Viral Load and Socio-Demographic Factors on Hepatitis B Virus (HBV) and Hepatitis C Virus (HCV) Coinfection in HIV-Infected Individuals in Calabar Metropolis, Cross River State, Nigeria

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Abstract: HIV/AIDS remains a significant public health issue globally, especially in sub-Saharan Africa. In Nigeria, high HIV prevalence has driven numerous health interventions and studies due to associated morbidities. Coinfections with HBV and HCV are common among HIV-positive individuals, complicating clinical management and accelerating disease progression. These infections share similar transmission routes, such as sexual contact and intravenous drug use. This study aimed to determine the impact of viral load and socio-demographic factors on HBV and HCV coinfection in HIV-positive patients in Calabar Metropolis, Cross River State, Nigeria. This was a cross-sectional study involving 200 patients diagnosed with HIV attending an ART clinic at Dr. Henshaw Memorial Hospital, IDH, Calabar. The demographic data were obtained using a questionnaire. Serum samples were tested for the detection of HBsAg and HCV using ELISA kits. The results show that HBV coinfection was 28%. The prevalence was higher in females (29%) and individuals aged >65 years (57.1%). No cases of HCV infection were detected in the study population. Analysis by viral load revealed that individuals with a viral load of 200+ copies/ml had the highest HBV coinfection rate (43.2%), followed by those with 21–75 copies/ml (29.5%), 76–199 copies/ml (13.3%), and <20 copies/ml (26%), this means that individuals with higher HIV viral loads are more susceptible to HBV coinfection. Unemployed patients were also more infected with HBV (54%). Based on marital status, widows and divorcees had a higher HBV prevalence (14.3%). The prevalence was higher in students (16.7%) and patients with a primary education background (25%). The absence of HCV coinfection in the study population suggests either a lower exposure rate or effective management of HCV in this region. Regular screening for HBV should be integrated into the routine care of people living with HIV/AIDS, especially for high-risk groups such as older individuals and those with higher viral loads.

1. INTRODUCTION

Human Immunodeficiency Virus (HIV) infection remains a major health concern worldwide, particularly in sub-Saharan Africa, where it is compounded by coinfections with other chronic viral diseases such as Hepatitis B virus (HBV) and Hepatitis C virus (HCV). These coinfections pose a significant clinical burden, leading to rapid disease progression and complicating treatment strategies in affected populations. Nigeria, with one of the highest burdens of HIV in Africa, continues to experience high rates of coinfections due to shared routes of transmission, including unprotected sex and contaminated needles (UNAIDS, 2023).

HBV and HCV are hepatotropic viruses that, when present alongside HIV, accelerate liver damage and increase the risk of liver-related morbidity and mortality. Coinfections are particularly concerning in HIV-positive individuals with compromised immune systems, as these patients are more susceptible to the chronic complications of HBV and HCV (WHO, 2022). Moreover, managing these coinfections is challenging due to potential drug interactions between antiretroviral therapy (ART) and antiviral medications for hepatitis.

The impact of viral load and socio-demographic factors on HBV and HCV coinfection in HIV-positive individuals is increasingly recognized as a critical determinant of clinical outcomes and disease progression. High HIV viral load is associated with increased replication of HBV and HCV, leading to more rapid liver disease progression and reduced immune control over co-infections (Chen et al., 2020). Furthermore, socio-demographic variables such as age, sex, level of education, marital status, and employment status significantly influence the

prevalence and severity of coinfections. Studies have shown that younger individuals and males may be at higher risk due to increased engagement in high-risk behaviors, including unprotected sex and intravenous drug use (Nwaneri et al., 2022). Low educational attainment and unemployment are also linked to poor health-seeking behavior, limited access to healthcare, and reduced awareness about transmission routes, which can contribute to higher coinfection rates (Ameh et al., 2019). Understanding these associations is crucial for tailoring public health interventions and ensuring equitable access to comprehensive care among people living with HIV.

Calabar Metropolis in Cross River State, Nigeria, is a region with moderate HIV prevalence and an at-risk population due to various socio-economic and environmental factors. Despite the public health significance of HBV and HCV coinfections among HIV-positive individuals, there is a scarcity of region-specific data to guide clinical interventions. Understanding the influence of viral load and socio-demographic factors such as age, sex, education, and employment status on the occurrence of HBV and HCV is crucial for effective healthcare planning.

This study aims to determine the prevalence of HBV and HCV coinfections and assess the influence of viral load and socio-demographic factors among HIV-positive patients in Calabar. The findings are expected to inform public health strategies and strengthen routine screening and integrated care models for people living with HIV/AIDS.

2. MATERIALS AND METHODS
2.1 Study Area
The study was conducted in Calabar Metropolis, Cross River State, Nigeria, using participants from Dr. Lawrence Henshaw Memorial Hospital/Infectious Disease Hospital (IDH), which provides ART services. Calabar is known for its tropical climate and a significant prevalence of HIV.

2.2 Study design
The study was a cross-sectional type where samples were collected from people living with HIV/AIDS at Dr. Lawrence Henshaw Memorial Hospital, IDH, Calabar, Cross River State.

2.3 Study population
The study involved 200 people living with HIV/AIDS undergoing clinical monitoring in the antiretroviral therapy (ART) unit at Dr. Lawrence Henshaw Memorial Hospital, IDH, Calabar, Cross River state.

2.4 Inclusion and Exclusion Criteria
Participants included in the study were confirmed HIV-positive adults (aged 18 and above), enrolled in ART programs and who provided informed consent. Patients who had received hepatitis vaccinations or declined consent were excluded.

2.5 Ethical Consideration
Ethical clearance was obtained from the Cross River State Ministry of Health Ethics Committee and the University of Port Harcourt Ethics Review Board. Informed consent was obtained from all participants.

2.6 Data Collection and Laboratory Procedures
Socio-demographic data were collected through structured questionnaires. Blood samples were collected and tested using commercially available ELISA kits to detect Hepatitis B surface antigen (HBsAg) and HCV antibodies. Tests were conducted according to the manufacturer's instructions.

2.7 Serological analysis
The serological analysis was conducted in the Virus and Genomics Research Laboratory, Faculty of Science, University of Port Harcourt. Co-infections were identified using ELISA techniques with commercially available Monolisa™ ULTRA ELISA kits from BIORAD (3, bd Raymond Poincare, 92430 Marnes-la-Coquette, France), which have a detection limit of less than 0.13 IU/ml. Serum samples were screened for HBV, HCV, following the manufacturer's protocols.

2.8 Data Analysis
Data were analyzed using Microsoft Excel. Seroprevalence was calculated as the number of seropositive cases divided by the total number of tested individuals. Chi-square tests were used to assess associations between demographic variables and HBV/HCV coinfection. A p-value of <0.05 was considered statistically significant.

3. RESULTS
Table 1 presents the socio-demographic characteristics of the study population, highlighting the frequency and percentage distribution for each category. The highest frequency for age is observed in the 35-44 age range, with 69 participants (34.5%). This is followed by the 45-64 age range, which includes 67 respondents (33.5%). Additionally, 48 respondents (24%) fall within the 18-34 age group, while 9 respondents (4.5%) are under 18 years of age. There are also 7 respondents (3.5%) aged 65 and above. Females constitute a larger proportion of the sample at 54%, compared to 46% for males. Furthermore, single individuals account for 53% of the sample, while married individuals make up 34%, and 13% are widowed or divorced. In terms of educational and occupational status, those with primary education and self-employed individuals have higher prevalence rates of 35% and 50.5%, respectively (Table 1).

Table 1: Socio-demographic characteristics

Variables	Categories	No. Tested	% Tested
Gender	Male	92	46
	Female	108	54
Age group	<18 years	9	4.5
	18-34	48	24
	35-44	69	34.5
	45-64	67	33.5
	65+	7	3.5
Marital status	Married	68	34
	Single	106	53
	Others	26	13
Educational status	Primary	70	35
	Secondary	62	31
	Tertiary	12	6
	None	56	28
Occupational status	Self employed	101	50.5
	Unemployed	24	12
	Student	30	15
	Employed	45	22.5
Total		**200**	**100.0**

Fig. 1: HBV/HIV Co-infection

Fig. 2: HCV/HIV Co-infection

Among the 200 HIV-positive participants, 56 (28%) tested positive for HBV in Fig. 1, while no cases of HCV infection were detected (Fig. 2).
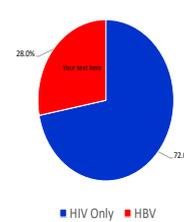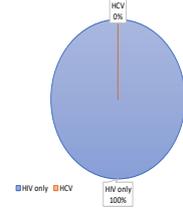
Females recorded a slightly higher prevalence of HBV (29%) compared to males (26.1%). The highest HBV prevalence (57.1%) was observed among individuals aged over 65 years. Occupation-wise, unemployed participants had the highest HBV prevalence (54%), followed by self-employed (29.7%). Marital status analysis revealed higher HBV infection rates among single individuals (31.1%). Participants with primary education also showed increased prevalence (35.7%) compared to those with higher educational attainment (Table 2).

Table 2 HIV/HBV Coinfection relating to their demographic characteristics

Variables	Categories	No. Tested	No. Positive	% Positive	No. Negative	Chi-square value
Gender	Male	92	24	26.1	68	X=0.309281, df=1, p=0.5781
	Female	108	32	29.6	76	
Age group	<18 years	9	2	22.2	7	X=4.44771, df=4, p=0.3488
	18-34	48	14	29.2	32	
	35-44	69	21	30.4	48	
	45-64	67	15	22.4	52	
	65+	7	4	57.1	3	
Marital status	Married	68	16	23.5	52	X=1.20489, df=2, p=0.5475
	Single	106	33	31.1	73	
	Others	26	7	26.9	19	
Educational status	Primary	70	25	35.7	45	X=5.25062, df=3, p=0.1543
	Secondary	62	12	19.4	50	
	Tertiary	12	2	16.7	10	
	None	56	17	30.4	39	
Occupational status	Self-employed	101	30	29.7	71	X=13.62833, df=3 p=0.00345
	Unemployed	24	13	54.0	11	
	Student	30	7	23.0	23	
	Employed	45	6	13.0	39	
Total		**200**	**56**	**28.0**	**144**	

Viral load analysis revealed that individuals with a viral load of 200+ copies/ml had the highest HBV coinfection rate (43.2%), followed by those with 21–75 copies/ml (29.5%), 76–199 copies/ml (13.3%), and <20 copies/ml (26%) as shown in Table 3.

Table 3: Distribution of HBV/HIV participants in relation to viral load

Viral load (Copies/ml)	No. Tested	No. Positive	% Positive	No. Negative
< 20	23	6	26.0	17
21-75	95	28	29.5	67
76-199	45	6	13.3	39
200+	37	16	43.2	21
TOTAL	**200**	**56**	**28.0**	**144**

4. DISCUSSION

The distribution of HIV cases by age in this study indicates that the majority of participants were concentrated in the 35–44 age group (34.5%), closely followed by the 45–64 age group (33.5%). This age pattern reflects the findings of Adeleke et al. (2023), who reported high rates of HIV and associated coinfections among individuals in their economically active years. According to Adeleke, occupational mobility and engagement in high-risk sexual behaviour may contribute significantly to this trend. However, contrasting evidence from Obot et al. (2022) suggests that younger adults, particularly those aged 25–34, also face elevated HIV risk in some regions. This has been attributed to early sexual initiation and limited access to comprehensive sexual education.

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In terms of gender distribution, females comprised a slightly higher percentage (54%) than males (46%) in the study population. This finding is consistent with the work of Nwosu et al. (2023), who observed higher HIV prevalence among women in sub-Saharan Africa due to a combination of socioeconomic vulnerabilities, gender norms, and biological susceptibility. Conversely, studies such as Adetola and Umar (2021) propose that in urban environments where gender roles are more balanced, men may show higher HIV prevalence rates due to occupational exposures and lower tendencies to seek healthcare promptly.

Marital status also emerged as a notable demographic factor, with single individuals representing the largest group (53%). This observation supports the findings of Okoro et al. (2024), who linked singlehood with increased engagement in high-risk sexual practices, such as multiple partnerships and inconsistent condom use. On the other hand, Bello et al. (2023) found that widowed or divorced individuals may also be at heightened risk, often due to the challenges of initiating new relationships and limited access to sexual health resources after the end of a marriage.

Educational attainment and employment status were also influential. The highest HIV prevalence was observed among individuals with only primary education (35%) and those who were self-employed (50.5%). These trends are corroborated by Adigun et al. (2023), who associated limited formal education with poor understanding of HIV prevention and reduced engagement with healthcare services. However, findings by Udoh et al. (2024) from more urbanized settings suggest that education level may not always be a strong predictor of HIV prevalence, as factors such as healthcare access and sociocultural norms can play an equal or greater role.

Collectively, these findings highlight the importance of designing HIV prevention and treatment programs that are responsive to the unique socio-demographic characteristics of affected populations. While the study results align with much of the existing literature, they also underscore the variability of risk patterns across different regions and contexts. Tailored public health interventions should therefore prioritize middle-aged adults, women, single individuals, and those with lower educational and economic standing, with a strong emphasis on addressing local determinants of vulnerability.

This study also revealed a 28% prevalence of HBV among HIV-positive individuals, aligning with the high burden of HBV/HIV coinfection reported across sub-Saharan Africa. Specifically, this rate falls within the range reported in Nigerian studies, which estimate HBV prevalence among HIV-positive individuals to be between 10% and 30% (Olawumi et al., 2023). Notably, no cases of HCV infection were detected in the study population, which may suggest a lower

exposure risk, more effective public health interventions, or demographic factors that limit HCV transmission in the Calabar Metropolis.

Demographic patterns revealed that HBV prevalence was slightly higher among females (29%) than males (26.1%). However, this gender-based difference was not statistically significant ($\chi^2 = 0.3093$, df = 1, p = 0.5781). This observation aligns with the findings of Ijeoma et al. (2020), who attributed higher HBV rates in HIV-positive women to reproductive health-related exposures such as childbirth and other clinical interventions. Umeh et al. (2021) similarly reported increased HBV vulnerability among women and older individuals, supporting the current study's findings that individuals over 65 years had the highest prevalence (57.1%). Still, the association between age group and HBV prevalence did not reach statistical significance ($\chi^2 = 4.4477$, df = 4, p = 0.3488). Muriuki et al. (2013), on the other hand, reported higher HBV prevalence among males in a Kenyan cohort, linking it to high-risk behaviors like intravenous drug use and unprotected sex, highlighting potential regional or cultural differences in transmission dynamics.

A key finding in this study was the association between HIV viral load and HBV coinfection. Participants with viral loads ≥200 copies/ml had the highest HBV prevalence (43.2%), indicating that poor HIV control may compromise immune defenses and increase susceptibility to HBV infection. Notably, even individuals with suppressed viral loads (<20 copies/ml) recorded a substantial coinfection rate (26%), suggesting that HBV may persist independently of HIV control. This is consistent with findings by Opaleye et al. (2019), who documented high HBV prevalence regardless of antiretroviral therapy (ART) status. Contrastingly, Ochola et al. (2021) reported a lower HBV prevalence (8.7%) in a Kenyan population and observed that effective ART was strongly correlated with reduced HBV coinfection, emphasizing the influence of treatment adherence and regional factors.

Socioeconomic characteristics also influenced HBV prevalence. The highest rates were observed among unemployed individuals (54%) and those with only primary education (35.7%). While the relationship between educational status and HBV infection was not statistically significant ($\chi^2 = 5.2506$, df = 3, p = 0.1543), a strong and statistically significant association was observed with occupational status ($\chi^2 = 13.6283$, df = 3, p = 0.00345), indicating that employment may be a key determinant in HBV vulnerability among HIV-positive individuals. This trend is supported by Adekanle et al. (2015), who reported that unemployment and lower educational attainment were significantly associated with increased HBV infection among HIV-positive patients in southwestern Nigeria. In contrast, Bigna et al. (2015) found no significant association between socioeconomic status and HBV prevalence in a

Cameroonian cohort, suggesting that other variables such as access to vaccination, geographic differences, and healthcare coverage might mediate these outcomes.

Regarding marital status, although singles had relatively higher HBV prevalence compared to married or previously married individuals, this difference was not statistically significant ($\chi^2 = 1.2049$, df = 2, p = 0.5475). Overall, the findings underscore the complex interplay of viral, demographic, and socioeconomic factors in HBV/HIV coinfection. They highlight the need for integrated management approaches that include routine HBV screening, targeted education, and tailored interventions for high-risk groups such as the unemployed, less educated, elderly, and individuals with poorly controlled HIV infection.

5. CONCLUSION

This study highlights a substantial burden of HBV coinfection among HIV-positive individuals in Calabar, with a prevalence of 28% and no detected cases of HCV. Key risk groups included females, older adults, individuals with high HIV viral loads, the unemployed, and those with lower educational attainment. These findings emphasize the need for routine HBV screening, especially among vulnerable subpopulations, and the integration of HBV prevention and management into existing HIV care programs to improve health outcomes.

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