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Serum Level of Adiponectin and Associated Risk of Cardiovascular Disease Among People Living With HIV Infection in Ilorin, Kwara State, Nigeria

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Abstract

This study investigates the precise connection between lipid profiles and serum adiponectin in HIV-infected individuals and reviews the metabolic and cardiovascular complications of HIV. The study is a case-control study involving HIV-infected subjects on antiretroviral therapy (ART) attending General Hospital Ilorin, Kwara State, Nigeria, and non-HIV-infected subjects of age-matched. The study involved 60 participants who were grouped into HIV-infected and non-infected groups. The non-infected group was the control group, consisting of 20 HIV-negative subjects; the HIV-infected group was the test group, which comprised 40 HIV-infected subjects. The adiponectin level was measured by ELISA, and the lipid profile was also measured by the spectrophotometry method. In this study, it was found that HIV patients on ART exhibited significantly lower mean serum adiponectin levels (7.04 ± 0.76 µg/mL) compared to the non-HIV-infected group (10.52 ± 0.46 µg/mL). The mean serum total cholesterol level in the non-HIV-infected subjects was lower (141.3 ± 2.71 mg/dl) compared to the HIV-infected patients (208.6 ± 6.52 mg/dl). The mean serum triglyceride level in the non-HIV-infected subjects was lower (133.44 ± 9.89 mg/dl) compared to the HIV-infected patients (183.9 ± 14.84 mg/dl). The mean serum low-density lipoprotein cholesterol level in the non-HIV-infected subjects was lower (67.79 ± 3.30 mg/dl) compared to the HIV-infected group (135.19 ± 6.16 mg/dl). The mean concentration of high-density lipoprotein cholesterol level in the non-HIV-infected group

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was higher (47.09 ± 4.36 mg/dl) compared to the HIV-infected group (36.48 ± 2.17 mg/dl). The results indicated a negative correlation between adiponectin levels and total cholesterol, triglycerides, and LDL-C among HIV-infected participants and a positive correlation between adiponectin and HDL-C at $p<0.01$. The findings suggest that the reduced adiponectin level in the HIV-infected subjects may be associated with obesity, type 2 diabetes, atherosclerosis, and other metabolic conditions. This result demonstrates that HIV patients are more susceptible to cardiovascular and metabolic dysfunction.

Keywords: Serum adiponectin, Lipid profile, Human Immunodeficiency Virus, Antiretroviral Therapy, Metabolic Complications.

INTRODUCTION

The Human Immunodeficiency Virus (HIV) is a viral infection that attacks the host's immune system by targeting white blood cells, particularly CD4+ T cells, crucial for the body's defence against infections. Without treatment, the loss of these cells causes the immune system to gradually weaken, eventually leading to Acquired Immunodeficiency Syndrome (AIDS) [1].

Individuals infected with HIV use a series of drugs known as antiretroviral therapy as part of their treatment plan [2]. When taken as prescribed, antiretroviral therapy (ART) suppresses the viral load to an insignificant level in patients, helping to preserve immune system function and prevent the spread of HIV [3]. The remarkably low viral load inhibits the virus from spreading from infected pregnant women to their fetuses as well as from the patients to their HIV-negative partners during intercourse [4]. Although antiretroviral therapy (ART) does not cure HIV, the virus still exists in the body and should be managed according to prescribed guidelines, even in cases when the viral load is undetectable. To maximize the benefits of treatment, patients must adhere to ART at a high level [5].

Complications from HIV are caused by either the virus itself or the side effects of antiretroviral therapy. These complications may include opportunistic infections (such as pneumocystis pneumonia, tuberculosis, candidiasis, cytomegalovirus, and toxoplasmosis), cancers (such as Kaposi’s sarcoma, non-Hodgkin lymphoma, and cervical cancer), neurological complications (such as HIV+ associated neurocognitive disorders, peripheral neuropathy, and HIV encephalopathy), cardiovascular issues (such as an increased risk of heart disease, stroke), gastrointestinal problems (such as chronic diarrhea, gastroenteritis, nausea, and vomiting), metabolic changes (such as lipodystrophy, dyslipidemia, insulin resistance, and diabetes), bone health issues (such as osteopenia, and osteoporosis), liver and kidney toxicity (such as hepatotoxicity, and nephrotoxicity), hypersensitivity reactions (such as skin rashes, and Steven-Johnson Syndrome), and psychiatric and neurological effects (such as depression, anxiety, and sleep disturbances) [6].

In patients with HIV, monitoring the lipid profile is particularly important due to the unique relationship between the virus, antiretroviral therapy (ART), and lipid metabolism, which can significantly impact cardiovascular health [7],[8]. HIV infection and chronic inflammation induced by the virus infection have been known to affect adiponectin levels, which cause impairment of lipid metabolism and alter lipid levels. Dyslipidaemia, or abnormal lipid levels, is frequently the outcome

of abnormalities in lipid metabolism brought on by the virus's immune system activation and chronic inflammation [9].

The prognosis for people with HIV has greatly improved because of antiretroviral therapy (ART); nonetheless, adherence to ART medications, which is important to reduce viral load, might result in abnormal adiponectin and cholesterol levels. The risk of cardiovascular illnesses may increase due to these alterations, which leads to decreased HDL cholesterol and increased triglycerides and LDL cholesterol (9,10). This study aimed to assess the serum level of adiponectin and the associated risk of cardiovascular disease among people living with HIV infection in Ilorin, Kwara State, Nigeria.

MATERIALS AND METHODS

This study was a case-control study involving HIV subjects on ART and negative subjects attending General Hospital Ilorin. The study recruited 60 subjects, which were grouped into test and control groups based on their HIV status: 40 HIV-positive patients on ART and 20 HIV-negative subjects.

Ethical Consideration

The ethical approval was obtained from the Kwara State Ministry of Health with the approval identification number ERC/MOH/2024/02/173. All subjects were required to give their consent to participate in the study.

Subject Selection and Data Collection

The subjects were selected from the HIV testing and counselling centre. However, several subjects were screened for their HIV status through an HIV testing algorithm. Based on their status, they were separated into HIV subjects and non-HIV subjects after meeting the inclusion criteria: subjects who were between the ages of 18 and 60 years and gave consent. While subjects less than 18 and older than 60 years of age and subjects who did not give consent were excluded. Data on their socio-demographic factors and their medical history were collected using a semi-structured questionnaire. Those who reported other diseases that can impact the cardiovascular risk among the HIV and non-HIV subjects were excluded from this study. However, the total number of subjects recruited was 40 HIV-positive subjects taking ART and 20 HIV-negative subjects.

Sample collection and storage

Five ml of blood samples were collected from each participant into plain bottles through venous puncture using aseptic techniques of sample collection. The blood was allowed to clot and then spun at 3000rpm for 5min to obtain serum. The serum was separated into a different bottle and stored at -20°C in the freezer until analysis.

Laboratory analysis

The samples were analysed to determine the adiponectin level and also the lipid profile level. Adiponectin was estimated using the ELISA techniques. For the lipid profile estimation, total cholesterol, triglyceride, and high-density lipoprotein (HDL) were estimated using spectrophotometric techniques. However, the low-density lipoprotein was calculated using the Friedewald equation [12].

LDL-C= TC- (HDL+ VLDL-C)

Very low-density lipoprotein cholesterol $=\frac{Triglyceride}{5}$

Therefore,

$LDL\text{-}C = TC - HDL - C - \frac{Triglyceride}{5}$

Where,

TC=total cholesterol

HDL-C= high-density lipoprotein cholesterol

VLDL-C= very low-density lipoprotein cholesterol

Statistical analysis

The SPSS version 29 was used for the analysis. Descriptive statistics were used to summarize participant characteristics and baseline data. Inferential data was presented as mean and standard deviation. An independent t-test was used to compare the means, and the significance level was considered at $P<0.05$.

RESULTS

Table 1 shows the demographic distribution of study participants, and their clinical characteristics were presented. The values for the mean standard deviation of age and the co-infection status were also presented. The student's t-test determined the P-value, and P < 0.05 was considered significantly different. The HIV-infected group consisted predominantly of females with the highest infection rates observed in the age group 35–60 years. Relatively more HIV-infected subjects have been on antiretroviral therapy for 1-4 years. There was no significant correlation between the gender of the HIV-infected group and the non-HIV-infected group (P = 0.120). However, there were significant correlations in the age, duration of antiretroviral therapy, adiponectin concentration, total cholesterol concentration, triglyceride concentration, low-density lipoprotein cholesterol concentration, and high-density cholesterol concentration of the HIV-infected group compared to the non-HIV-infected groups ($P<0.05$) "Table 1".

The HIV-infected group had significantly lower mean adiponectin levels (μg/mL) compared to the non-HIV-infected group ($P<0.05$). Furthermore, the mean concentrations of total cholesterol, triglycerides, and low-density lipoprotein were higher in the HIV-infected group compared to the non-HIV-infected group ($P<0.05$). Conversely, the mean concentration of high-density lipoprotein in the HIV-infected group was lower compared to the non-HIV-infected group (P<0.05) "Table 1".

Table 2 shows a positive correlation between age and adiponectin (r = 0.325; P = 0.011), total cholesterol (r = 0.275; P = 0.033), low-density lipoprotein cholesterol (r = 0.296; P = 0.022), and triglyceride (r = 0.353; P = 0.006).It also demonstrates a negative correlation between age and high-density lipoprotein cholesterol (P = <0.01). However, no correlation was found between gender and

adiponectin (P = 0.323), total cholesterol (P = 0.205), low-density lipoprotein cholesterol (P = 0.737), triglyceride (P = 0.336), and high-density lipoprotein cholesterol (P = 0.246).

Table 2 also revealed a negative correlation between the duration of antiretroviral therapy and adiponectin (r = -0.919; P = <0.01) and high-density lipoprotein cholesterol (r = -0.878; P = <0.01). Conversely, there is a positive correlation between the duration of antiretroviral therapy and total cholesterol (r = 0.926; P = <0.01), triglyceride (r = 0.874; P = <0.01), and low-density lipoprotein cholesterol (r = 0.902; P = <0.01).

Table 3 shows a significant relationship between age and adiponectin (P = 0.034), no statistical correlation was found between gender and adiponectin (P = 0.261), and a statistical correlation was found between the duration of antiretroviral therapy and adiponectin (P = 0.036) *in* the HIV-infected group.

Table 4 shows a negative correlation between adiponectin and total cholesterol (r = -0.897; P = <0.01), triglycerides (r = -0.931; P = <0.01), and low-density lipoprotein cholesterol (r = -0.835; P = <0.01), but a positive correlation between adiponectin and high-density lipoprotein cholesterol (r = 0.846; P = <0.01) within the HIV-infected group.

Table 1: Demographic Distribution and clinical characteristics of the Study Participants

Parameters	Non-HIV infected	HIV-infected	P-value
Gender			
Female	11(55%)	30(75%)	0.120
Male	09(45%)	10(25%)	
Age (mean and SD)	33.42±10.58	38.85±10.63	0.048
Age range			
19-35	12 (60%)	14 (35%)	
36-60	8 (40%)	26 (65%)	
Duration of ART			
< 1 year	Non-existence	19(47.5%)	<0.001
1-4 years	Non-existence	21(52.5%)	<0.001
Adiponectin (µg/mL)	10.52 ± 0.46	7.0 ± 0.76	<0.001

TC (mg/dl)	141.3 ± 2.71	208.6 ± 6.52	<0.001
Triglyceride (mg/dl)	133.4 ± 9.89	183.9 ± 14.84	<0.001
LDL-C (mg/dl)	67.79 ± 3.30	135.19 ± 6.16	<0.001
HDL-C (mg/dl)	47.09 ± 4.36	36.48 ± 2.17	<0.001
Other chronic infections	Negative	Negative	NA

Table 2: Correlation of demographic characteristics with adiponectin and lipid profile

Parameters	**Gender**		**Age**		**Duration of ART**	
	R	P	r	P	r	P
Adiponectin	-0.130	0.323	0.325	0.011	-0.919	<0.01
TC	0.166	0.205	0.275	0.033	0.926	<0.01
Triglyceride	0.126	0.336	0.353	0.006	0.874	<0.01
LDL-C	-0.044	0.737	0.296	0.022	0.902	<0.01
HDL-C	0.152	0.246	-0.520	<0.01	-0.878	<0.01

Table 3: Comparison of serum adiponectin concentration with demographic characteristics among HIV-infected participants

characteristics		**Adiponectin Mean ±SD**	**P-value**
Age range (years)	19 – 35	6.96 ± 0.99	0.034
	36 – 60	7.02 ± 0.55	
Gender	Male	6.64 ± 1.17	0.261
	Female	7.10 ± 0.57	
Duration of ART	< 1 year	7.21 ± 0.46	0.036

	1 - 4 years	6.27 ± 1.10	

SD = standard deviation

Table 4: Correlation of serum adiponectin and lipid profile concentrations of the HIV-infected participants

Parameters	Adiponectin	
	r	p
TC	-0.897	<0.01
Triglyceride	-0.931	<0.01
LDL-C	-0.835	<0.01
HDL-C	0.846	<0.01

DISCUSSION

In this study, HIV infection was mostly common in females. This is consistent with [12] research where they stated that "HIV is 1.62 times more prevalent among adult women than men". Also, the infection was more prevalent in the 35-60 age group, presumably because people in this age group are more sexually active.

This study found a positive correlation between age, adiponectin, total cholesterol, low-density lipoprotein cholesterol, and triglyceride levels. It also found a negative correlation between age and high-density lipoprotein cholesterol. This is consistent with previous research that found that serum adiponectin levels are positively associated with age in both healthy individuals and patients with diabetes [13]. As people age, total cholesterol, triglycerides, and low-density lipoprotein (LDL) cholesterol levels typically increase, while high-density lipoprotein cholesterol decreases. These changes are attributed to the natural deterioration of the biological system over time [14].

However, no correlation was found between gender, adiponectin, and lipid profile, which is similar to a study by [15], which found that there was a negative correlation between gender, adiponectin, and lipid profile. Additionally, the study revealed a negative correlation between the duration of antiretroviral therapy and serum concentrations of adiponectin and high-density lipoprotein cholesterol. Conversely, there is a positive correlation between the duration of antiretroviral therapy, total cholesterol, triglyceride, and low-density lipoprotein cholesterol. According to previous research, even though antiretroviral therapy (ART) effectively suppresses viral replication and improves the quality of life, long-term use of ART can reduce adiponectin and high-density lipoprotein cholesterol

levels and increase total cholesterol, triglycerides, and low-density lipoprotein cholesterol levels. These changes are associated with heightened cardiovascular and metabolic risk [16].

This study discovered significant variation in adiponectin levels and lipid profiles between the HIV-infected and non-HIV-infected subjects. The HIV-infected subjects exhibited significantly lower mean adiponectin levels compared to the non-HIV-infected group. This finding aligns with a study by [17] which discovered that adiponectin levels are significantly lower in patients with HIV and metabolic syndrome. Also, the mean total cholesterol concentration in the non-HIV-infected group was lower than in the HIV-infected group. The mean concentration of triglyceride in the non-HIV-infected group was lower than in the HIV-infected group. The mean concentration of low-density lipoprotein cholesterol in the non-HIV-infected group was lower than in the HIV-infected group. The mean high-density lipoprotein cholesterol concentration in the non-HIV-infected group was higher than in the HIV-infected group. Furthermore, research by [18] indicated that the HIV-negative control group had lower levels of total cholesterol and low-density lipoprotein cholesterol compared to the treatment-naïve HIV-infected group and the HIV-infected group on treatment. Likewise, HIV-infected patients exhibited higher total cholesterol levels compared to non-HIV-infected patients. Moreover, a higher prevalence of hypertriglyceridemia was observed among HIV-infected patients than non-HIV-infected patients. The serum abnormality of APO-B-containing lipoprotein, which carries about 50% of total cholesterol, or LDL-C, was higher at 35.4% in HIV-infected patients than 29.2% in non-HIV-infected patients. Additionally, the low level of non-APO-B-containing lipoprotein, or HDL-C, was more common in HIV-infected patients than in non-HIV-infected patients. HIV-infected patients had synchronized increases in serum total cholesterol and triglyceride levels and isolated low levels of HDL-C [19].

This research found a negative correlation between adiponectin, serum total cholesterol, triglycerides, and low-density lipoprotein cholesterol but a positive correlation with high-density lipoprotein cholesterol within the HIV-infected group. This indicates that there is a relationship between adiponectin and the lipid profile in HIV patients. Research by [16] stated that in the HIV-positive group, it was found that serum adiponectin levels had a negative correlation with total cholesterol and LDL cholesterol. Another study by [20] demonstrated that adiponectin levels were negatively correlated with serum triglycerides and serum insulin concentration and positively correlated with HDL-C. These findings suggest that because adiponectin is correlated with serum triglycerides, serum insulin concentration, and HDL-C, it may be linked to metabolic issues in HIV-related lipid dystrophy.

CONCLUSION

This study has established serum adiponectin and lipid profile concentration are affected by age and how long an HIV patient has been on antiretroviral therapy. Also, the serum adiponectin level in HIV patients affects their lipid profile concentration. This increases their susceptibility to cardiovascular and metabolic pathology.

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Ethical Approval

Ethical approval was obtained from the Kwara State Ministry of Health with approval identification number of ERC/MOH/2024/02/173

Patient's Consent Statement

The authors have obtained written consent from the patient (or legal guardian) to publish the manuscript, ensuring confidentiality and privacy.

Consent for Publication

Not Applicable

Availability of Data and Material

Data generated in this study are embedded in the manuscript.

Competing Interests

The authors declare that they have no competing interests, either financial or otherwise, that could influence or be perceived to influence the research presented in the manuscript.

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Authors' Contribution

WOG: conceptualized, designed, drafted the manuscript, and supervised the work. AOL: Drafted the manuscript, data collection, and laboratory investigation. MI: Drafted the manuscript, data interpretation and validity, and proofread the manuscript. TJO: Drafted the manuscript and proofread and revised the manuscript. IE and AP: Analyzed and interpreted the data and edited the manuscript. GMO: Drafted the manuscript and proofread and revised the manuscript.

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