemia was prevalent among participants: total cholesterol ≥ 200 mg/dL (63.6%), triglycerides ≥ 150 mg/dL (68.2%), low HDL (63.6%), and LDL ≥ 100 mg/dL (72.7%). Obesity (BMI ≥ 25 kg/m²) was present in 34.5% of patients and was significantly associated with elevated total cholesterol, triglycerides, and LDL ($p < 0.05$). Gender differences in lipid profiles were also significant. However, no statistically significant associations were found between smoking or alcohol use and dyslipidemia. **Conclusion:** Dyslipidemia is highly prevalent among PLWHA on ART, especially in those with elevated BMI. Routine lipid monitoring and targeted lifestyle interventions are essential to mitigate cardiovascular risks in this population.

INTRODUCTION

Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome (HIV/AIDS) remains a global public health challenge, with an estimated 36.7 million individuals living with HIV worldwide, of whom approximately 53% are on antiretroviral therapy (ART).^[1] While ART has dramatically improved the survival and quality of life of people living with HIV/AIDS (PLWHA),^[2] long-term therapy has been associated with an increased risk of

cardiovascular disease (CVD),^[3,4] now a leading cause of mortality in this population.

Dyslipidemia, characterized by abnormal lipid levels in the blood, is one of the most common metabolic complications among PLWHA.^[5,6] Its etiology is multifactorial, driven by the virus, chronic inflammation, immune activation, and the metabolic side effects of ART.^[6,7] HIV infection often leads to elevated triglycerides and reduced high-density lipoprotein cholesterol (HDL-C), even before treatment. These disturbances are further aggravated by ART, particularly protease inhibitors (PIs) and older nucleoside reverse transcriptase inhibitors

(NRTIs), which are linked to insulin resistance, central obesity, and altered lipid metabolism.^[8] The dyslipidemia profile in PLWHA has shifted in the HAART era. Earlier dominated by HIV-induced catabolism, it now reflects ART-associated metabolic effects despite newer regimens having a more lipid-friendly profile.^[9] Additional risk factors—such as obesity, diabetes, age, sex, smoking, and alcohol use—interact with ART to influence lipid levels.^[10,11] Persisting low-grade systemic inflammation and immune activation, even under viral suppression, also contribute to atherogenic lipid profiles.^[12,13] Understanding these dyslipidemia patterns is vital for early detection and cardiovascular risk mitigation. This study aims to analyze the lipid profile in PLWHA on ART and explore its association with BMI, smoking, and alcohol consumption.

MATERIALS AND METHODS

This cross-sectional study was conducted over 18 months in the Department of Medicine, Gajra Raja Medical College, and JA Group of Hospitals, Gwalior, Madhya Pradesh. A total of 110 consecutive HIV-positive adult patients receiving ART were enrolled based on predefined inclusion and exclusion criteria.

The sample size was calculated using G*Power 3.1.9.2 software with a 95% confidence interval and 90% power. Based on a mean HDL value of 17.84 ± 45.69 mg/dL, as Nayyar et al. (2019) reported, the minimum required sample size was 80. However, a final sample size of 110 participants was considered to increase the reliability and generalizability of the findings.

Inclusion criteria included clinically stable PLWHA aged 18 years and above of either sex, with proper compliance to ART. Patients were excluded if they were under 18 years of age, critically ill, or had known diabetes mellitus, hypertension, coronary artery disease, chronic kidney disease, or other chronic systemic illnesses.

Participants were interviewed and examined using a pre-tested, pre-validated structured proforma after obtaining informed written consent. Collected data included demographic details (age, sex, residence, occupation, income), detailed medical and treatment history, personal habits including dietary patterns, substance use, and family history of illness. Anthropometric measurements were obtained using standardized protocols. Height was measured using

non-stretchable tape against a flat surface, and weight was recorded using a calibrated digital weighing scale. Body Mass Index (BMI) was calculated and classified according to Asian criteria, with obesity as $\text{BMI} \geq 25 \text{ kg/m}^2$. Waist circumference was measured, with abdominal obesity defined as $\geq 90 \text{ cm}$ for males and $\geq 80 \text{ cm}$ for females.

Clinical examination included general and systemic evaluation. Fasting venous blood samples were collected after 12 hours of overnight fasting to analyze serum lipid profiles using the ERBA XL-300 automated biochemistry analyzer. Parameters measured included total cholesterol, triglycerides, high-density lipoprotein cholesterol (HDL-C), and low-density lipoprotein cholesterol (LDL-C). Lipid profile assessments were repeated at 6 months and 1 year for longitudinal observation, though baseline values were considered for the cross-sectional analysis.

The primary outcome was to determine the pattern of dyslipidemia in PLWHA on ART and its association with body mass index (BMI), smoking, and alcohol consumption. The secondary aim was to support appropriate ART regimen modifications or add-on lipid-lowering strategies to improve long-term cardiovascular outcomes.

Statistical analysis

Data were entered and managed in Microsoft Excel and analyzed using SPSS version 25. Quantitative data were expressed as mean \pm standard deviation or median with interquartile range, while categorical variables were presented as percentages or proportions. The chi-square test or Fisher's exact test was used for categorical comparisons. A p-value < 0.05 was considered statistically significant.

The study protocol was reviewed and approved by the Institutional Ethics Committee. Informed consent was obtained from all participants. No financial assistance or funding was received for this study. All investigations and treatment were conducted free of cost as per government hospital policy, ensuring no financial burden on the patients or their families.

RESULTS

Demographic Profile: Out of 110 participants, 75 (68.2%) were males and 35 (31.8%) were females. Most patients (49.1%) were aged between 31 and 45 years, followed by 32.7% between 46 and 60 years. Only 12.7% and 5.5% were in the 18–30 and above 60 age groups, respectively.

Table 1: Demographic and Clinical Characteristics

Variable	Frequency (n)	Percentage (%)
Total Patients	110	100.0
Gender - Male	75	68.2
Gender - Female	35	31.8
Age 18–30	14	12.7
Age 31–45	54	49.1
Age 46–60	36	32.7
Age >60	6	5.5
BMI Normal	38	34.5
BMI Overweight	34	31.0

BMI Obese	38	34.5
ART ≤ 3 years	45	40.9
ART > 3 years	65	59.1
Tobacco Users	26	23.6
Alcohol Users	13	11.8

Body Mass Index and ART Duration: Based on BMI classification, 34.5% of the participants were within the normal range (18.5–22.9 kg/m²), while 31% were overweight (23.0–24.9 kg/m²) and 34.5% were obese (≥25 kg/m²). A higher proportion of patients (59.1%) had been on ART for over three years.

Lifestyle Factors: Tobacco usage was present in 26 (23.6%) patients, and alcohol use in 13 (11.8%) patients. Despite these exposures, no statistically

significant associations were observed between tobacco or alcohol use and dyslipidemia.

Immunological and Metabolic Parameters: Most participants (61.8%) had CD4 counts >600 cells/mm³, with only 2.7% having CD4 counts ≤200 cells/mm³. Regarding blood pressure, 30% had systolic BP ≥130 mmHg, and 31.8% had diastolic BP ≥85 mmHg. Elevated fasting blood glucose (≥100 mg/dL) was observed in 53.6% of the cohort.

Table 2: Immunological and Metabolic Profile.

Variable	Frequency (n)	Percentage (%)
CD4 ≤ 200 cells/mm ³	3	2.7
CD4 201–400 cells/mm ³	16	14.6
CD4 401–600 cells/mm ³	23	20.9
CD4 >600 cells/mm ³	68	61.8
Systolic BP ≥130 mmHg	33	30.0
Diastolic BP ≥85 mmHg	35	31.8
Fasting Glucose ≥100 mg/dL	59	53.6
Waist Circumference (Males >90 cm)	22	29.3
Waist Circumference (Females >80 cm)	15	42.9

Waist Circumference: Among males, 29.3% had a waist circumference >90 cm; among females, 42.9% had a waist circumference >80 cm, per NCEP ATP III criteria.

Lipid Profile Abnormalities: A high prevalence of dyslipidemia was noted. Total cholesterol ≥200

mg/dL was seen in 63.6% of patients, and elevated triglycerides (≥150 mg/dL) in 68.2%. Low HDL levels (males <40 mg/dL, females <50 mg/dL) were seen in 57.3% of males and 77.1% of females. LDL cholesterol ≥100 mg/dL was observed in 72.7% of participants.

Table 3: Lipid Profile Abnormalities

Lipid Parameter	Frequency (n)	Percentage (%)
Total Cholesterol ≥200 mg/dL	70	63.6
Triglycerides ≥150 mg/dL	75	68.2
HDL (Low: M <40, F <50 mg/dL)	70	63.6
LDL ≥100 mg/dL	80	72.7

Associations with Gender, BMI, and Lifestyle: A statistically significant association was found between gender and all lipid parameters, with males showing a higher prevalence of deranged total cholesterol (p=0.001), triglycerides (p=0.003), HDL (p=0.04), and LDL (p=0.003).

No statistically significant association was observed between tobacco or alcohol use and lipid abnormalities (all p>0.05).

BMI showed a significant association with total cholesterol (p=0.002), triglycerides (p=0.001), and LDL (p=0.002), indicating a higher prevalence of dyslipidemia in overweight and obese individuals. However, the association between BMI and HDL was not statistically significant (p=0.22).

DISCUSSION

Dyslipidemia has emerged as a significant metabolic concern in people living with HIV/AIDS (PLWHA), especially in the context of long-term antiretroviral

therapy (ART). Although ART has revolutionized HIV care by improving survival and immune function, it has also introduced metabolic complications such as insulin resistance, lipodystrophy, and lipid abnormalities, which contribute to an elevated risk of cardiovascular disease.

In our study, most participants were male (68.2%), consistent with findings by Singh et al.^[14] In contrast, studies such as Ombeni et al.^[15] and Bekolo et al.^[16] reported a female preponderance. The mean age of our study population was 42.48 years, similar to the findings by Ombeni et al.^[15] and Achila et al.^[17] indicating that middle-aged adults form the most affected demographic segment of PLWHA on ART. Obesity and overweight were prevalent, with 34.5% of participants classified as obese and 31% as overweight. These findings closely align with the study by Kemal et al.^[18] which reported a comparable distribution of BMI among ART patients. Elevated BMI was significantly associated with dyslipidemia

in our research, particularly elevated total cholesterol, triglycerides, and LDL levels—findings that were statistically significant and consistent with observations by Achila et al.^[17]

Regarding CD4 counts, most patients (61.8%) had a CD4 count >600 cells/mm³, suggesting an effective immunological response to ART. These results are consistent with Kemal et al.^[18] and Malapati et al.^[19] who noted improvements in CD4 counts after ART initiation.

Blood pressure and fasting blood glucose were elevated in many patients. The mean systolic and diastolic blood pressures in our cohort were similar to those reported by Feigi et al.^[20] while fasting blood glucose abnormalities were in line with the findings of Bhowmik et al.^[21]

Waist circumference—an indicator of central obesity—was elevated in 29.3% of males and 42.9% of females. These findings reflect central adiposity patterns observed in studies like Anand et al.^[22] reinforcing the role of visceral fat in metabolic disturbances in PLWHA.

A significant proportion of our study population had deranged lipid profiles: total cholesterol ≥200 mg/dL (63.6%), triglycerides ≥150 mg/dL (68.2%), low HDL levels in both males and females, and LDL ≥100 mg/dL in 72.7%. These results closely mirror the dyslipidemia prevalence reported by Sun et al.^[23] and Bekolo et al.^[16] underscoring the metabolic burden of long-term ART.

When analyzed by gender, lipid abnormalities were more prevalent in males, with statistically significant differences in total cholesterol, triglycerides, HDL, and LDL levels. This contrasts with findings by Achila et al.^[17] who observed a higher prevalence of dyslipidemia in females, highlighting potential regional or behavioral differences.

Tobacco and alcohol use did not show statistically significant associations with dyslipidemia in our study, though trends suggested worse lipid profiles in users. While our findings were not statistically conclusive, they align directionally with Woldu et al.^[24] and Bekolo et al.^[16] which reported higher triglyceride and LDL levels among smokers and variable impacts of alcohol on lipid fractions.

Collectively, these findings point toward a multifactorial etiology of dyslipidemia in PLWHA, encompassing ART, lifestyle, body composition, and immunological status. Regular metabolic monitoring and proactive interventions are therefore essential for holistic HIV management.

CONCLUSION

This study demonstrates a high prevalence of dyslipidemia among people living with HIV/AIDS on ART, with a significant association seen with elevated BMI. While smoking and alcohol use were not statistically significant, trends suggested a worsening effect on lipid profiles. These findings highlight the need for regular lipid monitoring,

lifestyle interventions, and personalized ART regimens to reduce cardiovascular risk. Future research should explore the mechanisms linking ART, metabolic changes, and behavioral factors to improve long-term care in this population.

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