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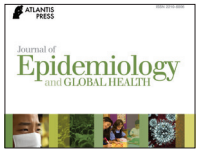

Research Article

Epidemiology of HBV in Pregnant Women, South West Nigeria

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ABSTRACT

Hepatitis B virus (HBV) remains a leading cause of chronic hepatitis, maternal complications, and neonatal deaths in sub-Saharan Africa. Pregnant women serve as a major reservoir for the persistence and ongoing transmission of hepatitis B virus and HIV in a generalized heterosexual epidemic. The aim of this study is to assess the epidemiology of Hepatitis B infection among pregnant women in South West-Nigeria. This is a cross-sectional study of 353 pregnant women across 10 health facilities in the region. Results showed that of the 353 pregnant women tested, 37 were positive for the HBV antigen giving a prevalence estimate of 10.5% (95% CI: 7.5%–14.2%). We found significant negative association between odds of HBV infection and knowledge of HBV transmission through sex (OR: 0.30: 95%CI–0.11–0.82) and a positive association with blood transfusion in the past three months (OR: 9.5: 95% CI-1.58–57.14). Findings strongly suggest high endemicity of HBV and the possible implication of blood transfusion as a major route of ongoing HBV transmission among pregnant women in south-western Nigeria. We recommend further study of a prospective design to investigate the possible causal link between blood transfusion and the risk of HBV infection among pregnant women in Nigeria.

1. INTRODUCTION

The significance of hepatitis B virus (HBV) infection as a public health issue is of topmost concern in sub-Saharan Africa, particularly in Nigeria [1]. According to the most recent report by the World Health Organization (2016), the current global burden of hepatitis B infection is estimated to be 2 billion, of which 360 million are chronically infected at the end of 2016, while 620,000 deaths occur annually [2]. Despite the fact that Hepatitis B virus accounts for more deaths than each of HIV, tuberculosis and malaria [2], the performance metrics of awareness, knowledge of transmission, vaccine prevention and control remain low in most affected (high risk) populations such as pregnant women in developing countries [3].

In sub-Saharan Africa, hepatitis B virus remains a leading cause of chronic hepatitis, maternal complications, and neonatal deaths. Pregnant women therefore, serve as a major reservoir for the persistence and ongoing transmission of the virus within populations [4,5]. HBV burden is further worsened by the high risk of co-infection with HIV within a generalized epidemic and poverty in this part of the world [1,2]. Hepatitis B virus remains the most significant viral hepatitis due to the high transmission potential through blood and body fluids, especially among pregnant women [5,6]. Its ability to cause chronic liver diseases such as liver cirrhosis and hepatocellular carcinoma, and a number of obstetric complications, before, during and after birth cannot be overlooked [6]. Similarly, pregnancy triggers physiological and in immunological response and a well known effect is the shift in the T helper 1-T helper 2 balance towards a T helper 2 response, which increases the presence/secretion of regulatory T cells and in turn contributes to a depressed immune response against the HBV pathogen [6]. This key change lowers the body's ability to mount an effective immune response, thereby resulting in the successful infection and proliferation of HBV DNA [6]. Such pregnant women are therefore at heightened risk of onward transmission to the unborn child especially in the absence of vaccine or prophylactic measures during the early phase of antenatal care.

The emergence of HIV in the past four decades, further worsened the complications due to hepatitis B infection in pregnant women as well as in the general population [7,8]. Furthermore, the highly contagious nature of both viral infections and common route of transmission through blood and body fluids especially during unprotected heterosexual contact, mother to child transmission, and ability to cause chronic disease state in affected individuals, account for the dual burden of co-morbidity due to hepatitis B and HIV in pregnant women [8]. This has a broader implication in a generalized HIV epidemic context. Maternal complications due to HBV and HIV co-infection pose significant threat to the survival of both the mother and unborn child. On the other hand, in a low-resourced country such as Nigeria, the economic cost attributable to the impact of HIV and HBV coinfection has been well documented both at the microeconomic (individual) and the macroeconomic (household and population) levels [9]. In addition, a major epidemiologic implication is the increasing probability of dual transmission of new HBV/HIV infections in a mixed setting creating new

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chimeric recombinant forms (hitherto unknown) which may even pose a greater threat than the two separate epidemics.

Prevalence estimate of hepatitis B and co-infection with HIV has been reported across a number of studies conducted in various parts of Nigeria. Studies conducted in northern Nigeria showed evidence of intermediate to high hepatitis B burden in the northern region. For instance, Ndams et al. [10] reported a prevalence of 12.3% in a cross-sectional study of hepatitis B in 261 pregnant women in Minna, with the highest rate observed in the middle age group who are more likely to be sexually active than the younger or older age groups [10]. Findings from the study was further supported by a similar cross-sectional screening of 231 pregnant women attending antenatal clinic at the Federal Medical Centre, Yola, where an estimated 8.2% of the women had hepatitis B infection with the highest rate found in women in the middle age group [11]. Similarly, a 3.9% rate of HBV/HIV co-infection was found in 8000 women attending antenatal care across four health facilities in Kaduna in an unpublished study by Oneh, 2013 [12]. Furthermore, studies conducted in southern Nigeria provide evidence of a moderate to high prevalence burden of hepatitis B and co-infection with HIV in the region. A case in point is a study by Ojide and colleagues with a reported estimate of 15.5% prevalence rate of hepatitis B surface antigen in HIV outpatients clinic in Benin City, Nigeria [13]. In a separate study conducted by Oladeinde et al., 2013 [14] in the same region, prevalence of HBV and HIV infections was found to be 2.2% and 7.2% respectively. This study found the highest rate of infections in pregnant women with no formal education and with multiple sexual partners, which provides support for the role of mother's education as an effective preventive intervention as well as the well known impact of multiple heterosexual partnerships in the occurrence of new infections especially in the general population.

However, prevalence situation in the Niger Delta reveals a low to moderate burden. A 3% point prevalence was observed in a cohort of 10,032 pregnant women attending antenatal at the Braithwaite Memorial hospital in Port Harcourt [15]. Buseri et al. (2010) [16] also reported a 5.3% and 4.1% prevalence of HBV and HIV infections respectively in 1000 apparently healthy pregnant women in the reproductive age group in the same region.

Furthermore, blood transfusion has been implicated as a major route of HBV and HIV transmission in the pregnant women population after heterosexual contact, particularly in sub-Saharan Africa [17,18]. It was also observed that significant differential exist with regard to hepatitis B and HIV infections between pregnant women receiving blood transfusion and those who do not as reported by studies in both developing and developed countries [19,20]. In the same vein, despite high efficacy of HBV vaccine, low vaccine awareness, availability and affordability and immunization-related challenges affect uptake among pregnant women in Nigeria and thus account for the upward trend observed in recent years across the country [21,22].

Sadly, the government of Nigeria, till date, has no formal guidelines for the treatment and prevention of viral hepatitis in the general population and in pregnant women. As a result, there are no readily available services for pregnant women in most parts of the country and where services are available, the cost of screening and vaccine uptake continue to put these services out of the reach of the bottom majority who need it most.

However, few studies so far, have assessed the burden of hepatitis B and HIV co-infection and risk factor profile in pregnant women in Nigeria. The most recent attempt to estimate the burden of HBV in the region was a study by Anaedobe et al. (2015) which only considered 180 pregnant women all screened from the University College Hospital Ibadan, a tertiary hospital in the region [23]. In this study, we attempt to provide an improved and more representative estimate of the HBV prevalence burden in the region. Also, most of the reviewed studies from the extant body of literature are descriptive at best with little effort made to identify specific risk factors of infections in this high risk population. This study is therefore an attempt to fill the gap in knowledge, risk factors and population impact of hepatitis B infection in pregnant women and make useful recommendations informed by study findings.

2. METHODOLOGY

In this section, we describe the design process, field implementation and analytical procedures that were carried out in order to achieve the set objectives of this study.

2.1. Study Design

This study is a cross-sectional design set up to examine randomly selected samples of pregnant women attending antenatal care in ten (10) maternity centers in south-west Nigeria. A structured questionnaire with closed ended questions about HIV/HBV history and exposure of study participants was employed to collect data on each consenting individual.

2.2. Study Settings and Population

This study was conducted across 10 maternity facilities of the Redeemed Christian Church of God in Ogun and Lagos States. These maternities are set up to provide maternal and child health services (including HIV treatment and prevention) to pregnant women and nursing mothers within the community where they are resident. Overall, it renders services to a population of approximately 280,000 pregnant women nationwide. Pregnant women were randomly selected from the locations presented in Table 1

Table 1 | Distribution of study centre across ten facilities in Lagos and Ogun states and the geographic coordinates

Location of maternity centre	State	Local government area	Npop	Geographic coordinates of LGA
Mowe	Ogun	Obafemi Owode	800	6.80596, 3.43803
Ibafo	Ogun	Obafemi Owode	700	6.74015, 3.42208
AkuteAjunwo	Ogun	Ifo	NA	6.67777, 3.35871
Agbado crossing	Lagos	Agbado	280	6.71380, 3.28515
Redemption Camp	Ogun	Obafemi Owode	4500	6.4531, 3.3958
Sabo Ikorodu	Lagos	Ikorodu West	3000	6.61941, 3.51045
Ipaja	Lagos	Alimosho	120	6.60541, 3.27989
AgbadoKollinton	Lagos	Ifako-Ijaye	1200	6.71380, 3.28515
Shagamu	Ogun	Sagamu	200	6.77880, 3.62178
Abuleiroko	Ogun	Ado-Odo/Ota	170	6.69916, 3.26385

Npop, Annual average population size attending antennal care at maternity.

along with the average population size of pregnant women attended to in each maternity centre in a year.

2.3. Inclusion and Exclusion Criteria

All consenting pregnant women between age 15 and 49 years were considered eligible to participate in this research. Medical as well as religious birth attendants in the selected study sites were excluded from the study.

2.4. Study Sample and Sampling Method

In order to obtain the required sample size for this study, the formula:

$$\text{Sample size} = Z^2_{1-\alpha/2} p(1-p) / d^2 \quad (1)$$

was considered [24]. In the above formula, $Z_{1-\alpha/2}$ is the standard normal variate with the value of 1.96 to estimate the significance of the P values at 5% type 1 error ($P < 0.05$), p is the expected proportion of P is the expected proportion of pregnant women with Hepatitis B infection in South West Nigeria – 0.08 as reported in a previous study in the same region [23]. Finally, the absolute error or precision d of 0.04 was chosen for this study. From the above formula in equation (1), we obtained a direct sample size estimate of 177. However, as a final adjustment to the sample size, we accounted for a 20% non response rate and a resulting final sample size of 350. A total of 353 consenting pregnant women were included in this survey. A simple random sampling approach was used at each Maternity Centre to recruit the number required for each stratum (i.e. pregnant women) Whenever a pregnant woman refused to participate, a suitable replacement was considered until the required sample size was attained. A sampling frame that contained a list of all pregnant women attending maternity was generated from the 10 study sites. Each Maternity Centre keeps record of the medical history of all pregnant women attending antenatal care.

2.5. Data Collection

Data was collected on demographic variables such as age, education, and marital status. Knowledge and risk assessment variables such as HIV routes of transmission, and prevention methods, age at first sex, casual and regular sexual partner in the past 3 months, multiple sexual partners and history of sexually transmitted infections in the last three months were also generated using an anonymous self-administered questionnaire. A total of 12 paid study assistants were used for the distribution of the questionnaires to selected pregnant women who also retrieved the questionnaires. The technical assistance of the Redeemed Action Programme Action Committee on AIDS (RAPAC) was solicited in the conduct, administration and testing of study participants across the various study locations. To ensure that study participants have full comprehension of questions, participants had interviewed in their first language of choice.

This study examined the knowledge level of pregnant women about hepatitis B virus infection (HBV) such as; person to person spread of HBV, previous HBV testing, knowledge of result, ever gone for treatment, HBV as a cause of liver cancer, prevention of HBV infection by use of vaccine, and sexual and blood transmission of the virus. Complaints of genital sores or ulcers were also noted. All variables were close-ended with a binary code assigned "yes = 1" and "no = 0".

2.6. Data Management

Data management activities such as validation of correctness and completeness of each questionnaire, data entry and coding for analysis were carried out in Excel spreadsheet. The cleaned data was exported into Stata version 12.1 statistical software package for analysis by a Statistician.

2.7. Data Analysis

Descriptive analysis was carried out according to the objectives of this study. Summary statistics such as mean and standard deviation were employed to describe continuous variables while frequency tables and percentages were utilised for categorical responses. Significant difference and association between variables were assessed at 95% level of confidence and 5% alpha level. This implies that only probability values (p-values) that are <0.05 are considered significant. Findings were also presented in tables and graphs.

2.8. Reliability and Validity

The reliability of the self-developed questionnaire was assessed by administering it to a small sample of 20 pregnant women twice and measuring the reliability ratio. The content validity of the questionnaire was assessed by an experienced researcher in the field of HIV/HBV and pre-tested on a small sample of 20 non-eligible participants (i.e. those who were in management positions) selected across the maternity centers. The objectives of the exercise were explained to them that they were meant to assist in assessing the clarity of questions, usability and logistics of administration. Subsequently, necessary adjustments were made using this information. The participants used for reliability and validity checks were excluded from the final research since they had been sensitized to the research questions and some of them did not meet the inclusion criteria.

2.9. Bias

This study may be subject to various kinds of bias commonly associated with cross-sectional survey research. For instance, selection bias may occur due to the fact that pregnant women who attended these maternities are more likely to be affiliated to the Redeemed Christian Church of God (RCCG) Mission. To minimize non-response bias, the questionnaire was made anonymous and confidentiality of test results assured. Voluntary consent form was completed and collected before the questionnaires were handed to the participants. There was also the possibility of recall bias as respondents had to recall past experiences to answer the questions in the questionnaire.

2.10. Ethical Considerations

As part of ethical considerations, participants were made to give their fully informed consent by signing the consent form, on which was stated the summary of the research project (title, scope, aims and purpose), benefits to society and study participants. The consent form clearly stated the voluntary nature of the research indicating that participants are free to decline to participate. The questionnaire did not capture the participants' identification particulars, thus ensuring anonymity

3. RESULTS

3.1. Brief Description of Study Facilities

This study was conducted across ten health facilities as presented in Table 1 along with their geographic coordinates in two states of south-west Nigeria. The annual average of antenatal visits across these facilities range from a 120 patients to 4500 patients with an overall estimated average of 1219 patients per year. (This excludes the Akute Ajuwon centre with no information available). The overall response rate for this study was 100%.

4. BRIEF DESCRIPTION OF STUDY PARTICIPANTS

We present the distribution of study participants across the ten facilities by socio-demographic characteristics in Table 2. A total of 353 pregnant women on antenatal care participated in the study with 100% overall response rate to survey structured questionnaire and HBV testing. Highest rate of participation (69%) was found in pregnant women in the 25–34 years age group comprising of at least 60% of respondents across all the health facilities (Table 2). A significant number of the respondents (≥84%) were married with at least primary education. This trend was consistently observed across the ten facilities.

5. HIV PREVALENCE IN STUDY POPULATION

Table 3 shows the distribution of HBV seropositivity status of the study population tested across the ten facilities. The overall prevalence of HBV infection was estimated at 10.5% (95%CI: 7.5%–14.2%) derived from a total of 37 positive cases in the study population. The highest prevalence rate was observed in the RCCG health facility while the lowest rate of 0% was found in Abule Egba health facility (Table 3).

6. HBV PREVALENCE ESTIMATES DISTRIBUTION BY SOCIO-DEMOGRAPHIC CHARACTERISTICS

Table 4 shows prevalence distribution of HBV by key socio-demographic characteristics of study participants. Highest prevalence of HBV infection was observed in pregnant women in the 25–34 years age group with an estimate of 12.2% HBV infection in the study population. The oldest group (≥35 years) had similar rate (6.8%) to pregnant women in the lowest age bracket (5.7%) had relatively similar infection rate. In addition, an absolute rate difference of 7.6% was observed in HBV infection between pregnant

Table 2 | Distribution of study participants across the ten facilities by socio-demographic characteristics

Variable	Ibafo (N = 39) n(%)	Shagamu (N = 29) n(%)	Abule Iroko (N = 20) n(%)	Agbado crossing (N = 20) n(%)	Akute Ajuwon (N = 40) n(%)	Camp (N = 51) n(%)	Ipaja (N = 26) n(%)	Kollington (N = 45) n(%)	Mowe (N = 43) n(%)	Sabo Ikorodu (N = 40) n(%)	Total (N = 353) n(%)
Age											
15–24	1(2.6)	2(6.9)	4(20.0)	1(5)	2(5)	3(5.9)	4(15.4)	2(4.4)	10(23)	6(15)	35(10)
25–34	29(74.4)	23(79.3)	15(75)	15(75)	31(77.5)	36(70.6)	15(57.7)	31(68.9)	26(61)	24(60)	245(69)
>=35	9(23.1)	4(13.8)	1(5)	4(20)	7(17.5)	12(23.5)	7(26.9)	12(26.7)	7(16)	10(25)	73(21)
Marital status											
Single	3(7.7)	0(0.0)	2(10)	0(0)	1(2.5)	0(0)	0(0)	2(4.4)	7(16)	2(5)	17(5)
Married	36(92.3)	29(100)	18(90)	20(100)	39(97.5)	51(100)	26(100)	43(95.6)	36(84)	38(95)	336(95)
State of residence											
Ogun	39(0.0)	29(100)	12(60)	14(70)	40(100)	50(98)	0(0.0)	0(0)	43(100)	0(0)	227(64)
Lagos	0(0.0)	0(0.0)	8(40)	6(30)	0(0)	1(2)	26(100)	45(100)	0(0)	40(100)	126(36)
Education											
None	1(2.6)	0(0.0)	0(0)	2(10)	2(5.1)	0(0)	1(4)	1(2.2)	0(0)	0(0)	7(2)
Primary	18(46.2)	12(41.4)	6(30)	3(15)	18(46.2)	36(73.5)	6(24)	22(48.9)	12(29)	12(31)	145(42)
Second	6(15.4)	2(6.9)	3(15.0)	5(25)	4(10.3)	3(6.1)	8(32)	10(22.2)	3(7)	4(10)	48(14)
Higher	14(35.9)	15(51.7)	11(55)	10(50)	15(38.5)	10(20.4)	10(40)	12(26.7)	27(64)	23(59)	147(42)

Table 3 | Distribution of Hepatitis B seropositivity across the ten facilities

HBV status	Ibafo n (%)	Shagamu n (%)	Abule n (%)	Agbado n (%)	Akute- n (%)	Camp n (%)	Ipaja n (%)	Kollington n (%)	Mowe n (%)	Ikorodu n (%)
Negative	36(92.3)	27(93.1)	20(100)	19(95)	35(87.5)	34(66.7)	25(96.2)	44(97.8)	41(95.4)	35(87.5)
Positive	3(7.7)	2(6.9)	0(0)	1(5)	5(12.5)	17(33.3)	1(3.9)	1(2.2)	2(4.7)	5(12.5)

Table 4 | Bivariate assessment of Hepatitis B seropositivity by socio-demographic variables

Variable	N	HBV positive n (%)	HBV negative n (%)	p-value
Age				0.261; chi2(2) = 2.69
15–24	35	2(5.7)	33(94.3)	
25–34	245	30(12.2)	215(87.8)	
≥ 35	73	5(6.8)	68(93.2)	
State of origin				0.024; Chi2(1) = 5.07
Lagos	126	7(5.6)	119(94.4)	
Ogun	227	30(13.2)	197(86.8)	
Parity				0.035; Chi(2) = 9.011; Fisher's exact = 0.024
0	74	2(2.7)	72(97.3)	
1	135	14(10.4)	121(89.6)	
≥2	104	15(14.4)	89(85.6)	
Education				0.576; Chi2(3) = 1.98
none	7	0(0.0)	7(2.3)	
primary	145	18(12.4)	127(87.6)	
secondary	48	6(12.5)	42(87.5)	
higher	147	13(8.8)	134(91.2)	
Total	353	37(10.5%)	316(89.5%)	

women from the less urbanized Ogun State and the metropolitan city of Lagos State. This difference was statistically significant. Of particular interest is the observation of a dose-response relationship found between HBV positivity and the number of previous children reported in the study population. This does-response effect was most amplified between pregnant women with no previous child and those with 1 child (a substantial absolute difference of 7.7%). Consequently, 14.4% of pregnant women who had had at least 2 children previously had HBV infection and this was statistically significant (Table 4). This implies therefore that the higher the number of previous children reported, the higher the likelihood of HBV infection in the study population. In contrast, no distinct dose-response pattern was found between education and HBV infection with highest rate observed in pregnant women that had secondary and primary education (12.5% and 12.4% respectively).

7. A COMPARATIVE ASSESSMENT OF HBV KNOWLEDGE AND EXPOSURE

In order to further characterize the predictive pattern of HBV infection in the population, this study conducted a comparative assessment of HBV positive and negative pregnant women regarding knowledge of HBV infection and its transmission and previous testing as presented in Table 5. We found marginally significant evidence in the difference between the HBV positive and negative pregnant women with regard to previous HBV test. The result showed that higher proportion of HBV negative pregnant women had had HBV test prior to the study (a percent point difference of 12.4%. On the other hand, we observed a very poor rate of knowledge of previous HBV results in both groups as only 1 pregnant woman in the entire study population reported knowledge of previous HBV result (Table 5). Similarly, higher proportion of HBV negative participants (66%) believed that HBV is more easily spread than HIV relative to 46% in HBV positive pregnant women (p-value = 0.012). Another key aspect of our finding is that blood transfusion in the past 3 months was reported 5 times more likely in the HBV positive pregnant women relative to their negative counterparts (Table 5). This was found to be statistically significant. A comparative high proportion of both groups had knowledge that HBV is vaccine-preventable (>90%) and can be transmitted through blood (>70%). On the other hand, a statistically significant difference was found in the knowledge of HBV transmission through sex. HBV negative pregnant women had higher knowledge of sexual transmission of HBV infection.

Table 5 | Assessment of the differences between Hepatitis B positive and negative participant with respect to HBV knowledge and exposure profile

Variable	N	HBV positive n (%)	HBV negative n (%)	p-value
Previous HBV test				0.086; chi2(1) = 2.95
no	260	32(86.5)	228(72.2)	
yes	87	5(13.5)	82(25.9)	
non-response	6	0(0)	6(1.9)	
Previous HBV result				<0.001; chi2(1) = 16.95 exact; 0.057
no	86	4(10.8)	82(25.9)	
yes	1	1(2.7)	0(0.0)	
non-response	266	32(86.5)	234(74.1)	
HBV more easily spread than HIV				0.012; chi2(1) = 6.27
no	123	20(54.1)	103(32.6)	
yes	224	17(45.9)	207(65.5)	
non-response	6	0(0)	6(1.9)	
Blood transfusion in the past 3 months				0.012; chi2(1) = 6.309 exact; 0.042
no	343	34(91.9)	309(97.8)	
yes	8	3(8.1)	5(1.6)	
non-response	2	0(0)	2(0.6)	
Think HBV can cause liver cancer				0.700; chi2(1) = 0.148
no	217	22(59.5)	195(61.7)	
yes	131	15(40.5)	116(36.7)	
non-response	5	0(0)	5(1.6)	
HBV vaccine can prevent infection				0.245; chi2(1) = 1.351
no	11	0(0.0)	11(3.5)	
yes	337	37(100.0)	300(94.9)	
non-response	5	0(0)	5(1.6)	
HBV transmission through blood				0.221; chi2(1) = 1.500
no	26	5(13.5)	21(6.6)	
yes	270	30(81.1)	240(75.9)	
non-response	57	2(5.4)	55(17.4)	
HBV transmission through sex				0.013; chi2(1) = 6.231 exact; 0.022
no	27	7(18.9)	20(6.3)	
yes	281	28(75.7)	253(80.1)	
non-response	45	2(5.4)	43(13.6)	
Genital sores				0.414; chi2(1) = 0.667
no	335	35(94.6)	300(94.9)	
yes	11	2(5.4)	9(2.8)	
non-response	7	0(0)	7(2.2)	
HBV risk score				0.154
Mean ± SD	348	3.54 ± 1.0	3.82 ± 1.1	
Total	353	37(10.5%)	316(89.5%)	

8. INFERENTIAL ANALYSIS OF HIV RISK IN THE STUDY POPULATION

We implemented a logistic regression model to obtain age adjusted effect of significant risk factors. The result is presented in Table 6. The model showed marginal evidence for increased odds of HBV infection in pregnant women from Ogun state while other factors in the model are held constant. In addition, knowledge of HBV being more easily spread than HIV significantly reduced odds of HBV infection by 60% (OR: 0.41; 95% CI: 0.19–0.88). A similarly protective effect was observed with regard to knowledge of HBV transmission through sex with 70% reduction in odds of infection (OR: 0.30; 95% CI: 0.11–0.82). On the other hand, pregnant women who had blood transfusion in the past three months had 9 times significantly greater odds of HBV infection.

However, only two pregnant women had co-infection with HIV resulting in a low HBV/HIV prevalence burden of 0.57%.

Table 6 | Risk factors of HBV in pregnant women

Variable	Odds ratio (95% CI)	S.E	P-value (<0.05)
Age			
15–24	–		
25–34	2.73(0.54–13.83)	2.26	0.224
≥35	1.35(0.18–10.14)	1.39	0.774
Age at first sex	0.96(0.87–1.05)	0.05	0.359
State of origin			
Lagos	–		
Ogun	2.37(0.97–5.81)	1.08	0.059
HBV more easily spread than HIV			
no	–		
yes	0.41(0.19–0.88)	0.16	0.022
HBV transmission through sex			
no	–		
yes	0.30(0.11–0.82)	0.15	0.019
Blood transfusion in the past 3 months			
no	–		
yes	9.50(1.58–57.14)	8.70	0.014

LR Chi2(7), 25.33; Prob > chi2, 0.0007; N, 299; 95% CI, 95% Confidence Interval; S.E, Standard error.

9. ASSESSMENT OF IMPACT MEASURES OF RISK FACTORS OF HBV INFECTION ON THE PREGNANT WOMEN POPULATION

We further examined the public health impact of exposure risks within the various categories of factors investigated to better quantify the increment and preventive impact of public health measures. The two key measures considered for the purpose of this study are the attributable fraction (also known as attributable proportion) simply defined as the proportion of HBV infection in the exposed group that can be attributed to the exposure. Similarly, it may also be described as the proportion of disease in the group that could be prevented by eliminating the risk factor. Giving the cross-sectional study design of the current study, we derived odds ratio-based estimates of attributable proportion and preventive fraction in line with the relative risks based estimated commonly used in cohort based studies. The second category of impact measures considered is the population attributable fraction which is briefly defined as the proportion of HBV cases in the entire study population that can be attributed to the exposure. On this premise, while the first measure is exposure group specific, the second measure simply scales the impact of the effect to the entire population in the study. We present the result in Table 7.

Table 7 | Attributable proportion and population attributable fraction of key HBV socio-demographic and exposure variables

Exposure	OR (95% CI)	AF_{exp}/AP_{exp} (95% CI)	PF_{exp} (95% CI)	PAF/PF_{pop}	p-value (exact)
Age group					
15–24	0.49(0.12–2.07)	–	0.51(−1.07 to 0.88)	0.05	0.559
25–34	2.01(0.87–4.68)	0.50(−0.15 to 0.79)	–	0.41	0.131
>=35	0.57(0.22–1.50)	–	0.43(−0.50 to 0.78)	0.09	0.292
Education					
primary	1.41(0.71–2.79)	0.29(−0.40 to 0.64)	–	0.14	0.378
secondary	1.26(0.50–3.21)	0.21(−1.01 to 0.69)	–	0.03	0.614
higher	0.74(0.36–1.50)	–	0.26(−0.50 to 0.64)	0.11	0.482
Parity					
0	0.19(0.05–0.72)	–	0.81(0.28–0.95)	0.18	**0.010**
1	0.98(0.49–1.98)	–	0.02(−0.98 to 0.51)	0.01	1.000
2	1.74(0.87–3.48)	0.42(−0.15 to 0.71)	–	0.17	0.129
State					
Lagos	0.36(0.16–0.82)	–	0.64(0.18–0.84)	0.24	**0.020**
Ogun	2.59(1.13–5.93)	0.61(0.11–0.83)	–	0.50	**0.029**
Previous HBV test	0.43(0.17–1.13)	–	0.57(−0.13 to 0.83)	0.15	0.108
HBV more easily spread than HIV	0.42(0.22–0.83)	–	0.58(0.17–0.78)	0.39	**0.017**
Blood transfusion in the past 3 months	5.45(1.45–20.52)	0.82(0.31–0.95)	–	0.07	**0.042**
Think HBV can cause liver cancer	1.15(0.57–2.30)	0.13(−0.75 to 0.56)	–	0.05	0.722
HBV transmitted through sex	0.32(0.13–0.78)	–	0.68(0.22–0.87)	0.63	**0.0219**
Genital sore	1.90(0.40–8.96)	0.48(−1.47 to 0.89)	–	0.03	0.333

p-value less than 5% are in bold.

We particularly noted the impact of four significant risk factors after adjusting for socio-demographic effects. These are parity, knowledge of HBV transmission, blood transfusion in the past three months and HBV transmission through sex. The attributable proportion of HBV infection among pregnant women with at least 2 previous children was 42%. In other words, 42% of all cases of HBV infections in this exposure category are actually due to the effect of this exposure group. On the other hand, a statistically significant preventable fraction of 81% was found in pregnant women with no history of previous birth (Table 7). With regard to knowledge of HBV easier transmission than HIV, we found a statistically significant preventable fraction of 58% in those who had this knowledge compared to those who did not. In contrast, blood transfusion in the past 3 months is attributable to 82% of all HBV infected pregnant women who had blood transfusion in the past 3 months. Finally, we found a statistically significant 68% preventable fraction in the odds of HBV infection in pregnant women who had knowledge of HBV transmission through sex.

10. DISCUSSION

This study examined the prevalence of the Hepatitis B virus (HBV) infection among pregnant women enrolled for antenatal care across ten facilities in Lagos and Ogun States, Nigeria. The overall HBV prevalence estimate in this study population was 10.5%. This estimated burden effectively classifies HBV infection as highly endemic (>8%) among pregnant women in south-west Nigeria according to the World Health Organization [25]. This provides another more recent evidence for the persistence of the Hepatitis B virus infection burden and spread in Nigeria. The prevalence estimate was consistent with similar studies conducted in the region and other parts of the country. For instance, the recent and most nationally representative HBV prevalence burden was reported to be 12.2% [26], while the most comprehensive meta-analytical study conducted till date (2000–2013) on HBV burden in Nigeria found an overall pooled estimate of 13.6% national prevalence and a 14.1% burden in pregnant women attending antenatal clinics across the country [27]. A similar study conducted in the region at the University College Hospital Ibadan, found 8.3% frequency of HBV infection in the study population [23].

A comparative estimate was found in studies conducted in the northern part of the country. For instance, Ndams et al. (2008) [10] found a 12.3% HBV prevalence rate among pregnant women in Minna, Nigeria while a case-control study by Yakasai and his colleagues (2012) reported an estimate of 7.9% HBV prevalence burden in pregnant women of child bearing age at Aminu Kano Teaching Hospital Kano, northern Nigeria. Similar estimates were found in the north-central part of the country; 11% in Markurdi [28] and 7%–8% in Abuja [29,30]. However lower prevalence rates have been reported by recent studies in the south-south region of Nigeria; viz 2.2% among pregnant women receiving ANC in a traditional birth home in Benin City [14] and 2.9% in a five-year prevalence study in Port Harcourt [15].

In addition, in this study, we found that pregnant women from Ogun state (13.2%) are 2.4 times more likely to have HBV infection than pregnant women from Lagos State (5.6%). Prevalence estimate among pregnant women in Ogun State is higher (13.2%) than the 6.7% rate reported by Emmanuel and Ifeanyi, 2015 [31] in a similar population of pregnant women in Ogun State. On the other hand, the observed prevalence rate among pregnant women from Lagos State was consistent with estimates by Rabiu et al. (2010) [32] and Adegbesan-Omilabu et al. (2015) [33] of 6% and 7.3% respectively. The observed lower rate in Lagos State relative to Ogun State may be as a result of higher level of education and easy access to healthcare interventions in the metropolitan city of Lagos.

Furthermore, a statistically significant dose-response relationship was observed between parity and the likelihood of HBV infection. Findings showed a significant increase in the likelihood of HBV infection with the increasing number of parity in the study population. A similar study conducted by Ngaira et al. (2016) [34] found significant association between parity and risk of HBV infection in Kenya. This association strongly suggests the institutional factors within health facilities that may account for the higher number of cases observed in previous pregnancies. With each succeeding pregnancy, women are likely to visit the healthcare facility for antenatal care services, which may require injection of fluids or blood into the body in emergency situations or due to complications. On the other hand, majority of pregnant women previously tested HBV positive may have had the HBV DNA replicating in their body since their first or second parity, while they never seek treatment either due to lack of knowledge of their positive status or lack of affordable access to effective treatment. The observed higher rate in pregnant women in the middle age group may be due to high frequency of sexual activity with their partner which makes them more likely to become pregnant and thus seek antenatal care services at health facilities [35].

In addition, pregnant women with history of previous HBV test and HBV transmission have a likelihood of reduced HBV infection. This finding is consistent with already known effectiveness of knowledge of HBV transmission and its translation to reduced risk of infection in this high risk population. Another key finding from our study is the significant association between blood transfusion and HBV infection as HBV positive pregnant women were 5 times more likely to have had blood transfusion in the past 3 months. This finding is consistent with similar studies conducted in Nigeria [5,11,23,36] and elsewhere [19,34]. One key explanation for this observed association is the fact that pregnant women in developing countries are prone to obstetric complications due to poor health infrastructure, high cost of specialized medical services along with sub-optimal clinical practices and lack of essential skills among health personnel required to effectively manage their conditions [3,26]. As a result, it is not uncommon for emergency situations to arise at critical point of care that warrants transfusion of blood. However, in most cases of blood transfusion in such a poorly monitored health care setting, blood screening for infections such as HBV and other blood-borne pathogens are rarely conducted on a routinely basis. This accounts for the often reported association between blood transfusion and higher HBV infection in pregnant women as reported by previous studies in Nigeria and other developing countries [15,35–37]. We also found evidence for the continuing effectiveness of knowledge of HBV sexual transmission as a potent risk reduction tool in the study population. Given the high knowledge of HBV vaccine in the study population, effort to make HBV vaccine accessible and available to this population will provide significant public health gains in terms of impact measures attributable to this exposure and subsequently reduce the transmission and rate of HBV spread.

In conclusion, the observed high prevalence of HBV infection in this study population provides evidence for the high endemicity of HBV infection among pregnant women in south-west Nigeria and the need for urgent intervention effective at a population scale. The evidence in this study shows that the screening of blood and blood products within healthcare facilities remains a topmost public health intervention priority if the gains due to high knowledge of transmission are to be effectively translated to progressive trends in prevention and control.

11. STUDY LIMITATIONS

The cross-sectional study design of the study did not allow for estimate of HBV risk in this high risk population group. Secondly, a sample size of 353 is still relatively small for an accurate estimate and representative estimate of HBV burden (HBsAg-surface antigen) in pregnant women in south-west Nigeria; hence, we consider this an improved estimate relative to previous studies. More so, only ten health facilities were screened which do not give a representative sample for the total health facilities present in the south-western Nigeria. Finally, we only screened for the hepatitis B surface antigen (which provides estimate of existing infection) rather than hepatitis e-antigen (which provide better estimate of recent HBV transmission in the study population and intensity of viral DNA replication).

CONFLICT OF INTEREST

The authors have no conflict of interest to declare.

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