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Original article

Seroprevalence of hepatitis B virus infection (HBsAg) and associated factors among antenatal clinic attendees in a secondary-level facility in southern Ghana

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ABSTRACT

Introduction: Vertical transmission of Hepatitis B Virus (HBV) infection is the predominant mode of HBV transmission in highly endemic settings worldwide where the HBV seroprevalence is above 8%. Newborns who contract HBV at birth have a higher risk of chronic infections that can result in liver cancer and liver cirrhosis. Preventing mother-to-child transmission of HBV through screening of pregnant women during the antenatal period and universal vaccination of newborns are important strategies for eliminating new childhood HBV infections. This study sought to estimate the prevalence of HBV infection among pregnant women in the study area and to determine the factors associated with a positive HBV disease status. The findings from this study will help in obtaining a baseline for comparing future trends and identifying risk factors for HBV that need to be eliminated in southern Ghana.

Methods: This was a cross-sectional hospital-based analytic study in which 225 pregnant women were surveyed using a semi structured questionnaire. Blood samples were taken and analysed qualitatively for HBsAg. The data were entered into Epi-data version 3.1 and exported into STATA version 17 for analysis, with a significance level set at <0.05.

Results: This study revealed that the seroprevalence of HBV infection (HBsAg positivity) was 8.0% CI (5%–12.4%) among the pregnant women. The HBV vaccination coverage was 50.2%. Pregnant women with a history of sexually transmitted diseases were six times more likely to test positive for HBsAg aOR: 6.36 (CI = 0.35–2.92, p = 0.019). Additionally, women who had received at least one dose of the HBV vaccine had lower odds of having HBV infection than did those who failed to vaccinate (aOR = 0.08, 95% CI = 0.01–0.66, P = 0.020).

Conclusions: The *prevalence of* HBV infection is relatively high in this population. HBV vaccination and sexually transmitted infections play significant roles in HBV infection and transmission in the study area. Interventions to promote HBV vaccination among the adult population as well as among newborns and STI prevention strategies are needed to reverse the trend of HBV infections in the study area.

1. Introduction

According to the Centers for Disease Control (CDC) and the World Health Organization (WHO), hepatitis B virus (HBV) infection affects 296–350 million people worldwide, including more than 6 million children under 5 years old. It has also been estimated that the disease resulted in 820 000 fatalities in 2019 alone.[1,2] HBV infection can cause severe and life-threatening complications, which include cirrhosis of the liver and hepatocellular cancer. Estimates available indicate that 25% of chronic HBV infections progress to liver cancer. HBV is efficiently transmitted through perinatal, sexual and parenteral/percutaneous transmission mechanisms.[1]

HBV-infected mothers can pass the infection to their infants across the placenta in utero, during delivery, or postnatally during care or through breast milk.[3] There is enough evidence to show that in the absence of postexposure immunoprophylaxis infants whose mothers have current and active HBV infections (positive for both HBsAg and HBeAg) have a 70%–90% risk of chronic HBV infection by the age of 6

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months.[4,5] Prevention of HBV via MTCT has become an essential step in reducing the burden of chronic HBV infections, especially in highly endemic areas where MTCT contributes largely to the pool of new infections.[6,7] To significantly decrease the MTCT of HBV and achieve global HBV elimination goals, all pregnant women (including those previously tested or vaccinated) should be tested routinely for HBsAg and given the recommended treatment during an early prenatal visit during each pregnancy. In addition, women who were not screened prenatally were tested at the time of admission to the hospital for delivery. The elimination strategy also includes the use of postexposure prophylaxis and universal vaccination of newborns against HBV.[8]

Hepatitis B surface antigen (HBsAg) is the first detectable serological marker of HBV infection. Its presence indicates an acute or chronic infection state, whereas its persistence for 6 months or more suggests chronic infection.[9]

Ghana is highly endemic to HBV,[10] with an estimated prevalence >8% in the general population.[11,12] Few studies have reported prevalence rates >8% among pregnant Ghanaian women.[13–15]

Knowing the current prevalence and risk factors for HBV infection within the study area can serve as a baseline for comparing future trends, assessing progress toward eliminating HBV, and helping plan interventions to prevent the sustenance of HBV infections, especially those resulting from MTCT. In this light, this study was undertaken to determine the seroprevalence of HBV infection (HBsAg seropositivity) and associated factors among pregnant women attending an antenatal clinic at a district hospital in Southern Ghana.

2. Materials and methods

2.1. Design

This was a cross-sectional hospital-based study implemented in the first half of 2023. The study involved pregnant women who attended an antenatal clinic at one of the district hospitals in the Volta Region of Ghana. A cross-sectional design was most appropriate for estimating the prevalence of HBsAg among the study population.

2.2. Study setting

The study site is a secondary-level health facility under the Ghana Health Service with a staff strength of 328 and 8 general practitioners, 2 specialist doctors, 237 nurses and 81 other staff. The facility has a maternity ward with a staff strength of 42. The facility also has an obstetrics and gynecology unit where a range of services, including antenatal, delivery and postnatal care services, are provided for women. Maternal HBV screening is routinely performed at the antenatal clinic for pregnant women, especially during their booking visits. Qualitative detection of HBV serological marker using rapid diagnostic test is the main approach utilized for screening women for HBV unlike the expensive methods such as HBV DNA quantification and HBeAg determination which are used in well-developed healthcare settings.

2.3. Study population

The study population included pregnant women, irrespective of parity and age, who reported to the hospital for antenatal services for the first time (booking visit). Pregnant women who were (a) too sick or weak and could not be interviewed and (b) had received a diagnosis of HBV infection in the past were excluded from the study.

2.4. Sample size estimation

The sample size for this study was determined using the formula for estimation proportions for cross-sectional studies.[16] The estimation was performed based on a 16.7% prevalence of HBsAg positivity among pregnant women in a related study,[17] a margin of error of 5% and a z value of 1.96. Allocation for nonresponse and missing data were duly considered, and in all, a total sample size of 225 was deemed appropriate for this study.

2.5. Participant recruitment and sampling

After applying the inclusion criteria, simple random sampling, specifically the lottery method, was used on the day of data collection to ensure that the pregnant women were eligible for inclusion in the study. The participants were randomly enrolled one after the other until the target sample size was reached.

2.6. Data collection instrument

A pretested questionnaire was used for data collection. The data collection instrument was prepared to answer the research questions, guided by the available literature on pregnancy-related HBV and associated factors. The instrument consisted of various sections, including demographic information (age, level of education, etc.), obstetric history (parity, etc.) behavioural risk factor information (tattoo, multiple sex partners, etc.) and STI history in terms of lifetime infection with Neisseria *gonorrhoeae*, Chlamydia *trachomatis, Trichomonas vaginalis*, *Treponema pallidum* and others were explored. The instrument was evaluated through expert evaluation and pretesting.

2.7. Data collection procedure

Participants were approached as they reported for their antenatal booking visits. The aims of the study were explained to them. The patients were told that the study required blood samples to be taken with a sterile needle for the detection of the serological marker for HBV. The inclusion and exclusion criteria were applied at each instance, and participants who were eligible and demonstrated interest in participating in the study were recruited randomly using the lottery method.

2.8. Sample collection and laboratory testing

We used 5 ml sterile syringes to collect 5 ml of venous blood from all consenting participants under aseptic conditions into ethylenediaminetetraacetic acid. We centrifuged the blood samples at 2200−2500 rpm for 15 min and separated the serum from the other blood components. The serum samples were then stored at 2−4 °C. The hepatitis B Surface Antigen Rapid Test Strip (TestSeaLabs), with a diagnostic accuracy of 99.6% and sensitivity of 93.8%,[18] was used for qualitative detection of the HBV serological marker HBsAg.

Two drops of each serum sample were dropped carefully into the designated wells of the test device. The results were read after 15 min, as we strictly followed all the instructions of the test kit manufacturers.

However, the study site is a secondary-level facility and lacks the necessary equipment, logistics and other resources needed for the detection of HBeAg and HBV DNA in the population. Furthermore, the cost of HBV DNA detection is very high in the country therefore we relied only on the qualitative detection of HBsAg to estimate HBV prevalence in the population. This is in line with the marker detection approach used by earlier researchers in HBV epidemiological research in Ghana.[19]

The focus of this study was to estimate HBV prevalence and associated factors among pregnant women. Therefore HIV testing or serology was not done therefore distribution of HIV cases among the study participants was not estimated as it was outside the scope of this present study.

2.9. Data management and analysis

The data were coded and entered with the statistical tool Epi Data version 4.1. The data were prepared for analysis and exported to STATA

Windows version 17.0. All the variables are described using descriptive statistics, including frequencies, proportions, means and standard deviations where necessary. We performed Pearson's chi-square test or Fisher's exact test to detect associations between HBsAg and sociodemographic and other participant characteristics. We also computed Odds Ratios (ORs) with 95% Confidence Intervals (CIs) through multivariate logistic regression analyses, with the level of significance set at < 0.05.

3. Ethical considerations

Ethical clearance for the study was obtained from the Institutional Review Board of the Ghana Institute of Management and Public Administration (GIMPA) with protocol ID number GM/IRB/09/23. Permission was further obtained from the Sogakope District Health Directorate. The study's nature and purpose were explained to the participants, after which they voluntarily completed the consent forms. Privacy and confidentiality, especially with respect to the participants' HBsAg results, were ensured for all the participants.

4. Results

4.1. Sociodemographic characteristics of the respondents

Table 1 presents the sociodemographic characteristics of the respondents involved in the survey. Majority of the participants (51.2%) of the 225 study participants fall within the 25-age range. Christians were the majority, with 91.1% representation. Almost 33% of the respondents had attained a primary level of education, with only 18.7% attaining a tertiary level of education. A little above half (52.9%) of the respondents were employed. Most of the participants (58.2%) were legally married, and 67.1% of the respondents lived in rented apartments or dwellings. A total of 42.7% of the respondents were primiparous. Table 1.

4.2. Medical, surgical and other personal characteristics of participants

As presented in Table 2. A total of 11.1% had a lifetime blood transfusion. The majority (99.6%) of the respondents had no history of injectable drug use. Additionally, 93.8% had no history of tooth extraction or any dental procedure. A total of 16.5% and 4.9% of the participants had a history of surgical procedure and lifetime STI, respectively. The overall HBV vaccination coverage was 50.2%, which was measured as the receipt of at least one dose of the HBV vaccine. Again, 94.2% of the respondents had never had a tattoo in their lifetime. Less than one-fifth of the study participants (15.1%) had multiple sexual partners. Table 2.

Table 1
Sociodemographic characteristics of the respondents.

Variable	Frequency (n = 225)	Percentage (%)
Age		
21–25	42	18.6
26–35	115	51.2
36–39	46	20.4
40+	22	9.8
Religion		
Christianity	205	91.1
Islam	20	8.9
Educational level		
No formal education	36	16.0
Primary	75	33.3
Secondary	72	32.0
Tertiary	42	18.7
Employment status		
Employed	119	52.9
Unemployed	106	47.1
Marital status		
Single	94	41.8
Married	131	58.2
Residence		
Rented	151	67.1
Self-owned	74	32.9
Parity		
Grand multiparous	41	18.2
Low multiparous	88	39.1
Primiparous	96	42.7

Table 2
Medical, surgical and other personal characteristics of the participants.

Variable	Frequency(n = 225)	Percentage (%)
History of blood transfusion		
No	200	88.9
Yes	25	11.1
History of medical condition		
No	194	86.2
Yes	31	13.8
History of Surgical procedure		
No	188	83.5
Yes	38	16.5
History of tooth extraction		
No	211	93.8
Yes	14	6.2
History of hospital admission		
No	129	57.3
Yes	96	42.7
History of STIs		
No	214	95.1
Yes	11	4.9
Ever done a tattoo in life		
No	212	94.2
Yes	13	5.8
Had multiple sexual partners		
No	191	84.9
Yes	34	15.1
Have received HBV vaccination		
No	112	49.8
Yes	113	50.2

5. Seroprevalence of HBV infection (HBsAg positivity)

Of the 225 pregnant women who were screened, 18 tested positive for HBsAg, with an overall seroprevalence of 8.0% CI (5%–12.4%).

The prevalence of HBV was greater among women who had never been vaccinated against HBV (15.2%) compared to those who had received at least one dose of the HBV vaccine (0.9%). The prevalence of HBV was equally greater in women with a history of STIs (36.4%) compared to those who never had STIs (6.5%). The disease frequency was also greater in patients with a history of blood transfusion and hospital admission with prevalent rates of 20.0% and 15.6%, respectively.

6. Bivariate analysis of HBV and sociodemographic, medical and other characteristics of participants

Table 3 shows the chi-square test and Fisher's exact test results for associations between sociodemographic, medical, and the other characteristics of the study participants and HBsAg positivity. The results show that a history of blood transfusion ($p = 0.019$), a history of hospital admission ($p < 0.001$), a history of STIs ($p = 0.007$) as well as a history of receipt of hepatitis B vaccine ($p = <0.001$) showed statistically significant association with HBsAg positivity.

7. Multivariate analysis of factors associated with HBsAg positivity (HBV infection)

Table 4 shows the results of a multivariate analysis of factors associated with HBsAg positivity. After adjusting for confounders, pregnant women who had a history of STIs were six times more likely to test

Table 3
Bivariate analysis of factors associated with HBV infection.

Variable	Hepatitis B infection		Chi test (p value)/Fisher's exact
	Negative	Positive	
Age			0.350[a]
21–25	36 (85.7)	6 (14.3)	
26–35	107 (93.0)	8(6.96)	
36–39	44 (95.65)	2(4.35)	
40+	20 (90.91)	2(9.09)	
History of blood transfusion			5.5027(0.019)
No	187 (93.5)	13(6.5)	
Yes	20(80.0)	5(20.0)	
History of medical condition			3.2281(0.072)
No	181 (93.3)	13(6.7)	
Yes	26(83.9)	5(16.1)	
History of surgical procedures			(0.507)[a]
No	174 (92.5)	14(7.5)	
Yes	33(89.2)	4(10.8)	
History of tooth extraction			0.090[a]
No	196 (92.9)	15(7.1)	
Yes	11(78.6)	3(21.4)	
History of hospital admission			(<0.001)[a]
No	126 (97.7)	3(2.3)	
Yes	81(84.4)	15 (15.6)	
History of STIs			(0.007)[a]
No	200 (93.5)	14(6.5)	
Yes	7(63.6)	4(36.4)	
Ever done tattoo in life			(0.279)[a]
No	196 (92.5)	16(7.5)	
Yes	11(84.6)	2(15.4)	
Had multiple sexual partners			(0.161)[a]
No	178 (93.2)	13(6.8)	
Yes	29(85.3)	5(14.7)	
Received Hep B vaccine.			(<0.001)[a]
No	95(48.8)	17 (15.2)	
Yes	112 (99.1)	1(0.9)	

[a] Estimate from Fisher's exact test.

positive for HBsAg than pregnant women who had no history of STIs. (aOR = 6.36; CI-1.35–2.92, p = 0.019). Additionally, women who had received at least one dose of the HBV vaccine had lower odds of having HBV infection than did those who failed to vaccinate (aOR = 0.08 95% CI = 0.01–0.66 P = 0.020) (Table 4).

Table 4
Factors associated with HBsAg positivity (HBV infection).

Covariates	cOR (95%CI), p value	aOR (95% CI), p value
Age		
<26 years	1.00	1.00
26–34	0.44(0.15–1.32) 0.231	0.81(0.42–7.73), 0.110
35–39	0.32(0.07–1.45) 0.054	1.58(0.42–5.94), 0.061
36+	0.68(0.14–3.24)0.421	1.55(0.95–44.98),0.233
Received Hep B vaccine		
No	1.00	1.00
Yes	0.05(0.01–0.38), 0.004	0.08(0.01–0.66), 0.020
History of blood transfusion		
No	1.00	1.00
Yes	3.59(1.16–11.12), 0.026	1.99(0.60–6.63), 0.259
History of hospital admission		
No	1.00	1.00
Yes	7.78(2.18–27.71), 0.002	2.56(0.65–10.03), 0.178
History of STIs		
No	1.00	1.00
Yes	8.16(2.13–31.26), 0.002	6.36(1.35–29.92), 0.019

8. Discussion

The study revealed an HBsAg seroprevalence of 8.0% in the southern part of Ghana. These findings, similar to the results from many other studies conducted in Ghana among various populations [12 11], confirmed that Ghana is a country that is highly endemic for HBV, with HBsAg positivity rates ≥8%–20%.[20] These findings are consistent with the high HBsAg positivity rate of 9.5% reported among pregnant Ghanaian women by Ephraim et al. in the Ashanti region.[21] Another study in the Western Region reported a twofold-fold greater incidence of HBV than what this study reported.[17] These estimates clearly show that even though Ghana is considered an endemic country for HBV, there still exists some level of heterogeneity in the distribution of the disease. Anabire et al. (2019) reported a seroprevalence rate of 7.5%, which is slightly lower than the 8.0% reported in our study.[22] This difference could be due to the use of the gold standard of polymerase chain reaction (PCR) for detecting HBsAg compared to the rapid diagnostic test (RDT), which was utilized in our study.

The use of the gold standard for detecting HBsAg provides an accurate estimate of the HBV burden in populations; however, this is not routine practice in many healthcare settings in Ghana and other sub-Saharan African countries, as HBV diagnosis in these resource-poor settings is based largely on results obtained by using rapid diagnostic tests only[23,24]

Again, in Ghana and most resource-poor settings, most primary and secondary healthcare facilities limit HBV diagnosis to the qualitative detection of HBsAg without HBeAg and the quantitative determination of HBV DNA. This is due to the high cost, unavailability of equipment and infrastructure, and lack of resources that constrain the utilization of these high-level tests.[25] However, among women with HBsAg positivity, MTCT is dependent on HBeAg positivity and/or an HBV DNA viral load >200 000 IU/ml.[26] Hence, it is essential to determine the HBeAg status and HBV DNA levels of HBV-infected pregnant women. This can provide better pathways to care for pregnant women and newborns to maximize the interventions outlined for MTCT of HBV. The high seroprevalence rate observed in this study is of concern because, in the absence of effective strategies, MTCT of HBV in this population could produce new infections in newborns, which are associated with a higher risk of chronic disease leading to the perpetuation of HBV infection across generations. This argument holds because preventing MTCT of HBV infection is a cornerstone of efforts to support progress toward the elimination of HBV. According to the current and international guidelines, maternal screening, antiviral therapy during the third trimester for high-risk pregnancies, universal and timely HBV birth dose vaccination, and postexposure prophylaxis with hepatitis B immunoglobulin (HBIG) for selected neonates are the major strategies required to prevent transmission of HBV.[24,25] However, in Africa, HBIG is very expensive and difficult to obtain. Its effectiveness also depends on the effectiveness of the cold chain system[27]; for these reasons, HBV vaccination in individuals in resource-poor settings as well as childhood vaccination with the HBV vaccine have proven effective and are considered largely useful for reducing the HBV burden in highly endemic populations.[28]

The Global Advisory Group of the Expanded Program on Immunization recommended the integration of the hepatitis B vaccine into national immunization systems in all countries with a hepatitis B carrier incidence (HBsAg) of 8% or greater by 1995.[29] Ghana responded to this

call and integrated the hepatitis B vaccine into the expanded programme of immunization in 2002,[30] and it has since been aggressively pursued in line with global targets of reducing new hepatitis infections by 90% and deaths by 65% between 2016 and 2030.

It is worth noting that individuals who were born in Ghana before 2002 did not benefit from the HBV vaccination as part of their childhood immunization program. Some of these individuals may have contracted HBV infection through the MTCT mode or horizontally, later in life and may be the ones now perpetuating HBV infections through MTCT in the population. This approach provides the basis for active HBV surveillance, diagnosis, and treatment of pregnant women infected with HBV and for the use of postexposure prophylaxis and the HBV vaccine for their newborns.

The phenomenon described above was clearly demonstrated in this study, as the frequency of HBV infection was greater among pregnant women who never received HBV vaccination (15.2%) than among those who were vaccinated (0.9%). The study equally revealed that the odds of HBV infection were far lower in the vaccinated group than in the group of pregnant women who had never been vaccinated against HBV (aOR = 0.08 95% CI = 0.01–0.66 P = 0.020).

In addition, at least 50.2% of the study participants received at least one dose of the HBV vaccine. Therefore, the high prevalence of HBV in this study could be attributed to the low uptake of HBV vaccination among the participants. In Ghana, HBV vaccination for the general adult population is not mandatory, is not part of the routine health services provided and is not covered by the social health insurance scheme, which is largely used in the country. The high cost of obtaining three doses of the vaccine coupled with poor awareness of the benefits of the vaccine could possibly be contributing to low vaccination rates among Ghanaian adults.

In the present study, a history of Sexually Transmitted Infections (STIs) was another factor that was significantly associated with HBsAg positivity (HBV infection); pregnant women who were diagnosed with at least one STI in the past had 6-fold greater odds of being infected with HBV. This observation is not new. Many studies have reported a significant association between HBV infection and STIs. This is because the HBV load is very high in semen and vaginal secretions. The higher prevalence of STIs in HBs Ag-positive pregnant women emphasizes that these infections share the same mode of contamination. Second, it is also known that having an STI increases a person's risk of contracting HBV and even human immunodeficiency virus (HIV) for both biological and behavioural reasons. STIs such as syphilis gonorrhoea and many others cause may produce physical changes, especially in the reproductive tracts of affected individuals, and therefore increase the accessibility or entry of HBV into vulnerable cells and tissues of the body. For these two reasons, it is not surprising that pregnant women who had received a diagnosis of STIs in the past had higher odds of being infected with HBV in this study.

9. Conclusion

The study revealed a high prevalence of HBV among pregnant women in Southern Ghana, and this estimate maintains Ghana, and specifically, the study area, within the highly endemic HBV transmission zone. As expected, HBV vaccination reduced the odds of HBV infection in the study population such that a greater disease frequency was observed in the unvaccinated group than in their vaccinated counterparts. The study also revealed that a lifetime diagnosis of sexually transmitted infection has a role in the current HBV status of the participants, as the two infections share similar modes of transmission.

It appears women who are not vaccinated against HBV may be the ones perpetuating HBV spread through vertical transmission (MTCT) in Southern Ghana. Therefore, to achieve the goals of HBV elimination in the study setting, additional pregnant women should be screened and treated with the recommended antivirals in addition to the implementation of the famous universal HBV vaccination of newborns at birth.

Study limitations

The authors were unable to estimate HBV prevalence using PCR techniques which is considered the gold standard for diagnosing HBV infection. However, the RDT used for the qualitative detection of HBsAg in this study has a high diagnostic accuracy and validity.

The study design and focus did not permit the testing of women for HIV and therefore the prevalence of HBV in HIV infected women in the study population could not be estimated.

Ethics statement

Ethical Clearance for the study was obtained from Institutional Review Board of The Ghana Institute of Management and Public Administration (GIMPA) with protocol ID number GM/IRB/09/23. Permission was further obtained from the Sogakope District Health Directorate. The study's nature and purpose were explained to participants, and thereafter, they voluntarily completed consent forms.

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Author contribution statement

E.A Conceptualization, Methodology, Data collection, Data Analysis. Writing, Original draft preparation of manuscript. *S*-D V.E, Methodology, Supervision, Writing, Original draft preparation of manuscript.

Declaration of competing interest

All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

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