

Determinants of Hepatitis B Viral Infection among Pregnant Women in Greater Monrovia, Liberia

Henry Torbandu Kohar¹, George Asumah Adu^{2*}, Henry Ofori Addo³, Edwin Afari¹, Ernest Kenu¹ and Frederick Wurapa¹

¹Department of Epidemiology and Disease Control, School Public Health, University of Ghana, Accra, Ghana

²National Malaria Elimination Programme, Public Health Division, Ghana Health Service, Accra, Ghana

³Department of Animal Biology and Conservation Science, College of Basic and Applied Sciences, University of Ghana

Corresponding Author

George Asumah Adu, National Malaria Elimination Programme, Public Health Division, Ghana Health Service, Accra, Ghana.

Submitted: 2024, Apr 25; Accepted: 2024, May 17; Published: 2024, Aug 26

Citation: Kohar, H. T., Adu, G. A., Addo, H. O., Afari, E., Kenu, E. et al. (2024). Determinants of Hepatitis B Viral Infection among Pregnant Women in Greater Monrovia, Liberia. *J Emerg Med OA*, 2(1), 01-08.

Abstract

Background: The global prevalence of hepatitis B virus infection is estimated to affect over 2 billion individuals, with a notable proportion ranging from 6% to 25% residing in the Sub-Saharan African region. The prevalence of hepatitis B virus (HBV) in Liberia, Guinea, and Sierra Leone has been estimated to be approximately 2%. However, current understanding of the actual risk factors associated with HBV in the Greater Monrovia remains unclear. Consequently, this study aimed to identify the factors associated with hepatitis B viral infection among pregnant women residing in Greater Monrovia, Liberia.

Methods: An unmatched case control study of 141 cases of HBV infected pregnant women and 141 controls was conducted. Data on socio-demographic characteristics, lifestyle activities and medical related risk factors were collected for both groups with a structured questionnaire. Bivariate and multivariate analyses established associations between the HBV infection and risk factors studied.

Results: In all, 141 cases of HBV infected pregnant women and 141 controls participated in this study. The mean age of cases was 35.6 years ($SD \pm 9.5$) and 36.1 years ($SD \pm 8.4$) for controls. Low-income level <100 dollars [aOR 13.0 (4.48-37.82, $p < 0.001$)], employment [aOR 0.04 (0.09-0.18) $p < 0.001$], STI history [aOR 5.19 (1.68-16.02, $p = 0.004$)] and living with a HBV infected person [aOR 35.11 (4.24-58.90), $p = 0.001$] were factors associated with HBV infection among pregnant women in Greater Monrovia.

Conclusion: The risk factors of HBV infection among pregnant women in Greater Monrovia were engagement in formal employment, low-income level, history of sexually transmitted infections (STIs), and residing with an individual infected with hepatitis B virus (HBV). Control efforts by designated state institutions should include advocacy and awareness creation on HBV status identification, safe sex, and vaccination of uninfected individuals.

Keywords: Case Control Study, Greater Monrovia, Hepatitis B, Liberia, Risk Factors

1. Introduction

Hepatitis B (HBV) is a viral infection that targets the liver and has the ability of causing both acute and chronic illnesses. According to the World Health Organization in 2019, hepatitis B infection accounted for around 820,000 fatalities, primarily attributed to cirrhosis and hepatocellular carcinoma, which is a kind of primary liver cancer [1,2]. The transmission of the virus typically occurs through vertical transmission from mother to child (MTCT) during the process of childbirth, during early infancy, and through contact

with blood or other bodily fluids during sexual intercourse with an infected partner, injections, or exposure to contaminated sharp tools [3,4]. Hepatitis B viral infection is of public health concern [1,5]. The prevalence of chronic infections was estimated to be at 296 million individuals in 2019, with an annual incidence of 1.5 million new infections [6,7]. Amongst these cases, it was observed that 68% resided in Africa and Western Pacific Asia [8,9]. Moreover, it has been reported that a significant proportion, ranging from 5% to 15% of individuals residing in underdeveloped

nations and countries with low income are persistently infected with the hepatitis B virus [10,11]. In addition, the World Health Organization (WHO) reveals that hepatitis accounted for 1.34 million fatalities in 2015, a figure comparable to tuberculosis-related deaths but exceeding those attributed to HIV [12]. Furthermore, a substantial number of children under the age of five, specifically 1.8 million, are currently afflicted with hepatitis B virus infection due to the high prices of HBV vaccine [13,14].

Hepatitis B Virus disease is more prevalent in Sub-Saharan Africa; about 6 to 25 percent Sub Saharan Africans are infected with the disease [15,16]. Greater Monrovia region and Liberia has a prevalence of about 2% [17]. HBV among pregnant women poses a lot of threats to mother and fetus, leading to complications such as preterm delivery, low birth weight, threatened post-partum hemorrhage and other associated complications. It is estimated that up to 40% of Hepatitis B virus prevalence can be attributed to mother to child transmission, and the core factor for chronic HBV infection [18,19]. Several studies have associated HBV infections to history of multiple sexual partners, previous blood transfusions, caring or living with HBV positive family member, tattooing, illicit drug use, accidental pricking with sharps and having unsafe abortions among others [20,21]. Presently, knowledge about the key risk factors is limited in Greater Monrovia and Liberia, therefore, this disease has not gained full national commitment and support from the Ministry of Health and other developing partners in Liberia. Greater Monrovia, being a business region, has a lot

of its inhabitants constantly engaging in many risky behaviors which could expose them to the disease. Hence, this study sought to explore factors associated with HBV infection among pregnant women in Greater Monrovia to improve knowledge for enhanced control efforts.

2. Methods

2.1 Study Design

This study adopted an unmatched case-control study using quantitative research methods and was implemented between August 2016 to July 2017, which included period of protocol development and submission for Ethics/IRB approval. Actual data collection to this study occurred from 1st March and 5th May 2017. Data on Hepatitis B serum Agglutination (HbsAg) test results of both cases and controls as well as data on socio-demographic, previous medical exposures and lifestyle factors were collected from participants in diverse locations as deemed appropriate and convenient by participants.

2.2 Study Area

This study was conducted in Greater Monrovia, the capital and commercial city of Liberia. Greater Monrovia comprises all the ethnic groups in Liberia and has a population of 1.5 million (Figure 1). It is bordered to the south by the Atlantic Ocean, the North by Paynesville, to the east by the Duazon community and to the west by Bushrod Island (Figure 1).



Figure 1: Map of Study Area

2.3 Study Population

This study involved pregnant women between the ages of 18-50 years registered at an Antenatal Clinic (ANC) in Greater Monrovia between the period of January 2015 to March 2017.

2.4 Case Definitions

• **Case:** A case was defined as an ANC registrant between the ages of 18-50 years, who resided in Greater Monrovia and attended ANC from January 2015–March 2017 and tested positive to HbsAg test.

• **Control:** A control is defined as an ANC registrant between the ages of 18-50 years, who resided in Greater Monrovia and attended ANC from January 2015–March 2017 and tested negative to HbsAg test.

2.5 Sample size Determination

To estimate the sample size for this study, a stat calculator in Epi info version 7 was used. It was assumed that 20% of the study population are exposed to the risk factors of HBV infection [22]. A detection of an odds ratio of 2.5 with an 80% power is to be achieved with a 95% confidence level (5% significance). A ratio of

1:1 case and control was used and since the prevalence of several of the known risk factors for HBV, is unavailable for Liberia, the figure used as the least exposure prevalence was multiple sexual contacts which was derived from by a study conducted by [23]. A total of 141 cases and 141 controls was derived and used for this study.

2.6 Sampling Procedure

A multi-staged sampling was applied to select participants for this study. First of all, health facilities that provide ANC services were grouped into three based on facility ownership as follows: private, public and faith-based facilities. Table of random numbers was employed to select one facility from each group of facilities. The sampled facilities were John F. Kennedy Medical Centre for private hospitals, Eternal Love Winning Africa (ELWA) and James N. Davis (JFD) for the Faith-based and Government hospitals respectively. Based on proportional to size sampling, 40% of the sample size (56 cases and corresponding controls) were drawn from the John F. Kennedy Memorial Hospital accounted for approximately, ELWA also accounted for 30% (43 cases and corresponding controls), and a government hospital, and James N. Davis (JFD) contributed approximately 30% (42 cases and corresponding controls). A line list of pregnant women who tested positive for the HbsAg test from a period spanning January 2015 to March 2017 was generated from Antenatal Care registration records. Finally, a table of random numbers was used to select respondents for the study. Same procedure was applied to the selection of controls in this study.

2.7 Data Collection

Between 1st March and 5th May, 2017, a semi-structured questionnaire consisting of questions on demographic characteristics, lifestyle and some previous medical exposures was administered face to face to the participants in their preferred places or via telephone in few instances where physical interviews

was not possible. The questionnaire was pretested at Redemption Hospital in Greater Monrovia for reliability and efficiency before actual data was collected. The questionnaire was administered in English language as it is the official main language of communication of people in Monrovia. Help was also sought from an interpreter where participant speaks different tongue.

2.8 Data Analysis

The raw data was inputted into Microsoft Excel spreadsheet (version 2010) and analyzed using Stata 13.0 software. Data was summarized as frequencies, proportions, means and medians where appropriate. Logistic regression analysis at p-value (<0.05) significance level was used to assess association between the risk factors associated with HBV infection.

2.9 Ethical Consideration

This study received ethical approval from the University of Liberia – Pacific Institute for Research & Evaluation Institutional Review Board (UL-PIRE IRB Assurance number FWA00004982). Formal permission was sought from the heads of John F. Kennedy Memorial Hospital, Eternal Love Winning Africa (ELWA) and James N. Davis Memorial Hospital. Written consent was obtained from all study participants before interviews were carried out. Study participants were made to understand their participation in the study was voluntary and could opt out of the study should they feel uncomfortable at any point in the study.

3. Results

3.1 Socio- Demographic Characteristics of Pregnant Women, Monrovia in Liberia, 2017

The mean age of cases was 35.6 years (SD ±9.5) and 36.1 years (SD ±8.4) for controls. More than a third of cases 39.0% (55/141) and controls 34.8% (49/141) had no formal education. Concerning employment, 5.0% (7/141) of cases compared with 21.3% (30/141) of controls were employed in the formal sector (Table 1).

Variables	Cases	Frequency (%)	Control	Frequency (%)
Age (Mean)	35.6 (SD ±9.5)		36.1 (SD ±8.4)	
Educational status				
No Formal education	55	39.0	49	34.8
Primary/JHS	26	18.4	27	19.1
Secondary	45	32.0	51	36.2
Tertiary	15	10.6	14	9.9
Employment				
Formal Sector	7	5.0	30	21.3
Informal Sector	127	90.0	100	70.9
Unemployed	7	5.0	11	8.0
Marital Status				
Married	113	80.1	101	71.6
Single	28	19.9	40	28.4

Table 1: Socio-Demographic Characteristics of Participants

3.2 Socio-Demographic Characteristics and Medical Risk Factors Associated with Hepatitis B Viral Infection

At crude level, earning an income of <100USD [cOR 6.32 (3.29-12.54), P<0.001], having undergone major surgical procedure [cOR=4.71 (2.16-11.07) P<0.00], ever been diagnosed of an STI

[cOR=4.7 (2.16-11.07) P=0.020] and having a history of abortion [cOR= 3.44 (1.42-9.18), P=0.003] increased the odds of HBV infection. On the other hand, been engaged in a formal sector employment [cOR= 0.19 (0.08-0.43), P<0.001] reduced the odds of HBV infection in this study (Table 2).

Hepatitis B Disease				
	Cases	Controls	cOR (95% CI)	P value
Age of PW				
≥ 30 years	89 (63.1)	102 (72.3)	0.66 (0.38-1.12)	0.10
< 30 years	52 (36.9)	39 (27.7)	1.0	
Marital Status of PW				
Single	28(19.9)	40 (28.4)	0.63 (0.35-1.13)	0.10
Married	113 (80.1)	101 (71.6)	1.0	
Education of PW				
≥SHS	60 (42.6)	65 (46.1)	0.87 (0.52-1.42)	0.55
<SHS	81(57.4)	76 (53.9)	1.0	
Employment status of PW				
Formal Sector	7 (6.0)	30 (23.0)	0.19 (0.08-0.43)	<0.000
Informal Sector	127 (94.0)	100 (77.0)	1.0	
Income level of PW				
<100USD	62(44.9)	16 (11.4)	6.32 (3.29-12.54)	<0.000
≥100USD	76 (55.1)	124 (88.6)	1.0	
Blood History of Blood transfusion				
Yes	70 (50.4)	64 (45.4)	1.22 (0.74-1.0)	0.41
No	69 (49.6)	77 (54.6)	1.0	
Major surgical procedure				
Yes	37(26.4)	10 (7.1)	4.71 (2.16-11.07)	<0.000
No	103 (73.6)	131 (92.9)	1.0	
Ever diagnosed an STI no data for this				
Yes	72(53.2)	52(37.0)	1.79 (1.08-2.98)	0.020
No	67(46.8)	87(63.0)	1.0	
Ever done Abortion				
Yes	24 (17.3)	8 (5.7)	3.44 (1.42-9.18)	0.003
8 (5.7)	115 (82.7)	132 (94.3)	1.0	

Table 2: Bivariate Analysis of Socio-Demographic and Medical Characteristics of Pregnant Women in Greater Monori Liberia

3.3 Lifestyle Risk Factors Associated with HBV Infection

Participants who had body tattoo and/or piercing [cOR= 2.46 (1.45-4.19), P=0.004], having multiple sexual partners [cOR=17.06 (2.52-75.0), p<0.001], having ever lived with HBV infected person [cOR 17.31 (5.48-67.79), P<0.001] and use of illicit drugs increased the odds of HBV infection (Table 3).

Hepatitis B Disease				
	Cases	Controls	cOR (95% CI)	P value
Tattoo & Body piercing				
Yes	72 (47.8)	108 (72.9)	2.46 (1.45-4.19)	0.004
No	66 (52.2)	38 (27.1)	1.0	
Multiple sexual partners				
Yes	102(87.2)	116 (99.1)	17.06 (2.52-75.0)	<0.001
No	15 (12.8)	1 (0.9)	1.0	
Penno-anal sex history				
Yes	124(96.1)	140 (99.3)	5.65 (0.62-268.8)	0.078
No	5 (3.9)	1 (0.7)	1.0	
Living with HBV infected person				
Yes	93 (66.4)	137 (97.2)	17.31 (5.98-67.79)	0.000
No	47 (33.6)	4 (2.8)	1.0	
Illicit drug use				
Yes	104 (74.8)	128 (90.8)	3.31 (1.607.17)	0.004
No	35 (25.2)	13 (9.2)	1.0	

Table 3: Lifestyle Characteristics of Pregnant Women and its Association with HBV Infection

3.4 Factors Associated with HBV among Pregnant Women, Greater Moronvia, 2017

After adjusting for confounders, employment status, income level, history of STI and living with an HBV infected person remained significantly associated with HBV infection. Pregnant women who earned less than USD 100 showed higher odds [aOR=13.0 (4.48-37.82, p< 0.001)] of HBV infection than those who earned ≥USD 100. Pregnant women who were employed in the formal sector

had a lower odd [aOR=0.04 (0.09-0.179), p-value <0.001] of HBV infections than those who were employed in the informal sector. Regarding STIs, pregnant women who reported history of STI had higher odds [aOR=5.19 (1.68-16.02), p= 0.004] of been diagnosed HBV positive than those who had no STI history. Also, having a history of living with an HBV infected person rendered pregnant women more prone [aOR=35.11 (4.24-58.9), p=0.001] to HBV infection than those with no history (Table 4).

Variable	HBV diseases		Adjusted Odd ratio	
	Cases	Controls	(95%CI)	P value
Income level of PW				
<0.001				
<100USD	76 (55.07)	124 (85.71)	13.0 (4.48-37.82)	
≥100USD	62(44.93)	16 (14.29)	1.0	
Employment status of PW				
Unemployed	132 (93.61)	104 (73.76)	0.04 (0.09-0.179)	<0.001
Employed	9 (6.39)	37 (26.24)	1.0	
Major surgical procedure				
Yes	103 (73.57)	131 (92.91)	4.06 (0.731-22.59)	0.109
No	37(26.43)	10 (7.09)	1.0	
Illicit drug use				
Yes	104 (74.83)	128 (90.78)	4.02 (0.39-40.44)	0.237
No	35 (25.17)	13 (9.22)	1.0	
Tattoo & Body piercing				
Yes	72 (47.82)	108 (73.98)	0.86 (0.24-2.14)	0.535
No	66 (52.18)	38 (26.02)	1.0	

Multiple sexual partners				
Yes	102(87.18)	116 (99.15)	2.81 (0.22-35.55)	0.425
No	15 (12.82)	1 (0.85)	1.0	
Living with HBV infected person				
Yes	93 (66.42)	137 (97.17)	35.11 (4.24-58.9)	<0.001
No	47 (33.58)	4 (2.83)	1.0	
Ever diagnosed an STI				
Yes	75(53.2)	52(37.0)	5.19 (1.68-16.02)	0.004
No	66(46.8)	87(63.0)	1.0	

Table 4: Multivariate Analysis of Determinants and its Association with HBV among Pregnant Women

4. Discussion

Hepatitis B virus infection is one of the world's leading public health challenges, causing significant morbidity and mortality [24]. A newborn infant whose mother is positive for both HBsAg and HBeAg has a 90% chance of developing chronic infection by the age of 6 [24]. Hepatitis B virus infection among pregnant women pose a serious public threat to both mother and baby and must be given the needed attention. It is on this premise that this study sought to determine factors associated with Hepatitis B Virus infection among pregnant women of Greater Monrovia. This study found an association between Hepatitis B virus infection and factors including informal sector employment, low-income status, having a history of Sexually Transmitted Infections (STIs), and living with a Hepatitis B Virus infected person.

4.1 Socio-Demographic Factors and Medical History

Current study indicates reduced odds of contracting HBV among pregnant women who were in the formal sector employment than those who were in the informal sector employment. This can be attributed to their improved economic and educational status leading to increased knowledge and awareness of HBV as well as having access to good medical care. Present findings agrees to a study conducted in Ethiopia as pregnant women who were unemployed were 8 times at risk of HBV infection than those who were employed [25]. A recent study on the knowledge of hepatitis B virus among pregnant women in the Ningo-Prampram District in Ghana found a strong association between educational level and positivity to hepatitis b virus [26]. This study also found an association between income status and HBV, as participants who earn <100USD had higher odds of developing HBV infection than those who earn ≥100USD. This agrees with a study conducted in Brazil which indicates a higher prevalence of HPV infection among individuals of lower socioeconomic status [27]. Another study in Japan also confirms association between socioeconomic status and hepatitis B virus prevalence [28]. Additionally, pregnant women who reported ever having sexually transmitted infection were more likely to be HBV infected than those who had never had any STIs.

4.2 Lifestyle Factors Associated with HBV Infection

The investigation delved into lifestyle-related factors, elucidating their association with HBV infection. Living with a Hepatitis B

infected person was significantly associated with HBV infection among pregnant women in in this study. The virus can spread through contact with infected body fluids such as blood, saliva, vaginal fluids, and semen. Living with an infected person exposes you to these fluids thereby increasing risk of transmission. This concurs with many recent findings [24,26]. A study conducted by Freitas et al. (2014) in Central Brazil also observed that pregnant women who resided with or had previous exposure to an individual infected with Hepatitis B had a higher likelihood of acquiring HBV infection compared to those who had no history of living with a Hepatitis B-infected individual. It is evident that pregnant women who had previously resided with an individual infected with Hepatitis B exhibited increased likelihood of being diagnosed as HBV positive, in comparison to those who had never cohabitated with a Hepatitis B infected individual [30,31]. Another study conducted in Northwestern Ethiopia Molla et al. (2015) validates the findings of current study as it also observed that pregnant women who had previously resided or were now residing with an individual infected with Hepatitis B exhibited a greater likelihood of experiencing adverse outcomes related to HBV compared to pregnant women who had never cohabited with a Hepatitis B infected individual. Another study in Tanzania also reported similar findings [33].

5. Conclusion

This study provides valuable insights into the complex interrelationships between socio-demographic, medical, and lifestyle factors influencing HBV infection among pregnant women in Greater Monrovia, Liberia. The study found that several risk factors significantly associated with Hepatitis B infection among pregnant women who registered for antenatal care in Greater Monrovia. These factors included having formal employment, having a low-income level, having a history of sexually transmitted infections, and living with a person infected with Hepatitis B virus. The multifactorial nature of HBV transmission underscores the importance of tailored interventions focusing on education, healthcare accessibility, behavioural modifications, and targeted screening programs to mitigate the burden of HBV among this vulnerable population. The Ministry of Health of Liberia and developing partners must enhance interventions aimed at preventing and controlling sexually transmitted infections (STIs), including initiatives focused on creating awareness on STI

prevention and control as well as promoting HBV vaccination among uninfected individuals.

Acknowledgment

The authors would like to thank all the health facilities and participants who availed themselves for this study.

References

1. Matthews, P. C., Maponga, T., Ghosh, I., Lemoine, M., Ocama, P., Abubakar, I., ... & Flanagan, S. (2022). Hepatitis B virus: infection, liver disease, carcinogen or syndemic threat? remodelling the clinical and public health response. *PLoS Global Public Health*, 2(12), e0001359.
2. Ajuwon, B. I., Yujuico, I., Roper, K., Richardson, A., Sheel, M., & Lidbury, B. A. (2021). Hepatitis B virus infection in Nigeria: a systematic review and meta-analysis of data published between 2010 and 2019. *BMC infectious diseases*, 21, 1-15.
3. Amin, O., Powers, J., Bricker, K. M., & Chahroudi, A. (2021). Understanding viral and immune interplay during vertical transmission of HIV: implications for cure. *Frontiers in Immunology*, 12, 757400.
4. Centers for Disease Control and Prevention. Prevention of Hepatitis B Virus Infection in the United States: Recommendations of the Advisory Committee on Immunization Practices. Vol. 67, Morbidity and Mortality Weekly Report. 2018.
5. Sanai, F., Alkhatry, M., Alzanbagi, A., & Kumar, S. (2023). Hepatitis B virus infection in Saudi Arabia and the UAE: public health challenges and their remedial measures. *Journal of Infection and Public Health*.
6. Efua, S. D. V., Adwoa, W. D., & Armah, D. (2023). Seroprevalence of Hepatitis B virus infection and associated factors among health care workers in Southern Ghana. *IJID regions*, 6, 84-89.
7. Yendewa, G. A., Wang, G. M., James, P. B., Massaquoi, S. P., Yendewa, S. A., Ghazawi, M., ... & Salata, R. A. (2023). Prevalence of chronic hepatitis B virus infection in Sierra Leone, 1997–2022: a systematic review and meta-analysis. *The American Journal of Tropical Medicine and Hygiene*, 109(1), 105.
8. Kilonzo, S. B., Gunda, D. W., Mpondo, B. C., Bakshi, F. A., & Jaka, H. (2018). Hepatitis B virus infection in Tanzania: current status and challenges. *Journal of tropical medicine*, 2018.
9. Maamor, N. H., Muhamad, N. A., Mohd Dali, N. S., Abdul Mutalip, M. H., Leman, F. N., Aris, T., ... & Abu Hassan, M. R. (2022). Seroprevalence of hepatitis B among healthcare workers in Asia and Africa and its association with their knowledge and awareness: a systematic review and meta-analysis. *Frontiers in Public Health*, 10, 859350.
10. Abbas, Z., & Siddiqui, A. R. (2011). Management of hepatitis B in developing countries. *World Journal of Hepatology*, 3(12), 292.
11. Ofori-Asenso, R., & Agyeman, A. A. (2016). Hepatitis B in Ghana: a systematic review & meta-analysis of prevalence studies (1995-2015). *BMC infectious diseases*, 16, 1-15.
12. World Health Organization. (2018). Global hepatitis report 2017: web annex A: estimations of worldwide prevalence of chronic hepatitis B virus infection: a systematic review of data published between 1965 and 2017.
13. Adam, A., & Fusheini, A. (2020). Knowledge, risk of infection, and vaccination status of hepatitis B virus among rural high school students in Nanumba North and South Districts of Ghana. *PloS one*, 15(4), e0231930.
14. Razavi, H. (2020). Global epidemiology of viral hepatitis. *Gastroenterol Clin North Am*, 49(2), 179-189.
15. Spearman, C. W., Afihene, M., Ally, R., Apica, B., Awuku, Y., Cunha, L., ... & Sonderup, M. W. (2017). Hepatitis B in sub-Saharan Africa: strategies to achieve the 2030 elimination targets. *The lancet gastroenterology & hepatology*, 2(12), 900-909.
16. Vueba, A. N., Almendra, R., Santana, P., Faria, C., & do Céu Sousa, M. (2021). Prevalence of HIV and hepatitis B virus among pregnant women in Luanda (Angola): geospatial distribution and its association with socio-demographic and clinical-obstetric determinants. *Virology Journal*, 18, 1-11.
17. Te, H. S., & Jensen, D. M. (2010). Epidemiology of hepatitis B and C viruses: a global overview. *Clinics in liver disease*, 14(1), 1-21.
18. Veronese, P., Dodi, I., Esposito, S., & Indolfi, G. (2021). Prevention of vertical transmission of hepatitis B virus infection. *World Journal of Gastroenterology*, 27(26), 4182.
19. Kirbak, A. L. S., Omolo, J., Idris, H., Usman, A., & Mbabazi, W. B. (2017). Sero-prevalence for Hepatitis B virus among pregnant women attending antenatal clinic in Juba Teaching Hospital, Republic of South Sudan. *The Pan African Medical Journal*, 26.
20. Fergusson, D. M., Boden, J. M., & Horwood, L. J. (2008). Exposure to childhood sexual and physical abuse and adjustment in early adulthood. *Child abuse & neglect*, 32(6), 607-619.
21. Harvala, H., Reynolds, C., Gibney, Z., Derrick, J., Ijaz, S., Davison, K. L., & Brailsford, S. (2021). Hepatitis B infections among blood donors in England between 2009 and 2018: Is an occult hepatitis B infection a risk for blood safety?. *Transfusion*, 61(8), 2402-2413.
22. El-Serag, H. B. (2012). Epidemiology of viral hepatitis and hepatocellular carcinoma. *Gastroenterology*, 142(6), 1264-1273.
23. Scorgie, F., Chersich, M. F., Ntaganira, I., Gerbase, A., Lule, F., & Lo, Y. R. (2012). Socio-demographic characteristics and behavioral risk factors of female sex workers in sub-saharan Africa: a systematic review. *AIDS and Behavior*, 16, 920-933.
24. Umer, A., Teklemariam, Z., Ayele, F., & Mengesha, M. M. (2023). Prevalence of hepatitis B infection and its associated factors among pregnant mothers attending antenatal care at public hospitals at Hararghe, Eastern Ethiopia. *Frontiers in Global Women's Health*, 4, 1056488.
25. Tanga, A. T., Teshome, M. A., Hiko, D., Fikru, C., & Jilo, G.

-
- K. (2019). Sero-prevalence of hepatitis B virus and associated factors among pregnant women in Gambella hospital, South Western Ethiopia: facility based cross-sectional study. *BMC infectious diseases*, *19*, 1-7.
26. Kwadzokpui, P. K., Akorsu, E. E., Abaka-Yawson, A., Quarshie, S. S., Amankwah, S. A., & Tawiah, P. A. (2020). Prevalence and knowledge of hepatitis B virus infection among pregnant women in the Ningo-Prampram District, Ghana. *International journal of hepatology*, *2020*.
27. Kops, N. L., Horvath, J. D., Bessel, M., Souza, F. M., Benzaken, A. S., Pereira, G. F., ... & Wendland, E. M. (2021). The impact of socioeconomic status on HPV infection among young Brazilians in a nationwide multicenter study. *Preventive Medicine Reports*, *21*, 101301.
28. Okui, T., & Nakashima, N. (2022). Analysis of the association between areal socioeconomic deprivation levels and viral hepatitis B and C infections in Japanese municipalities. *BMC Public Health*, *22*(1), 681.
29. Freitas, S. Z., Soares, C. C., Tanaka, T. S. O., Lindenberg, A. S. C., Teles, S. A., Torres, M. S., ... & Motta-Castro, A. R. C. (2014). Prevalence, risk factors and genotypes of hepatitis B infection among HIV-infected patients in the State of MS, Central Brazil. *Brazilian journal of infectious diseases*, *18*, 473-480.
30. Ezechi, O. C., Kalejaiye, O. O., Gab-Okafor, C. V., Oladele, D. A., Oke, B. O., Musa, Z. A., ... & Ujah, I. A. (2014). Sero-prevalence and factors associated with Hepatitis B and C co-infection in pregnant Nigerian women living with HIV Infection. *Pan African Medical Journal*, *17*(1).
31. Sirilert, S., & Tongsong, T. (2021). Hepatitis B virus infection in pregnancy: immunological response, natural course and pregnancy outcomes. *Journal of Clinical Medicine*, *10*(13), 2926.
32. Molla, S., Munshea, A., & Nibret, E. (2015). Seroprevalence of hepatitis B surface antigen and anti HCV antibody and its associated risk factors among pregnant women attending maternity ward of Felege Hiwot Referral Hospital, northwest Ethiopia: a cross-sectional study. *Virology journal*, *12*, 1-9.
33. Geffert, K., Maponga, T. G., Henerico, S., Preiser, W., Mongella, S., Stich, A., ... & Kasang, C. (2020). Prevalence of chronic HBV infection in pregnant woman attending antenatal care in a tertiary hospital in Mwanza, Tanzania: a cross-sectional study. *BMC infectious diseases*, *20*, 1-10.

Copyright: ©2024 George Asumah Adu, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.