South Asian Journal of Research in Microbiology

Volume 18, Issue 12, Page 56-65, 2024; Article no.SAJRM.128066
ISSN: 2582-1989

Prevalence of Occult Hepatitis B Infection among People Living with HIV/AIDS in Rivers State

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/sajrm/2024/v18i12407

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/128066

Original Research Article

Received: 04/10/2024
Accepted: 09/12/2024
Published: 12/12/2024

ABSTRACT

Background: Occult hepatitis B infection (OBI) has become a significant health concern, especially among individuals living with HIV/AIDS. Determining the prevalence of OBI among this population is crucial for informing targeted screening and intervention strategies. This study aimed to investigate the prevalence of OBI among people living with HIV/AIDS in Rivers State, Nigeria, and to assess potential demographic and clinical factors associated with OBI/HIV comorbidity.

Methodology: A cross-sectional study was conducted among 392 HIV-positive individuals attending healthcare facilities in Rivers State from May to July 2021. Blood samples were collected, and serum samples were analyzed for hepatitis B surface antigen (HBsAg) and hepatitis B core antibody (anti-HBc) to detect OBI. Demographic and clinical data were also collected from participants.

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***Cite as:** Danagogo, Lawson Stephenson, and Rhoda Nwalozie. 2024. "Prevalence of Occult Hepatitis B Infection Among People Living With HIV/AIDS in Rivers State". South Asian Journal of Research in Microbiology 18 (12):56-65. https://doi.org/10.9734/sajrm/2024/v18i12407.*

Results: Among the 392 participants, the overall prevalence of OBI was found to be 0.5%. Age-specific analysis revealed a higher prevalence among individuals aged 30-50 years. No statistically significant associations were observed between OBI/HIV comorbidity and marital status, educational status, employment status, or sex.

Conclusion: The study highlights a low prevalence of OBI among HIV/AIDS patients in Rivers State, Nigeria, with specific age-related patterns. While no significant associations were found with demographic factors, the findings underscore the importance of targeted screening efforts, particularly among middle-aged individuals. Future research with larger sample sizes and comprehensive risk factor assessments is recommended to elucidate further the burden and determinants of OBI among this population, ultimately contributing to more effective prevention and control strategies.

Keywords: Co-infection; HIV/AIDS; occult hepatitis B infection; prevalence; Rivers state.

1. INTRODUCTION

Hepatitis B virus (HBV) and human immunodeficiency virus (HIV) are major health issues in Nigeria and other sub-Saharan African nations, but they are not the only urgent health problems. The region also faces a range of infectious diseases, including malaria and tuberculosis, alongside non-communicable diseases such as hypertension, diabetes, and various cancers. According to Okoh et al., (2022) the presence of these illnesses presents special clinical and public health issues, and they have a substantial impact on morbidity and mortality rates. Occult hepatitis B infection (OBI), is defined by the presence of HBV DNA in the absence of HBsAg, the detectable hepatitis B surface antigen (Pollicino & Saitta, 2014). Because this concealed form of HBV infection can result in liver damage and consequences even in the absence of serological markers, it is becoming more and more well-known (Hu et al., 2021).

Diagnosis of OBI depends on the detection of HBV DNA in liver tissue or blood from HBsAg-negative individuals. However, although the gold standard for diagnosis is the detection of HBV genomes in liver DNA extracts, HBV DNA testing in the blood is much easier and more commonly applied. For instance, for the identification of potential seropositive OBI cases, such as in blood, tissue, or organ donation, or before starting immunosuppressive therapy, anti-HBc may be used as a surrogate marker (Raimondo et al., 2019). A valid diagnosis of OBI depends on the sensitivity of the tests used for HBsAg and HBV DNA detection. The commercially available HBsAg assays usually have a lower limit of detection (LLOD) of 0.05 IU/mL; however, up to 48% of the negative samples become positive when tested by more sensitive assays with LLOD 0.005IU/mL. In addition, inclusion of anti-HBs probes that target different HBsAG epitopes is necessary for the detection of S-escape variants (Ozeki et al., 2018).

Co-infection with HBV is frequent among those living with HIV/AIDS, with regional variations in prevalence rates. Studies conducted worldwide have revealed variable rates of OBI prevalence among HIV/AIDS (Acquired immunodeficiency syndrome) patients, underscoring the need of comprehending this co-infection phenomenon and its consequences for public health initiatives and disease management (Saha et al., 2017). Rivers State, Nigeria which is part of the Niger Delta, has a high rate of HIV/AIDS and HBV infections, among other serious health issues (Ugwu et al., 2023). There is no information on the prevalence of occult hepatitis B infection among people living with HIV/AIDS (PLWHA) in Rivers State, despite attempts to manage these infections (Okonko & Chindah, 2023). The necessity for thorough epidemiological investigations to determine the burden of OBI among PLWHA is highlighted by this knowledge gap.

It is important to comprehend the OBI incidence among PLWHA in Rivers State for a number of reasons. First, according to Hoffman et al. (2008), co-infection with HBV can hasten the course of liver disease in HIV/AIDS patients, increasing morbidity and mortality. Second, because traditional serological assays may not be able to identify HBsAg-negative HBV infections, OBI presents difficulties for antiviral therapy and diagnostic testing (Sherman et al., 2007). Furthermore, OBI may facilitate the spread of HBV in hospital environments and the general public, highlighting the significance of putting preventative measures and focused treatments into place (Abdool Karim et al., 2010).

Thus, by examining the frequency of occult hepatitis B infection among individuals living with HIV/AIDS in Rivers State, this study seeks to close the research gap. The study aims to ascertain the distribution of OBI/HIV in the study population with respect to demographics and to evaluate the overall prevalence of OBI/HIV in the study population. This study is to inform evidence-based methods for the prevention, diagnosis, and management of co-infections by clarifying the prevalence of OBI among PLWHA in Rivers State. In the end, this will improve the health outcomes for impacted individuals and communities.

2. MATERIALS AND METHODS

2.1 Study Design and Period

This study employed a cross-sectional design to investigate the prevalence of occult hepatitis B infection (OBI) among individuals living with HIV/AIDS in Rivers State, Nigeria. Duration of the study was from May to July, 2021.

2.2 Study Area/ Population

The study was conducted in Rivers State, Nigeria, which is located in the Niger Delta region. Rivers State is one of the 36 states in Nigeria and has a diverse population comprising various ethnic groups. The study population consisted of individuals living with HIV/AIDS who were receiving care and treatment at selected healthcare facilities in Rivers State. Participants were recruited from healthcare facilities across Rivers State, ensuring a diverse representation of individuals living with HIV/AIDS in the region. Blood samples were collected from consenting participants, and serum samples were subsequently analyzed for hepatitis B surface antigen (HBsAg) and hepatitis B core antibody (anti-HBc) to detect OBI. In addition to laboratory analyses, demographic and clinical data were collected from participants through structured questionnaires and medical records review. This comprehensive approach allowed for the assessment of potential demographic and clinical factors associated with OBI/HIV comorbidity, including age, sex, marital status, educational status, and employment status.

2.3 Inclusion Criteria

Individuals aged 18 and above with confirmed diagnosis of HIV/AIDS, out-patients of the two facilities, Rivers state University teaching hospital (RSUTH) and University of Port harcourt teaching Hospital (UPTH), patients that have given their consent and patients residing in Rivers state.

2.4 Exclusion Criteria

Individuals below 18 years of age were excluded from this study, Pregnant women, due to potential confounding effects on HBV infection status and clinical outcomes were also excluded in this study. Individuals with a history of hepatitis B vaccination or receipt of hepatitis B immunoglobulin within the past six months were also excluded. Those with known history of chronic liver disease other than hepatitis B or HIV/AIDS-related liver disease were also excluded from this study to avoid false positive results.

2.5 Sample Collection

Random sampling was used to recruit participants from selected healthcare facilities providing HIV/AIDS care and treatment services in Rivers State. A structured questionnaire was administered to collect demographic and clinical data from participants. 10ml of Blood were collected from each participant by trained healthcare personnel using standard venipuncture techniques. The collected blood samples were used for HBV serology.

2.6 Sample Analysis

Serological testing for hepatitis B surface antigen (HBsAg) was performed using enzyme-linked immunosorbent assay (ELISA) kits that are commercially available, adhering to the manufacturer's guidelines. The process starts with coating microtitre wells with antibodies that specifically target HBsAg. Serum or plasma samples are then introduced, allowing any HBsAg present to bind to these antibodies. After washing away any unbound substances, an enzyme-linked secondary antibody is added, followed by a substrate that triggers a color change. The intensity of the color, which is measured spectrophotometrically, indicates the concentration of HBsAg. This method is known for its high sensitivity and specificity, making it a dependable option for diagnosing HBV infection. Participants negative for HBsAg were further tested for the presence of HBV DNA using polymerase chain reaction (PCR) assays. Briefly, viral DNA was extracted from serum samples using a commercially available DNA extraction kit. PCR amplification of the HBV DNA was performed using specific primers targeting conserved regions of the HBV genome. Amplified products were analyzed by agarose gel electrophoresis, and positive samples were confirmed by sequencing.

2.7 Statistical Analysis

Statistical analysis was performed using statistical package for the social science (SPSS 29) by IBM. Descriptive statistics were used to summarize demographic and clinical characteristics of the study population. Testing for anti-HBc is useful in identifying past or current exposure to HBV, acting as a surrogate marker for occult hepatitis B infection (OBI) when HBsAg cannot be detected. In this study, the prevalence of OBI was determined by calculating the percentage of participants who tested positive for HBV DNA but negative for HBsAg, which helps in recognizing hidden infections and evaluating the risks of reactivation. Chi-square test was used to assess associations between OBI and socio-demographic characteristics.

3. RESULTS

3.1 Overall Prevalence of OBI/HIV in the Study Population

Table 1 below shows the overall prevalence of OBI in HIV/AIDs patients. It shows that through the ELISA method out of 392 participants examined, 390 tested negative while 2 (0.05%) tested positive to OBI in HIV/AIDs patients.

3.2 Age Specific Distribution of OBI in HIV/AIDs patients in the Study Population

Table 2 below shows the age specific distribution of OBI/HIV co-morbidity in the study population. It shows that out of 392 participants examined 51 (13.0%) were below age 20 years, 70 (17.9%) participants were between ages 21-29 years, 180 (45.9%) of the participants were between ages 30-39 years, 73 (18.6%) were between ages 40-50 and 18 (4.6%) participants were age 51 and above. The age related distribution also showed a p-value of 0.776 and chi square value of 1.783.

3.3 Distribution of OBI in HIV/AIDs patients in the Study Population by Marital Status

Table 3 shows the distribution of OBI/HIV comorbidity in the study population by marital status. It shows that out of 392 participants examined, 198 (50.5%) were married while 194 (49.5%) were unmarried. It also showed a p-value of 0.160 and Chi square value of 1.970 in the distribution of OBI/HIV comorbidity concerning marital status in the study population at $p<0.05$.

Table 1. Overall Prevalence of OBI/HIV in the study Population

Number Examined	Number Negative	Number Positive	Prevalence
392	390	2	0.5%

Table 2. Age Specific Distribution of OBI in HIV/AIDs patients in the Study Population

Metrics	Age (Years)					Total	Chi Square	df	p-value
	<20	21-29	30-39	40-50	51>				
Number Positive	0	0	1	1	0	2			
Percent Positive (%)	0.0%	0.0%	50.0%	50.0%	0.0%	100.0%			
Number Negative	51	70	179	72	18	390	1.783	4	.776
Percent Positive (%)	13.1%	17.9%	45.9%	18.5%	4.6%	100.0%			
Total Number Examined	51	70	180	73	18	392			
Total Percent (%)	13.0%	17.9%	45.9%	18.6%	4.6%	100.0%			

Table 3. Distribution of OBI in HIV/AIDs patients in the Study Population by Marital Status

Metrics	Marital State		Total	Chi Square	df	p-value
	Married	Unmarried				
Number Positive	2	0	2			
Percent Positive (%)	100.0%	0.0%	100.0%			
Number Negative	196	194	390	1.970	1	.160
Percent Positive (%)	50.3%	49.7%	100.0%			
Total Number Examined	198	194	392			
Total Percent (%)	50.5%	49.5%	100.0%			

Table 4. Distribution of OBI in HIV/AIDs patients in the Study Population by Educational Status

Metrics	Educational Status		Total	Chi Square	df	p-value
	Educated	Uneducated				
Number Positive	2	0	2			
Percent Positive (%)	100.0%	0.0%	100.0%			
Number Negative	372	18	390	.097	1	.756
Percent Positive (%)	95.4%	4.6%	100.0%			
Total Number Examined	374	18	392			
Total Percent (%)	95.4%	4.6%	100.0%			

Table 5. Distribution of OBI in HIV/AIDs patients in the Study Population by Employment Status

Metrics	Employment Status		Total	Chi Square	df	p-value
	Employed	Unemployed				
Number Positive	2	0	2			
Percent Positive (%)	100.0%	0.0%	100.0%			
Number Negative	366	24	390	.131	1	.717
Percent Positive (%)	93.8%	6.2%	100.0%			
Total Number Examined	368	24	392			
Total Percent (%)	93.9%	6.1%	100.0%			

3.4 Distribution of OBI in HIV/AIDs patients in the Study Population by Educational Status

Table 4 shows the distribution of OBI/HIV comorbidity in the study population by educational status. It shows that out of 390 participants examined, 374 (95.4%) were educated while 18 (4.6%) were uneducated. It also showed a p-value of 0.756. and Chi square value of 0.097.

3.5 Distribution of OBI/HIV Comorbidity in the Study Population by Employment Status

Table 5 shows the distribution of OBI/HIV comorbidity in the study population by employment status. It shows that out of 392 participants examined 368 (93.9%) were employed while 24 (6.1%) were unemployed. It also shows a p-value of 0.717 and a chi square value of 0.131 in the distribution of OBI in HIV/AIDs in the study population by employment status.

3.6 Sex Specific Distribution of OBI in HIV/AIDs Patients in the Study Population

Table 6 shows the sex-specific distribution of OBI/HIV comorbidity in the study population. It shows that out of 392 participants 154 (39.3%) were male while 238 (60.7%) were female. It also showed a p-value of 0.756 and a chi square value of 0.097.

Table 6. Sex Specific Distribution of OBI in HIV/AIDs patients in the Study Population

Metrics	Sex		Total	Chi Square	df	p-value
	Male	Female				
Number Positive	1	1	2			
Percent Positive (%)	50.0%	50.0%	100.0%			
Number Negative	153	237	390	.097	1	.756
Percent Positive (%)	39.2%	60.8%	100.0%			
Total Number Examined	154	238	392			
Total Percent (%)	39.3%	60.7%	100.0%			

4. DISCUSSION

In the study population, the overall prevalence of occult hepatitis B infection (OBI) among individuals living with HIV/AIDS was determined to be 0.5%. This prevalence rate agrees with results from related research carried out in Rivers State, Nigeria which was 1.1% by Erasmus et al. (2021), suggesting that OBI prevalence among PLWHA may be comparatively constant throughout the state. Furthermore, the study's prevalence matches WHO estimations of OBI prevalence among HIV/AIDS patients worldwide (Yin, 2020).

It's important to remember, though, that the frequency of OBI can vary greatly based on a number of variables, such as study methodology, population demographics, and geographic region. Variations in sample size, sampling strategy, and diagnostic methodologies can lead to disparities in prevalence rates amongst studies. For example, a study by Ihongbe et al. (2023) found that OBI prevalence was higher among HIV-positive people in a different state in Nigeria (prevalence of 3.6%).This finding emphasizes the need for more research to clarify the factors influencing OBI prevalence variations across different regions, including within Rivers State because this could likely be attributed to the efforts of public health agencies in the country focusing on HIV/AIDS prevention in higher rated states, which also offers protection against HBV due to similar routes of transmission shared by both viruses.

Although co-infection with HBV among PLWHA is common, the occult form of HBV infection may be less common in Rivers State, according to the study's comparatively low frequency of OBI. Even modest prevalence rates of OBI can have substantial effects on disease treatment and transmission prevention, which emphasizes the significance of frequent screening for HBV infection among HIV/AIDS patients in the state (Erasmus et al., 2021). Furthermore, in order to reduce the risk of liver-related problems in this susceptible population, the identification of people with OBI is essential for the implementation of suitable preventative measures and treatment strategies.

In Table 2 There were no instances of OBI/HIV comorbidity among those under 20 or older than 50. Additionally, it demonstrated that there was no statistically significant correlation in the study group between age and the prevalence of OBI/HIV comorbidity this could be that chronic or occult HBV infections are often associated with intermediate immune responses, which may occur more frequently in middle-aged adults compared to younger or older populations with more extreme immune profiles (strong or weakened).

The results of this study about the age-specific distribution of OBI/HIV comorbidity are in line with some earlier research done in Nigeria's Rivers State. For instance, a similar trend of age-specific OBI prevalence among HIV-positive people in Rivers State was observed by Moore-Igwe et al., (2022). This consistency raises the possibility that the age distribution of OBI/HIV comorbidity in the area is largely consistent.

Moreover, the results of this study show that there is no OBI/HIV comorbidity among those under 20 or over 50, which is in contradiction to some earlier research done in other areas. In a nearby state, for example, a research by Mudawi et al., (2014) identified cases of OBI/HIV comorbidity among people in both younger and older age groups. The disparity in the results could be explained by variations in the study demographics, healthcare availability, and underlying risk factors for HBV infection in the different regions because they influence HBV exposure, regions with limited healthcare, lower vaccination coverage, or higher HIV prevalence may have elevated OBI rates.

Table 3 shows the distribution of occult hepatitis B infection (OBI)/HIV comorbidity by marital status in the study sample. The OBI/HIV comorbidity prevalence among married individuals was 100.0%, according to the table, but there were no cases of OBI/HIV comorbidity among single individuals. The p-value and chi-square value suggests that the prevalence of OBI in HIV/AIDs comorbidity in the study sample was not statistically correlated with marital status.

The distribution of OBI/HIV comorbidity by marital status in this study's results is in line with some earlier research done in Rivers State. For instance, a study by Opalaye et al. (2014) found that married people in Rivers State had a similar pattern of OBI/HIV comorbidity prevalence. This consistency raises the possibility that OBI/HIV comorbidity in the area may not be significantly influenced by marital status.

It is noteworthy that the absence of statistical significance in the p-value at $p<0.05$ suggests that variables other than marital status could impact the occurrence of OBI/HIV comorbidity within the research population. These variables may include sexual orientation, financial standing, and ease of access to medical treatment. Additionally, the generalizability of the results within that subgroup is limited by the relatively small number of cases of OBI/HIV comorbidity among single individuals in our investigation.

Moreover, the results of various earlier studies carried out in different areas are in contrast with the absence of OBI/HIV comorbidity among single people in our study. In a nearby state, for example, a research by Sood et al., (2016) identified variations of OBI/HIV comorbidity among married and single people. The disparity in the results could be explained by variations in the study populations and cultural norms.

Table 4 shows the distribution of occult hepatitis B infection (OBI)/HIV comorbidity by educational status in the study sample.

A study by Ajuwon et al., (2021) revealed a similar pattern of OBI/HIV comorbidity prevalence among educated adults in Rivers State, which is comparable with the findings of this study regarding the distribution of OBI/HIV comorbidity by educational status. This consistency raises the possibility that OBI/HIV comorbidity in the area may not be significantly influenced by educational status because while potentially influencing awareness and preventive behaviors, it does not directly impact exposure to HBV or HIV risk factors such as unsafe sexual practices, needle sharing or mother-to-child transmission.

It's crucial to remember, though, that the lack of statistical significance suggests that the prevalence of OBI/HIV comorbidity in the research population may be influenced by variables other than educational attainment. These elements may consist of behavioral elements, healthcare service accessibility, and socioeconomic status.

Moreover, the results of this study show that OBI/HIV comorbidity was not present in the uneducated participants, which is in contrast to some other research done in different areas. In a neighboring state, for example, Ihongbe et al.'s study from 2022 (Ihongbe et al., 2022) documented cases of OBI/HIV comorbidity among both educated and uneducated adults. The disparity in the results could be explained by variations in the study populations, regional healthcare systems, and cultural norms.

Table 5 shows that the distribution of OBI/HIV comorbidity by work status in this study's findings is in line with some earlier research done in Rivers State, Nigeria. Ajuwon et al., (2021) study, for instance, found a comparable pattern in the prevalence of OBI/HIV comorbidity among working people. This consistency raises the possibility that OBI/HIV comorbidity in the area may not be significantly influenced by work status.

The absence of statistical significance in the chi-square analysis suggests that the prevalence of OBI/HIV comorbidity in the study population may be influenced by variables other than work status such as the overall lower prevalence. These elements may consist of behavioral elements, healthcare service accessibility, and socioeconomic status.

This study's findings on OBI/HIV comorbidity among unemployed people are in contradiction to those of several other studies that were carried out in different areas. In a neighboring state, for example, Opalaye et al.'s study from 2014 (Opaleye et al., 2014) documented incidences of OBI/HIV comorbidity among both working and unemployed people. The disparity in the results could be explained by variations in the study populations, facility healthcare systems, and cultural norms.

In Table 6, A non-significant result was obtained from the examination of the association between sex and OBI in HIV/AIDs comorbidity using a chi-square test. This shows that in the studied population, there is no statistically significance between the prevalence of OBI/HIV comorbidity and sex.

The results of this study's analysis of the sex-specific distribution of OBI/HIV comorbidity are consistent with some earlier studies carried out in Rivers State, Nigeria's. Notably, OBI/HIV comorbidity was equally distributed among males and females in the same region, according to a study by Ajuwon et al., (2021). The consistent results suggest that the prevalence of OBI/HIV comorbidity in this community may not be significantly influenced by a person's sexual orientation, implying that both males and female are exposed to similar environmental and healthcare-related risk.

It is imperative to recognize, nonetheless, that the chi-square analysis's lack of statistical significance suggests that factors other than sex might also have an impact on the occurrence of OBI/HIV comorbidity. These variables may include a range of behavioral, socioeconomic, and health-related characteristics.

Furthermore, this study's findings on the equal prevalence of OBI/HIV comorbidity in males and females are in contrast to those from some nearby states. For example, Okonkwo et al.'s research from 2021 revealed that in a nearby state, OBI/HIV comorbidity was more common in women than in men. These disparities in results may be explained by variations in the research populations, facility healthcare systems, and cultural norms.

5. CONCLUSION

This study sheds light on the prevalence of occult hepatitis B infection (OBI) among individuals living with HIV/AIDS in Rivers State, Nigeria. Although the overall incidence of OBI/HIV comorbidity was low, at 0.5%, age-specific analysis showed that the prevalence was higher in people between the ages of 30 and 50. Despite the lack of statistically significant correlations between OBI/HIV comorbidity and sex, marital status, educational attainment, or work status, the study highlights the significance of focused screening and intervention approaches, especially for middle-aged people. However, it is important to recognize the limitations, which include the cross-sectional design and limited sample size. These limitations call for larger cohorts and more thorough risk factor assessments in future research. In summary, this study highlights the necessity of continued monitoring and education initiatives to support early identification and treatment of OBI among HIV/AIDS patients in Rivers State, Nigeria, thereby advancing more successful preventive and control approaches for this demographic.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

ETHICAL APPROVAL AND CONSENT

Ethical approval for the study was obtained from The Rivers state Ministry of Health, in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants before enrollment in the study. Participants were informed about the study objectives, procedures, potential risks, and benefits, and their right to withdraw from the study at any time without consequences. Participants were also informed that those with positive cases will be kept confidential and treated separately.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
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