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Original Article

Seroprevalence of Hepatitis B virus and human immunodeficiency virus co-infection in pregnant women from Osun State, Nigeria

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Abstract

Introduction: Hepatitis B virus and human immunodeficiency virus (HBV/HIV) co-infection is a global health concern due to its significant impact on morbidity and mortality. Reports of HBV/HIV co-infections are increasing in Nigeria, but information on the disease burden in pregnant women and its implications on the fetus is scarce. This study aimed to determine the prevalence of HBV/HIV co-infection in pregnant women. In addition, the study identified the risk factors for the disease in pregnant women attending antenatal clinics in Osun State, Nigeria.
Methodology: We collected plasma samples from 303 consenting pregnant women and used enzyme-linked immunosorbent assay (ELISA) to test for HBV (HBsAg) and HIV I/II antigens. We obtained demographic and risk factor data on HBV and HIV transmission using a structured questionnaire.
Results: Our analysis revealed a prevalence of 3.96% for HBV/HIV co-infection in pregnant women. Bivariate analysis indicated a history of blood transfusion, oral or anal sex, and multiple sexual partners may be associated with an increased likelihood of HBV/HIV co-infection in pregnant women. After adjusting for other variables in multivariate analysis, none of these risk factors were significant at the 5% level. In contrast, formal education was a potential preventive factor in this population.
Conclusions: Our study provides valuable information on the disease burden of HBV/HIV co-infection in pregnant women in Osun State, Nigeria, highlighting the importance of routine screening for HBV and HIV during antenatal care and emphasizing the importance of implementing preventive measures to reduce the morbidity and mortality associated with HBV/HIV co-infection.

Key words: seroprevalence; ELISA; HBV/HIV; co-infection; pregnant women; Nigeria.

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Introduction

Hepatitis B virus (HBV) and human immunodeficiency virus (HIV) share similar transmission routes and co-infection is common, particularly in populations with a high burden of both diseases [1]. In sub-Saharan Africa, the prevalence of HBV/HIV co-infection is reported to be between 5-20% [2] and, in some settings, as high as 36% [3]. Studies have shown that individuals who engage in high-risk sexual behaviours, such as having multiple sex partners or engaging in anal sex, are more likely to acquire HBV and HIV infections [4]. Additionally, infants born to mothers with HBV/HIV co-infection are at a higher risk of acquiring both viruses during childbirth [5]. In addition, intravenous drug use is a major risk factor for HBV/HIV co-infection, as shared needles and syringes can transmit both viruses [6,7]. Other factors, such as poverty, lack of access to healthcare, and inadequate diagnosis and treatment services, can also contribute to the high rates of HBV/HIV co-infections [8].

The health implications of HBV/HIV co-infection are not yet fully understood. However, it has been observed that co-infected individuals have a higher risk of developing liver cirrhosis and hepatocellular carcinoma, which can result in liver-related morbidity and mortality [9]. Additionally, studies have suggested that the replication rate of HBV is higher in the presence of HIV, and there is a lower rate of spontaneous

resolution of HBV infection in co-infected individuals [1].

In Nigeria, the prevalence of HBV/HIV co-infection varies across different regions [10-17]. While several studies have investigated the burden of HBV/HIV co-infection in other populations, there is a significant knowledge gap concerning pregnant women. This population is particularly important due to the high chance of vertical transmission or perinatal transmission of the viruses, which can result in chronic hepatitis in children born to co-infected mothers [18,19].

In 2004, the Nigerian Government added the HBV vaccine to the national program on immunization for infants. However, this program does not address the virus's transmission risk from infected mothers to their babies. Additionally, more than 40% of Nigerians, including young women of reproductive age, live in poverty and cannot afford the HBV vaccination [22]. Routine screening during pregnancy is another preventive strategy for vertical transmission of HBV and HIV, but it is not commonly practiced in Nigeria due to the high cost of testing [20,21]. This is a concerning issue, and prompt action is necessary to protect the health of both mother and child and prevent the spread of these viruses. To address this, the first and crucial step is to understand the burden of HBV/HIV co-infection in pregnant women in Nigeria. Therefore, our study aims to provide current information on the prevalence and associated risk factors of HBV/HIV co-infection in pregnant women in Osun State, South-west Nigeria. The findings from this study will help inform antenatal HBV and HIV screening practices and highlight the importance of HBV immunization to prevent vertical transmission of the virus.

Methodology

Study design and period

This is a period prevalence serological survey of a cohort of pregnant women attending antenatal care at the State Specialist Hospital in Osun State, Nigeria, between April and June 2022. This study is designed to assess the prevalence of HBV/HIV co-infections and identify possible risk factors in this population. To achieve the objectives of this study, we utilized serological assays and statistical tests discussed subsequently.

Study site and population

The study was conducted at the State Specialist Hospital Asubiaro in Oshogbo, Osun State, Nigeria.

Sample size determination and sampling technique

The minimum sample size was determined using the formula published earlier [23,24]:

$$N = Z^2\, a.p(1-p)L^2$$

where N is the number of patients to be sampled from the hospital, Zα is the percentile of a standard normal distribution to obtain a 95% confidence level in the estimates (where α = 0.05), p is the probability (20%) of HBV/HIV co-infection informed by previous studies, and L is the precision of the estimates. We estimated a minimum sample size of 260.

In this study, we conducted a purposive sampling of 303 consenting pregnant women who presented at antenatal clinics and enrolled in the study.

Eligibility

All consenting pregnant women attending the State Specialist Hospital in Osun State for the antenatal clinic were included in the study.

Pregnant women unwilling to participate in the study were excluded. Additionally, pregnant women with preexisting diagnoses of either HBV or HIV infections were not included. Furthermore, pregnant women experiencing health complications, including active opportunistic infections and severe pregnancy conditions such as preeclampsia, eclampsia, gestational diabetes, and hypertension, were also excluded from the study.

Ethical approval

Ethical approval (approval number: HREC/27/04/2015/SSHO/601) to conduct a study and collect samples from pregnant women attending antenatal care at the State Specialist Hospital in Osun State was obtained from the State Specialist Hospital Osogbo Health Research Ethics Committee, Osogbo, Osun State, Nigeria.

Study questionnaire administration, sample collection and transportation

We used a structured questionnaire that included questions about age, stage of pregnancy, marital status, education, relevant medical histories such as the history of blood transfusion, history of HBV vaccination, and previous surgery to obtain personal and socio-demographic information from consenting participants. A qualified phlebotomist collected 5 millilitres (5 mL) of whole blood from each participant into EDTA sample bottles. Plasma was obtained from collected whole blood on site, and transported to the African Center of Excellence for Genomics of Infectious Diseases (ACEGID), Redeemer's University, in the

cold chain. The plasma samples were stored at -20 °C until they were required for the serological assays.

ELISA screening for HBsAg and HIV I/II antigen

Plasma samples were screened for the presence of hepatitis B virus surface antigen (HBsAg) and HIV I/II antigen by ELISA. We conducted a two-step screening process, wherein participants were first screened for HBV antigen (HBsAg), and those positive for HBV were subsequently screened for HIV I/II antigen. HBsAg enzyme-linked immunosorbent assay (ELISA) and HIV I/II ELISA were performed in duplicates per plasma sample following the manufacturer's instruction (Melsin Medical Co., Limited, Jilin, China). Optical density (OD) cut-off values for HBV and HIV I/II seropositivity were obtained following the manufacturer's instructions, and samples were considered seropositive if they had OD values (mean) higher than the calculated cut-off. HBV/HIV co-infection was defined as a seropositive result for both HBsAg and HIV I/II antigen in the plasma samples screened.

Statistical analysis

Independent variables included age, stage of pregnancy, marital status, educational status, important medical history (history of blood transfusion, HBV vaccination, sexually transmitted infection, and previous surgery), unsafe practices (intravenous drug usage and sharing of sharps), and sexual behaviours (multiple sexual partners, unprotected sex, oral and anal sex). The data analysis involved descriptive analysis using SPSS version 20 [25] and logistic regression analysis using the R statistical program version 2.2.2 [26]. Independent variables with a p value less than 0.25 in bivariate analysis were selected for multivariable analysis [27]. The odds ratio with a 95% confidence level was calculated to determine significant associations, with a p value less than 0.05 considered statistically significant.

Results

Socio-demographic characteristics of study participants

This study included 303 pregnant women who attended antenatal care at the State Specialist Hospital in Osun State, Nigeria. The average age of the participants was 29 years, with 83.5% between 17-34 years. Of the women enrolled, 97.7% were married, and 66% were in the final trimester of their pregnancy (Table 1). Most (96.08%) were formally educated, with only 1.98% being uneducated. 80.2% were self-employed, 53.80% were Muslims, and 93.07% were of the Yoruba tribe (Table 1).

Prevalence and risk factors associated with HBV/HIV co-infection among pregnant women

Of the 303 pregnant women enrolled in this study, 12 (3.96%) tested positive for HBV/HIV co-infection.

Bivariate analysis revealed that pregnant women with a history of blood transfusion (crude Odds Ratio [cOR] = 4.08, 95% CI: 1.98-9.84, $p = 0.05$) and sexually transmitted infections (cOR = 4.65, 95% CI: 1.67-7.30, $p = 0.06$) had higher odds of HBV/HIV co-infection. However, these associations were not statistically significant after adjusting for other variables in

Table 1. Demographic characteristics of participants.

Characteristics	Frequency (303) (%)	Seropositivity	
		Positive HBV/HIV co-infection (%)	Negative HBV/HIV co-infection (%)
Age			
17-34	253 (83.50)	8 (2.64)	245 (80.86)
35-46	50 (16.50)	4 (1.32)	46 (15.18)
Marital status			
Single	7 (2.31)	1 (0.33)	6 (1.98)
Married	296 (97.69)	11 (3.63)	285 (94.06)
Stage of pregnancy			
First trimester	2 (0.66)	1 (0.33)	1 (0.33)
Second trimester	102 (33.66)	3 (0.99)	99 (32.67)
Third trimester	199 (65.68)	8 (2.64)	191 (63.04)
Formal education*			
Yes	297 (96.08)	11 (3.63)	286 (94.39)
No	6 (1.98)	1 (0.33)	5 (1.65)
Occupation			
Civil servant	23 (7.59)	0	23 (7.59)
Healthcare worker	6 (1.98)	0	6 (1.98)
Self employed	243 (80.20)	11 (3.63)	232 (76.57)
Unemployed/others	31 (10.23)	1 (0.33)	30 (9.90)

*Formal education encompasses primary, secondary and tertiary education.

multivariate analysis (adjusted Odds Ratio [aOR] = 2.76, 95% CI: 0.95-7.51, $p = 0.22$, and aOR = 3.42, 95% CI: 1.38-10.82, $p = 0.2$, respectively). Similarly, higher odds for HBV/HIV co-infection were observed among those who practiced oral or anal sex (cOR = 3.71, 95% CI: 1.48-10.41, $p = 0.06$) and had multiple sexual partners (cOR = 3.96, 95% CI: 1.07-10.04, $p = 0.09$) in bivariate analysis but was not statistically significant after adjusting for other variables in multivariate analysis (aOR = 2.03, 95% CI: 0.71-8.62, $p = 0.41$, and aOR = 2.19, 95% CI: 0.81-10.85, $p = 0.45$, respectively).

Also, single women had lower odds of co-infection than married women (aOR = 0.30, 95% CI: 0.13-1.30, $p = 0.35$), and those with a history of surgery had 2.27 times higher odds ratio of co-infection (aOR = 2.27, 95% CI: 0.53-8.35, $p = 0.23$), although both were not statistically significant (Table 2). Similarly, women with formal education had lower odds of co-infection (aOR = 0.13, 95% CI: 0.07-1.74, $p = 0.09$).

There were no associations between age, use of sharps and intravenous drugs, HBV vaccination, and practicing safe (protected) sex with co-infection, and these variables were not included in the multivariate analysis (Table 2).

Discussion

This study reported a prevalence of 3.96% for HBV/HIV co-infection in pregnant women attending antenatal clinics in a teaching hospital in Osun State, Nigeria. The prevalence of HBV/HIV co-infection reported in this study is similar to earlier reports in other parts of Nigeria [28,29], but lower than those reported in other African countries, such as Ethiopia [30], Uganda [31], and Sudan [32]. The variations in prevalence may be attributed to differences in geographical location, risk factors, socio-cultural

Table 2. Risk factors associated with HBV/HIV co-infection among pregnant women attending a Teaching Hospital in Southwest, Nigeria.

Participants' variables	HBV/HIV co-infection	No HBV/HIV co-infection	Bivariate analysis[+]		Multivariate analysis	
			cOdds ratio [95 CI]	*p* value	aOdds ratio [95 CI]	*p* value
Age						
17-34	8 (2.64)	245 (80.86)	1.00 (0.89, 1.13)	0.89		
35-46	4 (0.33)	46 (15.18)				
Intravenous drug use and sharing of sharps						
Yes	2 (0.66)	39 (12.87)	1.29 (0.70, 3.14)	0.75		
No	10 (3.30)	252 (83.17)				
Formal education*						
Yes	11 (3.63)	286 (94.39)	0.19 (0.09, 1.99)	0.15	0.13 (0.07, 1.74)	0.09
No	1 (0.33)	5 (1.65)				
Marital status						
Single	1 (0.33)	6 (1.98)	0.23 (0.10, 1.57)	0.19	0.30 (0.13, 1.30)	0.35
Married	11 (3.63)	285 (94.06)				
Blood transfusion						
Yes	3 (0.99)	22 (7.26)	4.08 (1.98, 9.84)	0.05	2.76 (0.95, 7.51)	0.22
No	9 (2.97)	269 (88.78)				
Multiple sexual partners						
Yes	2 (0.66)	14 (4.62)	3.96 (1.07, 10.04)	0.09	2.19 (0.81, 10.85)	0.45
No	10 (3.30)	277 (91.42)				
HBV vaccination						
Yes	2 (0.66)	48 (15.84)	1.01 (0.15, 3.99)	0.99		
No	10 (3.30)	243 (80.20)				
Oral or anal sex						
Yes	3 (0.99)	24 (7.92)	3.71 (1.48, 10.41)	0.06	2.03 (0.71, 8.62)	0.41
No	9 (2.97)	267 (88.12)				
History of surgery						
Yes	4 (1.32)	48 (15.84)	2.53 (0.85, 4.38)	0.14	2.27 (0.53, 8.35)	0.23
No	8 (2.64)	243 (80.20)				
Protected sex						
Yes	1 (0.33)	49 (16.17)	1.28 (0.78, 4.45)	0.72		
No	7 (2.31)	194 (64.03)				
History of STI						
Yes	2 (0.66)	12 (3.96)	4.65 (1.67, 7.30)	0.06	3.42 (1.38, 10.82)	0.2
No	10 (3.30)	279 (92.08)				

*Formal education encompasses primary, secondary and tertiary education. [+]only variables with *p* values less than 0.25 were analysed in multivariate logistic regression. cOR: crude odds ratio, aOR: adjusted odds ratio, HBV: Hepatitis B virus, STI: sexually transmitted infection.

practices, study design, sample size, and test methods [33].

We employed bivariate and multivariate logistic regression models to examine the risk factors associated with HBV/HIV co-infection in pregnant women. The bivariate analysis revealed a suggestive association, indicating that pregnant women with a history of blood transfusion might face a higher risk of HBV/HIV co-infection. This observation aligns with similar findings from a study in southwest Nigeria, where pregnant women with recent blood transfusions exhibited an increased risk of HBV infection [34]. However, it is crucial to note that the significance was not sustained in the multivariate analysis.

Considering the modes of transmission for both HBV and HIV, it is noteworthy that blood serves as a primary route, particularly in developing countries where testing and screening for these pathogens before blood transfusion may be less strict or thorough [35,36]. To address this concern, it becomes essential to ensure that blood screening and testing protocols are implemented effectively to minimize the risk of transmission of both HBV and HIV through blood transfusions. Moreover, raising awareness and providing education on the risks associated with blood donation and the importance of safe blood transfusion practices can play a crucial role in reducing the incidence of HBV/HIV co-infection among pregnant women and the general population.

Furthermore, pregnant women who engaged in oral or anal sex or had multiple sexual partners had higher odds of HBV/HIV co-infection. These findings support previous research identifying these sexual behaviours as high-risk factors for transmitting HBV and HIV [35,37]. Although, after adjusting for other variables in multivariate analysis, neither sexual behaviour was a significant risk factor, suggesting that other risk factors might have confounded the observed associations in the earlier bivariate analysis conducted.

In contrast, our analysis suggests that formal education could potentially act as a preventive factor for HBV/HIV co-infection in this population. Our study showed that pregnant women who had received formal education had lower odds of being co-infected with HBV/HIV than those who had not. This finding provides additional support to the idea that education has a positive impact on health outcomes [38]. Formal education may plausibly empower women with better healthcare knowledge and awareness of safe sexual and social behaviours, thereby reducing the risk of contracting HBV or HIV [39]. On the other hand, uneducated women might encounter economic and social barriers that increase their vulnerability to infection [39]. This study highlights the critical role of education in preventing HBV/HIV co-infections within this population. Moreover, designing and implementing sex education and awareness campaigns focusing on HBV and HIV, particularly for pregnant women and women of reproductive age residing in rural and semi-urban areas of Nigeria, could effectively reduce the risk of transmission for both viruses. By emphasizing the importance of education and targeted awareness initiatives, public health interventions can better address the challenges posed by HBV and HIV among pregnant women and those of reproductive age, ultimately leading to improved health outcomes and reduced transmission rates.

Conclusions

Our findings emphasized the importance of routine screening for both viruses during antenatal care due to the well-established risk of mother-to-child transmission and associated health outcomes in children. Future studies with larger sample sizes and broader risk factor assessments are recommended to understand the epidemiology and disease burden of HBV/HIV co-infection in pregnant women in this setting.

Overall, our study underscores the need for effective prevention and treatment strategies to improve maternal and child health outcomes in the context of HBV/HIV co-infection. More targeted interventions can be developed by better understanding the risk factors and disease burden.

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Authors' contributions

KTA, BIO and FOA: conceptualization and project administration; BIO and KTA: methodology; BIO, KTA, EAE, OOD, MDO, NAB, OAM, FDK and AMI: investigation; KTA and A-KTM: data curation and formal analysis; KTA: writing - original draft; BIO, EAE, OOD, MDO, NAB, OAM, FDK, AMI, A-KTM, and FOA: writing - review editing; all authors have read and agreed to the published version of the manuscript.

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