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The Prevalence of Liver Dysfunction among HIV Infected Patients on Antiretrovral Therapy in Edo North Senatorial District of Nigeria

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Abstract
Liver dysfunction is a known complication of antiretroviral therapy in human immuno-deficiency virus positive patients, caused by drug toxicity, viral effects, and co-infections. monitoring liver function is critical for preventing antiretroviral-induced hepatotoxicity in this population. This study evaluated liver function tests (alanine amino transferase, aspartate amino transferase, bilirubin) in patients infected with human immuno-deficiency virus on antiretroviral therapy at Edo State University Teaching Hospital, Auchi.
A comparative cross-sectional design was used, involving 50 human immuno-deficiency-positive patients on antiretroviral and 50 control subjects comprising of those without human immuno-deficiency virus. Serum alamine amino transferase, aspartate amino transferase, and bilirubin levels were determined using standard spectrophotometric methods. The results were recorded and tabulated using Microsoft Excel (Microsoft office 2019). Statistical Package for Social Sciences (SPSS version 25) was used for the statistical analysis. Significance level used was <0.05.
The prevalence of liver dysfunction among hiv-infected individuals shows that eighty percent (80%) of participants had normal alanine amino transferase levels, while twenty percent (20%) exhibited abnormal alanine amino transferase levels, suggesting liver inflammation or damage. eighty eight percent (88.2%) had normal aspartate amino transferase levels, and twelve percent (12%) displayed abnormal aspartate amino transferase levels, further supporting the presence of liver damage. ninety four percent (94%) had normal direct bilirubin levels, while six (6%) showed abnormal direct bilirubin levels, indicating impaired bile flow or liver damage. seventy eight percent (78%) had normal total bilirubin levels, and twenty two percent (22%) exhibited abnormal total bilirubin levels, suggesting liver dysfunction or haemolysis.
This study emphasizes the importance of routine liver function monitoring for human immuno deficiency virus-positive patients on antiretroviral therapy, especially those with risk factors like alcohol consumption and smoking. Personalized antiretroviral regimens, lifestyle changes, and increased access to healthcare, particularly in rural areas, are critical for reducing liver damage and improving patient outcomes.

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Keywords: Alanine Amino Transferase, Aspartate Amino Transferase, Bilirubin, Human Immuno-Deficiency Virus, Anti-Retroviral Therapy.

Introduction

The immune systems of humans are impacted by the intricate and linked diseases known as Human immuno deficiency virus (HIV) and Acquired Immunodeficiency Syndrome (AIDS). One of the biggest issues facing global health is still HIV/AIDS. The World Health Organization (WHO) estimated that by the end of 2019, 38 million people worldwide would be HIV/AIDS positive. Sub-Saharan Africa is disproportionately affected, with nearly two-thirds of all HIV-positive people living in the region. However, HIV/AIDS is a global problem that affects people of all ages, genders, and socioeconomic backgrounds (Kumah *et al.*, 2023) [11]. HIV is a single-stranded RNA retrovirus from the Lentivirus genus that targets and infects human immune cells, specifically Cluster of differentiation 4CD4) + T cells, macrophages, and dendritic cells.

Since CD4+ T cells are necessary for cell-mediated immunity, HIV uses these cells to multiply, gradually decreasing the number of these cells. HIV is mainly spread through sharing contaminated needles or syringes, mother-to-child transmission during pregnancy, childbirth, or breastfeeding, blood transfusions or organ transplantation from an infected donor, and sexual contact (vaginal, anal, or oral) with an infected person (German Advisory Committee Blood, 2016) [8].

Acquired Immunodeficiency Syndrome (AIDS) is the most advanced form of HIV infection, marked by the presence of certain opportunistic infections or cancers along with a severely compromised immune system. The Centres for Disease Control and Prevention (CDC) have defined AIDS as follows: a CD4+ T cell count of less than 200 cells/mm³ (normal range: 500-1500 cells/mm³); the presence of specific opportunistic infections, such as Toxoplasma gondii, Pneumocystis pneumonia, or Mycobacterium tuberculosis; and the presence of specific cancers, such as lymphoma or Kaposi's sarcoma. AIDS is not contagious; rather, it is the outcome of an HIV infection that is poorly managed or left untreated, which permits the virus to spread and seriously compromise the immune system (Maffei *et al.*, 2022) [12].

HIV infection and AIDS are different diseases. HIV infection is classified into four stages: initial infection (often asymptomatic), chronic HIV infection (asymptomatic or mildly asymptomatic, with ongoing viral replication), advanced HIV disease (symptomatic, with declining CD4+ T cell counts and increasing viral load), and AIDS (severally compromised immune system, opportunistic infections, and cancers) (Ewetola *et al.*, 2021) [6].

By inhibiting viral replication and boosting immune function, antiretroviral therapy (ART) has completely changed how HIV infection is managed. With antiretroviral therapy (ART), viral loads can be controlled and people can live healthier lives by taking a combination of medications that target different stages of the virus' life cycle. Timely intervention is crucial in preventing the progression of HIV to AIDS, as early diagnosis and ART initiation are critical. By strengthening the immune system and preventing opportunistic infections, antiretroviral therapy (ART) drugs, such as nucleoside/nucleotide reverse transcriptase inhibitors (NRTIs), non-nucleoside reverse transcriptase inhibitors (NNRTIs), protease inhibitors (PIs), integrase inhibitors (INIs), and entry inhibitors (EIs), play a crucial role in suppressing viral replication, reducing disease progression, and preventing transmission risks. It boosts the immune system by increasing CD4+ T cell count and aids in the prevention of opportunistic infections. It also lowers transmission risks to sexual partners and from mother to child during pregnancy, childbirth, and breastfeeding, emphasizing its importance in public health. ART not only improves HIV patients' quality of life, but it also protects them from HIV-related illnesses like cardiovascular disease, kidney disorders, and neurological complications (Apetroaei *et al.*, 2024) [3].

Current guidelines recommend starting ART as soon as possible after HIV diagnosis, regardless of CD4+ T cell count, using drug combinations to prevent resistance, and monitoring viral load and CD4+ T cell counts on a regular basis to assess treatment efficacy and adjust therapy as needed. Following recommended regimens exactly is crucial to maintaining viral suppression and preventing the emergence of resistance, since treatment discontinuation or missing doses can result in drug resistance, virological failure, and the advancement of the illness (SeyedAlinaghi *et al.*, 2023) [18].

The liver is a multipurpose organ that is essential to preserving general health. Its duties encompass synthesis, storage, detoxification, metabolism, and bile production. During metabolism, the liver converts nutrients, drugs, and toxins into usable or excretable forms. It produces proteins such as clotting factors and albumin, which are required for bodily functions. The liver also stores glycogen, vitamins, and minerals, which when released are needed to maintain stable blood glucose levels and support metabolic processes. It detoxifies harmful substances such as drugs, alcohol, and metabolic waste products, shielding the body from damage. The liver also produces bile, which aids in the digestion and absorption of fats and fat-soluble vitamins. (Ozougwu, 2017) [16]

Liver function tests (LFTs) are a group of blood tests used to assess the liver's health and function. They usually include measurements of enzymes like alanine aminotransferase (ALT) and aspartate aminotransferase (AST), bilirubin, and albumin levels. Each of these components contains useful information about liver health and can aid in the diagnosis of a variety of liver conditions. Understanding each test's significance, normal range, interpretation of results, and the importance of monitoring liver function in specific patient populations, such as HIV-positive individuals on antiretroviral therapy (ART), is critical for effective patient management and care. ALT and AST enzymes are mostly found in liver cells (Akter *et al.*, 2021)[1]. ALT is more specific to the liver, whereas AST is also found in other tissues such as the heart and muscles. These enzymes are released into the circulation when liver cells are injured or inflamed, which raises the levels of these enzymes. While conditions affecting the liver, heart, or skeletal muscles may cause an increase in AST levels, elevated ALT levels are suggestive of hepatocellular injury.

HIV infection can have a substantial effect on liver function, which can result in a number of complications that can have a major negative influence on general health. The virus can directly damage and inflame liver cells. It can also make liver damage worse by encouraging the growth of other viruses, such as hepatitis B and C. This can trigger a cycle of chronic inflammation and fibrosis, raising the risk of serious complications such as cirrhosis and hepatocellular carcinoma. Furthermore, HIV-related immune dysregulation can cause liver inflammation and fibrosis, increasing the risk of liver damage (Sherman and Thomas, 2022) [19]. Antiretroviral drugs used to treat HIV/AIDS can also harm the liver, resulting in liver toxicity, elevated liver enzymes, and, in some cases, liver failure. This is especially concerning because many antiretroviral drugs are metabolized in the liver, and liver dysfunction can reduce the efficacy of these medications. Furthermore, HIV-positive people are more likely to be infected with hepatitis B or C viruses, which can accelerate liver disease progression and increase the risk of complications such as cirrhosis. According to research, those who are HIV-positive and co-infected with hepatitis B or C are much more likely to develop hepatocellular carcinoma and liver cirrhosis than people who are not co-infected. Due to this, liver problems such as fatty liver disease, increased liver enzymes, co-infections with hepatitis B and C, and liver fibrosis leading to cirrhosis are frequent in people who are HIV positive. Screening for and managing liver disease in

HIV-infected people is critical for optimizing HIV treatment outcomes and preventing liver-related morbidity and mortality. Regular monitoring of liver function and prompt treatment of liver complications can help to mitigate the impact of HIV on the liver and improve overall health outcomes. Furthermore, early detection and treatment of liver disease can help HIV-positive individuals avoid long-term complications and improve their quality of life. This includes routine liver function tests, viral load monitoring, and imaging tests to detect liver fibrosis and cirrhosis. In cases of advanced liver disease, liver transplantation may be required, emphasizing the importance of early detection and intervention (Price and Thio, 2010) [17].

Nigeria's HIV/AIDS epidemic remains a significant public health threat, with Edo State bearing a disproportionate burden. The 2018 NAIIS survey revealed a staggering 3.4% HIV prevalence rate in the state, far exceeding the national average of 1.4%. This crisis has prompted a multifaceted response, which includes the implementation of HIV testing, prevention programs, and antiretroviral therapy (ART). Edo State has made significant progress in increasing ART access by establishing healthcare facilities and implementing programs aimed at improving testing and counseling services, strengthening the healthcare system, and improving the quality of life for HIV-positive people (Onovo *et al*., 2023) [14]. Despite these efforts, formidable challenges such as stigma, discrimination, and a lack of resources continue to impede effective HIV service delivery. In order to get past these barriers, persistent efforts are concentrated on addressing the social and economic determinants of health that fuel the epidemic, reaching underserved and difficult-to-reach populations, and guaranteeing the long-term viability of HIV treatment and care programs. This includes increasing awareness and education campaigns, reducing stigma and discrimination through community engagement and advocacy, and allocating resources to innovative HIV prevention and treatment initiatives. Edo State's higher HIV prevalence necessitates consistent investment in HIV prevention, testing, and treatment programs in order to mitigate the impact of HIV/AIDS and improve the health and well-being of its population. Continued efforts are necessary to address the complex challenges, ensure equitable access to HIV services, and ultimately reduce the burden of HIV/AIDS in the state. (Obarisiagbon *et al*., 2019) [13]

The objective of this study is to determine the prevalence rate of liver dysfunction among HIV infected individuals attending the virology clinic of Edo State University Teaching Hospital, Auchi, Edo State, Nigeria.

Materials and Methods

Study Design

This descriptive cross-sectional study was conducted at the Antiretroviral Therapy (ART) Clinic/Laboratory of Edo State Teaching Hospital in Auchi, Edo North. The target population comprises of adult HIV-1 infected patients aged 18 years and above who have been on ART for at least 6 months. Participants were recruited based on inclusion criteria, including willingness to provide informed written consent. A structured questionnaire was utilized to collect socio-demographic information such as gender, age, educational level, occupation, and residential area, along with knowledge related to liver function tests and HIV/AIDS. Data collection involved face-to-face interviews with the study participants. Ethical considerations was paramount, ensuring adherence to ethical principles, obtaining informed consent, and maintaining participant confidentiality. Approval from relevant institutional review boards or ethics committees obtained before commencement of the study.

Study Population

For this study, a total of 100 participants were enrolled, 50 as control subjects and 50 as test subjects. All participants provided informed consent before their inclusion in the study. The control samples consisted of HIV-negative individuals, whereas the test group consisted of HIV-positive patients who were currently receiving antiretroviral therapy.

Inclusion Criteria

1. HIV positive patients receiving antiretroviral therapy (ART) at Edo State University Teaching Hospital.
2. Patients who have been on ART for at least 6 months.
3. Patients with a confirmed HIV diagnosis and currently receiving care at the hospital's HIV clinic.
4. Patients who have given informed consent to participate in the study.

Exclusion Criteria

- Individuals not on ART
- Non-consenting participant
- Adult patients (age ≤18 years)
- Patients with co-infection

Sample Collection

Each participants were informed of the sample collection procedure, so they could still decide whether or not to give their consent. Each participant who provided informed consent was seated comfortably before having a blood sample drawn from a vein in their arm. A tourniquet was wrapped around each participants arm, the antecubital fossa was disinfected with cotton wool soaked in methylated spirit and blood samples were collected from the prominent vein in the antecubital fossa (The Basilic, The Cephalic or The Median Cubital Vein) into a well labeled lithium heparin anticoagulated tube, with the puncture site covered with a cotton swab and/or an adhesive bandage. The blood samples collected was centrifuged at 3000rpm for 3 minutes and the plasma/serum was separated into a plain container and stored in a freezer at 2ºC until the samples were analyzed.

Methods

Alanine Aminotransferase (ALT) Estimation (Youssef and Wu, 2024)

Alanine Aminotransferase (ALT) was determined using the International Federation of Clinical Chemistry UV (IFCC UV) method (IFCC 1980). ALT is an enzyme primarily found in the liver and serves as a relatively reliable diagnostic index for liver disease.

Principle: ALT catalyzes the reversible transamination of L-alanine and α-ketoglutarate to pyruvate and L-glutamate. The pyruvate is then reduced to lactate in the presence of lactate dehydrogenase (LDH) with the concurrent oxidation of nicotinamide adenine dinucleotide hydrogen(NADH) to nicotinamide adenine dinucleotide(NAD). The system monitors the rate of change in absorbance at 340 nm over a fixed time interval. The rate of change in absorbance is directly proportional to the ALT activity in the sample (Youssef and Wu, 2024).

Procedure: (Youssef and Wu, 2024)

1. **Sample and Blank Preparation:** 0.5 ml of ALT reagent 1 (R1 - Buffer) was added to both blank and sample test tubes. 0.1 ml of sample was then added to the corresponding sample test tube.
2. **Incubation:** The mixture was mixed thoroughly and incubated for 30 minutes at 37°C.
3. **Reagent 2 Addition:** 0.5 ml of reagent 2 (R2 - 2,4-Dinitrophenylhydrazine) was dispensed into both the reagent blank and sample test tubes. The mixture was then mixed and incubated for 20 minutes at room temperature.
4. **Sodium Hydroxide Addition:** 5 ml of 0.4 M Sodium hydroxide (0.4M NaOH) was added to both the reagent blank and sample test tubes and allowed to stand for 5 minutes.
5. **Spectrophotometric Measurement:** The absorbance of each test tube was read at 546 nm wavelength using a spectrophotometer.

Aspartate Aminotransferase (AST) Estimation (Youssef and Wu, 2024)

Aspartate Aminotransferase (AST) was determined by the International Federation of Clinical Chemistry UV (IFCC UV) method (IFCC 1980). AST is an enzyme found in various organs including the liver, heart, skeletal muscle, kidneys, brain, red blood cells, and gall bladder. It is an index of liver disease.

Principle: AST catalyzes the reversible transamination of L-aspartate and α-ketoglutarate to oxaloacetate and L-glutamate. The oxaloacetate is then reduced to malate in the presence of malate dehydrogenase with the concurrent oxidation of NADH to NAD. The system monitors the rate of change in absorbance at 340 nm over a fixed time interval. The rate of change in absorbance is directly proportional to the AST activity in the sample (Youssef and Wu, 2024).

Procedure: (Youssef and Wu, 2024)

1. **Sample and Blank Preparation:** 0.5 ml of AST reagent 1 (R1 - Buffer) was added to both blank and sample test tubes. 0.1 ml of sample was then added to the corresponding sample test tube.
2. **Incubation:** The mixture was mixed thoroughly and incubated for 30 minutes at 37°C.
3. **Reagent 2 Addition:** 0.5 ml of reagent 2 (R2 - 2,4-Dinitrophenylhydrazine) was dispensed into both the reagent blank and sample test tubes. The mixture was then mixed and incubated for 20 minutes at room temperature.
4. **Sodium Hydroxide Addition:** 5 ml of 0.4 M Sodium hydroxide (0.4M NaOH) was added to both the reagent blank and sample test tubes and allowed to stand for 5 minutes.
5. **Spectrophotometric Measurement:** The absorbance of each test tube was read at 546 nm wavelength using a spectrophotometer.

Bilirubin Estimation (Guerra Ruiz *et al.,* 2021) [9]

Bilirubin, a product of hemoglobin breakdown, plays a crucial role in clinical diagnostics for liver and haemolytic diseases, with elevated levels indicating potential liver dysfunction, biliary obstruction, or haemolysis. Bilirubin concentrations was measured spectrophotometrically using Jendrassik and Grof method (1938) (Guerra Ruiz *et al.,* 2021).

Principle:

Direct Bilirubin: Conjugated bilirubin reacts with diazotized sulphanilic acid in an alkaline medium, forming a blue-coloured complex. The intensity of this colour, measured at a wavelength of 546 nm, is proportional to the concentration of direct bilirubin (Guerra Ruiz *et al.,* 2021) [9].

Total Bilirubin: In the presence of caffeine, bilirubin bound to albumin is released, allowing it to react with diazotized sulphanilic acid. The resulting blue complex is measured at a wavelength of 578 nm, providing the total bilirubin concentration in the sample (Guerra Ruiz *et al.,* 2021) [9].

Procedure

Total Bilirubin (Tbil) Procedure (Guerra Ruiz *et al.,* 2021) [9]

1. 200 µl of Reagent 1 (Sulphanilic Acid) was pipetted into well-labelled sample, blank, and standard cuvettes.
2. 1000 µl of Reagent 3 (Caffeine) was then added to each cuvette.
3. 50 µl of Reagent 2 (Nitrite) was added to the sample and standard cuvettes only.
4. 200 µl of the sample was added to the corresponding sample cuvette and 200 µl of bilirubin standard was added to the standard cuvette. The contents were mixed and incubated at 20-25°C for 10 minutes.
5. 1000 µl of Reagent 4 (Tartrate) was added to each cuvette, the contents were mixed, and incubated for an additional 5-30 minutes and the absorbance of the sample and standard were measured against the blank at 578 nm using a spectrophotometer.

Direct Bilirubin (Dbil) Procedure (Guerra Ruiz *et al.,* 2021) [9]

1. 200 µl of Reagent 1 (Sulphanilic Acid) was pipetted into well-labeled sample, blank, and standard cuvettes.
2. 2000 µl of 0.9% sodium chloride (NaCl) was added to each cuvette.
3. 50 µl of Reagent 2 (Nitrite) was added to the sample and standard cuvettes only.
4. 200 µl of the sample was added to the corresponding sample cuvette and 200 µl of bilirubin standard was added to the standard cuvette. The contents were mixed and incubated at 20-25°C for 10 minutes. The absorbance of the sample and standard were measured against the blank at 546 nm using a spectrophotometer.

Result

Table 1 presents the socio-demographic characteristics of the study participants, comparing HIV-negative controls (n=50) and HIV-positive individuals (n=50). The mean age of the HIV-positive group (44.66±10.17) showed a significant increase compared to the HIV-negative group (38.94±14.89), with a p-value of 0.02. The gender distribution was similar in both groups, with more females than males. There was a significant increase in the proportion of HIV-positive individuals living in rural areas (32%) compared to HIV-negative controls (13%), with a p-value of 0.003. Educational attainment showed a significant increase in individuals with primary education among the HIV-positive group (11%) compared to none in the HIV-negative group, with a p-value

of 0.001. Conversely, the HIV-negative group had a significant increase in individuals with tertiary education (41%) compared to the HIV-positive group (18%). The occupational distribution revealed a significant increase in self-employment among HIV-positive individuals compared to the HIV-negative group. Additionally, there was a significant increase in the use of herbs among HIV-positive individuals (p=0.001).

Table 1: Socio-demographic Characteristics of the Study Participants

Variable	HIV Neg Control (n=50)	HIV- Positive (n=50)
Age, Mean ± SD	38.94±14.89	44.66±10.17
Gender (n%)		
Male	23(46.0)	16(32.0)
Female	27(54.0)	34(68.0)
Residence (n%)		
Urban	37	18
Rural	13	32
Education		
Primary	0	11
Secondary	9	21
Tertiary	41	18
Occupation		
Student	16	13
Civil servant	22	11
Self-employed	12	26
Alcohol Use		
Yes	14	15
No	36	35
Cigarette use		
Yes	0	3
No	50	47
Use of Herbs		
Yes	6	22
No	44	28

Data is presented as mean ± standard deviation, where * is ($p<0.05$).

Table 2. presents the prevalence of LFT dysfunction among HIV-infected individuals. Eighty percent (80%) of participants had normal ALT levels, while twenty percent (20%) exhibited abnormal ALT levels, suggesting liver inflammation or damage. Eighty eight percent (88.2%) had normal AST levels, and twelve percent (12%) displayed abnormal AST levels, further supporting the presence of liver damage. Ninety four percent (94%) had normal direct bilirubin levels, while six (6%) showed abnormal direct bilirubin levels, indicating impaired bile flow or liver damage. Seventy eight percent (78%) had normal total bilirubin levels, and twenty two percent (22%) exhibited abnormal total bilirubin levels, suggesting liver dysfunction or haemolysis.

Table 2. Prevalence of LFT Dysfunction among HIV-infected person (N=50)

Variable	Normal LFT (%)	Abnormal LFT (%)	P-value
ALT (IU/L)	40 (80.0)	10(20.0)	0.0001*
AST(IU/L)	44(88.2)	6(12.0)	0.0001*
Direct Bilirubin (mg/dL)	47(94.0)	3(6.0)	0.0001*
Total Bilirubin (mg/dL)	39(78.0)	11(22.0)	0.0001*

Where * is ($p<0.05$).

Discussion

The increasing prevalence of liver dysfunction among HIV-positive patients on antiretroviral therapy (ART) is a major public health concern (Sherman *et al.,* 2022) [19]. Despite ART's effectiveness in HIV management, long-term use has linked to hepatotoxicity. Direct viral effects, drug-induced hepatotoxicity, and co-infections with hepatitis B and C are all factors that contribute liver dysfunction (Das *et al.*,2017) [5]. Elevated liver enzymes, such as ALT, AST, and bilirubin, are common indicators of liver damage in this populations. In this study, the serum levels of bilirubin, ALT and AST in HIV-positive patients receiving antiretroviral therapy (ART) were measured and compared to those of HIV-negative controls.

A significant increase in demographic characteristics was observed between HIV-positive and HIV-negative individuals, aligning with previous research by Ibrahim *et al.,* (2019) [10], indicating disparities in HIV prevalence among demographic groups HIV-positive individuals were significantly older, which is consistent with the chronic nature of HIV infection and the increased life expectancy from antiretroviral therapy (ART). A higher proportion of people lived in rural areas, confirming HIV's disproportionate impact in rural communities, often linked to limited healthcare access, socioeconomic disparities, and potentially increased risk factors for transmission. The HIV-positive group had a higher proportion of self-employed people, suggesting occupational factors related to varying risk exposure or limited access to healthcare services in these sectors (Ibrahim *et al.,* 2019) [10]. Furthermore, a higher use

of herbs among HIV-positive individuals is consistent with previous research on the prevalence of traditional medicine practices among HIV patients (Marwa *et al.,* 2024).
In this study, it was observed that there was a significant increase in the levels of alanine aminotransferase (ALT) and aspartate aminotransferase (AST) between HIV-positive individuals and HIV-negative controls, Specifically, ALT and AST levels are notably higher in the HIV positive group, in line with earlier research by Anyanwu *et al.,* (2021)[2] suggesting elevated liver enzymes associated with HIV infection. The elevation of ALT and AST, enzymes primarily released from hepatocytes, indicates hepatocellular damage, and can be attributed to several factors, such as, hepatocyte infection, persistent immune activation, co-infections, and ART-induced hepatotoxicity (such as nevirapine and stavudine) causing liver cell damage and inflammation which leads to elevated ALT and AST, (Ganesan *et al.,* 2018; Otto *et al.,* 2021) [7,15]. While the incidence of severe liver injury with newer ART regimens has decreased, it remains a potential risk. Total bilirubin levels was significantly higher in HIV-positive individuals than HIV-negative controls, suggesting impaired bilirubin metabolism or excretion, which further reflects potential liver dysfunction.
This study observed a significant prevalence of liver dysfunction among the 50 HIV-infected participants, specifically 20% of the 50 HIV-infected individuals exhibited abnormal alanine aminotransferase (ALT) levels, and 12% had elevated aspartate aminotransferase (AST) levels, implying liver damage (Chamroonkul *et al*., 2019) [4]. Also 6% of the participants had elevated direct bilirubin, while 22% had abnormal total bilirubin levels, with elevated bilirubin level indicative of cholestasis or liver parenchymal damage, which may be further aggravated by HIV-related factors such as antiretroviral therapy or co-infection with hepatitis viruses the widespread of liver dysfunction in this group (Chamroonkul *et al*., 2019) [4].

Conclusion

This study reveals a notable prevalence of liver dysfunction among HIV-positive individuals on antiretroviral therapy (ART), with elevated alanine aminotransferase (ALT) and aspartate aminotransferase (AST) levels, as well as increased bilirubin concentrations, compared to HIV-negative controls. The persistent elevation of these liver enzymes suggests ongoing hepatocellular damage and inflammation, likely due to ART-induced hepatotoxicity, persistent immune activation, and co-infections such as hepatitis B and C. Lifestyle factors, including alcohol consumption and smoking, further exacerbate liver dysfunction, highlighting the multifaceted nature of liver damage in this population. Despite the advancements in ART reducing hepatotoxicity, a significant proportion of HIV-positive patients exhibit abnormal liver function tests, with 20% showing elevated ALT, 12% with elevated AST, and 22% with abnormal total bilirubin levels. These findings emphasize the need for regular monitoring of liver function in HIV-positive patients and underscore the importance of addressing both ART-related and lifestyle-related risk factors to mitigate liver damage and improve overall health outcomes in this group.

List of Abbreviations

ALT: Alanine Amino Transferase
AST; Aspartate Amino Transferase
HIV: Human immune-deficiency Virus
AIDS: Acquired Immube Deficiency Syndrome
ART: Antiretroviral Therapy
CD4: Cluster of Differentiation 4
NRTI: Nucleoside/Nucleotide Reverse Transcriptase Inhibitor
NNRTI: Non-nucleoside Reverse Transcriptase Inhibitor
PIs: Protease Inhibitors
INIs: Integrase Inhibitors
EIs: Entry Inhibitors
LDH: Lactate Dehydrogenase
NADH: Nicotinamide Adenine Dinucleotide Hydrogen
NAD: Nicotinamide Adenine Dinuceotide

Ethical Approval and Consent to Participate

The approval for this study was given by the ethical committee of Health Research Ethics Committee of Edo State University, Uzairue, Edo State, Nigeria. Informed consent was obtained from each participant prior to specimen collection.

Availability of Data and Materials

The authors declare consent for all available data present in this study.

Author's Contributions

Conception and design of the work/idea: Christian Onosetale Ugege and Mathew Folaranmi Olaniyan
Collect data/obtaining results: Blessing Kehinde Adeniran and David Olufemi Adebo
Manuscript writing: Christian Onosetale Ugege
Analysis and interpretation of data: Blessing Kehinde Adeniran and Ozavize Olatunji
Critical revision of the manuscript: Edward Eghonghon Imadojemu and Caleb Akhere Aigbokhan
Final research review: Christian Onosetale Ugege

Competing Interests

The authors declare no conflicts of interest

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