Research Article

Serological and Molecular Detection of HBV, HCV, and Co-Infection Among HIV Patients Receiving Antiretroviral Therapy at Prince Abubakar Audu University Teaching Hospital, Anyigba, Kogi State

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Abstract | Hepatitis C virus (HCV) and Hepatitis B virus (HBV) coinfection accelerate liver damage and heightened susceptibility to antiretroviral therapy–related hepatotoxicity in HIV infected patients. Seroprevalence, social-demographic characteristics, and predisposing risk factors were assessed in HIV-positive patients undergoing antiretroviral therapy at Prince Abubakar Audu University Teaching Hospital (PAAUTH) in Kogi State, Nigeria. In a cross-sectional study design, blood samples collected from 450 patients were screened for HBsAg and anti-HCV using commercial rapid immunoassay kits. Positive samples were confirmed using polymerase chain reaction (PCR). Data on demographics and behavioral risk factors were obtained from each HIV patient with a structured questionnaire. Overall, 1.6% (7/450), 0.9% (5/450), and 0.2% (1/450) patients were positive for HBV, HCV, and HBV/HCV co-infection, respectively. Statistical analysis revealed that the age of participants was significantly associated with HBV infection (χ^2 = 15.603, p = 0.029), while the association between age and HCV infection was not statistically significant (χ^2 = 4.957, p = 0.666). The prevalence of both HIV/HBV and HIV/HCV increased with a history of transfusion of contaminated blood, sharing of sharp objects, and intake of alcohol. The overall prevalence of HBV has declined while that of HCV remains constant when compared to earlier epidemiological investigations. Nevertheless, increased HBV vaccination coverage, routine screening for both HBV and HCV, and increasing public education about disease prevention may further reduce the burden of HBV and HCV in HIV positive people in the area.

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Introduction

Hepatitis B virus (HBV) and hepatitis C virus (HCV) infections continue to pose serious public health challenges worldwide and are recognized as leading contributors to chronic liver disease. Together, these infections account for a large proportion of cases of liver cirrhosis and hepatocellular carcinoma, with

the greatest impact observed in low- and middle-income countries (WHO, 2025; Abraham *et al*., 2023). Infection with HBV or HCV may result in either acute or chronic disease, and the clinical outcome is largely determined by factors such as host immune response, viral characteristics, and the presence of coexisting conditions, including HIV infection, excessive alcohol intake, and exposure to hepatotoxic agents (Dagnaw *et al*., 2025; Ndako *et al*., 2020). Hepatitis B virus is an enveloped virus with a partially double-stranded DNA genome and is classified within the family Hepadnaviridae. In contrast, the hepatitis C virus is a positive-sense, single-stranded RNA virus belonging to the family Flaviviridae (Ndako *et al*., 2020; WHO, 2022). Both viruses are predominantly transmitted through contact with infected blood and body fluids. Major routes of transmission include unsafe blood transfusion practices, mother-to-child transmission, unprotected sexual activity, and exposure to contaminated sharp objects such as needles and razors (Odimayo *et al*., 2018; Mustapha *et al*., 2020). The similarity in transmission pathways plays a significant role in the frequent occurrence of HBV and HCV co-infections, particularly among people living with HIV/AIDS (PLWHA).

Nigeria is regarded as a hyperendemic setting for HBV infection and represents a substantial proportion of the viral hepatitis burden in sub-Saharan Africa (Olayinka *et al*., 2016; WHO, 2020). Epidemiological studies conducted across various regions of the country have reported HBV prevalence rates ranging from approximately 8% to over 14% in the general population, while HCV prevalence rates typically fall between 1.5% and 4.0%, depending on the population studied (Pennap *et al*., 2010; Musa *et al*., 2015). Several factors have been implicated in sustaining this high disease burden, including inadequate hepatitis B vaccination coverage, unsafe medical practices, engagement in high-risk sexual behaviors, and limited availability of routine screening services (Ajuwon *et al*., 2021). The likelihood of developing chronic HBV infection is closely linked to the age at which exposure occurs as well as the immune status of the infected individual. In Nigeria, infections acquired during childhood frequently progress to chronic carriage, whereas those contracted during adolescence or adulthood are more likely to resolve spontaneously unless the individual is immunocompromised (Odimayo *et al*., 2018). Chronic HBV infection often remains clinically silent for extended periods but may gradually advance to liver fibrosis, cirrhosis, and hepatocellular carcinoma. Owing to the virus's low infectious dose, transmission can occur through minimal exposure, such as sharing personal items like toothbrushes or razor blades, making household transmission an important concern in endemic communities (WHO, 2020).

The presence of HIV infection further complicates both the epidemiology and clinical course of HBV and HCV infections. Co-infection with HBV and HIV has been associated with more rapid HIV disease progression and markedly higher rates of liver-related illness and mortality compared with HBV mono-infection (Musa *et al*., 2015; Forbi *et al*., 2007). Within Nigeria, reported rates of HIV/HBV co-infection vary considerably, ranging from about 5% to over 30% among different HIV-infected populations, reflecting regional variations and differences in study methodologies (Mustapha *et al*., 2020). HIV-associated immunosuppression reduces the effectiveness of immune-mediated HBV clearance, facilitates persistent viral replication, and increases the risk of advanced liver disease, including cirrhosis and hepatocellular carcinoma. Although the widespread use of highly active antiretroviral therapy (HAART) has led to a marked decline in AIDS-related opportunistic infections, chronic liver disease resulting from HBV and HCV co-infection has emerged as a major cause of morbidity among PLWHA (WHO, 2022).

The clinical management of individuals with dual infections is further complicated by issues such as drug-induced hepatotoxicity, interactions between antiviral agents, and the potential selection of drug-resistant viral strains, particularly when treatment regimens possess activity against both HIV and HBV (Dagnaw *et al*., 2025). Hepatitis C virus infection also represents an important public health concern in Nigeria, especially among populations at increased risk and individuals with compromised immune systems. Although HCV prevalence is generally lower than that of HBV, co-infection with HIV has been linked to more rapid progression of liver fibrosis, earlier onset of cirrhosis, and poorer therapeutic outcomes (WHO, 2019, 2020). Despite increasing recognition of viral hepatitis as a significant contributor to illness among HIV-infected persons, data on the sero-prevalence and molecular detection of HBV and HCV among HIV patients remain limited in several regions

of Nigeria, including Anyigba in Kogi State. The biological interaction between HIV and HCV has important implications for disease progression and clinical outcomes. Immunosuppression associated with HIV infection enhances HCV replication and accelerates the development of liver fibrosis, thereby increasing the likelihood of cirrhosis, hepatocellular carcinoma, and liver-related mortality among co-infected individuals (Balogun *et al*., 2012; Thomadakis *et al*., 2024). Clinical management of HIV/HCV co-infection is further complicated by challenges such as adverse drug–drug interactions between antiretroviral and antiviral therapies, treatment-related hepatotoxicity, and the emergence of drug-resistant viral strains, particularly in settings with limited resources (Hajizadeh *et al*., 2024).

In Nigeria, the transmission dynamics of HIV, HBV, and HCV are influenced by a complex interaction of behavioral, socio-cultural, and economic factors. Practices such as unprotected sexual activity, perinatal transmission, unsafe blood transfusion, and injection drug use have been identified as key drivers sustaining the spread of these infections (Abraham *et al*., 2023; Omatola *et al*., 2019; Odaibo *et al*., 2021). Individuals exposed to risk factors for HIV infection are similarly vulnerable to HBV and HCV due to shared transmission pathways, resulting in a high frequency of co-infections (Ndako *et al*., 2020). Among HIV-infected persons, chronic viral hepatitis is associated with increased infectivity, progressive liver damage, and heightened susceptibility to antiretroviral therapy–related hepatotoxicity (Abraham *et al*., 2023; Okonko *et al*., 2020).

Although numerous studies have reported the prevalence of HIV, HBV, HCV, and their co-infections in various Nigerian populations, there remains a notable gap in data concerning asymptomatic infections and the molecular characteristics of circulating viral strains among PLWHA, particularly in North-Central Nigeria. Anyigba, a town in Kogi State, which has a considerable population of PLWHA who receive care at the Prince Abubakar Audu University Teaching Hospital, a key referral facility in the region. Investigating the HBV and HCV seroprevalence among HIV-infected individuals in this setting is therefore crucial for elucidating local transmission dynamics and providing evidence-based prevention and clinical management strategies.

Material and Methods

Study area

This study was conducted in Anyigba, a city in Kogi State. Anyigba is a town located in the Dekina Local Government Area in Kogi State. It's found between latitudes 7°15'N-7°29'N and longitudes 7°11'E-7°32'E. The town is about 385 meters above sea level on average. It covers a land area of 420 square kilometers and is home to around 189,976 people. The area has a tropical wet and dry climate, known as AW, which means it has savanna landscapes. The weather includes an average yearly rainfall of 1250 mm and an average temperature of 25 °C. Agriculture serves as the primary livelihood for the residents. Certain practices among the inhabitants include early initiation of sexual activity, traditional customs like tribal markings, intravenous drug usage, unscreened blood transfusions, and sexual promiscuity (Omatola *et al*., 2019).

Study population

This was a hospital-based cross-sectional study in which 450 consenting HIV positive patients on HAART at the Prince Abubakar Audu University Teaching Hospital between January and April 2025 were recruited using a non-probability convenience sampling technique. These hospitals run a weekly HIV/AIDS clinic and are the most utilized health facilities in the study area, with a record of approximately 4000 HIV patients per year. Trained medical personnel in the hospital clearly explained the objectives/benefits of the study to the patients, and only those who gave consent by completing and endorsing filled-in questionnaires were consecutively recruited. Consenting attendees, male or female, aged 5 years and above who provided written informed consent were eligible for participation in the study. Ethical approval for the study was obtained from the ethical review committee of Prince Abubakar Audu University, Anyigba in accordance with Helsinki's code of conduct for biomedical research involving human subjects (Ethical clearance no: 058). Each participant provided consent to publish clinical data related to them in peer-reviewed publications.

Sample collection and storage

A total of two (2) ml of blood sample were aseptically collected from each of the 450 consenting HIV positive patients by vein-puncture into a well-labeled non-anticoagulant tube. Information concerning patients'

demographic profiles and associated risk factors was also obtained by means of structured questionnaires. Blood samples obtained from each patient were centrifuged at 3000 rpm for 8-10 seconds to separate serum from whole blood. Sera samples were stored at -20 °C in line with the manufacturer's instructions until screened for HBsAg.

Immunologic assays for HBsAg and anti-HCV antibody

A one-step test detection kit was used to detect HBsAg in serum using Coschesic strips®. This method is immuno-chromatographic and qualitative in nature and detects HBV antigen in human blood. The test strip, which is coated with the mouse monoclonal anti-HBs capture antibody, has more than 99.9% sensitivity and 98.6% specificity when read *in-vitro*. The test and interpretation of the results were done in accordance with the guidelines of the kit's manufacturers. The presence of anti-HCV antibody in serum was assayed using Coschesic strips®. This method is also immuno-chromatographic and qualitatively detects HCV antibody in human blood. The test strip, which is coated with the mouse monoclonal anti-HCV capture antibody, has more than 99.9% sensitivity and 98.6% specificity when read *in-vitro*. The test and interpretation of the results were done in accordance with the guidelines of the kit's manufacturers

Molecular confirmation

Viral genomic RNA was extracted from each of the samples using the Norgen Total RNA Purification Kit (NorgenBiotek Corp., Canada), while HBV DNA was extracted using the Column Pure Blood Genomic DNA Mini Kit (Applied Biological Materials Inc., Vancouver, Canada) according to the manufacturer's instructions. HBV PCR involved a 25 µL reaction volume comprising 10 µL of 2× PCR Taq Plus MasterMix/ with dye, 1 µL each of forward primer (10 pmol/µL) and reverse primer (10 pmol/µL), 3 µL template DNA, and 10 µL nuclease-free water. HBV DNA amplification targeted the surface antigen (S) gene using specific forward (5′-TCACCATATTCTTGGGAACAAGA-3′) and reverse (5′-CGAACCACTGAACAAATGGC -3′) primers. PCR reactions involved an initial denaturation stage at 95 °C for 10 minutes, followed by denaturation at 94 °C for 30 seconds, annealing at 45 °C for 30 seconds, and extension at 72 °C for 1 minute. PCR was for 35 cycles followed by final extension for 5 minutes at 72 °C and held at 4 °C. HCV PCR was carried out in a 25 µL total volume consisting of 12.5 µL of 2× master mix, 0.5 µL forward primer (10 pmol/µL), 0.5 µL reverse primer (10 pmol/µL), 1.1 µL RT-PCR Enzyme Mix (RT +Taq), 7.4 µL nuclease-free water, and 3 µL extracted HCV RNA template. The RT-PCR involves first reverse transcribing RNA into DNA, followed by the other stages in PCR targeting the conserved HCV RNA 5′ UTR region using the forward 5′- GCGACACTCCACCATAGATCA -3′ and reverse 5′- GTGCTCATGGTGCACGGTCTA -3′ primers. At the start of the reaction, the first stage involved reverse transcription at 50 °C for 30 minutes; followed by the initial denaturation stage at 95 °C for 10 minutes. This was followed by 35 cycles of PCR reaction involving DNA template denaturation at 94 °C for 30 seconds, annealing at 58 °C for 30 seconds, and extension at 72 °C for 45 seconds. This is allowed by a final extension at 72 °C for 10 minutes and a holding step at 4 °C. Both the HBV and HCV amplicons were confirmed through electrophoresis on agarose gel.

Data analysis

The data obtained from the questionnaire and the results of laboratory tests were analyzed using SPSS 20 (Statistical Package for Social Sciences version 20), and the results obtained were presented in tables, figures, and graphs. HIV, HBV, and HCV Seroprevalence was determined from the proportion of seropositive individuals in the total population under study and expressed as a percentage. A binary logistic regression was conducted to evaluate the association between socio-demographic and behavioral factors and HBV co-infection among HIV-positive individuals. The Pearson chi-square test was employed to determine the relationships between the demographic data and clinical information with HIV, HBV, and HCV infection. P values of ≤ 0.05 were considered significant at 95% confidence interval.

Results

Of the 450 HIV participants screened, 7 were tested positive for hepatitis B surface antigen (HBsAg), giving an overall prevalence of 1.6%. Anti-HCV antibodies were detected in 4 participants, representing a prevalence of 0.9%, while only one participant (0.2%) was co-infected with both HBV and HCV. Age distribution showed that HBsAg positivity was highest among participants aged 61–70 years (11.7%), followed by those aged 51–60 years (3.3%), 41-50 years (1.6%), and 31-40 years (1.2%). No cases were

recorded in age groups 1-10 years, 11-20 years, 21-30 years, and 71-80 years. Statistical analysis revealed Ages of participants were significantly associated with HBV infection (χ^2= 15.603, p= 0.029). In contrast, higher HCV Infection was recorded in the age group 41-50 years (1.6%), followed by the age group 31-40 years with 1.2% prevalence rate. No cases were detected in participants aged 1-10 years, 11-20 years, 21-30 years, 51-60 years, 61-70 years, and 71-80 years. The association between age and HCV infection was not statistically significant (χ^2= 4.957, p= 0.666). Coinfection of HBV/HCV (0.8) was detected in the age group 41-50. HBV/HCV coinfection was not associated with age (P = 0.914) (Table 1).

Table 1: *Distribution of HBV and HCV in relation to the ages of participants.*

Age	No tested	HBsAg positive (%)	P value	Anti-HCV positive (%)	P value	HBV/HCV co-infection	P value
1-10	9	0(0)	0.029	0(0)	0.666	0(0)	0.914
11-20	37	0(0)		0(0)		0(0)	
21-30	65	0(0)		0(0)		0(0)	
31-40	166	2(1.2)		2(1.2)		0(0)	
41-50	123	2(1.6)		2(1.6)		1(0.8)	
51-60	30	1(3.3)		0(0)		0(0)	
61-70	17	2(11.7)		0(0)		0(0)	
71-80	3	0(0)		0(0)		0(0)	
Total	450	7(1.6)		4(0.9)		1(0.2)	

Table 2: *Distribution of HBV and HCV in relation to gender of participants.*

Gender	No tested	HBsAg positive (%)	P value	Anti-HCV positive (%)	P value	HBV/HCV co-infection	P value
Male	160	2(1.3)	0.918	2(1.3)	0.83	0(0)	0.75
Female	290	5(1.7)		2(0.7)		1(0.3)	
Total	450	7(1.6)		4(0.9)		1(0.2)	

Analysis of infection distribution in relation to gender revealed that HBV was slightly more prevalent among females (1.7%) than males (1.3%), whereas HCV was higher in males (1.3%) than females (0.7%). There was no statistically significant relationship between gender and HBV (χ^2 = 0.171, p = 0.918) or HCV (χ^2 = 0.373, p = 0.830). HBV/HCV was more prevalent among females (0.3) than males (Table 2).

In relation to marital status, HBV prevalence was higher among widowed participants (5.0%), followed by married individuals (2.3%), while singles and divorced participants recorded no infection. However, HCV seropositivity was only recorded among the married group (1.5%). Associations between marital status and infection were not significant for either HBV (χ^2 = 5.196, p = 0.158) or HCV (χ^2 = 2.949, p = 0.400). Married subjects showed greater exposure for HBV/HCV coinfection (0.4%: P = 0.866) (Table 3). Occupationally, the business group displayed a higher positivity rate for HBsAg (4.0%), followed by farmers (1.7%), civil servants (1.3%), and the unemployed category with zero (0%) prevalence. Similar to HBV, high occurrence of HCV (3.0%) was observed among business group compared to civil servants with (0.7%) prevalence rate. No HCV cases were recorded among the farmers and the unemployed category. Neither HBV (χ^2= 6.296, p= 0.098) nor HCV (χ^2= 7.025, p = 0.070) showed a significant association with the occupation of participants. Similar to HBV and HCV, coinfection of HBV/HCV (1.0%) was detected among the business group (Table 4).

Table 3: *Distribution of HBV and HCV in relation to marital status of participants.*

Marital	No tested	HBsAg positive (%)	P value	Anti-HCV positive (%)	P value	HBV/HCV co-infection	P value
Single	156	0(0)	0.158	0(0)	0.4	0(0)	0.866
Married	260	6(2.3)		4(1.5)		1(0.4)	
Divorced	14	0(0)		0(0)		0(0)	
Widowed	20	1(5.0)		0(0)		0(0)	
Total	450	7(1.6)		4(0.9)		1(0.2)	

Table 4: *Distribution of HBV and HCV in relation to occupation of participants.*

Occupation	No tested	HBsAg positive (%)	P value	Anti HCV positive (%)	P value	HBV/HCV co-infection	P value
Farming	57	1(1.7)	0.098	0(0)	0.07	0(0)	0.314
Business	99	4(4.0)		3(3.0)		1(1.0)	
Civil servant	153	2(1.3)		1(0.7)		0(0)	
Unemployed	141	0(0)		0(0)		0(0)	
Total	450	7(1.6)		4(0.9)		1(0.2)	

Participants with tertiary education recorded the highest prevalence of HBV (1.8%) and HCV (1.2%) compared to other educational groups. Similarly, HBV/HCV coinfection rate of (0.2%: P = 0.951) compared to other levels. However, the differences were not statistically significant for either HBV (χ^2 = 0.563, p = 0.905) or HCV (χ^2 = 1.402, p = 0.705) (Table 5). Analysis of HBV risk factors showed that infection was more common among participants with a history of blood transfusion (4.9%) compared to those without (1.2%), although this difference was not statistically significant (OR = 4.0, 95% CI: 0.46–1.285; p= 0.71). Participants who reported intravenous drug use had a higher prevalence of HBV infection (2.1%) compared to non-users (1.5%) (OR = 1.4, 95% CI: 0.084–6.043; p= 0.755). Similarly, individuals with prior knowledge of HBV recorded a prevalence of 2.2% compared to 1.3% among those without such knowledge (OR= 1.7, 95% CI: 0.378–7.750; p= 0.481). Alcohol consumption was also associated with a higher prevalence (2.8%) compared to non-consumers (1.3%), although this difference was not significant (OR= 2.2, 95% CI: 0.412–11.401; p= 0.349). No HBV cases were detected among participants with a history of tooth extraction, whereas 1.6% of those without such a history tested positive (p= 0.536). A slightly higher prevalence (1.9%) was observed among participants without scarification marks compared to those with marks (1.3%) (OR= 0.7, 95% CI: 0.151–3.083; p= 0.617). Interestingly, none of the participants with a family history of HBV infection tested positive, whereas 1.6% of those without such a history were positive (p= 0.938). A statistically significant association, however, was observed with the sharing of sharp objects.

Table 5: *Distribution of HBV and HCV in relation to level of education of participants.*

Level of education	No tested	HBsAg positive (%)	P value	Anti-HCV positive (%)	P value	HBV/HCV co-infection	P value
None	6	0(0)	0.905	0(0)	0.705	0(0)	0.951
Primary	7	0(0)		0(0)		0(0)	
Secondary	103	1(1.0)		0(0)		0(0)	
Tertiary	334	6(1.8)		4(1.2)		1(0.2)	
Total	450	7(1.6)		4(0.9)		1(0.2)	

Participants who reported sharing sharps had a higher prevalence of HBV infection (3.6%) compared to those who did not share sharps (0.4%) (p = 0.028) (Table 6). Analysis of HCV risk factors showed that prevalence was higher among participants with a history of blood transfusion (2.1%) compared to those without (0.7%), although the association was not statistically significant (OR= 3.0, 95% CI: 0.030–2.908; p= 0.267). Similarly, intravenous drug users had a higher HCV prevalence of 2.1% compared to 0.7% among non-users. The difference was not significant (OR= 3.0, 95% CI: 0.036–3.466; p= 0.351). No HCV cases were detected among participants with prior knowledge of HCV, whereas 1.3% of those without knowledge of HCV were positive (p= 0.143). Alcohol consumers recorded a prevalence of 1.4% compared to 0.8% among non-consumers, though the difference was not significant (OR= 1.8, 95% CI: 0.184–17.461; p= 0.611). None of the participants with a history of tooth extraction tested positive, while 0.9% of those without an extraction history were positive (p= 0.641). Equal prevalence of 0.9% was observed among

Table 6: *Risk factors associated with HBV seropositivity among study participants.*

Variables	No tested	HBsAg positive (%)	Odd ratio (95%CI)	P value
Transfusion				
Yes	41	2(4.9)	4.0(0.46-1.285)	0.71
No	409	5(1.2)	Reference	
Intravenous drug use				
Yes	48	1(2.1)	1.4(0.084-6.043)	0.755
No	402	6(1.5)	Reference	
Knowledge of HBV				
Yes	138	3(2.2)	1.7(0.378-7.750)	0.481
No	312	4(1.3)	Reference	
Alcohol consumption				
Yes	71	2(2.8)	2.2(0.412-11.401)	0.349
No	379	5(1.3)	Reference	
Tooth extraction				
Yes	24	0(0)	-	0.536
No	426	7(1.6)		
Scarification				
Yes	235	3(1.3)	0.7(0.151-3.083)	0.617
No	215	4(1.9)	Reference	
History of HBV				
Yes	8	0(0)	-	0.938
No	442	7(1.6)		
Sharing of sharps				
Yes	167	6(3.6)	-	0.028
No	283	1(0.4)		

participants with and without scarification marks (OR= 1.0, 95% CI: 0.128–6.547; p= 0.929). None of the participants with a history of HCV infection tested positive for HCV, while 0.9% of those without such a history were positive (p= 0.964). A relatively higher prevalence was noted among participants who reported sharing of sharps (1.8%) compared to those who did not (0.4%), but the difference was not statistically significant (p= 0.291).

Table 7: *Risk factors associated with HCV seropositivity among study participants.*

Variables	No tested	HBsAg positive (%)	Odd ratio (95% CI)	P value
Transfusion				
Yes	41	2(2.1)	3.0(0.030-2.908)	0.267
No	409	3(0.7)	Reference	
Intravenous drug use				
Yes	48	1(2.1)	3.0(0.036-3.466)	0.351
No	402	3(0.7)	Reference	
Knowledge of HCV				
Yes	138	0(0)		0.143
No	312	4(1.3)		
Alcohol consumption				
Yes	71	1(1.4)	1.8(0.184-17.461)	0.611
No	379	3(0.8)	Reference	
Tooth extraction				
Yes	24	0(0)	-	0.641
No	426	4(0.9)		
Scarification				
Yes	235	2(0.9)	1.0(0.128-6.547)	0.929
No	215	2(0.9)	Reference	
History of HCV				
Yes	2	0(0)		0.964
No	448	4(0.9)		
Sharing of sharps				
Yes	167	3(1.8)		0.291
No	283	1(0.4)		

Discussion

Hepatitis B virus (HBV) and hepatitis C virus (HCV) infections are major global health concerns as they are significant causes of chronic hepatitis, cirrhosis, and hepatocellular carcinoma (WHO, 2025; Ali *et al.*, 2024). The incidence of these viral infections has been reported in different regions of Nigeria, and due to their shared transmission routes with HIV, co-infection with viral hepatitis is common (Omatola *et al.*, 2019; Odaibo *et al.*, 2021). This study was designed to assess the seroprevalence of HBV and HCV among HIV-confirmed patients. The overall HBV prevalence of 1.6% observed in this study is lower than the national prevalence of 11% in 2016 (FMoH, 2016) and 7.5 % in 2022 elsewhere in the State (Oseni and Arome, 2022). It is also lower than the 3.0%, 2.4%, and 2.8% reported among febrile patients (Ali *et al.*, 2024), asymptomatic pregnant women (Omatola and Okolo, 2021), and asymptomatic polytechnic students (Abraham *et al.*, 2023), respectively, in other parts of the State. A recent study by Omatola *et al.* (2017) documented a higher HBV prevalence of 6.0% among apparently healthy students. In addition, higher HBV 12.0% were reported in Cameroon (Ndifontiayong *et al.*, 2020). The comparatively low HBV rate in our study may be attributed to the preventive effect of HBV vaccination, as previously reported (Abraham *et al.*, 2023; Omatola *et al.*, 2024).

In the study, HCV prevalence of 0.9% was recorded among HIV patients, which is comparable to the national HCV prevalence of 1.1% (NACA, 2019). This finding is also consistent with the 1.0% prevalence recently reported in the same region (Ali *et al.*, 2024; Omatola *et al.*, 2024). Similarly, Odaibo *et al.* (2021) reported a prevalence of 1.0% among sickle cell patients in Ogbomosho. However, higher HCV prevalence rates of 3.33%, 4.0%, and 4.5% were documented among HIV-positive patients by (Ndifontiayong *et al.*, 2020; Edia-Asuke and Usman, 2017; Omatola *et al.*, 2016), respectively. Differences in the transmission risk factors, sample sizes, and detection methods may explain the different prevalence rates observed in the different studies. Dual HBV/HCV co-infection was detected in 0.2% of HIV-confirmed patients receiving antiretroviral therapy (ART) at PAAU Teaching Hospital. This co-infection of HBV/HCV in this study may reflect overlapping transmission routes and risk factors, as previously documented (Odaibo *et al.*, 2021).

Regarding gender distribution, HBV surface antigenemia was more common among females. This agrees with Omatola *et al.* (2024), who reported higher HBV prevalence among female undergraduate students in the same area. However, these finding contrasts report of Ali *et al.* (2024), who observed comparable rates of HBV infection between males and females in a different population. The higher HBV prevalence among females in this study could

be linked to socio-economic, biological, and cultural factors, including increased exposure risk through sexual contact (Glynn *et al.*, 2020). Contrary to HBV infection, HCV was more prevalent among males (1.3%) compared to females (0.7%), which did not align with the report of other authors (Edia-Asuke and Usman, 2017; Fiore *et al.*, 2023) who reported higher HCV among female patients. Differences in the prevalent patterns for specific viruses may explain this observation. HBV infection was most prevalent among participants aged 61–70 years. This pattern may be linked to age-related immune decline and the historically low coverage of HBV vaccination within this population group (Abraham *et al.*, 2023; Ali *et al.*, 2024). The higher HBV prevalence observed among this older age group contrasts with the findings of Ali *et al.* (2024), who reported increased HBV infection rates among individuals aged 11–20 years. In contrast, HCV infection was more common among patients aged 40–50 years. This aligns with the findings of Glynn *et al.* (2020), who documented higher HCV prevalence in patients aged 40 years and above in Port Harcourt, Nigeria. However, our observation differs from those of authors (Ali *et al.*, 2024; Jeremiah *et al.*, 2008), who both noted a higher HCV prevalence among younger patients aged 21–30 years. The relatively higher prevalence of both HBV and HCV among older age groups, compared with younger counterparts, may be attributed to prolonged exposure to risk factors such as unprotected sexual activity, multiple sexual partnerships, and intravenous drug use (Omatola *et al.*, 2024).

Analysis by marital status revealed that HBV prevalence was higher among widowed participants (5.0%), followed by married individuals (2.3%), while no cases were recorded among singles and divorced participants (χ^2= 5.196, p= 0.158). This finding contrasts with the report of Pius*et al.* (2020) in Kwara, in a similar hospital-based study, who observed higher HBV prevalence among unmarried individuals. For HCV, Seropositivity was detected only among the married individuals (1.5%), with no significant association observed between marital status and HCV infection (χ^2 = 2.949, p = 0.400). This aligns with the findings of Ali *et al.* (2024), who also documented a higher prevalence of HCV among married populations. Marriage can facilitate viral transmission through sexual intercourse, and high-risk sexual behaviors by one's partner may further increase the susceptibility of the other partner to infection (Ali *et al.*, 2024). In this study, HBV prevalence was higher among participants with tertiary education compared to those with lower levels of education, a finding consistent with the report of Pius *et al.* (2020). Similarly, HCV infection was also more common among individuals with tertiary qualifications. This contrasts with the findings of Iduh *et al.* (2024), who reported higher HCV prevalence among participants with no formal education. The relatively high occurrence of HBV and HCV infections among individuals with tertiary education is somewhat unexpected, as this group is generally assumed to possess greater awareness of disease prevention and control measures.

Occupationally, the reason for the peak infection among business people compared to other occupational groups could be attributed to high exposure of the people to risk factors of transmission. The business category was more predisposed to HIV. This observation is consistent with a previous report of Omatola *et al.* (2024), who observed a high occurrence of Infection among self-employed and unemployed subjects in the study area. The present study demonstrates that several behavioral and exposure-related risk factors contributed to HBV and HCV seropositivity among HIV-infected patients, though most associations did not reach statistical significance. For HBV, sharing of sharp objects emerged as a significant risk factor, consistent with previous reports that highlight the role of contaminated instruments in HBV transmission, particularly in low-resource settings where sterilization practices may be inadequate (Omatola *et al.*, 2024; WHO, 2021). Similarly, blood transfusion and intravenous drug use were associated with higher HBV prevalence, although not significant, a pattern also observed in earlier studies linking unsafe transfusion practices and drug use to HBV transmission (Odaibo *et al.*, 2021). The absence of HBV among individuals with a family history of infection further underscores that transmission in this cohort is more strongly related to behavioral exposures rather than hereditary risk. Importantly, previous studies have shown that lack of vaccination significantly increases HBV susceptibility (Odaibo *et al.*, 2021; Omatola *et al.*, 2024), underscoring the need to scale up vaccine coverage among high-risk groups, including people living with HIV.

For HCV, higher prevalence was observed among participants with a history of blood transfusion and intravenous drug use, findings that align with

global and national evidence identifying these as major transmission routes (Ali *et al*., 2024). Alcohol consumption also appeared to increase HCV prevalence, echoing the evidence that alcohol use exacerbates risky sexual behavior and worsens disease outcomes in co-infected individuals (Shuper *et al*., 2020). The findings emphasize that among HIV patients, HBV and HCV transmission remains linked to modifiable behavioral exposures, including unsafe transfusion, sharp-object sharing, and risky sexual practices. This is consistent with reports from Nigeria and sub-Saharan Africa where overlapping risk factors drive HIV–HBV–HCV co-infections (Omatola *et al*., 2018; Kharsany and Karim, 2020; Reid, 2020). Targeted interventions focusing on vaccination, safe transfusion services, harm-reduction programs for drug users, and behavioral change communication are therefore essential to reduce the burden of viral hepatitis in HIV-positive populations.

This study has some limitations. The seroprevalence in the current study may not reflect the true burden of disease in the study area, since only hospital-based cases were considered. Also, our findings may not fully represent the entire population of Anyigba, as only patients seeking medical attention in Prince Abubakar Audu Teaching Hospitals were included. Additionally, the immunochromatographic techniques used for preliminary screening of eligible subjects in the study might not have completely ruled out false-negative results, particularly for those with latent infections or within the window period, potentially leading to an underestimation of the current burden of HBV, HCV, and HIV in the area. However, despite these limitations, the findings of this study are significant as they contribute to the limited epidemiological data on the prevalence and coinfection of these viruses in the area. This underscores the importance of regular serological screening for the entire population to accurately determine the number of individuals affected by these viruses. The data generated could inform government policies aimed at strengthening HBV, HCV, and HIV surveillance and intervention programs to prevent further spread.

Conclusion and Recommendations

This study highlights a relatively low seroprevalence of HBV and HCV among HIV-infected individuals compared to national and regional benchmarks, suggesting encouraging progress in preventive measures, particularly HBV vaccination. Nonetheless, the detection of mono and dual infections reflects the continued influence of overlapping transmission routes and risk factors. Behavioral factors such as unsafe transfusions, intravenous drug use, alcohol intake, and sharing of sharp instruments remained relevant contributors. Although statistical significance was not uniformly observed, the findings reinforce the importance of addressing modifiable risk factors in curbing viral hepatitis transmission within HIV-positive populations. To further reduce co-infection rates, public health efforts should prioritize expanded HBV immunization coverage, enhanced transfusion safety, harm-reduction programs for drug users, and culturally sensitive behavioral change communication. Ongoing surveillance and region-specific research are imperative to inform evidence-based interventions tailored to local epidemiological contexts.

Novelty Statement

This study provides a critical update on the shifting epidemiological landscape of viral hepatitis co-infections among HIV patients, revealing a significant decline in HBV prevalence while HCV rates remain stagnant compared to historical data. By correlating these trends with specific behavioral risk factors, notably blood transfusion history and alcohol consumption, this research identifies a pivotal transition in co-infection dynamics, highlighting the success of current HBV interventions and the need for targeted HCV-specific public health strategies.

Author's Contribution

M-LOO and CAO: Conceptualized and supervised the work. Samples collection and experimental work were carried out by JUS. Data analysis was done by VOA and CAO. The initial draft was written by JUS. All authors revised and approved the final draft for publication.

Data availability statement

All data generated or analyzed during this study are included in this published article

Generative AI and AI assisted technology statement

The authors declare that no generative AI and AI assisted technology was used in the creation of this manuscript.

Conflict of interest

The authors have declared no conflict of interest.

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