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Original Article

Hepatitis B and C infection in HIV-infected children and young adults attending HIV treatment centres in Calabar, Nigeria

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Abstract

Introduction: Globally, approximately 2.7 million and 2.3 million people living with HIV are co-infected with hepatitis B and C virus, respectively. Relatively, little is known regarding HBV or HCV co-infection in HIV-infected children in Calabar, Nigeria, though the routes of transmission of the three viruses are similar. This study aimed to determine the seroprevalence and risk factors for HBV and HCV among HIV-infected children and young adults attending Paediatric HIV Care and Treatment Centres in Calabar, Cross River State, Nigeria.

Methodology: This was a cross sectional study involving 204 HIV-infected children and young adults aged 1–23 years attending four outpatient treatment centers. Blood samples were obtained and tested for hepatitis B surface antigen (HBsAg) and HCV antibody (anti-HCV antibodies). Seroprevalence and factors associated with HBsAg were analyzed using Chi-square test or Fisher's exact test. A p-value of < 0.05 was considered significant.

Results: The mean age of the study participants was 13.20 ± 4.39 years. Overall, four study participants were positive for HBsAg, a seroprevalence of 2%, and none was positive for HCV-Ab. All positive study participants were females aged 11 years and above, and belonged to the low and middle socio-economic class, with no vaccination against HBV.

Conclusions: The seroprevalence of hepatitis B infection in this study was low, none of those positive received vaccination against HBV. In view of the public health importance of HBV infection, vaccination against HBV should be extended to children and young adults above 14 weeks of age in Nigeria.

Key words: HIV infection; hepatitis B and C infection; HbsAg; HBV vaccine; Nigeria.

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Introduction

Hepatitis B virus (HBV) and hepatitis C virus (HCV) are hepatotropic viruses that negatively impact the liver and increase morbidity and mortality among those co-infected with human immunodeficiency virus (HIV) [1]. Approximately, 1% of individuals living with HBV infection, that is 2.7 million people, are infected with HIV [2]. In contrast, the global prevalence of HBV infection in HIV-infected persons is about 7.4%. Worldwide, approximately 2.3 million persons (6.2%) of the estimated 37.7 million living with HIV have serological evidence of HCV infection, either currently or in the past [1].

In Nigeria, an estimated 1.9 million people are living with HIV, accounting for a prevalence of 1.4% [3]. Among children and adolescents, HIV prevalence is estimated to be 0.2–3.5% [3,4], the highest among countries in West and Central Africa [4]. The seroprevalence of hepatitis B surface antigen (HBsAg) in Nigeria ranges from 1.2% to 44.7%, varying from one region to another [5-12]. In Calabar, the seroprevalence of HBV infection among children and adolescents is 1.2% [5].

HBV, HCV and HIV infection share the same transmission routes. Studies in Nigeria among HIV co-infected children with HBV and HCV show a prevalence in the range of 5.3% to 19% [13-17].The seroprevalence of these viruses depends on the risk factors, geographic region and the age of the individuals [13-17]. Co-infection of HIV-positive patients with HBV/HCV infection increases risk of morbidity and mortality from chronic hepatitis B and hepatitis C infection with progression to liver cirrhosis and hepatocellular carcinoma (HCC) [1]. This may be due to the impaired function of the immune system in Persons living with HIV (PLWH) and the hepatotoxicity of drugs used in treatment of HIV infection and other opportunistic infection which may be implicated [18-20].

The World Health Organization (WHO) recommends screening PLWH for HBV and HCV infection before initiation of anti-retroviral therapy (ART) [21]. Since 2015, WHO has recommended treatment for everyone diagnosed with HIV infection, regardless of the stage of disease [2]. Tenofovir, which is included in the treatment combinations recommended as first-line therapy for HIV infection, is also active against HBV [2]. In Nigeria, screening for HBV and HCV in HIV-positive adolescents is not routinely practiced. This screening for HBV and HCV in adolescents with HIV infection is important as the Global Health Sector Strategy on viral hepatitis 2016–2021 reported low screening rates, fragile national surveillance systems, and that new infections and mortality are usually under-reported [22]. WHO set a goal of 90% reduction in incidence and a 65% reduction in mortality for HBV and HCV by 2030, along with targets for improvements in testing, treatment and hepatitis B vaccination [22]. Vaccination and screening are also recommended for at-risk adults and this includes PLWH [2].

To curb HBV infection, the Nigerian Government introduced the HBV vaccine into the National Programme on Immunization (NPI) schedule in 2004. However, this vaccine is limited to new-borns from birth to 14 weeks of age [5]. Therefore, adolescents and young adults born before 2004 are not protected against HBV infection and when infected become chronic carriers of the virus with increased risk of complications such as liver cirrhosis and HCC. There is no study in Calabar, south-south Nigeria, showing the seroprevalence of co-infection rates of HIV-infected children with HBV and HCV infection. This study aimed to determine the seroprevalence and risk factors for HBV and HCV infection among HIV-infected children and young adults attending Paediatric HIV Care and Treatment Centres in Calabar, Cross River State, Nigeria.

Methodology

Study design and setting

This was a cross-sectional study conducted in four Paediatric HIV Care and Treatment Centres in Calabar. Children and young adults aged one year to 23 years with confirmed HIV infection by polymerase chain reaction (PCR) in those younger than 18 months of age, or enzyme-linked immunosorbent assay (ELISA) in those older than 18 months attending the Paediatric HIV Care and Treatment Centre were recruited purposively into the study.

Sample size determination

The formula for single proportion [23]

$$N = \frac{z^2 qp}{d^2}$$

was used to calculate sample size in this study, where N was the sample size, "z" critical value set at 95% alpha level of significance (1.96), "d" was estimated margin of error (0.05), "p" was set at 12.9 reported as prevalence of past and present exposure to HBV in a previous study [15] and q = 1−p. With the assumption of a 15% non-response rate, this yielded a minimum sample size of 204. A total of 204 study participants were recruited over a 6-month period between February 2021 and September 2021. Recruitment strategies for study participants included hospital sensitization through oral announcements by health care workers and contact with HIV focal persons in the community who organized recruitment days. These Paediatric HIV Care and Treatment clinics provide health care services for all HIV-positive patients in communities closest to the people's place of residence regardless of socio-economic status.

Data collection

Data were collected using interviewer-administered semi-structured questionnaire. Information obtained included biodata of study participants, family socio-demographic characteristics, clinical history relating to HIV infection and history of vaccination against HBV. The social class of parents/guardians was determined using the social classification proposed by Olusanya *et al*. [24], considering the parents/guardian's occupation and educational qualifications. Questions asked were simple, clear and easy for the participants to understand with little explanation.

Laboratory investigations

Two millilitres (2 mL) of venous blood was obtained from each study participant under aseptic procedure into a clean plain-labelled bottle and allowed to clot. HBsAg and HCV-Ab were detected using commercially available rapid chromatographic immunoassays for the qualitative detection of HBsAg and HCV-Ab both manufactured by Acro Biotech (Rancho Cucamonga, CA, USA). The qualitative assays were performed using one-step test strips for detection of HBsAg and HCV-Ab in serum samples. Test was performed within 1 hour of specimen collection and separation. Clear, non-haemolyzed serum samples were used for analysis. The test strip and quality control sera were allowed to equilibrate to room temperature (15–30° C) prior to testing. Test strip was

immersed vertically in the serum for 10–15 seconds with arrows pointing toward the serum sample as indicated on the test strip. Test strip was placed on a non-absorbent flat surface and the timer started. The immunochromatographic reaction was allowed to take place within minutes and the result read off at exactly 15 minutes after. The presence of two distinct coloured lines indicated a positive result, while a negative result was indicated by one coloured line in the control region and no apparent line in the test region. To serve as a procedural control, a coloured line always appeared in the control line region, indicating that proper volume of membrane wicking had occurred. The HBsAg assay has manufacturer-reported specificity, sensitivity and accuracy of > 99.0%, 97.0% and 98.5%, respectively, while the HCV-Ab antibody assay has a reported specificity, sensitivity and accuracy of > 99.0%, 98.6% and 99.3%, respectively.

Table 1. Sociodemographic and clinical characteristics of children infected with HIV (n = 204).

Variable	Mean ± SD	Median (IQR)	No. (%)
Age (years)	13.20 ± 4.39		
Age group			
1–5			15 (7.4)
6–10			34 (16.7)
11–15			82 (40.1)
> 15			73 (35.8)
Sex			
Male			81 (39.7)
Female			123 (60.3)
Social class			
Low			67 (32.8)
Middle			76 (37.3)
High			61 (29.9)
No. children in family			
1–4			150 (73.5)
> 4			54 (26.5)
Age at HIV diagnosis (years)		7 (1–12)	
Mother's HIV status			
Positive			121 (59.3)
Negative			45 (22.1)
Unknown			38 (18.6)
Blood transfusion			
Yes			50 (24.5)
No			154 (75.5)
History of yellow eyes			
Yes			6 (2.9)
No			198 (97.1)
Family history of yellow eyes			
Yes			4 (2.0)
No			200 (98.0)
Surgery in the past			
Yes			7 (3.4)
No			197 (96.6)
HBV immunization			
Yes			14 (6.9)
No			190 (93.1)
On HIV treatment			
Yes			164 (80.4)
No			40 (19.6)

Statistical analysis

Data were analysed using Statistical Package for Social Sciences (SPSS) for Windows, Software Version 22.1. (SPSS, Chicago, IL, USA). Categorical variables were presented as frequency distribution tables. Chi square test was used to test for statistical significance of categorical variables among study participants. Continuous variables were presented as mean and standard deviation for normally distributed variables and as median and inter-quartile range for skewed variables. A p-value of ≤ 0.05 will be considered statistically significant.

Ethical considerations

Ethical approval was obtained from the Cross River State Ethics and Research Committee. Informed consent and assents were obtained from mothers and children as applicable. Mothers who could not read and write the English language had a detailed explanation in the local language of the nature of the study before recruitment of their children into the research and thumb printed the consent form. This research adhered to the Helsinki code for medical research.

Results

Sociodemographic and clinical characteristics of study participants

A total of 204 HIV-infected children and young adults were enrolled into the study. The age range was between 1 and 23 years with a mean age of 13.20 ± 4.39 years. Female to male ratio was 1.4:1, and children from the high and low social family background made up 29.9% and 32.8% of the study participants, respectively. Families with four children or less constituted 150 (73.5%) of the study population. The median age at HIV diagnosis was 7 years with an inter-quartile range of 1–12 years, and 59.3% mothers were HIV positive. Most of the study participants (80.4%) were on HIV treatment and 24.5% had blood transfusion. A few of the children had a history of yellow eyes (2.9%), a family history of yellow eyes (2.0%), surgery (3.4%) and a history of HBV immunization (6.9%). These data are summarized in Table 1.

Seroprevalence of HBV and HCV in HIV-positive children

Four of the study participants were positive for HBsAg, giving an overall seroprevalence of 2.0%. None of the HIV-positive children tested positive to anti-HCV.

Social, demographic and clinical factors and their relationship with HBV infection

The relationship between important sociodemographic/clinical factors (age group, age at diagnosis of HIV, sex, social class of caregivers, number of children in the household, blood transfusion history, past surgical history, yellowness of the eyes and HBV vaccination history) and hepatitis B infection as measured by HBsAg in study participants managed for HIV was explored using the Chi-square test of independence. None of these factors reached statistical significance. Study participants were exposed to sexual assault (0.5%), scarification incision (1.5%), unsafe injection (1.0%), sharing of sharps (1.0%), circumcision (2.5%), sexual activities (0.5%), tattoos (1.5%), IV drug use (0.5%) nose piercing (2.5%) and ear piercing (17.0%). These characteristics were not statistically significant with HBsAg positivity. These data are summarized in Table 2.

Discussion

The prevalence of HBV/HIV co-infection in this study was 2%. This low prevalence is comparable to studies in Kenya, Tanzania and Ethiopia in children co-infected with HIV and HBV with prevalence of 1.82%, 1.2% and 2%, respectively [25-27]. Other studies in Nigeria have shown higher prevalence, ranging from 5.3% to 19% in children with HIV co-infected with HBV [13-17]. Some of these studies had a smaller sample size and used different screening methods for laboratory analysis, which may account for differences in the prevalence rates [28].

All study participants positive for HBV were females. Studies carried out by Anigilaje *et al*. [14] in Makurdi, Nwolisa *et al*. [29] in Owerri, both in Nigeria, and in Tanzania [26], showed more females co-infected with HIV and HBV. However, these did not reach level of significance. The reason for these findings cannot be readily elucidated.

In the present study, positivity to HBsAg was not significantly associated with age group, however, those positive were from 11 years of age and above. This is similar to findings in other studies carried out in Nigeria and Ethiopia where those positive were 11 years of age and above [14,15,27]. Although this age group in the current study in Nigeria were delivered within the period of commencement and introduction of HBV vaccine into the NPI schedule, none of those positive had received HBV immunization. This demonstrates the importance of HBV vaccination in the prevention of HBV infection. The immunization rate was generally low among the study participants, with 6.9% of those receiving the vaccine. Hepatitis B vaccination has been shown to be 90% to 95% effective in preventing perinatal transmission when given to new-borns within the first 24 hours of life, followed by two or three doses

Table 2. Relationship between sociodemographic factors, clinical factors, social characteristics and positivity for HBsAg among children and adolescents positive for HIV.

Sociodemographic factor	HBsAg		Chi-square value (χ^2)	*p*-value
	Negative (%)	Positive (%)		
Age group (years)				
1–5	15 (100.0)	0 (96.3)	1.31	0.727
6–10	34 (100.0)	0 (97.2)		
11–15	80 (97.6)	2 (2.4)		
> 15	71 (97.3)	2 (2.7)		
Age at diagnosis (years)				
0–4	54 (98.2)	1 (1.8)	3.47	0.324
5–9	42 (97.7)	1 (2.3)		
10–14	44 (100.0)	0 (0.0)		
≥ 15	11 (81.8)	2 (18.2)		
Sex				
Male	81(100.0)	0 (0.0)	FET	0.148
Female	123 (96.8)	4 (3.2)		
Social class				
Low	67(98.5)	1(1.5)	FET	0.261
Middle	73 (96.1)	3 (3.9)		
High	61 (100.0)	0 (0.0)		
No. children in family				
1–4	147 (98.0)	3 (2.0)	FET	1.000
>4	46 (97.9)	1 (2.1)		
Blood transfusion				
Yes	50 (98.0)	1 (2.0)	FET	1.000
No	154 (98.1)	3 (2.0)		
Past surgery				
Yes	7 (85.7)	1 (14.3)	FET	0.134
No	197(98.4)	3(1.6)		
Yellowness of eyes				
Yes	6(100.0)	0 (0.0)	FET	1.000
No	198 (97.9)	4 (2.1)		
HBV immunization				
Yes	14 (100.0)	0 (0.0)	FET	1.000
No	185 (97.8)	4 (2.2)		
Sexual assault				
Yes	1 (100.0)	0 (0.0)	FET	1.000
No	188(97.9)	4(2.1)		
Scarification incision				
Yes	3 (100.0)	0 (0.0)	FET	1.000
No	191 (97.9)	4 (2.1)		
Unsafe injection				
Yes	2 (100.0)	0 (0.0)	FET	1.000
No	193 (98.0)	0 (0.00)		
Sharing of sharps				
Yes	2 (100.0)	0 (0.0)	FET	1.000
No	197 (98.0)	4 (2.0)		
Circumcision				
Yes	5 (100.0)	0 (0.0)	FET	1.000
No	194 (98.0)	4 (2.0)		
Sexually active				
Yes	2 (100.0)	1 (0.0)	FET	1.000
No	196 (98.0)	4 (2.0)		
Tattoos				
Yes	2 (66.7)	1 (33.3)	FET	0.059
No	195 (98.5)	3 (1.5)		
IV drug use				
Yes	1 (100.0)	0 (0.0)	FET	1.000
No	193 (98.0)	4 (2.0)		
Nose piercing				
Yes	5 (100.0)	0 (0.0)	FET	1.000
No	190 (97.9)	4 (2.1)		

[30]. Nigeria adopted the four-dose schedule for vaccination against HBV with the first dose given at birth or within 24 hours and subsequent doses given at 6, 10 and 14 weeks of life [31]. The WHO African region had a birth-dose coverage of 17% [32] and in Nigeria, the Nigerian Demographic and Health Survey of 2018 reported a rate of 53% [33]; these rates are below the WHO expected coverage of > 90% [34]. Antigua and Barbuda, however, achieved a timely and total birth dose of 72% and 81%, respectively, showing that remarkable achievement is possible [35]. Hesitancy to receiving vaccination in Nigeria is multifactorial and these factors may have contributed to the low vaccination rate among study participants who were delivered after the vaccine had been introduced into the NPI schedule. These include poor community acceptance of vaccine, inconsistent vaccination supplies especially to rural areas, vaccination, cultural and religious beliefs, risk perception and lack of trust in vaccines and their delivery systems [36]. The extension of the vaccination age beyond the new-born period against HBV infection is desirable in Nigeria to cover those who were delivered before the introduction of the vaccine into the NPI schedule in 2004; this will also increase the coverage of adolescents and young adults against HBV infection. In Brazil, HBV vaccination was introduced into the National Immunization Program in 1997 and was extended in 2001 to cover individuals up to 19 years of age [37].

Positive study participants were from the low and middle socio-economic class. This, however, did not reach the level of significance. Similarly, Sadoh *et al*. [15], working in Benin City, Nigeria, showed that those from the low socio-economic class were more positive for HBsAg, though there was no significant association.

History of blood transfusion was not associated with positivity of HBV infection among the study participants and only one of those positives received blood transfusion. In general, blood transfusion rate was 24.5% among the study participants. This may be attributed to about 80.4% of participants receiving ARVs which may have kept them well enough to prevent severe complications of HIV infection which could include severe anaemia, requiring blood transfusion.

None of the study participants positive for HBsAg had yellowness of the eyes; therefore it is difficult to attribute yellow eyes to HBV infection and most infection in children is asymptomatic. In addition, the study participants were not screened for sickle-cell anaemia, which is highly prevalent in Nigeria [38] and maybe the cause of yellow eyes. Yellow eyes may also be due to complications of HIV infection affecting the liver, but this is difficult to confirm as the study participants were not screened for liver complications.

This study showed that scarification incision, sharing of sharps, circumcision, ear and nose piercing, and unsafe parenteral injections were not associated with seropositivity for HBsAg. These findings were documented from previous studies in Nigeria [15,39,40]. Studies in Tanzania and Pakistan also corroborated these findings. However, in the Pakistani study, there was an association between those who received therapeutic injections, despite the use of new needles and syringes, with positivity to HbsAg [27,41]. The lack of association between some of these known drivers of HBV infections may be due to the increased campaigns to create awareness on possible routes of transmission of HIV and HBV infections.

None of the study participants was positive for HCV. This is comparable to other studies with 0.0%–0.7% in Calabar and Lagos (Nigeria), Ivory Coast Democratic Republic of the Congo and in southern Brazil [13,42-44]. This may be attributed to low prevalence of HCV in these region and possibly effective blood transfusion program in Nigeria. The robust and extensive national and stable blood transfusion program, which enforces mandatory screening for HCV among other transfusion-transmittable infections, may explain the observed low prevalence of hepatitis C among HIV-infected children in Nigeria [45]. However, in other regions of Nigeria, the prevalence of HCV infection in children infected with HIV ranges from 1.7% to 5.2% [15,46,47], since HCV prevalence has been shown to vary from one geographical region to another and higher prevalence has been found with an effective blood-transfusion program [1,13,15].

The limitation of this present study includes the fact that the study was carried out in treatment centres, which may not be a true reflection of the prevalence of the infection in the community amongst those infected with HIV. Secondly, the limited number of children included in the study and the low number of those positive for HBsAg may have contributed to not finding significant associations in those positive even though some associations were observed that did not reach levels of statistical significance.

Conclusions

All children and young adults positive for HBV did not receive vaccination against HBV and the vaccination rate was generally low amongst the study participants. In view of the public health importance of

HBV infection, there is the need to address factors mitigating against effective delivery of vaccines to children and to extend the vaccination age against HBV in Nigeria to cover those who were delivered before the introduction of the vaccine into the NPI schedule in 2004 and at risk population.

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Authors' contributions

JI conceptualized, designed the study, and wrote up the manuscript. KU assisted in data collection and had an overview of the manuscript. AE made significant inputs into the study design and had an overview of the final manuscripts. IE and EE critically reviewed the final manuscript. All authors reviewed and approved the final manuscript.

References

1. World Health Organization (WHO) (2022) Hepatitis C. Key facts. Available: https://www.who.int/news-room/fact-sheets/detail/hepatitis-c. Accessed: 19 April 2022.
2. World Health Organization (WHO) (2022) Factsheet on Hepatitis B virus. Available: https://www.who.int/news-room/fact-sheets/detail/hepatitis-b. Accessed:15 April 2022.
3. Federal Ministry of Health (2019) A new survey indicates that Nigeria has an HIV prevalence of 1.4%. (2019). Available: http://www.unaids.org/en/resources/presscentre/pressreleaseandstatementarchive/2019/march/20190314_nigeria. Accessed: 22 Oct 2022.
4. Pharr JR, Enejoh V, Mavegam BO, Olutola A, Karick H, Ezeanolue EE (2017) A cross-sectional study of the role of HIV / AIDS knowledge in risky sexual behaviours of adolescents in Nigeria. Int J High Risk Behav Addict 6: 1-6. doi: 10.5812/ijhrba.63203.
5. Ikobah JM, Okpara H, Iwasam E, Ogarepe Y, Udoh E, Ekanem E (2016) The prevalence of hepatitis B virus infection in Nigerian Children prior to vaccine introduction into the National Programme on Immunization. Pan Afr Med J 23: 128. doi: 10.11604/pamj.2016.23.128.8756.
6. Ugwuja E, Ugwu N (2009) Seroprevalence of hepatitis B surface antigen and liver function tests among adolescents in Abakaliki, south Eastern Nigeria. Internet J Trop Med 6: 1-9.
7. Agbede OO, Iseniyi JO, Kolawole MO, Ojuawo A (2007) Risk factors and seroprevalence of hepatitis B surface antigenaemia in mothers and their pre-school age children in Ilorin, Nigeria. Therapy 4: 67-72. doi: 10.2217/14750708.4.1.67.
8. Adoga, MP, Gyar, SD, Pechulano S, Bashayi, OD, Emiasegen, SE, Zungwe T, Iperepolu OH, Agupugo C, Agwale, SM (2010) Hepatitis B virus infection in apparently healthy urban Nigerians: data from pre-vaccination tests. J Infect Dev Ctries 4: 397-400.
9. Abiodun PO, Okolo SN (1991) Hepatitis B surface antigenamia in in and outpatient children at University of Benin Teaching Hospital. Nig J Paediatr 18: 105-112.
10. Chukwuka JO, Ezechukwu CC, Egbuonu I (2003) Cultural influences on hepatitis B surface antigen seropositivity in primary school children in Nnewi. Nig J Paediatr 30: 140-142. doi: 10:4314/njp.v30i4.12077.
11. Bukbuk DN, Barsi AP, Mungoro ZM (2005) Seroprevalence of hepatitis surface antigen among primary school pupils in rural Hawal valley, Borno State, Nigeria. Niger J Commun Med Prim Health Care 17: 20-23.doi: 10.4314/jcmphc.v17i1.32420.
12. Donbraye E, Japhet MO, Adesina AO, Abayomi OA (2014) Prevalence of asymptomatic hepatitis B virus surface antigenemia in children in llesha, Osun state, south-Western Nigeria. Afr J Micro Res 8: 2329-2331. doi: 10.5897/AJMR11.1118.
13. Lawal MA, Adeniyi OF, Akintan PE, Salako AO, Omotosho OS, Temiye EO (2020) Prevalence of and risk factors for hepatitis B and C viral co-infections in HIV infected children in Lagos, Nigeria. PLoS ONE 15: e0243656. doi: 10.1371/journal.pone.0243656.
14. Anigilaje EA, Olutola A (2013) Prevalence and clinical and immunovirological profile of human immunodeficiency virus-hepatitis B coinfection among children in an antiretroviral therapy programme in Benue State, Nigeria. ISRN Pediatrics volume 2013, Article ID: 932697. doi.org/10.1155/2013/932697.
15. Sadoh AE, Sadoh WE, Iduoriyekemwen J (2011) HIV co-infection with hepatitis B and C viruses among Nigerian children in an antiretroviral treatment programme. SA J Child Health 5: 7-10. doi: 10.7196/sajch.295.
16. Rawizza H, Ochigbo S, Chang C, Melonil M, Oguche S, Osinusil K, Ekong E, Kanki P. (2010) Prevalence of hepatitis co-infection among HIV infected Nigerian children in the Harvard PEPFAR ART program. In Proceedings of the 17th Conference on Retroviruses and Opportunistic Infections. February 2010, San Francisco, NC, USA, Poster abstract S-181, Avaliable: http://retroconference.org/2010/Abstracts/39148.htm. Accessed: 22 Oct 2022.
17. Ashir GM, Rabasa AI, Gofama MM, Bukbuk D, Abubakar H, and Farouk GA (2009) Study of hepatic functions and prevalence of hepatitis B surface antigenaemia in Nigerian children with human immunodeficiency virus infection. Niger J Med 18: 260–262. doi: 10.4314/njm.v18i3.51171.
18. Puoti M, Torti C, Bruno R, Filice G, Carosi G (2006) Natural history of chronic hepatitis B in co-infected patients. J Hepatol 44: S65-70. doi: 10.1016/j.jhep.2005.11.015.
19. Awoleye OJ, Thron C (2015) Determinants of human immunodeficiency virus (HIV) infection in Nigeria: A synthesis of the literature. J AIDS HIV Res. 7: 117–29. doi: 10.5897/JAHR2015.0338.
20. Khakshour A, Moghadam HT, Kiani MA, Saeidi M, Zarif B (2014) Key facts about epidemiology of HIV/AIDS in children worldwide. Int J Pediatr. 2: 145–52. doi: 10.22038/ijp.2014.2508.
21. World Health Organization (WHO) (2010) Antiretroviral therapy for HIV infection in adults and adolescents: Recommendations for a public health approach. Geneva, 63p.
22. World Health Organization (WHO) (2021) Global Health Sector Strategy on viral hepatitis 2016-2021. Available:

https://www.who.int/publications-detail-redirect/WHO-HIV-2016.06. Accessed 26 February 2023.
23. Araoye MO (2004) Subject selection. In Araoye MO (editor) Research methodology with statistics for health and social sciences. Ilorin: Nathadex, 115-129.
24. Olusanya O, Okpere E, Ezimokhai M (1985) The importance of social class in voluntary fertility control in developing country. West Afr J Med 4: 205-212.
25. Langat B, Muge EK, Night D, Okoth F, Ochwedo KO, Songok EM (2023) Sero-prevalence of hepatitis B virus and compliance with hepatitis B vaccination schedules among outpatient clinic attendees in Nairobi. PLoS ONE 18: e0281256. doi: 10.1371/journal.pone.0281256.
26. Telatela SP, Matee MI, Munubhi EK (2007) Seroprevalence of hepatitis B and C viral co-infections among children infected with human immunodeficiency virus attending the paediatric HIV care and treatment center at Muhimbili National Hospital in Dar-es Salaam, Tanzania. BMC Public Health 7: 338-343. doi:10.1186/1471-2458-7-338.
27. Abera B, Zenebe Y, Mulu W, Kibret M and Kahsu G (2014) Seroprevalence of hepatitis B and C viruses and risk factors in HIV infected children at the felgehiwot referral hospital, Ethiopia. BMC Res Notes 7:838. doi:10.1186;1756-0500-7-838.
28. Musa BM, Bussell S, Borodo MM, Samaila AA, Femi OL (2015) Prevalence of hepatitis B virus infection in Nigeria, 2000-2013: a systematic review and meta-analysis. Niger J Clin Pract 18: 163-172. doi: 10.4103/1119-3077.151035
29. Nwolisa E, Mbanefo F, Ezeogu J, Amadi P (2013) Prevalence of Hepatitis B co-infection amongst HIV infected children attending a care and treatment centre in Owerri, South-eastern Nigeria. Pan Afr Med J 14.89. doi: 10.11604/pamj.2013.14.89.1711.
30. World Health Organizaation (WHO) (2021) Hepatitis B in the WHO European Region. Available: https://www.who.int/europe/publications/m/item/factsheet---hepatitis-b-in-the-who-european-region. Accessed: 16 April 2024.
31. Hepatitis B Foundation (2016) National Guidelines for the Prevention, Care and Treatment of Viral Hepatitis in Nigeria. Management of hepatitis B. Available: https://www.hepb.org/assets/Uploads/Nigeria-Hepatitis-Guidelines-TX-guidelines.pdf. Accessed: 16 April 2024.
32. Njuguna HN, Hiebert L, Gupta N, War JW (2023) Status of HBV birth dose vaccination in Africa: the impact of COVID-19 and Gavi support on policy development. Lancet Gastroenterol Hepatol 8: 502-503. doi: 10.1016/52468-1253(23)00071-7.
33. National Population Commission (NPC) [Nigeria] and ICF International (2014) Nigeria Demographic and Health Survey 2018. Abuja, Nigeria, and Rockville, Maryland, USA: NPC and ICF International. Available: https://dhsprogram.com/pubs/pdf/SR264/SR264.pdf. Accessed: 16 April 2024.
34. Khetsuriani N, Lesi O, Desai S, Armstrong PA, Tohme RA (2022) Progress toward the elimination of mother-to-child transmission of hepatitis B virus – worldwide, 2016–2021. MMWR Morb Mortal Wkly Rep 71: 958–963. doi: 10.15585/mmwr.mm7130a2.
35. Belle Jarvis S, Fenton-Lee T, Small S (2024) Introduction of the hepatitis B vaccine – birth dose: Methods of improving rates in a milieu of vaccine hesitancy. Vaccines 12: 25. doi: 10.3390/vaccines12010025.
36. Ogundele OA, Ogundele T, Beloved O (2020) Vaccine hesitancy in Nigeria: Contributing factors – way forward. Niger J Gen Pract 18:1-4 doi: 10.60787/njgp.v18i1.28.
37. Ministry of Health, Brazil (2008) Instructional material for training in surveillance of viral hepatitis. Available: http://www.aids.gov.br/sites/default/files/cbve_hepatites.pdf Accessed: 25 February 2023.
38. Meremikwu MM, Okomo U (2011) Sickle cell disease. BMJ Clin Evid 2016: 2402.
39. Chukwuka JO, Ezechukwu CC, Egbuonu I (2003) Cultural influences on hepatitis B surface antigen seropositivity in primary school children in Nnewi. Niger J Paediatr 30 : 140-142. doi: 10.4314/njp.v30i4.12077.
40. Angyo IA, Yakubu AM (2001) Lack of association between some risk factors and hepatitis B surface antigenaemia in children with sickle cell anaemia. West Afr J Med 20: 214-218.
41. Jafri W, Jafri N, Yakoob J, Islam M, Tirmizi SF, Jafar T, Akhtar S, Hamid S, Shah HA, Nizami S (2006) Hepatitis B and C: prevalence and risk factors associated with seropositivity among children in Karachi, Pakistan. BMC Infect Dis 6: 101-110. doi: 10.1186/1471-2334-6-101.
42. Ikobah JM, Okpara HC, Agbor IE, Etuk IS, Ekanem EE (2017) Asymptomatic hepatitis C infection in Nigerian adolescents. EC Gastroenterol Dig Syst 4: 113-118.
43. Rouet F, Chaix ML, Inwoley A, Anaky MF, Fassinou P, Kpozehouen A, Rouzioux C, Blanche S, Msellati P; Programme Enfant Yopougon (Agence Nationale de Recherches sur le SIDA et les Hepatites Virales B et C 1244/1278) (2008) Frequent occurrence of chronic hepatitis B virus infection among West African HIV type-1-infected children. Clin Infect Dis. 46: 361–366. doi: 10.1086/525531.
44. Miyanga SA, Shindano TA, Shindano EM, Kyambikwa CB, Kabinda JM (2023) Prevalence of hepatitis B and C viral co-infection and associated factors with HIV infection in children in South Kivu, Democratic Republic of the Congo. BMC Infect Dis 23: 531. doi: 10.1186/s12879-023-08474-8.
45. Scaraveli NG, Passos AM, Voigt AR, Livramento Ad, Tonial G, Treitinger A, Spada C (2011) Seroprevalence of hepatitis B and hepatitis C markers in adolescents in Southern Brazil. Cad Saude Publica 27: 753-758. doi: 10.1590/s0102-311x2011000400014.
46. National Blood Transfusion Service, Federal Ministry of Health (Nigeria) (2006) The National Blood Policy. FMOH_Nigerian_National_Blood_Policy.pdf Available: http://nairametrics.com. Accessed:25 February 2023.
47. Durowaye MO, Ernest SK, Ojuawo IA (2014) Prevalence of HIV co-infection with hepatitis B and C viruses among children at a tertiary hospital in Ilorin, Nigeria. Int J Clin Med 1: 42-47. doi: 10.4236/ijcm.2016.74030.

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