



Study on Hepatitis B Virus Infection and Risk Factors among Children in a Community, North Central Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Author JAN drafted and designed the study and performed the statistical analysis. Author SSKSO cross checked the protocol. Author VOF wrote the first draft of the manuscript. Authors JAA, VTD and ICI managed the analyses of the study. Author AOO and OON managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Background: Hepatitis B Virus (HBV) is a worldwide health issue and a source of major concern around the globe. Infections caused by hepatitis B virus pose a major challenge to public health. This study evaluates the prevalence and transmission rate of Hepatitis B Virus infection among children of primary school age at our study location.

Method: Three hundred and three (303) volunteer subjects were screened. Structured questionnaire were administered to consenting participants to determine demographic and other

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risk factors for HBV infection. Samples obtained were analysed using a Laboratory-based immunoassay-HBsAg rapid diagnostic test (RDTs) in lateral flow assays formats. Sera samples obtained were stored at -20°C prior use.

Results: Overall result showed that 46 (15.2%) were sero-positive for HBV infection. Considering age factor, Children aged 10 – 12 years showed a higher prevalence of 16(5.3%) [P-value 0.736; (P >0.05)]. Based on gender of subjects screened, a prevalence of 34(11.2%) was recorded among the males subjects compared to females with 12(4.0%) positivity, [(P < 0.05)]. Risk factors on family history recorded 13(4.3%) positivity, considering place of circumcision as risk factors among male subjects; result showed that subjects circumcised using traditional methods recorded 17 (11.7%) positivity. [P-value 0.856 (P>0.05)]. Respondents with history of cuts recorded a prevalence of 29(9.6%) positivity; [P-Value 0.362 (P>0.05)] considering enzyme assay of positive subjects, 13 (4.3%) subjects recorded an elevated Alanine transaminases.

Conclusion: The transmission rate of HBV infection among the family members was found to be high in this study. This upsurge calls for an urgent vaccination of the population by relevant healthcare providers.

Keywords: HBV infection; transmission; school age; children; prevalence.

ABBREVIATIONS

HBV : Hepatitis B Virus
RDT : Rapid Diagnostic test
ALT : Alanine transaminases
HCC : Hepatocellular Carcinoma

1. INTRODUCTION

Hepatitis B virus is one of the most infectious diseases in the world and a major public health concern [1]. The highest incidence rate is recorded in Sub-Saharan Africa and East Asia in which the infection affects 5–10% of the general populace [2]. The infection in most cases is self-limiting, but still occurs as latent. Most individuals with Chronic infection develops cirrhosis, liver failure, and end stage Hepatocellular carcinoma observed in 15–40% of patients [3]. In Nigeria, the occurrence rate of HBV has been estimated as 13.6% approximately based on a meta-analytic study and ranged from 0.5% to 46.8% with over 21 million seropositive individuals [4].

HBV infection result results in acute to fatal fulminant hepatitis [5]. However, chronic hepatitis can lead to severe complication as hepatocellular carcinoma and liver cirrhosis [6]. Findings, reveals that 80 – 95% of infants and children exposed to HBV are mostly chronic carriers of the virus. Individuals with chronic HBV infection are always asymptomatic for long periods but usually possess a high risk of developing hepatocellular carcinoma. [7].

There are definite high risk group to HBV infection, these include parenteral drug abusers, sexually promiscuous individuals, health care providers, multiple transfused persons and new-

born babies born to mothers with HBV [8,9]. The increase rate of HBV carriers globally is about 1-20%. Several regions were characterized as low, intermediate and high prevalence regions due to their disease occurrences geographically [10].

A survey of the prevalence of HBV infection in Africa showed that Mozambique ranked highest in sub – Saharan region followed by Nigeria. In Nigeria, the situation is alarming due to mass illiteracy in health related matters, ignorance of the high prevalence of the disease in the society, life style of the people and poor awareness campaign [10]. High infectious rate and ease of transmission of HBV has been severally attributed to risk factors such as through transfusion transmitted hepatitis, traditional practices like ear piercing, tattooing, circumcision in males but rarely in females, serve as a major factor to the spread of HBV in Nigeria [7,10].

2. MATERIALS AND METHODS

2.1 Study Area and Population

The study was conducted among children of a primary school aged 3-15, in Vwang district of Jos-South LGA. Subjects were recruited for the study from three [3] Locations within the community.

2.1.1 Sample size

The sample size used in this research work was obtained from Three-Hundred and three (303) volunteers. Subjects recruited for this study were informed about the study and their consents obtained. Well-structured questionnaires were

used to collect demographic data and other pertinent information.

2.1.2 Sample Size Formulae

Mode of Sample size calculation for the Prevalence of HBV determination in this study was:

$$n = \left[z^2 \times \frac{p \times q}{d^2} \right]$$

where

n = sample size

z = linked to 95% confidence interval.

p = previous prevalence.

q = 1 – p (previous non-prevalence)

d = relative desired precision

With the minimum sample size as n above, the sample size of 303 used in the study was to ensure wider coverage of the population, hence increase in precision.

2.1.3 Inclusion and exclusion criteria

Subjects with symptomatic HBV infection were included in the study while asymptomatic subjects with history of Vaccination for HBV were excluded.

2.1.4 Sample collection and processing

Three-Five (3-5) ml of blood was collected from each Volunteer using standard method. Sera obtained were dispensed into a clean, dry cryovial and stored at -20°C prior use.

2.2 Method of Assay

The sera were screened using a Laboratory-based immunoassay-HBsAg rapid diagnostic test (RDTs) kit. The HBsAg RDTs is a rapid chromatographic immunoassay for the qualitative detection of Hepatitis B surface antigen in serum or plasma, with a relative sensitivity, greater than 99%. Specificity and accuracy were 99.7% and 99.8% respectively. HBsAg RDTs have good sensitivity and excellent specificity compared to laboratory immunoassays as a reference standard. Expanding HBV diagnosis into low resource settings will require high quality but inexpensive rapid diagnostic tests (RDTs) to detect HBsAg.

2.3 Liver Function Test

The liver enzyme – Alanine aminotransferase level for sero positive subjects was determined according to manufactures instruction.

Colorimetric reagent kit manufactured by Fortress diagnostic limited, UK, was used for the ALT assay.

2.4 Data analysis

Results were presented as percentages and frequencies while statistical analyses were carried out using SPSS 10.0 software package. A p-value less than or equal 0.05 was considered significant. Chi-square (X^2) test was used for the analyses of categorical variables.

3. RESULTS

Table 1: Shows the overall seroprevalence 46(15.2%) out of 303 subjects screened for HBsAg. Three hundred and three volunteer pupils that participated in the study were made up of 91[30.0%] from Location 1, 120(39.6%) from Location 2 and 92(30.4%) from Location 3.

HBsAg seropositivity was found to be higher in Location 1 with 29(9.6%), followed by Location 3 recording 11(3.6%) and lower at Location 3 with a record of 6(2.0%). The statistical differences in HBsAg seroprevalence among the three schools were extremely significant with P-value 0.001 ($P < 0.05$).

Table 2: The study reveals the age distribution of HBV infection among the subjects screened. Children aged 10 - 12 showed a higher prevalence of 16(5.3%) followed by those aged 7 - 9 with a prevalence of 13(4.3%).subjects aged 13-15 showed a seroprevalence of 9(3.0%), and the least prevalence was recorded among volunteers aged 3-6,with 8(2.6%) seropositivity. However, statistically there was no significant difference in HBsAg seroprevalence by age with P-value 0.736 ($P > 0.05$).

Table 3: showed distribution of HBV infection based on gender among the screened subjects. A higher proportion of males 34(11.2%) were found to be seropositive compared to females 12(4.0). This difference was very significant with P-value 0.000 ($P < 0.05$).

Table 4: Showed the distribution of HBV infection based on clinical risk factors. Seroprevalence was higher in children without family history of HBV infection 33(10.9%) compared to subjects with previous family history of HBV infection 13(4.3%). Those without history of blood transfusion recorded a higher prevalence of 45(14.9%) compared to those with history of blood transfusion 1(0.3%).subjects without history of surgical operation also had a

higher seroprevalence of 44(14.5%) compared to those with history of surgical operation 2(0.7%). Statistically, there were no significant differences found in between these parameters.

Table 5: showed the distribution of HBsAg based with risk factors, Male subjects with history of circumcision at Health Facility showed a higher prevalence of 17(11.7%) out of 58 respondents while subjects circumcised through traditional methods equally showed a prevalence of 17(11.7%) out of 87 respondents. Subjects without history of tattoo showed a higher prevalence of 41(13.5%) compared with those with a History of tattoo 5(1.7%). Subjects who do not share toothbrush showed a higher prevalence of 41(13.5%) compared to those who shared toothbrush 5(1.7%). Subjects who had history cuts recorded a higher seroprevalence of 29(9.6%) compared to those who do not with a prevalence of 17(5.6%). The two categories of subjects showed no statistically significant difference.

Table 6: showed the distribution of HBsAg based on clinical features related to HBV infection. Subject without history of jaundice at or after birth recorded a higher seroprevalence of 40(13.2%) compared to subject with history of jaundice at or after birth who recorded a

prevalence of 6(2.0%). This parameter showed a statistical significance different at P-value 0.027 ($P < 0.05$). Subjects who had no recent fever showed a higher prevalence of 28(9.2%) with ($P=0.234$ ($P > 0.05$)) this compared to those who had recent fever with a prevalence of 18(5.9%). There was no significant difference among this category of risk factor. The prevalence of HBsAg in vaccinated and unvaccinated subjects was also considered. Unvaccinated subjects recorded a higher seroprevalence of 43(14.2%) seropositivity, while vaccinated subjects had a seroprevalence of 3(1.0%). However, no significant statistical difference was observed with a [P-value of 0.856; ($P > 0.05$)].

Table 7: showed serum alanine amino transferase (ALT) level in HBsAg seropositive subjects. Out of the 46(100%) HBsAg seropositive subjects, 33(71.7%) recorded normal ALT level while those with elevated ALT level recorded 13 (28.3%). Data also showed that 23 (50.0%) males subjects had normal ALT levels compared to 11(23.9%) with an elevated ALT levels. Female with normal ALT recorded 10(21.7%) compared to 2(4.3%) with an elevated ALT level. However, there was no significant difference among gender with [$P = 0.299$ ($P > 0.05$)].

Table 1. Seroprevalence of HBsAg among subjects screened based on locations

School	Total No. (%)	No positive (%)	No. Negative (%)	P-Value
Location 1	91(30.0%)	6(2.0%)	85(28.1%)	0.001
Location 2	120 (39.6%)	29(9.6%)	91(30.0%)	
Location 3	92(30.4%)	11(3.6%)	81(26.7%)	
Total	303(100.0%)	46(15.2%)	257(84.8%)	

Table 2. Distribution of HBsAg among subjects screened based an age

Age Group	Total (%)	No positive (%)	No. Negative (%)	P-Value
3 – 6	71 (23.4%)	8 (2.6%)	63(20.8%)	0.736
7 – 9	73 (24.1%)	13 (4.3%)	60(19.8%)	
10 – 12	102(33.7%)	16 (5.3%)	86(28.4%)	
13 – 15	57(18.8%)	9 (3.0%)	48(15.8%)	
Total	303(100.0%)	46 (15.2%)	257(84.8%)	

Table 3. Distribution of HBsAg among subjects based on gender

Sex	Total (%)	No positive (%)	No. Negative (%)	P-Value
Male	145(47.9%)	34(11.2%)	111(36.6%)	0.000
Female	158(52.1%)	12(4.0%)	146(48.2%)	
Total	303(100.0%)	46(15.2%)	257(84.8%)	

Table 4. Distribution of HBsAg based on clinical history of subjects screened

Variable	Total (%)	No positive (%)	No. Negative (%)	P-Value
Family History of HBV				
Yes	67(22.1%)	13(4.3%)	54(17.8%)	0.275
No	236(77.9%)	33(10.9%)	203(67.0%)	
History of Blood transfusion				
Yes	6(2.0%)	1(0.3%)	5(1.7%)	0.918
No	297(98.0%)	45(14.9%)	252(83.2%)	
History of Surgical Operation				
Yes	9(3.0%)	2(0.7%)	7(2.3%)	0.55
No	294(97.0%)	44(14.5%)	250(82.5%)	

Table 5. Risk factors distribution based on life- style among subjects screened

Variable	Total (%)	No positive (%)	No. Negative (%)	P-Value
Circumcision (Males)				
Health centre	58(40.0%)	17(11.7%)	41(28.3%)	0.174
Traditionally	87(60.0%)	17(11.7%)	70(48.3%)	
Tattoo				
Yes	40(13.2%)	5(1.7%)	35(11.6%)	0.612
No	263(86.8%)	41(13.5%)	222(73.3%)	
Sharing of Toothbrush				
Yes	23(7.6%)	5(1.7%)	18(5.9%)	0.362
No	280(92.4%)	41(13.5%)	239(78.9%)	
Cut				
Yes	186(61.4%)	29(9.6%)	157(51.8%)	0.802
No	117(38.6%)	17(5.6%)	100(33.0%)	

Table 6. Distribution of clinical risk factors and vaccination status

Variable	Total (%)	No positive (%)	No. Negative (%)	P-Value
Jaundice at/after				
Yes	18(5.9%)	6(2.0%)	12(4.0%)	0.027
No	285(94.1%)	40(13.2%)	245(80.9%)	
Recent fever				
Yes	143(47.2%)	18(5.9%)	125(41.3%)	0.234
No	160(52.8%)	28(9.2%)	132(43.6%)	
Vaccination Status				
Vaccinated	18(5.9%)	3(1.0%)	15(5.0%)	0.856
Unvaccinated	285(94.1%)	43(14.2%)	242(79.9%)	
Total	303(100.0%)	46(15.2%)	257(84.8%)	

Table 7. ALT Determination among HBV Seropositive Subjects

Variable	Total No. of Seropositive Subjects	No. Showing Normal ALT Levels	No. Showing Elevated ALT	P-Value
Sex				
Male	34(73.9%)	23(50.0%)	11(23.9%)	0.299
Female	12(26.1%)	10(21.7%)	2(4.3%)	
Age				
3 – 6	8(17.4%)	4(8.7%)	4(8.7%)	0.348
7 – 9	13 (28.3%)	9(19.6%)	4(8.7%)	
10 – 12	16(34.8%)	12(26.1%)	4(8.7%)	
13 – 15	9(19.6%)	8(17.4%)	1(2.26%)	

4. DISCUSSION

This study has demonstrated a prevalence rate of 46(15.2%). Findings from this result is higher than the report of Ndako et al, [11] in a study conducted among children in Kuru-North-Central Nigeria where 9.7% positivity was recorded. Similarly, findings from this report is also higher than the 7.6% reported by Chukwuka et al, [13] in a study among primary school children at Nnewi and 10.7% prevalence recorded by Jibrin, et al [12] among children in Sokoto, while 9.4% prevalence was recorded by Ashir, et al, [10] in a similar study carried out at Maiduguri. Earlier studies have also documented higher prevalence of HBV among children, 44.7% prevalence was recorded by Bukbuk et al [14] in a study among Children in Maiduguri. Similar finding in a previous cohort study in sub-Saharan Africa showed that two-thirds of infected HBV children tested positive for HBsAg and continued to tolerate the virus [15]. This upsurge in in HBsAg rates call for strengthening of routine immunization and sustained efforts in all parts of Nigeria, to reduce significantly the endemicity of HBV at our study location.

Similar prevalence rates recorded in this study have also been observed in several other countries such as Indonesia, reported to have an incidence of HBV rate at 2.5-10% [16] and Canada with a percentage of 0.5-1.0 which is lower in comparison with other countries such as South Africa and Zimbabwe with records of 13.4% and 17.1% respectively[17,18]. These variances may be as a result of the unavailability of adequate health facilities in these developing countries.

A higher seroprevalence of HBsAg 16(5.3%) was observed among pupils aged 10-12, followed by 13(4.3%) among subjects aged 7-9, this finding is however in contrast to the work of Ndako et al. [19] where Age distribution of HBV infection recorded 15.0%, sero positivity amongst children aged 5-9. The report of an increase in seroprevalence with age is comparable to a study by Ndako et al.[11], in a research conducted among primary school children. Increase in seroprevalence with age may be attributed to the fact that at this age most children are very active with exposure to several risk factors.

Considering gender, this study showed that more males subjects 34(11.2%) were seropositive for HBV infection; this findings is similar to the report

of Ashir et al [10] ; Habib et al. [20]; Sabir et al [21]. Nwoediuko (24) in his report also recorded a significantly higher (79.2%) rate of infection among male subjects compared to females (20.8%). Females were said to elaborate more antibodies to HBs for HBV infection compared males as indicated in the findings of Vierucci et al.[22] In their study among thalassemia patients in Italy. However this contrasted with a study carried out by Ikobah et al.[23] Who reported a higher prevalence in females (1.8%) than in males (0.8%). Upsurge in prevalence among the Male subjects in this study could be attributed to factors such as unhygienic method of circumcision among male subjects studied which might have predisposed them to HBV infection early in life.

Considering clinical risk factors, It has been documented that subjects previously infected with HBV are highly vulnerable to this infection from reports by Alavian [25]. Castolo et al. [26] and Ali et al [27], established an increased rate of HBV infection in multi-transfused individuals. Similarly, Qureshi et al.[28] gave a report on potentially acquiring HBV and HCV infection through blood transfusion[28]. Unavailability of proper equipment to aid blood screening in health facilities is a probable reason for increased risk of acquiring HBV in majority of third world countries like Nigeria. According Moosa et al.[29]; poor or lack of adherence to hygienic measures increases risk of infection for HBV.

The high seroprevalence recorded among subjects with history of cuts may indicate early life horizontal transmission which is a significant finding in this study. Exposure to risk factors such as sharing of toothbrush, making of tattoos and giving of tribal mark were also studied and result observed showed a veritable predisposing factor among the children screened. Body piercing, sharing of personal items such as toothbrush, use of sharp/piercing objects have been documented from previous studies to be associated with HBV infection in children. [30]. Finding from previous studies showed history of tattooing as potential risk factors of HBV infection from parents/guardians to children, whereas shared items and blood transfusion were potential risk factors in children, [31].

However, an intraoral trauma during brushing could be the source of transmission, the chances of transmitting the virus through this route is likely to be substantial, given the fact that such

sharing is likely to occur over prolonged periods. This finding is similar to that by Nwokediuko, [24].

Unvaccinated subjects had higher seroprevalence of 43(14.2%) compared to vaccinated subjects with prevalence of 3(1.0%). The variation was not significant with P-value 0.856 ($P>0.05$). The prevalence of HBV has been proven to decline due to the availability of HBV vaccines among the seropositive individuals [32]. Reduced occurrence of HBV in this report compared to studies with a much higher prevalence could be attributed to gradual enlightenment and health education strategy among the population. These preventive measures will validate strict adherence to universal precaution against HBV infection.

Analysis of liver enzyme on HBsAg seropositive subjects screened recorded 13 (28.3%). With an elevated ALT, this reveals a high-level risk of HBV in these subjects. In a research conducted by Tsai et al [33], tests for liver function are determinants for detection of liver damage or its function impaired among the children that tested positive for the HBV. ALT result showed 6.9% abnormality. ALT levels have been correlated positively with liver inflammation, while patients with persistently normal ALT levels had significantly lower liver damage compared with patients with either intermittent or persistently elevated ALT Levels [34]. Hence, measuring aminotransferase levels by serial observations and analysis is the most reliable and widely used method for the identification of inflamed liver cells in patients specifically those chronically infected with HBV infection.

5. CONCLUSION

The high prevalence of HBV infection observed in this study is alarming going by the predisposing risk factors highlighted. Parents and guardian of subjects tested seem not to be properly informed on the potential dangers of Hepatitis B virus infection. This emphasize the need for public enlightenment campaign coupled with routine screening, prompt vaccination regimen and management of infected individuals as measures that would help reduce the cycle of transmission in the population..

CONSENT AND ETHICAL APPROVAL

Ethical clearance and approval was obtained from the appropriate ethical committee of the VCH-Mission Hospital.

Only consented subjects obtained through volunteer forms filled were enrolled for the study.

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COMPETING INTERESTS

The authors declare that they have no competing interests

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