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Seroprevalence of Hepatitis B-surface Antigenemia (HBsAg) among Health Workers in a South-eastern Nigerian Tertiary Health Center

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Abstract

Background: Hepatitis B virus infection is a major public health problem of this age responsible for chronic infections, HBV-related liver disease or hepatocellular carcinoma. As a result of its mode of transmission (Sexual and Transfusion transmissible infection), HBV is an important occupational hazard to the general populace and in particular to health care providers. However, it is preventable by immunization. The aim of this study was to analyze the seroprevalence of HBsAg among health workers and possible risk factors of contamination. Blood samples from 275 consented health workers were tested for HBsAg using third generation ELISA. Data analysis was obtained using SPSS version 20. HBsAg screening was performed on a consecutive sample of 275 respondents (95 males and 180 females with M/F ratio of 1:1.9) aged 18-59 years who voluntarily turned up for the survey. Mean age ± SD was 36.1 ± 9.6 years. The overall prevalence of HBV was 1.5% (4/275). The prevalence in females 3/180 (1.7%) was insignificantly higher than in males 1/95 (1.1%) (P>0.05). In relation to age group, the younger age group (< 20 years) has significantly higher prevalence (1/5 (20%) compared to other age groups (P=0.02). Blood transfusion and vaginal discharge (STD) were the highest predisposing factors to HBV infection with ORs of 5.9 and 4.2 respectively. This study showed a decline in overall prevalence of HBV in South-eastern Nigeria. However, the younger and older age groups of the population were mostly at risk. There is need to institute targeted group health education and national guidelines for hepatitis B prevention and treatment in Nigeria.

Keywords: Seroprevalence; HBsAg; Health Workers; Risk factors; South eastern Nigeria.

Introduction

Infection with hepatitis B virus (HBV) is one of the major public health problems worldwide [1, 2]. About one-third of the world's population (approximately 2 billion people) has serological evidence of infection with hepatitis B virus (HBV) [2, 3]. There are well over 350 million people with chronic HBV infections globally with annual mortality rate of 0.6 - 1 million from chronic liver disease, including liver cirrhosis and hepatocellular carcinoma [2, 4]. HBV infection endemicity varies greatly depending on geographical region but majority of those infected (approximately 45% of the global HBV populations) are in developing countries especially in Asia and Africa [2, 5]. Nigeria is a hyper-endemic area [4, 6, 7] with infected population of 18 million though the carriage rates vary widely between 2-20% [7 - 11] depending on the population studied but with a median of about 10.3% [7], though much higher figures have been reported [12 - 14]. However, the epidemiological scenario of HBV has been changing rapidly over the last two decades globally, possibly due to immunization program initiated by the World Health Organization [15].

HBV is a member of the Hepadnaviridae family, genus orthohepatodnavirus [16, 17]. It is a partially double-stranded enveloped DNA virus with about 3200 nucleotides in its genome. HBV is the smallest known DNA virus [18] and the only pathogenic hepadna virus in which the proteins and genome were clearly identified and characterized. The hepatitis B surface antigen, HBsAg (formerly known as "Australian antigen") was first recognized in 1968 in an Australian aborigine [19]. In 1970, Dane and colleagues first described the 42 nm particles that are the hepatitis B virions. The viral nature of Dane particles was confirmed by the detection of an endogenous DNA-dependent DNA polymerase within their core. HBV infected cell produce multiple virus related particles [20]. Electron microscopy of HBsAg positive serum reveals three morphologic forms: the 22-nm size spheres which are actually the HBsAg. They are the most numerous existing separately from the whole virion [21]. These are followed by the 20 nm diameter filamentous forms and the 200 nm variable length. The third forms are the double shelled particles with diameter of 42 nm. These are the complete and intact infective virions, the Dane particles [22, 23].

There are about four major serological subtypes (adr, adw, ayw and ayr) and seven genotypes (A-H) of HBV. Each of the HBV genotypes has a distinctive geographical distribution which provides a valuable epidemiological marker for identifying the source of a particular infection [24]. For example, Genotype A (mainly found in North West Europe, North America and Central Africa), B and C (South East Asia including China, Taiwan and Japan); D (southern Europe, India and the Middle East); E (West Africa); F (South and Central America); G (France and USA); and H (Central and South America). All HBV subtypes share one common antigenic determinant –"a". Thus, antibodies to the "a" determinant confer protection to all HBV subtypes.

The serologic and virologic markers elaborated during HBV infection may include: HBsAg, anti-HBc, anti-HBs, HBeAg, anti-HBe and HBV DNA. Among these immunologic and virologic markers, HBsAg is the first marker detectable in serum following HBV infection [21]. It appears late in the incubation period (4th-10thweek) declining to undetectable levels in 3-6 months. Its presence indicates infectivity of blood rarely persisting beyond six months except in chronic infections. When HBsAg disappears in the period of convalescence ('window' period), antibody to hepatitis B surface antigen (anti-HBs) becomes detectable in serum and remains in the serum for longer period of time. High titre of anti-HBs is an indication of immunity [25].

Anti-HBc is readily detectable in the serum after appearance of HBsAg but weeks or months before anti-HBs is detected. Anti-HBs is usually not present until HBsAg has disappeared and a variable period of weeks separate disappearance of the latter and appearance of the former creating a window period in which only anti-HBc represents serological evidence of current or recent HBV infection. Most cases of isolated anti-HBc represent hepatitis B infection in the remote past. Anti-HBc of the IgM class predominates during the first six months while IgG anti-HBc is usually isolated in the rare patient with chronic hepatitis B whose HBsAg is below the sensitivity threshold of contemporary immunoassays (a low-level carrier). Generally, in persons who have recovered from hepatitis B, anti-HBs and anti-HBc persist for long time.

HBeAg may be detected in the serum concurrently or shortly after appearance of HBsAg. Its appearance coincides with high levels of virus replication reflecting presence of circulating intact virions and detectable HBV DNA. The exception is in patients with precore mutations who do not synthesize hepatitis B e antigen (HBeAg). In self-limiting HBV infections, HBeAg becomes undetectable shortly after elevation of aminotransferase activity, but before the disappearance of HBsAg, anti-HBe becomes detectable, coinciding with the period of relatively lower infectivity and clinical resolution of infection. Although the presence of HBeAg reflects continued viral replication, HBeAg is only a qualitative marker while HBV DNA is quantitative indicator.

Generally, in persons who have recovered from hepatitis B infection, anti-HBs and anti-HBc persist for long time. The temporal association between the appearance of anti-HBs and resolution of HBV infection as well as the observation that persons with anti-HBs in serum are protected against re-infection with HBV suggests that anti-HBs are the protective antibody. Therefore, strategies for prevention of HBV are based on providing susceptible persons with circulating anti-HBs [21, 25].

In hepatitis B primary infection, HBsAg is detectable in the serum within the fourth and sixth weeks of incubation period. This is followed by rise in total anti-HBc antibody titre in the serum. There may or may not be a rise in circulating HBeAg. A high HBV DNA may be recorded. At high HBV DNA replication rate (i.e. 10^9-10^{10}) the HBV infection becomes highly contagious. However, decrease in HBsAg correlates with onset of T-cell mediated immunity response. Also, when present, correlates with onset of elevated liver enzymes. Traditionally, conversion to anti-HBs antibody signal cure. Sometimes HIV DNA may persist for years to lifetime.

The various mode of transmission of HBV include unprotected sexual intercourse, intravenous drug abuse, transfusion of infected blood, horizontal transmission in childhood, perinatal transmission from infected mother to the baby and occupational exposure especially among health-care providers. According to center for disease control 1992 report, heterosexual intercourse and transfusion of hepatitis B infected blood rank highest among the risk factors responsible for HBV transmission in adulthood while perinatal transmission from infected mothers ranks highest in newborns in endemic regions.

This study aimed at determining the seroprevalence of Hepatitis B surface antigen among the staffs of Federal Medical centre, Umuahia, a south eastern Nigerian Tertiary Hospital. Also, possible risk factors that will determine the HBV status of an individual and the primary interventionary mechanisms will be explored in this study.

Methodology

This cross sectional study was conducted at the Department of Hematology, Federal Medical Centre, Umuahia, Abia state Nigeria during the period of June, 2013 after duly obtaining ethical clearance from the same hospital. Federal Medical center, Umuahia is the only federal tertiary health center in Abia state, south eastern Nigeria. It subserves the state and other neighboring states in the south eastern zone of Nigeria. A total of 275 staffs of Federal Medical Center, Umuahia who gave consent to participate in the study were recruited. The inclusion criterion was that the participant must be a staff of Federal Medical Centre, Umuahia. Participants who were recently immunized against HBsAg were excluded from the study. The bio-data which include personal and demographic information such as age, sex as well as medical history regarding risk factors and all other relevant information were collected with the aid of pretested self-administered questionnaire to the consenting participant who met the inclusion and exclusion criteria. Each participant completed a serially numbered questionnaire administered by the researcher after being duly informed on the intended study. The study was at no cost to the participants. Confidentiality of participant information was also maintained.

Five milliliters (5ml) of venous blood was collected aseptically from each participant and emptied into a sterile labelled plain vacutainer tube. Blood was allowed to clot by standing at room temperature and then spun in a centrifuge at 2500 rpm for 5 minutes to separate the serum. The serum was disposed in a clean dry glass tube and used to test for HBsAg using third generation National AIDS Control Organization (NACO) approved Enzyme-Linked Immunosorbent Assay (ELISA); CTK Biotech, onsite rapid HBsAg test kit (LOT:F1214H1). The test was done following manufacturer's instructions and the results interpreted and documented accordingly. Every reactive sample was re-tested for confirmation before labeling it seropositive.

Statistical Analysis

Data obtained were entered and analyzed with SPSS version 20. The association between categorical variables was tested using Chi square (X^2) test. $P<0.05$ is considered statistically significant.

Results

A total of 275 respondents were recruited for the study. The age range of respondents was 18-59 years with mean age of 36.1 ± 9.6. Females (n=180; 65.5%), constituted the majority, while males accounted for 95 (34.5%) with female to male ratio of 1.9:1. Five (1.8%) of the respondents were less than 20 years while 34 (12.4%) were above 50 years. The highest number of respondents was in the 30-39 (n=104; 37.8%) and 20-29 (n=74; 26.9%) years age brackets. Majority of the respondents were married (n=169; 61.5%), while single respondents accounted for 92(35.5%). Ten (3.6%) of the respondents were widowed. Those with tertiary education (n=232; 84.4%) were the highest respondents, followed by secondary (n=33; 12.3%) and primary (n=10; 3.6%) education respectively (Tables 1 and 2).

Four (1.5%) out of the two hundred and seventy five respondents were HBsAg seropositive. The female gender recorded the highest prevalence rate (3/180; 1.7%) compared to male counterpart (1/95; 1.0%), but this was not statistically significant ($p>0.05$) (Figures 1 and 2). The age groups <20 and 40-49 years have the highest prevalence rates of 1(20.0%) and 2(3.5%) respectively. There was no HBV infection recorded in the age groups 30-39 and 50-59 years. The highest prevalence rate of HBV was found in respondents with secondary (1/33; 3.0%) compared to tertiary (3/233; 1.2%) education (Table 2).

The clinical variables with the highest prevalence rates of HBsAg were previous blood transfusion 1(6.7%) and vaginal discharge 1(6.2%) followed by previous intravenous drug use 1(1.3%) and surgery 1(1.2%) respectively. However, these were not statistically significant. There was no HBsAg seropositive respondent with a past history of STI, hepatitis and scarification/tatoon marks from this study (Table 3).

Table 1: General characteristics of staff in the study

Characteristics	**Male n = 95 N (%)**	**Female n = 180 N (%)**	**Total n = 275 N (%)**
Age of respondents (years)			
< 20	0	5(1.8)	5(1.8)
20 - 29	18(18.9)	56(31.1)	74(26.9)
30 -39	43(45.3)	61(33.9)	104(37.8)
40 - 49	21(22.1)	37(20.6)	58(21.1)
50 - 59	13(13.7)	21(11.7)	34(12.4)
Total	95 (100)	180 (100)	275 (100)
Marital status			
Single	33(34.7)	63(35.0)	96(35.0)
Widowed	2(2.1)	8(4.4)	10(3.6)
Married	60(63.2)	109(60.6)	169(61.4)
Highest Level of Education			
Primary	6 (6.3)	4 (2.2)	10(3.6)
Secondary	10 (10.5)	23 (12.8)	33(12.3)
Tertiary	79 (83.2)	153 (85)	232 (84.4)
Total	95 (100)	180 (100)	275(100)

Note: Mean age; median age 37.2±8.9, 35.5±9.8, 36.1±9.6

Table 2: Socio-demographic characteristics by HBsAg status

Variable	**HBsAg Positive n = 4 N (%)**	**HBsAg Negative n = 271 N (%)**	**Total**	***FT***	**p value**
Sex					
Male	1(1.1)	94(98.9)	95(34.5)	0.16	1.0
Female	3(1.7)	177(98.3)	180(65.5)		
HIV					
Negative	2(1.0)	202(99.0)	204(74.2)	4.29	0.21
Positive	0	25(100)	25(9.1)		
Unknown	2(4.3)	44(95.7)	46(16.7)		
Level of education					
Primary	0	10(100)	10(3.6)	1.66	0.5
Secondary	1(3.1)	32(96.9)	33(12.0)		
Tertiary	3(1.3)	229(98.7)	232(84.4)		
Marital status					
Single	2(2.1)	94(97.9)	96(35.0)	2.23	1.0
Married	2(1.2)	167(98.8)	169(61.5)		
Widowed	0	10(100)	10(3.5)		
Age Group (years)					
<20	1(20.0)	**4(80.0)**	**5(1.8)**		**0.02**
20-29	**1(1.4)**	**73(98.6)**	**74(26.9)**		
30-39	**0**	104(100.0)	**104(37.44)**		
40-49	**2(3.5)**	**56(96.5)**	**58(20.88)**		
50-59	**0**	**34(100.0)**	**34(12.24)**		

Figure 1: Pie Chart showing the distribution of staff by HBsAg

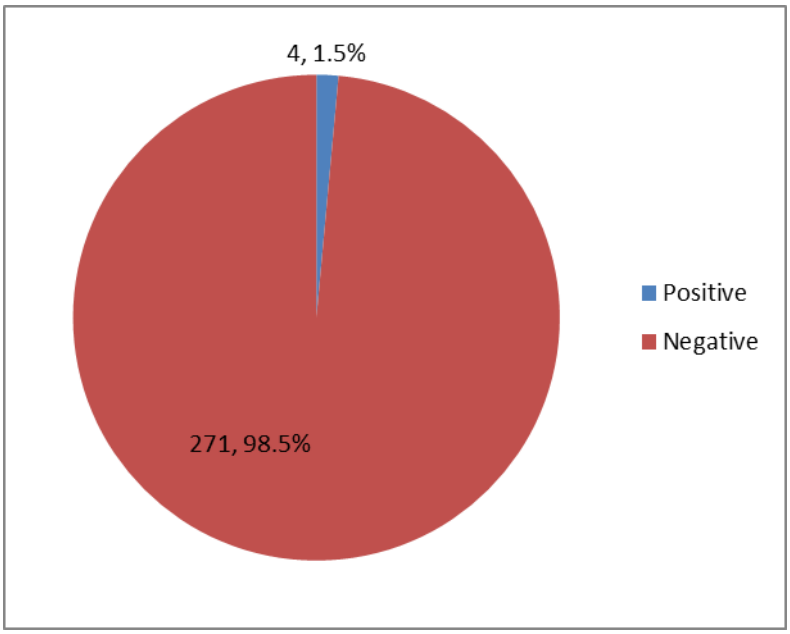

Figure 2: Distribution of HBsAg status by gender

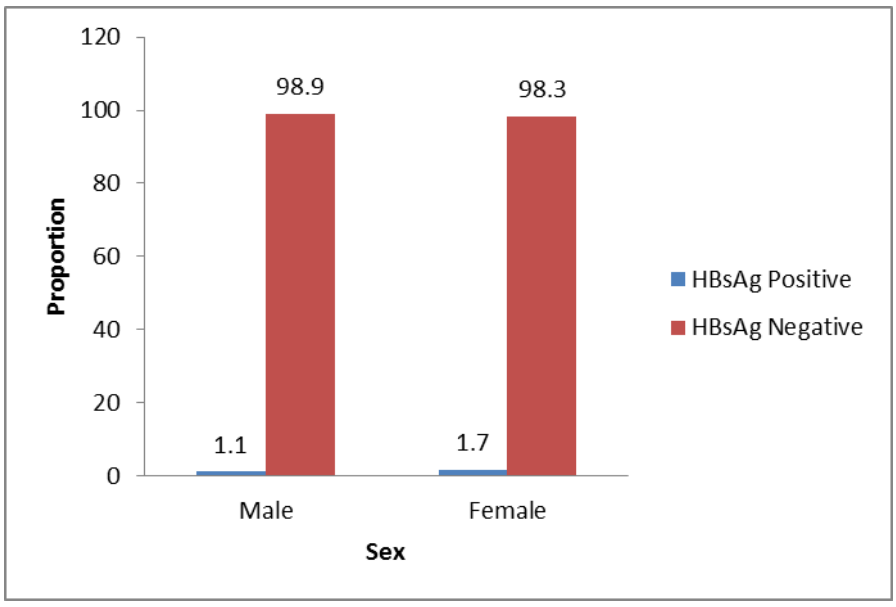

Table 3: Distribution of clinical history among staff by HBSAg results.

Variable	HBsAg Positive n = 4 N (%)	HBsAg Negative n = 271 N (%)	Total	*FT*	p value
Past History of STI					
No	4(1.5)	268(98.5)	272(98.9)	0.05	1.0
Yes	0	3(100)	3(1.1)		
Past history of vaginal discharge					
No	3(1.2)	256(98.8)	259(94.2)	2.73	0.21
Yes	1(6.2)	15(93.8)	16(5.8)		
Past history of genital ulcer					
No	4(1.5)	267(98.5)	271(98.5)	0.06	1.0
Yes	0	4(100)	4(1.5)		
Past history of dental/surgery					
No	3(1.5)	192(98.5)	195(70.9)	0.03	1.0
Yes	1(1.2)	79(98.8)	80(29.1)		
History of IV drug use					
No	3(1.5)	196(98.5)	199(72.4)	0.01	1.0
Yes	1(1.3)	75(98.7)	76(27.6)		
History of scarification/tattoo					
No	4(1.5)	262(98.5)	266(96.7)	0.14	1.0
Yes	0	9(100)	9(3.3)		
History of blood transfusion					
No	3(1.2)	257(98.8)	260(94.5)	3.0	0.20
Yes	1(6.7)	14(93.3)	15(5.5)		
Past History of contact-jaundice					
No	4(1.8)	223(98.2)	227(82.5)	0.86	1.0
Yes	0	48(100)	48(17.5)		
Past history hepatitis					
No	4(1.5)	259(98.5)	263(95.6)	0.19	1.0
Yes	0	12(100)	12(4.4)		
Past history of jaundice					
No	4(1.5)	270(98.5)	274(99.6)	0.02	1.0
Yes	0	1(100)	1(0.4)		

Note: FT – Fischer's Exact test used when and expected cell count is less than 5

Discussion

In our study, females were the predominant respondents, constituting 180 (65.5%), with male: female ratio of 1:1.9. This is at variance with the ratio of 1.3:1 reported by Sirisena, et al. [7] in a similar study in an urban community in Jos, but similar to a report from Turkey where 62.7% were female donors while 37.3% were male [26]. The gender ratio of this study represents apparently healthy individuals who voluntarily turned up for the survey. It is not a good representation of the male: female ratio in blood donation in Nigeria. Majority of our respondents were married healthy adults, between 30 to 49 years with mean age ± SD of 36.1 ± 9.6 years. This agrees with mean age of 32.58 ±10.24 reported by Buseri, et al. [27].

Seroprevalence of HBsAg in this study was 1.5%. This value is lower than 7.5%, 15.1% and 14.3% earlier reported by Onoja, et al. [28], Egah, et al. [29], and Uneke, et al. [30] respectively among blood donors in Jos, North central Nigeria. It is also lower than 13.22% reported by Fasciola, et al. [31] in Ibadan, 7.50% by Salawu, et al. [32] in Ile-Ife, south western Nigeria and 5.6% reported by Okocha, et al. [33] in Nnewi, South eastern Nigeria. Findings in some Asian part of the world such as Karnataka in India showed a prevalence of 3.2% in pre-transfusion blood donors [34]. However, this value was in keeping with 1.7% reported by Arora, et al. [35] in Southern Haryana and higher than 0.3% reported by Nwokeukwu, et al. [36] among blood donors in Umuahia, South eastern Nigeria. These findings are in keeping with previous observations that in Nigeria, the prevalence of HBsAg seropositivity increase as one migrates from the south to the North though the reason is yet to be clearly understood [37, 38]. This, therefore, calls for an in-depth study of the characteristics of the different serotypes of HBV found in the various geopolitical zones of Nigeria.

The study showed that prevalence of HBsAg positivity was higher in females than males. The percentages were 1.7% versus 1.1%. However, this was not statistically significant (P = 1.0). Similar pattern in a similar study was obtained by Okocha, et al. [33] from Nnewi, where the prevalence was 5% and 8.5% in males and females respectively. However, in the study, the difference was statistically significant (P = 0.04) while the odd ratio showed males were 0.5 times less likely to be HBsAg positive than females. Similarly, Sirisena, et al. [7] recorded a statistically higher prevalence of HBsAg in females (13.0%) compared to their male counterpart (8.2%) from their study in Jos, Nigeria.

The effect of age on the prevalence of HBV infection was remarkable in this study. It showed a reduction in the prevalence of HBsAg with advancing age with the highest in those aged <20 years (20%) and the least in those above 50 years (0%). This relationship was found to be statistically significant (P=0.02). This finding was similar to that obtained by Okocha, et al. [33] where they found a decreasing prevalence of HBsAg positivity with advancing age (i.e, 18.6% in those <20 years and 2.9% in those >50 years) with a statistically P trend (P = 0.005). However, this pattern tend to differ in similar study by Sirisena, et al. [7] in North central Nigeria where the prevalence tend to follow a non-uniform pattern with the highest prevalence in the age group above 60 years (21.4%) while the least prevalence was between 31-40 years (6.1%). In our study, no HBsAg seropositivity was recorded between age group of 30-39 years.

This study showed HBsAg prevalence decreased with increasing educational level with the highest prevalence in secondary population (3.1%) while the least was with tertiary population (1.3%). Although the difference was not statistically significant, it was in keeping with similar studies in China [39] where epidemiological serosurvey of hepatitis B in a population of children and adult 1-59 years of age following hepatitis B immunization showed highest prevalence among illiterate population (9.7%) while undergraduate population recorded 3.1%. In the same study, a multivariable logistic regression to identify factors that will affect prevalence of HBsAg in a population identified education as one of the independent variables that can predict the HBsAg status of an individual. Other independent variables include gender, location (urban versus rural community), ethnicity, occupation, and immunization history. Xiaofeng, et al. [39] in their study identified vaccination status as the strongest predictor of HBsAg status (with unvaccinated status carrying an OR of 2.5).

This study showed previous history of blood transfusion as the clinical variable with the highest prevalence HBsAg (6.7%). Again, this was not unexpected as hepatitis B virus is a transfusion transmissible infectious agent. Previous studies have shown unsafe blood transfusion practice as one of the modes of transmission of HBV infection especially in resource-limited centers of sub-Saharan Africa where the standard of screening is poor and commercial (remunerated) blood donation constitute major source of blood supply in the national blood transfusion centers [36, 40]. The odd ratio (OR) of previous blood transfusion from this study was 5.2. Therefore, exposure to blood transfusion carries a high risk on the HBV status of an individual.

This study also showed that previous history of vaginal discharge was associated with high prevalence of HBV. About 6.2% of HBsAg seropositive patients presented with vaginal discharge. Kura, et al. [41] reported similar high prevalence of HBV infection (8.8%) among STD clinic attendee in Bombay, India. This finding underscores the need to provide HBV vaccine to commercial sex workers and their clients in India. HBV infection is a sexually transmitted infection and can co-exist with other ulcerative STIs such as chancroid, gonorrhea, syphilis and genital herpes just to mention a few. Therefore, the clinician should exercise a high index of suspicion of HBV in patient who presents with vaginal discharge in the clinic and such patient must be screened for Hepatitis B virus. Other clinical variables which are risk factors of HBV infection include intravenous drug abuse, previous surgical history, scarification/tatoon marks. Although their associations with HBV infection from this study were not statistically significant due to the sample population, they are known predisposing factors to HBV transmission. For example, tatooning was found to be independently associated with anti-HBc among STD clinic attendees in Pune, India [42].

Conclusion/Recommendations

HBV is still a public health problem globally and Nigeria is an endemic zone. Although the prevalence in the south eastern Nigeria is on the decrease, education, blood transfusion practices, sexual habits and immunization are the strong predictors of HBV status of the population.

We therefore recommend that the federal ministry of health should scale-up the awareness of HBV to the public and establish national guidelines for hepatitis B prevention and treatment in Nigeria. In this guideline or policy, they should as a matter of urgency, remove the financial barriers to access hepatitis B immunization in both children and adult population. By so doing, hepatitis B disease burden will be reduced to the barest minimum in Nigeria.

Limitation

We must acknowledge the limitations encountered in carrying out this research. For instance, we could not include other hepatitis B markers such as HBeAg, Anti-HBc, Anti-HBs, Anti-HBe and HBV DNA in our study based on financial grounds. We hope in future studies we will include these markers to produce better results.

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References

1. Maddrey WC. Hepatitis B: an important public health issue. Med Virol 2000; 61: 362-363.
2. World Health Organisation, Hepatitis B. World Health Organization Fact Sheet 204. 2000 http://www.who.inf/inf-fs/en/fact204.html.
3. Soods S., Malvankar S. Seroprevalence of hepatitis B surface antigen, antigen to hepatitis C virus and Human immunodeficiency virus in a hospital based population in Jaipur, Rajasthan. Indian J. Community Med 2010; 1: 165-169.
4. Eke AC., Eke UA., Okafor CI., Ezebialu IU., Ogbuagu C. Prevalence, correlates and pattern of hepatitis B surface antigen in a low resource setting. Virology Journal 2011; 8: 12.
5. Alavian SM., Fallahian F., Lankarani KB. Implementing strategies for hepatitis B vaccination. Saudi J Kidney Dis Transpl 2010; 21(1): 10-22.
6. Mbaawuga EM., Enenebeaku MNO., Okopi JA., Damen JG. Hepatitis B virus infection in pregnant women in Makurdi Nigeria. Afr. J. Biomed Res. 2008; 11: 155-159.
7. Sirisena ND., Njoku MO., Idoko JA., Isamade E., Barau C., Jelpe D. et al. Carriage rate of hepatitis-B surface antigen (HBsAg) in an Urban community in Jos, Plateau State, Nigeria. Niger Postgrad Med J. 2002; 9(1): 7-10.
8. Akani CI., Ojule AC., Opurum HC., Ejile AA. Seroprevalence of hepatitis B surface antigen in pregnant women in Port Harcourt, Nigeria. Niger Postgrad Med J. 2005 Dec; 12(4): 266-70.
9. Onakewhor JU., Offor E., Okonofua FE. Maternal and neonatal seroprevalence of hepatitis B surface antigen in Benin City, Nigeria. J Obstet Gynaecol 2001; 21: 583-586.
10. Kabiru AR., Oluwarotimi IA., Adeniyi AA., Olufemi MO., Temitope OO. Risk factors for hepatitis B virus infection among pregnant women in Lagos, Nigeria. Acta Obstetricia et Gynecologica Scandinavia 2010; 89(8) 1024-1028.
11. Olokoba AB., Salawu FK., Danburam A., Olokoba LB., Midala JK., Badung LH., Olatinmo AW. Hepatitis B virus infection amongst pregnant women in North-Eastern Nigeria-A calls for action. Nigerian Journal of clinical practice 2011; 14(1): 10-13.
12. Ekanem EE., Etuk IS., Uniga AJ. Features of childhood hepatic failure in Calabar, Nigeria. Niger Postgrad Med J 2001; 8: 86-9.
13. Iwalokun BA., Hodonu SO., Olaleye BM., Olabisi OA. Seroprevalence and biochemical features of hepatitis B surface antigenemia in patients with HIV-1 infection in Lagos, Nigeria.
14. Bukbuk DN., Bassi AP., Mangoro ZM. Seroprevalence of hepatitis B surface antigen among primary school pupils in rural Hawal valley, Borno state, Nigeria. Journal of Community Medicine and Primary Health Care.2005; 17(1): 20-23.
15. Komas NP., Bai-Sepou S., Manirakiza A., Leal J., Bere A., Le Faou A. The prevalence of hepatitis B virus markers in a cohort of students in Bangui, Central African Republic. BMC Infect Dis. 2010, 29; 10: 22.
16. Brooks GF. Hepatitis viruses. In Butel JS, Muse SA. (Editors): Medical Microbiology. Boston McGraw Hill. 23rd Edition 2004: 466-476.
17. Robinson WS. The genome of hepatitis B virus. Annu Rev Microbiol 1977; 31: 357-77.
18. Kao JH.,Chen DS. Global control of Hepatitis B virus Infection. The Lancet Infectious Diseases 2002; 2: 395-403.
19. Okochi K., Murakanmi S. Observations on Australia antigen in Japanese. Vox Sang 1968; 15: 375-85.
20. Kaplan PM., Greenman RL, Gerin JL., Purcell RH, Robinson WS. DNA polymerase associated with human hepatitis B antigen. J Virol 1973; 12: 995-1054.
21. Acute Viral hepatitis. In Fausi, Braunwald E., Kasper DL., Hauser SL, et al. (Editors): Harrison's principles of Internal medicine. 17th Edition. New York McGraw hill. 2008.

22. Dane DS., Cameron CH., Briggs M. Virus-like particles in serum of patients with Australia-antigen-associated hepatitis. Lancet 1970; 1: 695-98.
23. Emechebe GO., Emodi IJ., Ikefuna AN., Ilechukwu GC., Igwe WC., Ejiofor OS, et al. Hepatitis B virus infection in Nigeria-A Review. Niger Med J 2009; 50(1): 18-22.
24. Scheiblauer H., El-Nageh M., Diaz S., Nick S., Zeichhardt H., Grunert HP., Prince A. Performance evaluation of 70 hepatitis B virus (HBV) surface antigen (HBsAg) assays from around the world by a geographically diverse panel with an array of HBV genotypes and HBsAg subtypes. Vox Sang 2010; 98: 403-414.
25. Arevalo JA., Hepatitis B in Pregnancy. West J Med 1989; 150: 668-674. Result of FMC staff HBSAg survey.
26. Kose S, Mandiracioglu A, Cavdar G, Ulu Y, Turken M, et al. Seroprevalence of hepatitis B and C: A community based study conducted in Izmir, Turkey. Kafkas J Med Sci 2014, 4: 95-101.
27. Buseri FI, Muhibi MA, Jeremiah ZA. Sero-epidemiology of transfusion-transmissible infectious disease among blood donors in Osogbo, south-west Nigeria. Blood Transfu 7: 293-299.
28. Onoja AM, Orkuma JA, Nwannadi AI, Ejele OA, Egesi OJ, et al. Seroepidemiology of Some Transfusion Transmissible Viral Infections in Jos, North-Central Nigeria. J Blood Lymph 2015, 5:142. Doi: 10.4172/2165-7831.1000142.
29. Egah DZ, Banwat EB, Audu ES, Iya D, Mandong BM, et al. Hepatitis B surface antigen, hepatitis C and HIV antibodies in a low-risk blood donor group, Nigeria. East Mediterr Health J 2007, 13: 961-966.
30. Uneke CJ, Ogbu O, Inyama PU, Anyanwu GI, Njoku MO, et al. Prevalence of hepatitis-B surface antigen among blood donors and human immunodeficiency viral-infected patients in Jos, Nigeria. Mem Inst Oswaldo Cruz 2005, 100: 13-16.
31. Fasola FA, Odaibo GN, Aken'Ova YA, Olaleye OD. Hepatitis B and C viral markers in patients with sickle cell disease in Ibadan, Nigeria. Afr J Med Sci 2003, 32: 293-295.
32. Salawu I, Murainah HA. Pre-donation screening of intending blood donors for antibodies to infectious agents in a Nigerian tertiary health institution: a pilot study. Afr J Med Sci 2006, 35: 453-456.
33. Okocha EC, Oguejiofor OC, Odenigbo CU, Okonkwo UC and Asomugha L. Prevalence of hepatitis B surface antigen seropositivity among HIV-infected and non-infected individuals in Nnewi, Nigeria. Niger Med J. 2012; 53(4): 249-253.
34. Kulkarni N. Analysis of the seroprevalence of HIV, HBsAg, HCV and Syphilis infections detected in the pretransfusion blood: A short report. International Journal of Blood Transfusion and Immunohematology 2012; 2: 1-3. Doi: 10.5348/ijbti-2012-6-SR.
35. Arora D, Arora B, Khetarpal A. Seroprevalence of HIV, HBV, HCV and Syphilis in blood donors in Southern Haryana. Indian J Pathol Microbial 2010; 53(2): 308-9.
36. Nwokeukwu IH, Nwabuko CO, Chuku A, Ajuogu E & Okoh DA. Prevalence of Human Immunodeficiency virus, hepatitis B virus, hepatitis C virus, and syphilis in blood donors in a tertiary health facility in south eastern Nigeria. Hematol Leuk 2014; 2:4. Doi: 10.7243/2052-434x-2-4.
37. Ejele OA, Ojule AC. The prevalence of hepatitis B surface antigen (HBsAg) among prospective blood donors and patients in Port Harcourt, Nigeria. Niger J Med. 2004; 13(4): 336-8.
38. Ihekwaba AE, Nwankwo NC. Clinical profile of hepatocellular carcinoma at the University of Port Harcourt Teaching Hospital, Port Harcourt. Trop J Med Res 2003; 7: 26-8.
39. Xiaofeng Liang, Shengli Bi, Weizhong Yang, Longde Wang, Gang Cui, et al. Reprint of: Epidemiological serosurvey of Hepatitis B in China- Declining HBV prevalence due to Hepatitis B vaccination. Vaccine 2009; 27(47): 6550-7. Doi: 10.1016/j.vaccine.2009.08.048.
40. Nwabuko CO, Nnoli MA, Okoh DA, Chukwuonye II. Taming the tide of HIV and TTI Scourge in sub-Saharan Africa using autologous blood transfusion. Hematol Leuk 2013; Volume 1, Issue 7. Doi: 10.7243/2052-434x-1-7.
41. Kura MM, Hira S, Kohli M, Dalal PJ, Ramnani VK, et al. High occurrence of HBV among STD clinic attenders in Bombay, India. Int J STD AIDS 1998, vol.9 no.4:231-233. Doi: 10.1258/0956462981921954.
42. Risbud A, Mehendale S, Basu S, Kulkarni S, Walimbe A, et al. Prevalence and incidence of hepatitis B virus infection in STD clinic attendees in Pune, India. Sex Transm Infect 2002; 78: 169-173.