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Research Article

The Course of HBcAb as A Surrogate Marker for Occult Hepatitis B Infection: A Population Based Survey In Rivers State Nigeria

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Abstract

Background: Occult hepatitis B infection (OBI), characterized by the presence of hepatitis B virus (HBV) DNA in the absence of detectable hepatitis B surface antigen (HBsAg), poses a significant public health challenge globally. particularly in sub-Saharan Africa where the prevalence of the infection is steadily rising. Nigeria has been shown to have one of the highest endemic rates of hepatitis B virus (HBV) in the world, with estimates indicating that over 20 million people are chronically infected.
Objective: This study aimed to determine the prevalence of OBI among residents of Rivers State, Nigeria, and examine its association with demographic and clinical factors.
Methodology: A cross-sectional study was conducted among adult residents aged 18 years and above in selected communities across Rivers State. Demographic information and blood samples were collected from participants, and serum samples were tested for HBsAg and hepatitis B core antibody (HBcAb) using enzyme-linked immunosorbent assay (ELISA) kits. Statistical analysis was performed to assess the prevalence of OBI and its association with age, sex, marital status, education level, and HIV status.
Results: Among the 392 participants included in the study, the prevalence of OBI was found to be 2.8%. HBcAb positivity was identified as a sensitive marker for OBI detection, with 90.9% of OBI cases testing positive for HBcAb alone. While age, sex, marital status, and education level did not emerge as significant predictors of OBI prevalence, HIV co-infection was strongly associated with OBI ($p < 0.05$).
Conclusion: This study highlights the epidemiology of OBI among residents of Rivers State, Nigeria, and underscores the clinical significance of OBI in the context of co-infections and disease progression. The findings emphasize the importance of integrated screening and management strategies for OBI, particularly among individuals living with HIV. Moving forward, comprehensive hepatitis B surveillance and control programs are warranted to address the burden of OBI and improve public health outcomes in Nigeria.

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1. Introduction

Global public health is facing a challenge due to the Hepatitis B virus (HBV), particularly in sub-Saharan Africa where the prevalence of the infection is steadily rising. Nigeria has been shown to have one of the highest endemic rates of hepatitis B virus (HBV) in the world, with estimates indicating that over 20 million people are chronically infected [1]. Occult hepatitis B infection (OBI) is a unique yet elusive form of HBV infection that is defined by the lack of detectable HBsAg in the serum despite the presence of other viral indicators, such as HBcAb [2–4]. Acute and chronic hepatitis B infections are well-known. Because of its covert nature and propensity for transmission, OBI presents special hurdles for diagnosis and management. This emphasizes the need of determining its epidemiology and therapeutic relevance.

Hepatitis B core antibody, or HBcAb, has become a useful proxy marker for OBI, offering information about the frequency and dynamics of this mysterious virus [5–7]. In contrast to HBsAg, which is commonly employed in the diagnosis of acute and chronic HBV infection, HBcAb remains long after HBsAg has cleared, acting as a marker of prior HBV exposure [8–10]. The presence of HBcAb in the absence of HBsAg is significant because it indicates occult infection. This highlights the function of HBcAb in identifying OBI patients who could otherwise go undiagnosed by traditional diagnostic tests [11].

Even though OBI is becoming more and more recognized as a clinically relevant phenomenon, little is known about its prevalence and contributing factors, especially when considering Rivers State, Nigeria. There is a strong need to look into the prevalence and clinical implications of OBI in Rivers State due to the state's distinct sociodemographic characteristics and varied epidemiological landscape. This work attempts to fill the knowledge gap by clarifying the function of HBcAb as a surrogate marker for OBI and adding to our knowledge of the hepatitis B epidemiology in Rivers State.

The present study aims to accomplish three distinct objectives firstly, to ascertain the prevalence of HBcAb within the study population in Rivers State, Nigeria secondly, to investigate the co-occurrence rate of HBsAg and HBcAb among individuals diagnosed with hepatitis B in Rivers State; and thirdly, to assess the clinical implications of this finding.

By fulfilling these objectives, this research hopes to provide insight into the OBI epidemiology and how it affects hepatitis B screening, diagnosis, and treatment approaches in Nigeria's Rivers State.

2. Materials and Methods

Study Design

This study employed a cross-sectional study design to investigate the prevalence of occult hepatitis B infection (OBI) among adult residents of Rivers State, Nigeria. data on demographic characteristics, hepatitis B markers, and HIV status were collected from participants through structured interviews and blood sample collection. Serum samples were analyzed for hepatitis B surface antigen (HBsAg) and hepatitis B core antibody (HBcAb) using enzyme-linked immunosorbent assay (ELISA) kits. Individuals testing positive for HBcAb but negative for HBsAg were classified as having occult hepatitis B infection (OBI). HIV status was also determined using standard serological assays. The study population was selected using a multistage sampling technique, which involved stratifying communities into urban and rural areas, followed by random selection of clusters and systematic sampling of households within selected clusters.

Study Area Population

This population-based survey was conducted in Rivers State, Nigeria, which is located in the Niger Delta region of the country. Rivers State is known for its diverse population and socioeconomic characteristics, with urban and rural communities representing a broad spectrum of sociodemographic backgrounds. The study population comprised adult residents aged 18 years and above residing in selected communities across the state.

Ethical Consideration Informed Consent

Ethical approval for this study was obtained from the appropriate authorities. All participants provided written informed consent prior to enrollment in the study. Confidentiality of participants' personal information and test results was strictly maintained throughout the study period.

Inclusion and Exclusion Criteria

Individuals aged 18 years and above who provided informed consent were eligible for inclusion in the study. Pregnant women and individuals with a history of liver transplantation or known liver diseases other than hepatitis B infection were excluded from the study.

Sample Collection

A multistage sampling technique was employed to select study participants. First, communities within Rivers State were stratified into urban and rural areas. Next, clusters were randomly selected from each stratum, and households within the selected clusters were systematically sampled. Trained research assistants conducted door-to-door visits to recruit eligible participants. Following informed consent, demographic information and risk factors for hepatitis B infection were obtained through structured interviews. Blood samples were then collected from consenting participants using sterile venipuncture techniques. Samples were collected into ethylenediaminetetraacetic acid (EDTA) tubes and transported to the laboratory for analysis.

Sample Analysis

Serum samples were centrifuged at 3000 rpm for 10 minutes to obtain clear supernatants. HBsAg and HBcAb were detected using enzyme-linked immunosorbent assay (ELISA) kits following the manufacturer's instructions. HBsAg-positive samples were further tested for HBcAb to assess co-occurrence. Quality control measures were implemented throughout the testing process to ensure accurate and reliable results.

Statistical Analysis

Data analysis was performed using statistical package for Social Sciences (SPSS) version. Descriptive statistics were used to summarize demographic characteristics and prevalence rates of HBcAb and HBsAg. The co-occurrence of HBsAg and HBcAb was calculated as a proportion of HBsAg-positive individuals who were also positive for HBcAb. Bivariate and multivariate analyses were conducted to assess associations between demographic variables and hepatitis B markers. Statistical significance was set at $p < 0.05$.

3. Results

Prevalence of Occult Hepatitis B in the Study Population

Table 1 below shows the prevalence of Occult Hepatitis B in the study population. It shows that out of 392 participants, 381 tested negative to occult Hepatitis B while 11 (2.8%) tested Positive.

Table 1: Prevalence of Occult Hepatitis B in the Study Population.

Number Tested	Number	Number	Prevalence Rate	Remark
392	381	11	2.8%	

Distribution of Occult Hepatitis Infection obtained using HCAb and HBsAb

Table 2 below shows the distribution of Occult Hepatitis infection obtained using HCAb and HBsAb. It shows that out of 11 participants that tested positive to hepatitis B infection, 10 (90.9%) tested positive to HCAb only while 1 (9.1%) tested positive to both HBsAb and HCAb.

Table 2: Distribution of Occult Hepatitis Infection obtained using HCAb and HBsAb.

	Only Positive for HBsAb	Positive for HBsAb HCAb	Total Rate of Occult Hepatitis B Infection
Number (%)	10 (90.9%)	1 (9.1%)	11 (100%)
OBI Status	Positive	Positive	Positive

Note: OBI= Occult Hepatitis B Infection;Total Rate of Occult
Hepatitis B Infection = Number positive for HCAb alone and/or Number Positive for HBsAg

Contingency Table Chi Square Distribution of Occult Hepatitis B Infection by Age Group

Table 3 shows the contingency table Chi Square distribution of occult hepatitis B Infection by age group. It shows that out of the 11 participants tested positive to hepatitis B infection, 6 (54.5%) were less than 40years of age while 5 (45.5%) were 40 years and above. Also out of 381 that tested negative to hepatitis B infection, 295 (77.4%) were less than 40 years of age and 86 (22.6%) were 40 years and above with a P-value of 0.08.

Table 3: Contingency Table Chi Square Distribution of Occult Hepatitis B Infection by Age Group.

HCAb Status Statistics	Less than 40years	40years and Above	Total
Positive	6 (54.5%)	5 (45.5%)	11 (100%)
Negative	295 (77.4%)	86 (22.6%)	381 (100%)
Total	301 (76.8%)	91 (23.2%)	392 (100%)
Chi Square		3.140	
Df		1	
p-value		0.08	

Contingency Table Chi Square Distribution of Occult Hepatitis B Infection by Sex

Table 4 below shows the contingency table Chi Square distribution of occult hepatitis B infection by sex. It shows that out of 11 participants that tested positive to hepatitis B infection, 7 (63.6%) were male while 4 (36.4%) were female. Also out of 381 participants that tested negative to hepatitis B infection, 147 (38.6%) were male and 234 (61.4%) were female with a p-value of 0.09.

Table 4: Contingency Table Chi Square Distribution of Occult Hepatitis B Infection by Sex.

HCAb Status Statistics	**Male**	**Female**	**Total**
Positive	7 (63.6%)	4 (36.4%)	11 (100.0%)
Negative	147 (38.6%)	234 (61.4%)	381 (100.0%)
Total	154 (39.3%)	238 (60.7%)	392 (100.0%)
Chi Square		2.814	
Df		1	
p-value		0.09	

Contingency Table Chi Square Distribution of Occult Hepatitis B Infection by Marital Status

Table 5 below shows the contingency table Chi square distribution of occult hepatitis B infection by marital status. It shows that out of the 11 participants that tested positive to hepatitis B infection, 5 (45.5%) were married while 6 (54.5%) were unmarried. Also out of 381 participants that tested negative, 193 (50.7%) were married and 188 (49.3%) were unmarried with a p-value of 0.73

Table 5: Contingency Table Chi Square Distribution of Occult Hepatitis B Infection by Marital Status.

HCAb Status Statistics	**Married**	**Unmarried**	**Total**
Positive	5 (45.5%)	6 (54.5%)	11 (100.0%)
Negative	193 (50.7%)	188 (49.3%)	381 (100.0%)
Total	198 (50.5%)	194 (49.5%)	392 (100.0%)
Chi Square		0.116	
Df		1	
p-value		0.73	

Contingency Table Chi Square Distribution of Occult Hepatitis B Infection by Education

Table 6 below shows the contingency table Chi Square distribution of occult hepatitis B infection by education. It shows that out of the 11 participants tested positive to hepatitis B infection, 10 (90.9%) were educated while 1 (9.1%) was uneducated. Also, out of the 381 participants tested negative to hepatitis B infection, 364 (95.5%) were educated while 17 (4.5%) were uneducated with a p-value of 0.47.

Table 6: Contingency Table Chi Square Distribution of Occult Hepatitis B Infection by Education.

HCAb Status Statistics	**Educated**	**Uneducated**	**Total**
Positive	10 (90.9%)	1 (9.1%)	11 (100.0%)
Negative	364 (95.5%)	17 (4.5%)	381 (100.0%)
Total	374 (95.4%)	18 (4.6%)	392 (100.0%)
Chi Square		0.523	
Df		1	
p-value		0.47	

Contingency Table Chi Square Distribution of Occult Hepatitis B Infection by HIV Status

Table 7 below shows the contingency table Chi square distribution of occult hepatitis B infection by HIV status. It shows that out of 11 participants that tested positive for hepatitis B infection, 2 (18.2%) tested positive to HIV while 9 (81.8%) tested negative to HIV. Also, out of 381 participants that tested negative to hepatitis B infection, 2 (0.5%) tested positive to HIV while 379 (99.5%) tested negative to HIV with a p-value of 0.00.

Table 7: Contingency Table Chi Square Distribution of Occult Hepatitis B Infection by HIV Status.

HCAb Status Statistics	**HIV Positive**	**HIV Negative**	**Total**
Positive	2 (18.2%)*	9 (81.8%)	11 (100.0%)
Negative	2 (0.5%)	379 (99.5%)	381 (100.0%)
Total	4 (1.0%)	388 (99.0%)	392 (100.0%)
Chi Square		33.002	
Df		1	
p-value		0.00	

Note: *= HIV OBI co-infection

4. Discussion

Occult hepatitis B infection (OBI) was found to be 2.8% common in the research population. This result is in line with earlier research that found that different populations have differing OBI prevalence rates. For example, the prevalence found in our study is similar to that reported in a study by [12]. in southwest Nigeria, which found a frequency of 3.5% among blood donors. Our results are in close agreement with a study conducted in Bodo City, Rivers State, by Forbi and Reuben [1], which found a prevalence of 2.9% among the local population.

It is interesting, nonetheless, that our findings regarding the prevalence of OBI are different from those of some earlier research done in different parts of Nigeria. For example, a study conducted in northern Nigeria by Olusola [13] found that 5.7% of pregnant women who attended prenatal clinics had a greater frequency of OBI. The observed range in prevalence rates may be explained by variations in the research populations, sampling techniques, and geographic variations in the epidemiology of hepatitis B in Nigeria.

Our research population's comparatively low OBI prevalence may be a result of Rivers State's successful hepatitis B immunization campaigns and public health initiatives. Nigeria has made great progress in recent years in increasing the availability of hepatitis B vaccinations, especially with programs aimed at high-risk groups including newborns and healthcare professionals. By stopping the spread of the infection and avoiding new infections, these initiatives might have helped lower the prevalence of OBI.

Using hepatitis B surface antibody (HBsAb) and hepatitis B core antibody (HCAb), researchers were able to determine the distribution of occult hepatitis B infection (OBI), which provided intriguing new information on the diagnostic indicators for OBI in the study group. Just 9.1% of those who tested positive for OBI also tested positive for HBsAb. In contrast, 90.9% of those who tested positive for HCAb did so alone. This implies that, in comparison to HBsAb, HCAb may be a more sensitive marker for identifying occult hepatitis B infection.

Our results are consistent with other research demonstrating the usefulness of HCAb in identifying OBI patients. For example, a study conducted in the southwest of Nigeria by Odaibo [14] found that those with OBI were similarly more likely to be positive for HCAb. The significance of integrating HCAb testing into hepatitis B screening algorithms to enhance the identification of latent infections is shown by the data' consistency.

It's crucial to remember, too, that our distribution of OBI markers is different from some earlier research that focused on the significance of HBsAb in OBI diagnosis. For instance, a study conducted in eastern Nigeria by Ugochukwu [15] found that a greater percentage of people with OBI tested positive for HBsAb as opposed to HCAb. The differences in study demographics, sample sizes, and laboratory techniques used in various studies may be the cause of this disagreement in results.

The prevalence of HCAb positive among OBI participants in our study may be explained by a number of variables. First off, HCAb is a consistent indication of occult infection since it indicates prior exposure to hepatitis B virus (HBV) and can continue to exist even after HBsAg has cleared. Moreover, HCAb may be more sensitive in identifying residual viral antigens or low-level HBV replication in people with OBI, which could account for its increased incidence in this situation.

The reported incidence of OBI further emphasizes how crucial it is to use sensitive diagnostic assays, such HBcAb testing, in order to find occult infections that traditional HBsAg screening alone could miss. OBI is a hidden HBV reservoir that makes it difficult to control the disease and stop it from spreading. To identify and treat infected persons, thorough surveillance and screening programs are essential.

Using a contingency table and Chi-square distribution, researchers were able to obtain intriguing insights on the relationship between age and the status of occult hepatitis B infection (OBI) in the study population. Based on hepatitis B core antibody (HCAb) status, 54.5% of people under 40 years old tested positive for OBI, whereas 45.5% of people over 40 years old tested positive for OBI. This implies that younger people may have a comparatively higher prevalence of OBI, even if the difference was not statistically significant ($p = 0.08$).

Our results about the relationship between OBI status and age are consistent with some earlier research done in Nigeria. For example, a similar trend of greater OBI prevalence among younger age groups was documented in a study conducted by Olusola [13] among pregnant women in northern Nigeria. It is noteworthy, therefore, that our observation that there is no statistically significant relationship between age and OBI status also aligns with the findings of earlier research that produced comparable findings. For instance, Otegbayo [16] study in southwest Nigeria discovered no correlation at all between the age of HIV-positive patients and the prevalence of OBI.

Interesting trends in the prevalence of occult hepatitis B infection (OBI) in males and females within the study group were found by examining the contingency table Chi-square distribution of OBI by sex. Based on the hepatitis B core antibody (HCAb) status, 63.6% of males and 36.4% of females tested positive for OBI. Nevertheless, $p = 0.09$ indicates that there was no statistically significant difference in OBI prevalence between the sexes.

These results align with a few earlier research projects carried out in Nigeria. For instance, a 2019 study conducted in Rivers State by Forbi and Reuben [1] found a similar tendency of a higher OBI prevalence in men than in women. In southwestern Nigeria, Adekanle [12] study discovered no discernible variation in the prevalence of OBI among blood donors between males and females.

There was no discernible correlation between marital status and the prevalence of occult hepatitis B infection (OBI) in the study population, according to the contingency table Chi-square distribution of OBI by marital status. Based on the hepatitis B core antibody (HCAb) status, 45.5% of married individuals tested positive for OBI, whereas 54.5% of single individuals tested positive for OBI.

These results are in line with earlier research done in Nigeria, which likewise found no connection between the prevalence of OBI and married status. For instance, Otegbayo [16] research of HIV-positive patients in southwest Nigeria discovered no discernible variation in the prevalence of OBI between married and single individuals. This congruence of results implies that among Nigerians, marital status may not be a major factor in determining one's vulnerability to OBI.

There could be other reasons for the lack of statistical significance in the correlation between OBI prevalence and married status. First off, the various social and behavioral elements that influence the risk of OBI may be too complex for marital status alone to fully represent. In assessing the prevalence of OBI, other variables like sexual behavior, intravenous drug use, and household contacts might be more important.

There was no discernible correlation between education and the prevalence of occult hepatitis B infection (OBI) in the study population, according to the contingency table Chi-square distribution of OBI by education level. Based on their hepatitis B core antibody (HCAb) status, 90.9% of educated people tested positive for OBI, compared to just 9.1% of unskilled people. On the other hand, the p-value of 0.47 suggests that there is no statistically significant correlation between the prevalence of OBI and education level.

These results are consistent with some earlier research done in Nigeria, which likewise found no evidence of a significant relationship between the prevalence of OBI and education level. For example, Adekanle [12] research of blood donors in southwest Nigeria revealed no discernible difference in the prevalence of OBI between those with and without education. The data' consistency points to the possibility that

OBI susceptibility in the Nigerian population may not be significantly influenced by education level.

There was a strong correlation between HIV status and the prevalence of occult hepatitis B infection (OBI) in the study population, according to the contingency table Chi-square distribution of OBI by HIV status. Based on their hepatitis B core antibody (HCAb) status, 18.2% of HIV-positive people tested positive for OBI, whereas 81.8% of HIV-negative people tested positive for OBI. The low p-value of 0.00, which indicates a strong statistical relationship between HIV status and OBI prevalence, reflects this significant difference.

These results are in line with earlier research done in Nigeria, which similarly found a strong correlation between the prevalence of OBI and HIV status. For instance, Otegbayo [16] study of HIV-positive patients in southwest Nigeria discovered that OBI was more common among HIV-positive people than HIV-negative people. The congruence of these data implies that OBI may be significantly predisposed to HIV infection in the Nigerian populace.

There are multiple reasons for the correlation between OBI prevalence and HIV status that has been observed. First off, it is well known that HIV infection weakens immunity, which raises the possibility of co-illnesses with other viral infections like HBV. OBI risk may also be elevated in HIV-positive people due to shared modes of transmission, such as intravenous drug use and unprotected sexual activity. It is crucial to test for OBI in this population since the existence of OBI in HIV-positive people may also have an impact on the course and treatment of the disease.

5. Conclusion

The epidemiology of occult hepatitis B infection (OBI) and its correlation with clinical and demographic variables are clarified by this study. According to the study, OBI is quite common in the locals, and a sensitive marker for detecting it is the hepatitis B core antibody (HCAb). Although OBI prevalence was not significantly predicted by age, sex, marital status, or educational attainment, co-infection with HIV was substantially correlated with OBI, emphasizing the significance of integrated screening and management measures for people living with HIV. These results highlight the clinical importance of OBI in the context of co-infections and disease progression, and they highlight the necessity of comprehensive hepatitis B surveillance and control efforts in Rivers State. Going forward, lowering the incidence of hepatitis B infection and enhancing public health outcomes in Nigeria would require significant efforts to improve diagnostic capabilities, increase immunization accessibility, and address socioeconomic determinants of health.

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