



## SEROLOGICAL PREVALENCE OF HEPATITIS B VIRUS AMONG PATIENTS ATTENDING O. B. LULU BRIGGS HEALTH CENTRE IN PORT HARCOURT, RIVERS STATE, NIGERIA.

Okonko IO, Ejukwu C, Okonko BJ, Baeka GB

<sup>1</sup>Virus & Genomics Research Unit, Department of Microbiology, University of Port Harcourt, Port Harcourt, Nigeria

<sup>2</sup>Virology & Immunology Research Unit, Department of Applied Microbiology, Ebonyi State University, Abakaliki, Nigeria

<sup>3</sup>Virology Research Unit, Department of Microbiology, Rivers State University, Nkpolu Oroworukwo, mile 3, Port Harcourt, Nigeria

E-mail: [iheanyi.okonko@uniport.edu.ng](mailto:iheanyi.okonko@uniport.edu.ng); Tel: +2347069697309

**ABSTRACT:** Nigeria has one of the greatest disease burdens from chronic viral hepatitis. Thus, this study aimed to investigate the prevalence of HBV infection amongst patients attending Lulu Briggs Health Centre, University of Port Harcourt, Nigeria and its associated factors among patients. Serum samples from 100 participants were screened for a serological marker of HBV infection (HBsAg) by Monolisa HBsAg ULTRA enzyme-linked immunosorbent assay (ELISA) kit (manufactured by BIO-RAD Laboratories, California, United States) following the manufacturer's guidelines. Of the 100 patients tested, 8.0% were positive for HBsAg. A higher prevalence of HBV occurred in males (12.2%), age groups 21-40 years (13.5%), the married (16.7%), graduates (21.4%), and civil/public servants/lecturers (33.3%). From the results, the prevalence of HBV among these patients is moderate (8.0%), which indicates a rise in the study area. The findings of this study confirm the findings of other studies that HBV is endemic in Nigeria. This study adds important granularity to our understanding of hepatitis endemicity. For a more accurate description of HBV prevalence, large cross-sectional studies are required.

[Okonko IO, Ejukwu C, Okonko BJ, Baeka GB. **Serological Prevalence of Hepatitis B Virus Among Patients Attending O. B. Lulu Briggs Health Centre in Port Harcourt, Rivers State, Nigeria.** *Academ Arena* 2023;15(2):1-9]. ISSN 1553-992X (print); ISSN 2158-771X (online). <http://www.sciencepub.net/academia>. 01. doi:[10.7537/marsaaj150323.01](https://doi.org/10.7537/marsaaj150323.01).

**Keywords:** HBsAg, Patients, Prevalence, Nigeria

### INTRODUCTION

Chronic viral hepatitis is one of the highest disease loads in Nigeria (Cookey et al., 2022; Okonko et al., 2022). Hepatitis B virus (HBV) is responsible for approximately 96% of viral hepatitis deaths worldwide (Cooke et al., 2019; Flower et al., 2022), however, the incidence of these illnesses is poorly documented (Flower et al., 2022). According to WHO estimations from 2021, serological evidence of HBV infection exists in one-third of the world's population. Three hundred and sixty (360) million people worldwide are HBV carriers (El-Serag, 2012), and more than 2 billion people worldwide have the hepatitis B virus, according to studies by Zhu et al. (2008) and Li et al. (2010). Around 70 million of those with chronic HBV infections are Africans, making it commonly known as Africa's silent killer (Muanya, 2022), 75.0% of them reside in Asia, and 25.0% of them pass away from infection-related liver problems (Sato et al., 2014; Cooke et al., 2019; Flower et al., 2022; Demarchi et al., 2022).

HBV is widespread in sub-Saharan Africa, where it is the primary cause of most viral-related chronic liver diseases (Kharsany & Karim, 2016; WHO, 2017; Tassachew et al., 2022). Nigeria's population is predicted by the United Nation to be 211.4 million in 2021. (World Population Dashboard Nigeria, 2021; Ajuwon et al., 2021). Nigeria's overall population is made up of about 13.6% chronic HBV carriers (Zampino et al., 2015). Hepatitis B virus (HBV) cases are on the rise in Nigeria, which has an 8.1% prevalence rate and is one of the most severely affected countries on the continent by the disease with an estimated 19 million people living with it (Muanya, 2022).

To prove that it should no longer be considered a hazard to public health, comprehensive prevalence data are necessary. The Hepatitis B virus (HBV) is a significant issue for public health (Flower et al., 2022). Hepatitis B is a transient disease. This study sought to evaluate the seroepidemiological characteristics of HBV infection and its related factors among patients presenting to a healthcare centre named O. B. Lulu

Briggs in the University of Port Harcourt, Nigeria, in light of the prevalence of HBV infections found there.

## MATERIALS AND METHOD

### 2.1 Study Area

The study was conducted at Lulu Briggs Health Centre in Port Harcourt, Rivers State with coordinates Latitude: 4.9018429 and longitude: 6.9089949

### 2.2 Study Population

A total of one hundred (100) adult samples from patients attending Lulu Briggs Health Centre in Port Harcourt with their information on their age, and social economic status were collected, and the samples collected were tested for the presence of Hepatitis B surface antigen.

### 2.3 Inclusion and Exclusion Criteria

The patients included in this work comprised all members attending the Lulu Briggs Health Centre in Port Harcourt, Rivers State during the period of research they gave their consent to participate in the study. The patients excluded in this work comprised people who did not give their consent to participate in the study.

### 2.4 Sample Collection

The method of sample collection is the venipuncture technique. Two millilitres (2 ml) of the blood sample were collected into EDTA bottles and transported in a cold chain to the Virus & Genomics Research Unit, Department of Microbiology, University of Port Harcourt, Port Harcourt, Nigeria for analysis and processing using standard laboratory procedure.

### 2.5 Specimen Preparation / Processing

Venipuncture was used to take blood aseptically, and serum was produced using the standard method for preparing samples for clinical laboratory examination. The sample was prepared with citrate EDTA and heparin without encountering any interference. To prevent incorrect interpretation of the results, samples were appropriately labelled with codes. Electronic readings and barcode labelling were done. Samples that were hemolyzed (red) and lipemic (milky) were discarded because they can produce erroneous results. To prevent the possibility of receiving inaccurate results, samples with fibrin residue or heavy particles were discarded.

### 2.6 Serological Analysis

Serum samples were analyzed for Hepatitis B Virus, surface antigens (HBsAg) using the rapid diagnostic kits. ELISA test was also used and performed according to the manufacturer's instructions. Serum samples were analyzed *in vitro* for HBsAg using the Enzyme-Linked Immunosorbent Assay (ELISA) kit manufactured by DIA. PRO Diagnostic Bioprobes, (Milano) Italy. The

Elisa test and interpretation of results were done according to the manufacturer's instructions. This test utilizes a combination of monoclonal and polyclonal antibodies to selectively detect elevated levels of HBsAg in serum. The serological analysis is a blood test that looks out for antibodies in a blood sample. It involves proteins made by the immune system.

### 2.7 Data Analysis

Data were analyzed using the Statistical Package for Social Science (SPSS) version 22.0. The prevalence of HBV was expressed as a percentage. Chi-square or Fisher's exact was used where appropriate to test association. A p value of <0.05 was considered significant.

## 3. RESULTS

### 3.1 Characteristics of the patients

The total number of patients included in this study was 100. The socio-demographic data for these samples were stratified and shown in Table 1. The patient's age ranges from <20 – 65 years. The age group <20 constituted the largest population making up 51.0%, followed by the age groups 21- 40 years (37.0%) while the age group 41 to 65 were the least (12.0%). Females predominated the study by constituting 51.0% of the population while 49.0% were males. Based on marital status, 76.0% of the patients were single while 24.0% were married. It was observed that 81.0% of the patients were undergraduate students, 14.0% were graduates and 5.0% were secondary school leavers. Artisans, civil/public servants, and businessmen/ women each constituted 4.0% of the population, teachers (5.0%) and healthcare workers (3.0%) while students constituted a greater (80.0%) part of the population (Table 1).

### 3.2. Serological Prevalence of Hepatitis B virus

Of the 100 patients tested, 8.0% tested positive for the virus. Age group 21-40 had the highest prevalence of HBV (13.5%) compared to other age groups, ≤20 and 41-65 years had a prevalence of 3.9% and 8.3%, respectively. Although females predominated in the study, the males had the highest prevalence of HBV (12.2%) while females had a 3.9% prevalence. A higher prevalence of HBV occurred among married patients (16.7%) than the singles (5.3%). Based on the level of education, a higher prevalence of HBV occurred among the graduates (21.4%) than the undergraduates (6.2%) and secondary school leavers (0.0%). Based on occupations, a higher prevalence of HBV occurred among Civil/Public servants/Lecturers (33.3%) than artisans/traders (12.5%) and students (5.0%) as seen in Table 1. Our findings demonstrated no statistically significant difference in the risk of HBV in all the demographic profiles of patients analyzed, including age (p = 0.26), gender (p = 0.13), marital status (p = 0.07),

and educational level ( $p = 0.12$ ), except for occupational status ( $p = 0.03$ ) which was statistically associated (Table 1).

**Table 1: The socio-demographic characteristics of the patients.**

Variables	Category	No. Tested	No. Positive (%)	Chi-Square Analysis
Age group (Years)	<20	51	2 (3.9)	P = 0.26
	21-40	37	5 (13.5)	
	41-65	12	1 (8.3)	
Sex	Males	49	6 (12.2)	P = 0.13
	Females	51	2 (3.9)	
Marital status	Singles	76	4 (5.3)	P = 0.07
	Married	24	4 (16.7)	
Educational Level	Secondary	5	0 (0.0)	P = 0.12
	Undergraduates	81	5 (6.2)	
	Graduates	14	3 (21.4)	
Occupation	Artisans/traders	8	1 (12.5)	P = 0.03
	Civil/Public servants/Lecturers	9	3 (33.3)	
	Students	80	4 (5.0)	
	Healthcare workers	3	0 (0.0)	
<b>Total</b>		<b>100</b>	<b>8 (8.0)</b>	

#### 4. DISCUSSION

Infection with the Hepatitis B virus (HBV) is a significant global health burden (Im et al., 2022). An estimated 296 million people had chronic HBV infection in 2019, and more than 820,000 people died as a result of HBV (WHO, 2021b; Im et al., 2022). Every demographic group's endemicity of Hepatitis B is described by the prevalence of the HBV serological marker (HBsAg), and this data may be important to inform preventative and control strategies that improve public health (Demarchi et al., 2022). To find out the serological prevalence of HBV among patients at the O. B. Lulu Briggs Health Centre of the University of Port Harcourt in Port Harcourt, Nigeria, this study was conducted. In this study, a prevalence rate of HBV exposure (8.0%) was found. According to the WHO (2010) classification of HBV, this study's prevalence rate of HBV exposure (8.0%) was considered moderate.

The study's 8.0% reported prevalence is in line with global trends (WHO, 2017) and with the WHO African region's prevalence of 6-25%. (Mustapha et al., 2020). The 9.0% that Ajuwon et al. (2021) got for research between 2010-2014 and 2015-2019 in Nigeria is equivalent to the 8.0% reported in this population. The 8.3% recorded in Ibadan, Nigeria (Chinenye et al., 2015), the 8.2% recorded in FMC Yola, Adamawa State, Nigeria (Olokoba et al., 2011), and the 8.0% recorded in Koutiala, Mali are similarly comparable (MacLean et al., 2011).

This study's HBV prevalence of 8.0% is higher than the 6.8% reported in Ekiti State, southwest Nigeria (Esan et

al., 2014), the 6.7% in Bauchi (Mustapha et al., 2020), the 6.6% in Cross River State, Nigeria (Utoo, 2013), the 6.0% in Ethiopia (Yazie & Tebeje, 2019), and the 2.7% in Benue State, Nigeria (Emmanuel et al., 2014).

Additionally, the moderate prevalence (8.0%) reported in our current study was lower when compared to the overall pooled HBV prevalence in Nigeria (9.5%) (Ajuwon et al., 2021), the 20.4% discovered in Cameroon (Ducancelle et al., 2013), the 17.2% prevalence documented in Bayara hospital, Bauchi State, Nigeria (Ndako et al., 2012), the 16.5% in Osogbo, Osun State (Kolawole et al., 2012), the 13.4% discovered in Japanese Immigrants and Descendants in Brazil (Demarchi et al., 2022), the 13.3% discovered in patients in Nasarawa State, Nigeria (Pennap et al., 2010), the 12.5% in Edo State (Ugbebor et al., 2011), the 10.2% discovered by Noubiap et al. (2015), the 9.5% discovered in Ghana (Ephraim et al., 2015), the 11.2% discovered in Cameroon (Bigna et al., 2017), the 11.2% discovered in Burkina Faso (Lingani et al., 2018), the 11.0% in Makurdi, Benue State (Mbaawuaga et al., 2008), the 10.3% discovered in Port Harcourt, Nigeria (Ejele et al., 2004), the 9.20% discovered in Banjul, The Gambia (Bittaye et al., 2019), and the 10.87% discovered in Brazil (Demarchi et al., 2022). The fact that this study was carried out in a medical facility located in an urban region may be the cause of the discrepancy. In comparison to earlier studies conducted in Nigeria, the moderate frequency of HBV may reflect more public knowledge of the condition (Locarnini et al., 2015).

When compared to other age groups, those between the ages of 21 and 40 had a higher prevalence of 13.5%, while those between the ages of  $\leq 20$  had 3.9% and 41-65 had 8.3%. This shows that the high rate of sexual activity, tattooing, and various sexual partners with which this population is typically linked increased the likelihood of contracting HBV via exposure with increasing age. This agrees with findings from other earlier investigations. In Warri, Nigeria, Okonko et al. (2023) reported somewhat similar. At Port Harcourt, Nigeria, Cookey et al. (2022) showed a higher frequency among 20 to 30-year-olds. According to Demarchi et al. (2022), the frequency was high in Brazil's age range of 21 to 30.

This study's findings regarding age-related prevalence differed from those of other research (Isa et al., 2014; Ximenes et al., 2015; Olayinka et al., 2016; Lima et al., 2020; Dos Santos Weis- Torres et al., 2020; Mustapha et al., 2020). According to Olayinka et al. (2016), older age groups (60 to 69) had greater HBV prevalence (15.6%) than younger age groups. Mustapha et al. (2020) for people under the age of  $<17$ . According to Isa et al. (2014), those over 50 had a greater prevalence of HBsAg. According to Boateng et al. (2019), those between the ages of 18 and 33 in Kumasi, Ghana, had a greater risk of contracting both HIV and HBV. Only those between the ages of 16 and 20 are affected by HBV infection in Port Harcourt, Nigeria, according to Okonko et al. (2020b). Cookey et al. (2021) found a greater rate of HBV infection in the age group  $>59$  years in a different study conducted in Port Harcourt, Nigeria. In senior age groups ( $>58$  years), several investigations (Kim et al., 2021; Tassachew et al., 2022) demonstrated a significant association contrary to this study which showed no significant association with age.

Males had the highest prevalence of HBV (12.2%), whilst females had a 3.9% prevalence, even though females predominated in the research. Though, this difference was not significantly associated ( $p > 0.05$ ). This observation is in line with prior ones made by other researchers. Okonko et al. (2020b) also reported that males were more probable than females to have HBV infection in Port Harcourt, Nigeria. The outcomes are in line with those of Isa et al. (2014), who found that males had a higher prevalence than females. According to Zafrin et al. (2019), males are more likely than females to have HBV. The Omatola et al. (2020) study found that males were more likely than females to have HBV.

The results from various other research in Nigeria did not corroborate the observed sex-specific prevalence. According to Okonko et al. (2022), there was a greater prevalence of HBV among females in Port Harcourt, Nigeria. Females in Anyigba, Nigeria showed higher

HBsAg seropositivity than males, according to a study by Omatola et al. (2019). Gyar et al. (2014) also demonstrated that females were more likely than males to have HBV. Cookey et al. (2021 & 2022) also reported that females were more probable than males to have HBV infection in Port Harcourt, Nigeria. At Warri, Nigeria, Okonko et al. (2023) reported HBV only among females. The study's many locations could be to blame for this. Although there is not any concrete proof at the moment, these affected males probably have a variety of infection-risk characteristics.

Married patients (16.7%) had a greater frequency of HBV than single individuals (5.3%). Also, this difference was not significantly associated ( $p > 0.05$ ). In Port Harcourt, Nigeria, married people had a higher risk of HBV infection, according to Cookey et al. (2022) and Okonko et al. (2020a, 2022), findings that are supported by this information. This information is in line with studies by Chen et al. (2011, 2013) and Weldemhert et al. (2016), which discovered that married people in Ethiopia, China, and Punjab had higher rates of HBV than unmarried respondents. Okonko et al. (2023) found that married people had a higher risk of HBV in Warri, Nigeria. According to Mustapha et al. (2020), married people have a greater prevalence of HBV. According to Zafrin et al. (2019), married people had a higher prevalence than single people.

According to earlier research by Omatola et al. (2019) and Sule et al. (2010) in Kogi State, Sirisena et al. (2002) in Plateau State, Ezegbudo et al. (2004) in Anambra State, and Mohammed et al. (2015) in Kano State, Nigeria, there is a high link between marital status and HBV infection. This finding, however, does not agree with certain other earlier investigations conducted in Nigeria and abroad. According to Demarchi et al. (2022)'s research, unmarried Brazilians are more likely than married Brazilians to have HBsAg. At Uyo, Nigeria, Innocent-Adiele (2021) likewise noted a higher frequency among single people than among married people. At Port Harcourt, Nigeria, Cookey et al. (2021) discovered higher HBV infection rates among widowed people. Omatola et al. (2019) found that widowed patients had a significantly higher prevalence of HBsAg. The sexual preferences of married people versus unmarried people may help to explain this outcome. It might also be because single persons have a higher risk of contracting HBV due to exposure to promiscuous sexual behaviour and unhealthy habits and lifestyles.

According to education level, graduates (21.4%) had a greater prevalence of HBV than undergraduates (6.2%) and secondary school dropouts (0.0%). However, this difference was not significantly associated ( $p > 0.05$ ). This result is consistent with our past research in Warri,

Nigeria, where HBV infection was exclusively found in people with tertiary education (Okonko et al., 2023). This concurs with findings from Ihongbe et al. (2022), who discovered a greater prevalence of HBV among persons with tertiary education. Moreover, Innocent-Adiele et al. (2021) discovered that those with prior educational status had a greater frequency in Uyo, Nigeria. Omeje et al. (2016) in Abakaliki discovered greater HBV prevalence (3.7%) among secondary school dropouts, contradicting this finding. Also, it contradicts a 2020 study by Katamba et al. that asserted elementary school attendance was a predictor of HBV infections. Omatola et al. (2020), who asserted that individuals with less formal education had a higher frequency of HBV, are likewise at odds with this conclusion. Okonko et al. (2022) discovered a higher frequency among people with secondary education in Port Harcourt, Nigeria. Omatola et al. (2019) discovered that people with only an elementary education or no formal education had a higher prevalence of HBV in Anyigba, Nigeria.

According to vocations, civil/public servants/lecturers had a greater prevalence of HBV (33.3%) than artisans/tradespeople (12.5%) or students (5.0%). These differences were significantly associated ( $p < 0.05$ ). This result is consistent with the findings of other studies (Okonko et al., 2020b). This complements the research we conducted in Port Harcourt, Nigeria, where we discovered greater rates of HBV infection in non-students (Okonko et al., 2020a). This discovery contrasts with our past research in Warri, Nigeria, which showed that exclusively traders had HBV infections. The results of Okonko et al. (2022), who reported a higher rate of HBV among self-employed people in Port Harcourt, Nigeria, were likewise not supported by this. Omatola et al. (2020), who asserted that patients who were housewives had a higher prevalence of HBV, are at odds with this conclusion.

## 5. CONCLUSION

This study on the prevalence of hepatitis B infection among patients attending O. B. Lulu Briggs Health Center at the University of Port Harcourt showed a moderate prevalence (8.0%), which indicates a rise in the prevalence of HBV in the study area. This finding views males as being more prone to the risk of HBV infection. The prevalence of older adults was higher than younger adults, this is considered cogent as older adults are implicated in risk factors for HBV infection. The findings of this study confirm the findings of other studies that HBV is endemic in Nigeria. Planning any strategy to control HBV infection among patients requires an understanding of the prevalence of the infection. Also, the knowledge gained may be applied in a broader sense to raise awareness among all patient

groups or even healthcare professionals about the gravity of the risk of catching the virus or spreading it. For a more accurate description of HBV prevalence, large cross-sectional studies are required.

## REFERENCES

- [1]. 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: 1120
- [2]. Bigna, J. J., Amougou, M. A., Asangbeh, S. L., Kenne, A. M., Noumegni, S. R. N., Ngo-Malabo, E. T., (2017). Seroprevalence of hepatitis B virus infection in Cameroon: a systematic review and meta-analysis. *BMJ Open*.; 7(6):e015298.
- [3]. Bittaye, M., Idoko, P., Ekele, B. A. (2019). Hepatitis B virus sero-prevalence amongst pregnant women in the Gambia. *BMC Infectious Diseases* 19, 259.
- [4]. Boateng R, Mutocheluh M, Dompheh A, Obiri-Yeboah D, Odame Anto E, Owusu M, et al. (2019) Sero-prevalence of Hepatitis B and C viral co-infections among HIV-1 infected ART-naïve individuals in Kumasi, Ghana. *PLoS ONE* 14(4): e0215377. <https://doi.org/10.1371/journal.pone.0215377>
- [5]. Chen, J. J., Yu, C. B., Du, W. B., & Li, L. J. (2011). Prevalence of hepatitis B and C in HIV-infected patients: a meta-analysis. *Hepatobiliary & pancreatic diseases international: HBPD INT*, 10(2), 122–127. [https://doi.org/10.1016/s1499-3872\(11\)60020-9](https://doi.org/10.1016/s1499-3872(11)60020-9)
- [6]. Chen, C. F., Lee, W. C., Yang, H. I., Chang, H. C., Jen, C. L., Iloeje, U. H., Su, J., Hsiao, C. K., Wang, L. Y., You, S. L., Lu, S. N., Chen, C. J., & Risk Evaluation of Viral Load Elevation and Associated Liver Disease/Cancer in HBV (REVEAL–HBV) Study Group (2011). Changes in serum levels of HBV DNA and alanine aminotransferase determine the risk for hepatocellular carcinoma. *Gastroenterology*, 141(4), 1240–1248.e12482. <https://doi.org/10.1053/j.gastro.2011.06.036>
- [7]. Chinenye G, Adeola F, Chukwuma E, Rasheed A. (2015). Prevalence, socio-demographic features and risk factors of hepatitis B virus infection among pregnant women in southwestern Nigeria. *Pan Afr Med J*.; 8688:1–11
- [8]. Cooke, G. S., Andrieux-Meyer, I., Applegate, T. L., Rifat, A., Burry, J. R., Hugo, C., Dusheiko, G., Jordan, J. F., Charles, G., (2019). Accelerating the elimination of viral hepatitis: a *Lancet Gastroenterology & Hepatology Commission Lancet Gastroenterol Hepatol*.; 4(2):135–184.

- [9]. Cooney TI, Odenigbo KC, Okonko BJ & Okonko IO. (2022). Prevalence of HBsAg among patients attending a tertiary hospital in Port Harcourt, Nigeria. *International Journal of Life Science Research Archive*, 03(02), 125–134
- [10]. Cooney, T. I., Okonko, I. O., & Frank-Peterside, N. (2021). HIV and HBV Coinfections in the Highly HIV-infected Population of Rivers State, Nigeria. *Asian Journal of Advanced Research and Reports*, 15(6): 1-10.
- [11]. Demarchi, L. H. F., Bandeira, L. M., Taira, D. L., Zardin, M. C. S. U., Ibanhes, M. L., Esposito, A. O. P., de Arruda, L. D. C., Gonçalves, C. C. M., Weis-Torres, S. M. D. S., Cesar, G. A., (2022). Hepatitis B Virus Infection among Japanese Immigrants and Descendants: The Need to Strengthen Preventive and Control Measures. *Viruses*, 14: 1085.
- [12]. Dos, Santos Weis-Torres, S. M., Fitts, S. M. F., Cardoso, W. M., Junior, M. G. H., Lima, L. A., Bandeira, L. M., Castro, V. O. L., Carneiro, F. A., Iglecias, L. M. M., Cesar, G. A., (2020). High level of exposure to hepatitis B virus infection in a vulnerable population of a low endemic area: A challenge for vaccination coverage. *International Journal of Infectious Disease*. 90, 46–52.
- [13]. Ducancelle, A., Abgueguen, P., Birguel, J., Mansour, W., Pivert, A., Guillou-guillemette, L., (2013). High Endemicity and low molecular diversity of hepatitis B virus infections in pregnant women in a Rural District of North Cameroon. *PLoS One*, 8(11):10–12
- [14]. Ejele, O. A., Nwauche, C. A., & Erhabor, O., (2004). The prevalence of hepatitis B surface antigenaemia in HIV positive patients in the Niger Delta Nigeria. *Nigeria Journal of Medicine*.13:175–179.
- [15]. El-Serag H. B. (2012). Epidemiology of viral hepatitis and hepatocellular carcinoma. *Gastroenterology*, 142(6), 1264–1273.e1. <https://doi.org/10.1053/j.gastro.2011.12.061>
- [16]. Emmanuel, M., Mbaawuaga, C. U. I., & Anthony, C. I. (2014). Hepatitis B Virus (HBV) Serological Patterns in Benue State, Nigeria. *Open Journal of Medical Microbiology* 4: 1-10.
- [17]. Ephraim R, Donko I, Sakyi SA, Ampong J, & Agbodjakey H. (2015). Seroprevalence and risk factors of Hepatitis B and Hepatitis C infections among pregnant women in the Asante Akim North Municipality of the Ashanti region, Ghana; a cross-sectional study. *African Health Science*, 15(3):1–5
- [18]. Esan AJ, Omisakin CT, Owoseni MF, Fasakin KA, & Ogunleye AA. (2014). Sero-prevalence of hepatitis B and hepatitis C virus co-infection among pregnant women in Nigeria. *Am J Biomed Res.*, 2(1):11–15
- [19]. Ezegebudo CN, Agbonlahor DE, Nwobu GO, Igwe CU, Agba MI, et al. The seroprevalence of hepatitis B surface antigen and human immunodeficiency virus among pregnant women in Anambra state, Nigeria. *Dept of Int Med Shiraz E-Medical J*. 2004;5(2):1–8.
- [20]. Flower, B, Hong DD, Thi Kim HV, Minh KP, Geskus, RB, Day J & Cooke GS. (2022). Seroprevalence of Hepatitis B, C and D in Vietnam: A systematic review and meta-analysis. *The Lancet Regional Health - Western Pacific*, 24: 100468. <https://doi.org/10.1016/j.lanwpc.2022.100468>
- [21]. Gyar, S.D., Agbo P. and Reuben, C.R. (2014). Assessment of Hepatitis B Co-infection among HIV/AIDS Patients Attending Antiretroviral Therapy (ART) Clinic in Garaku, Central Nigeria. *Research Journal of Microbiology*, 9: 232-238.
- [22]. Ihongbe JC, Enitan SS, Dada MO, Ofem OG, Effiong EJ, Kemiki OA, Ogbonna AF. Detection of Hepatitis B Virus Serological markers among Adult HIV Positive Female Patients on HAART in Ogun State, Nigeria. *Qeios*, CC-BY 4.0, YLB5K9 · <https://doi.org/10.32388/YLB5K9>
- [23]. Im, Y.R., Jagdish, R., Leith, D., Kim, J. U., Yoshida, K., Majid, A., Ge, Y., Ndow, G., Shimakawa, Y. & Lemoine, M. (2022). Prevalence of occult hepatitis B virus infection in adults: a systematic review and meta-analysis. *Lancet Gastroenterology and Hepatology*, 7: 932–942
- [24]. Innocent-Adiele, H.C., Michael, B.B.T., Okonko, I.O. & Ogbu O. (2021). Seroprevalence Of Hepatitis B Virus Infection among HIV Infected Individuals in Uyo, Akwa Ibom State, Nigeria. *Med Rxiv preprint for Health Sciences. Cold Spring Harbor Laboratory and BMJ Yale*. doi: <https://doi.org/10.1101/2021.03.06.21253060>
- [25]. Isa, M. A., Bello, H. S., Aliyu, B. & Manga, H. K. (2014). Seroprevalence of Hepatitis B Surface Antigenaemia among Patients Attending Sokoto Specialist Hospital, Sokoto State, Nigeria. *Journal of Applied Sciences Research*. 1(3): 242-249
- [26]. Katamba C, Chungu T and Lucile C. HIV, syphilis and hepatitis B coinfections in Mkushi, Zambia: a cross-sectional study [version 2; peer review: 2 approved]. *F1000Research* 2020, 8:562.
- [27]. Kharsany AB, Karim QA. HIV infection and AIDS in Sub-Saharan Africa: current status, challenges and opportunities. *Open AIDS Journal*, 2016;10:34–48. doi:10.2174/1874613601610010034

- [28]. Kim HN, Newcomb CW, Carbonari DM, et al. Risk of HCC with Hepatitis B Viremia among HIV/HBV-coinfected persons in North America. *Hepatology*. 2021;74 (3):1190–1202. doi:10.1002/hep.31839
- [29]. Kolawole, O.M., Wahab, D.A. Adekanle, T.S. & Okoh, A.I. (2012). Seroprevalence of hepatitis B surface antigenemia and its effects on hematological parameters in pregnant women in Osogbo, Nigeria. *Virology Journal*. 9:317. <https://doi.org/10.1186/1743-422X-9-317>
- [30]. Li, W., Miao, X., Qi, Z., Zeng, W., Liang, J., & Liang, Z. (2010). Hepatitis B virus X protein upregulates HSP90alpha expression via activation of c-Myc in human hepatocarcinoma cell line, HepG2. *Virology Journal*, 7, 45. <https://doi.org/10.1186/1743-422X-7-45>
- [31]. Lima, L.A.; Lago, B.V.; Weis-Torres, S.M.S.; Martins, R.M.B.; Cesar, G.A.; Bandeira, L.M.; Rezende, G.R.; Lindenberg, A.S.C.; Gomes, S.A.; & Motta-Castro, A.R.C. (2020). Hepatitis B: Changes in epidemiological features of Afro-descendant communities in Central Brazil. *Sci. Rep.*, 10, 6708.
- [32]. Lingani M, Akita T, Ouoba S, Sanou AM, Sugiyama A, Tarnagda Z, & et al. (2018). High prevalence of hepatitis B infections in Burkina Faso (1996–2017): a systematic review with meta-analysis of epidemiological studies. *BMC Public Health*, 18(1):551.
- [33]. Locarnini S, Hatzakis A, Chen D, & Lok A. (2015). Review Strategies to control hepatitis B: Public policy, epidemiology, vaccine and drugs. *Journal of Hepatology*, 62(1): S76–86
- [34]. MacLean, B., Hess, R. F, Bonvillain, E., Kamate, J., Dao, D. Cosimano, A., & Hoy, S. (2011). Seroprevalence of hepatitis B surface antigen among pregnant women attending the Hospital for women & children in Koutiala, Mali. *South Africa Medical Journal*, 102(1):47–49.
- [35]. Mbaawuaga, E. M., Enebeaku, M. N. O., Okopi, J. A., Damen, J. G., (2008) Hepatitis B Virus (HBV) Infection among Pregnant Women in Makurdi, Nigeria. *African Journal of Biomedical Research* 11: 155-159.
- [36]. Mohammed Y, Sharif A, Dabo NT. Seroprevalence of HBsAg Among Patients with Febrile Illnesses in Murtala Muhammad Specialist Hospital, Kano, Nigeria. *Bayero J of Pure and Applied Sc.* 2015;8(1):19–23.
- [37]. Muanya C. (2022). Over 19m Nigerians living with chronic, viral hepatitis B and C. *Health. The Guardian* Newspapers <https://guardian.ng/features/over-19m-nigerians-living-with-chronic-viral-hepatitis-b-and-c/>
- [38]. Mustapha, G.U., Ibrahim, A., Balogun, M.S. & et al. (2020). Seroprevalence of hepatitis B virus among antenatal clinic attendees in Gamawa Local Government Area, Bauchi State, Nigeria. *BMC Infect Dis* 20, 194. <https://doi.org/10.1186/s12879-020-4863-9>
- [39]. Ndako J, Echeonwu G, Nwankiti O, Onovoh E, Ujah A, Ikani P, & et al. (2012). Hepatitis B virus Sero-prevalence among pregnant females in Northern Nigeria. *Res J Med Sci.*, 6(3):129–133
- [40]. Noubiap, J. J., Aka, P. V., Nanfack, A. J., Agyingi, L. A., Ngai, J. N., & Nyambi, P. N. (2015). Hepatitis B and C Co-Infections in Some HIV-Positive Populations in Cameroon, West Central Africa: Analysis of Samples Collected Over More Than a Decade. *PLoS one*, 10(9), e0137375. <https://doi.org/10.1371/journal.pone.0137375>
- [41]. Okonko IO, Asagba OH, Okonko BJ, Baeka GB. (2023). Prevalence of Hepatitis B Virus Coinfection Amongst HIV-Infected Patients in Capitol Hill Hospital, Warri, Delta State, Nigeria. *Cancer Biology*, 13 (1): in press
- [42]. Okonko, I. O., Udo, O.L., Cookey, T.I. & Adim, C.C. (2020a). Prevalence of Hepatitis B Virus among Women of Child-Bearing Age in Port Harcourt, Nigeria. *Asian Journal of Immunology*, 4(4): 1-7,
- [43]. Okonko, I.O., Adewuyi, S.A., Omatsone, C. & Cookey, T.I. (2020b). Detection of Hepatitis B Virus Among HIV Positive Fresh Undergraduate Students in Port Harcourt, Nigeria. *Asian Journal of Research and Reports in Gastroenterology*, 3(3): 8-13
- [44]. Okonko, I.O., Okobia VC, Cookey TI, & Innocent-Adiele HC. (2022). Dual Positivity of Human Immunodeficiency Virus (HIV) and Hepatitis B Virus (HBV) In the Highly Infected Population of Rivers State, Nigeria. *Report & Opinion*, 14(10):1-9
- [45]. Olayinka, A. T., Oyemakinde, A., Balogun, M. S., Ajudua, A., Nguku, P., Aderinola, M., Egwenu-Oladejo, A., Ajisegiri, S. W., Sha'aibu, S., Musa, B. O., Gidado, S., & Nasidi, A. (2016). Seroprevalence of Hepatitis B Infection in Nigeria: A National Survey. *The American Journal of Tropical Medicine and Hygiene*, 95(4),902–907. <https://doi.org/10.4269/ajtmh.15-0874>
- [46]. Olokoba, A. B, Salawu, F. K, Danburam, A., Olokoba, L. B, Midala, J. K, Badung, L. H. (2011). Hepatitis B virus infection amongst pregnant women in north-eastern Nigeria -a call for action. *Nigerian Journal of Clinical Practice*. 14(1):10–13.

- [47]. Omatola CA, Okolo M-LO, Adaji DM, Mofolorunsho CK, Abraham Oyiguh J, Zige DV, Akpala NS, Ocholi Samson S. Coinfection of Human Immunodeficiency Virus-Infected Patients with Hepatitis B Virus in Lokoja, North Central Nigeria. *Viral Immunology*, 2020;33(5):391–395. Available: <https://doi.org/10.1089/vim.2019.0157>
- [48]. Omatola, C. A., Idofe, J., Okolo, M. O., Adejo, P. O., Maina, M. M., & Oyiguh, J. A. (2019). Seroprevalence of HBV among people living with HIV in Anyigba, Kogi State, Nigeria. *African health sciences*, 19(2), 1938–1946. <https://doi.org/10.4314/ahs.v19i2.17>
- [49]. Omeje KN, Ibekwe RC, Ojukwu JO, Una AF, Ibe BC. Risk factors for hepatitis B surface antigenaemia among secondary school students in Abakaliki, South Eastern Nigeria. *Niger J Paediatr*. 2017;44(1):14. doi: 10.4314/njp.v44i1.3.
- [50]. Pennap, G. R., Yakubu, A., Oyige, O., & Forbi, J. (2010). Prevalence of hepatitis B and virus infection among people of a local community in Keffi, Nigeria. *African Journal of Microbiology Research Vol. 4 (4)*, pp. 274-278.
- [51]. Sato, T., Do, S. H., Asao, T., Akita, T., Katayama, K., Tatara, K., Miyakawa, Y., & Tanaka, J. (2014). Estimating numbers of persons with persistent hepatitis B virus infection transmitted vertically and horizontally in the birth cohort during 1950–1985 in Japan. *Hepatology Res*. 44: 181–188.
- [52]. Sirisena, N. D., Njoku, M. O., Idoko, J. A., Isamade, E., Barau, C., Jelpe, D., Zamani, A., & Otowo, S. (2002). The carriage rate of hepatitis-B surface antigen (HBsAg) in an urban community in Jos, Plateau State, Nigeria. *The Nigerian Postgraduate Medical Journal*, 9(1), 7–10. *International Journal of Life Science Research Archive*, 2022. 03(02) : 12
- [53]. Sule WF, Okonko IO, Ebute AJ, Donbraye E, Fadeyi A, et al. Farming and Non-Farming Individuals Attending Grimard Catholic Hospital, Anyigba, Kogi State, Nigeria were Comparable in Hepatitis B Surface Antigen Seroprevalence. *Current Res J of Biol Sc*. 2010;2(4):278–282
- [54]. Tassachew Y, Abebe T, Belyhun Y, Teffera T, Shewaye AB, Desalegn H, Andualem H, Kinfu A, Mulu A, Mihret A, Howe R, Aseffa A. Prevalence of HIV and Its Co-Infection with Hepatitis B/C Virus Among Chronic Liver Disease Patients in Ethiopia. *Hepat Med*. 2022;14:67-77
- [55]. <https://doi.org/10.2147/HMER.S365443>
- [56]. Ugbebor, O., Aigbirior, M., Osazuwa, F., Enabudoso, E., & Zabayo, O. (2011). The prevalence of hepatitis B and C viral infections among pregnant women. *North America Journal of Medical Sciences*. 3(5): 238–241
- [57]. Utoo, B. T. (2013). Hepatitis B surface antigenemia (HBsAg) among pregnant women in southern Nigeria. *African Health Sciences*. 13(4):1139–1143
- [58]. Weldemhret L, Asmelash T, Belodu R, Gebreegziabiher D. Sero-prevalence of HBV and associated risk factors among HIV positive individuals attending ART clinic at Mekelle hospital, Tigray, Northern Ethiopia. *AIDS Res Ther*. 2016;13 (1):6. doi:10.1186/s12981-016-0090-2
- [59]. World Health Organisation (WHO), author *Prevalence of hepatitis virus in the world by country*. 2010. <http://www.who.int/csr/disease/hepatitis/en/> Date accessed online (June 2011)
- [60]. World Health Organization. *Global hepatitis report 2017*. World Health Organization; 2017. [www.who.int/hepatitis/publications/global-hepatitis-report2017/en/](http://www.who.int/hepatitis/publications/global-hepatitis-report2017/en/) Accessed 8th November 2019.
- [61]. World Health Organization (WHO, 2021a). Hepatitis B. Key Facts. Available online: <https://www.who.int/en/news-room/fact-sheets/detail/hepatitis-b> (accessed on 22 August 2021).
- [62]. World Health Organization (WHO, 2021b). Global progress report on HIV, viral hepatitis and sexually transmitted infections, 2021. July 15, 2021. <https://www.who.int/publications/i/item/9789240027077> (accessed Dec 4, 2021).
- [63]. World Population Dashboard Nigeria. United Nations Population Fund. <https://www.unfpa.org/data/world-population/NG>. Accessed 3 Mar 2021
- [64]. Ximenes, R.A.A.; Figueiredo, G.M.; Cardoso, M.R.A.; Stein, A.T.; Moreira, R.C.; Coral, G.; Crespo, D.; Santos, A.A.; Montarroyos, U.R.; Braga, M.C.; & et al. (2015). Population-Based Multicentric Survey of Hepatitis B Infection and Risk Factors in the North, South, and Southeast Regions of Brazil, 10–20 Years after the Beginning of Vaccination. *Am. J. Trop. Med. Hyg.*, 93, 1341–1348.
- [65]. Yazie, T. D & Tebeje, M. G. (2019). An updated systematic review and meta-analysis of the prevalence of hepatitis B virus in Ethiopia. *BMC Infectious Diseases*. 19(1): 917
- [66]. Zafrin N, Sarkar M.A.S., Rahman Md. M, Salma U, Mahbub T, & Azhar M.A. (2019). Hepatitis B Virus Infection: Knowledge and Awareness Among the Patients Admitted in a Tertiary Care



- Hospital in Bangladesh. *Viral Hepatitis Journal* 25(1):6-13.
- [67]. Zampino, R., Boemio, A., Sagnelli, C., Alessio, L., Adinolfi, L. E., Sagnelli, E., & Coppola, N. (2015). Hepatitis B virus burden in developing countries. *World journal of gastroenterology*, 21(42), 11941–11953. <https://doi.org/10.3748/wjg.v21.i42.11941>
- [68]. Zhu, R., Zhang, H. P., Yu, H., Li, H., Ling, Y. Q., Hu, X. Q., & Zhu, H. G. (2008). Hepatitis B virus mutations associated with in situ expression of hepatitis B core antigen, viral load and prognosis in chronic hepatitis B patients. *Pathology, research and practice*, 204(10), 731–742. <https://doi.org/10.1016/j.prp.2008.05.001>

2/25/2023