

# Seroprevalence and Risk Factors of Hepatitis B Virus Infection among Adolescents in Enugu, Nigeria

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## ABSTRACT

**Objectives:** The aim of the study was to determine the prevalence and correlates of hepatitis B virus infection in adolescents in Enugu-urban.

**Methods:** A cross-sectional seroprevalence survey was conducted among school children aged 10–18 years. Subjects were selected using multistage sampling. Hepatitis B surface antigenaemia (HBsAg) was assayed for in blood using rapid enzyme-linked immunosorbent assay kits. Data were analyzed using statistical package for social sciences version 16.0 ( $p < 0.05$ ).

**Results:** Four hundred and twenty children were recruited. Of these, 13 tested positive for HBsAg, giving an overall hepatitis B seroprevalence of 3.1%. Social class, scarifications/tattooing, circumcision and history of surgery were the significant modes of transmission.

**Conclusion:** The seroprevalence of hepatitis B among children in the study population is high. Its screening in school children should be incorporated into school health services in our setting while awareness campaigns and health education on its modes of transmission and prevention should be promoted and strengthened.

**KEYWORDS:** HBsAg, prevalence, risk factors, children.

## INTRODUCTION

Hepatitis B virus (HBV) infection is a global public health challenge. Of the 2 billion persons (about a third of the world's population) infected with HBV, about 360 million are known to be chronic carriers [1]. Further, about a million of these infected

individuals die annually mainly from hepatitis B complications including liver cirrhosis and liver cancer [2].

Sub-Saharan Africa has the second largest global burden of chronic carriers of hepatitis B infection after Asia [1]. Though the actual burden of HBV infection in sub-Saharan Africa is not certain owing to

inaccurate medical records keeping and under-reporting of cases particularly from the rural communities, which are the homes to the majority of the people.

Estimates of hepatitis B antigenaemia seroprevalence of 6–20% have been reported [3, 4], making sub-Saharan Africa a hyper-endemic region. Nigeria is also a hyper-endemic country for HBV with various rates ranging from 0.5 to 44.7% [5–11].

The risk of developing chronic HBV infection commonly defined as being positive for hepatitis B surface antigenaemia (HBsAg) for greater than 6 months is inversely related to the age of acquisition of the infection. Generally the risk of chronic HBV infection is 90% following infants infected at birth while the risk is put at 30% for children infected between 1 and 5 years of age, and about 1–5% for those infected as older children and adults [12].

Chronic HBV infection has been associated with the risk of development of chronic liver disease in addition to hepatocellular carcinoma [12, 13]. Although about eight different genotypes of HBV have been reported, E genotype has been shown to be the most prevalent genotype in the sub-Saharan Africa.

HBV is highly infectious and is commonly spread by vertical transmission through mother to infant during birth, blood products, intravenous drug use, sexual contacts, scarifications/tattooing, use of shared inadequately sterilized syringes and needles and institutional care and intimate care with carriers [11, 14, 15]. The hepatitis B vaccine is the mainstay of hepatitis B prevention [16]. The hepatitis B vaccine is about 95% effective in preventing its infection [15].

The World Health Organization (WHO) has recommended that all newborns receive the HBV vaccine soon after birth, preferably within the first 24 h. WHO is also working to raise awareness, promoting partnerships and mobilizing resources as well as formulating evidence-based policy and data for action and promotion of access to screening, care and treatment services to control the spread of the HBV infection [16].

Despite the universal HBV vaccination to all newborns in Nigeria since 2004, the prevalence of HBV among Nigerian children is still in the hyper-endemic range [9].

Hence, the aim of this study was to determine the prevalence and correlates of HBV infection in adolescents aged 10–18 years in Enugu capital city. Children currently aged 10–18 years are the last age-group of unimmunized children before the introduction of universal hepatitis B vaccination in Nigeria in 2004.

## METHODOLOGY

A cross-sectional study was conducted among school children aged 10–18 years in Enugu capital city (consisting of three local government areas, namely, Enugu East, Enugu North and Enugu South Local Government Areas (LGA)) in July 2014.

### Study sampling

A stratified multistaged sampling method was used to select the study population. A total of six schools (three private and three public) made up of four co-educational, one all girls and one all boys were selected by simple random sampling.

### Permission for the study

Ethical approval for the study was sought from the Health Ethics and Research Committee of the University of Nigeria Teaching Hospital, Ituku-Ozalla, Enugu.

Permission to conduct the study was obtained from the Ministry of Education Enugu State, Nigeria, while consent was obtained from the respective school principals and parents/caregivers as well as the students.

### Questionnaire

Information obtained from a semi-structured questionnaire designed for the study included age, sex, parental highest educational attainment and occupation and child's medical history including history of blood transfusion, traditional uvulectomy, sharing of tooth brush, razor blades/hair clippers or other sharps, scarifications/tattoos, circumcision, surgery, history of jaundice/liver disease, intravenous drug use and multiple sex partners. [17, 18, 19, 20] Social classification was determined using the method described by Oyediji [21]. Here the social class of each child was determined based on the occupational

status and highest educational attainment of the parents. The four scores were summed and the mean (approximated to the nearest whole number) obtained. The mean score was used to assign the child to one of the socio-economic classes (1–5). The social classes of the subjects were further stratified into upper (social classes I and II), middle (social class III) and lower (social classes IV and V) [17].

#### Procedure for field work

Two research assistants who were housemen were trained for two consecutive days by the investigators who are paediatricians.

In the course of the training, the investigators and research assistants practiced on how to administer and fill the semi-structured questionnaires, and method of collection of blood samples.

The questionnaire was pretested and validated 1 month before the commencement of the work and the contents found not to be ambiguous to the subjects.

Before the commencement of the work, the investigators and research assistants visited the selected schools to familiarize themselves with the school authorities and students. During the familiarization visits, the students and teachers were given a brief talk on HBV infection including the risk factors for its acquisition and methods of prevention and control. Also, the objectives of the study were explained to the students.

The selected students were given a consent form to take home to their parents and brought back the next day. On the following day, the selected students were assembled in their respective school halls and the consent forms retrieved from them.

One semi-structured questionnaire per student was administered and completed by the investigators and each enrolled student.

#### Exclusion criteria

Subjects who had symptoms and signs suggestive of liver disease and history of HBV vaccinations in infancy or later in childhood were excluded.

#### Procedure

About 5 ml of venous blood was obtained from each subject after tourniquet application. To obtain

plasma for the HBV screening, venous blood was collected into Ethylene-Diamine-Tetra-Acetic Acid (EDTA) bottles and plasma separated after centrifuging at 6000 revolutions per minute for about 5 min.

Parallel testing for HBsAg was applied for the screening test. The parallel testing will allow for the application of two rapid enzyme-linked immunosorbent assay (ELISA) test kits simultaneously. The two ELISA test kits used in the current study were the HBsAg test kits manufactured by ABON, Biopharm (Hangzhou, China) and DiaSpot (relative sensitivity >99% and specificity 97%). The application of two or more test kits in this study was following the WHO recommendations of at least two different testing strategies (algorithms) involving simple re-paired assays for surveillance. The different manufacturer's guidelines were followed faithfully during the testing. Two simultaneously positive test results for a particular sample were interpreted as positive. If one result was positive and one negative, a third kit (Cortez Diagnostics Incorporated, USA) was applied as tie breaker to resolve the difference.

#### Data analysis

Data were analyzed using the statistical package for social sciences software version 16.0. Results were presented as percentages and frequencies, while bivariate analysis was used to determine the predictive risk factors for HBV infection.

### RESULTS

Four hundred and twenty school children aged 10–18 years were selected and studied over a period of 1 month. Of the 420 students sampled, males and females were 210 each, giving a male to female ratio of 1:1.

The social class distribution of the subjects shows that majority of them, i.e. 109 (26.0), were of middle socio-economic class (social class 3), as shown in [Table 1](#). The overall mean age was  $14.26 \pm 2.017$  while the median age was 14.0 (range 10–18) years. Further, the mean age for the males was  $14.97 \pm 2.135$ , while among the females it was  $14.40 \pm 1.946$  ( $p > 0.5$ ).

Thirteen (3.1%) subjects tested positive to HBsAg screening, giving an overall seroprevalence of

3.1% as shown in Table 2. Eight (61.5) children of the 13 positive HBsAg cases were males while 5 (38.5%) were females. The median age for HBsAg positively was 14 years and age was not statistically associated with HBV infection.

The putative risk factors were more frequent among the positive HBsAg group compared with the negatives as shown in Table 3.

The social class distribution of the HBsAg positive cases is as follows: high social class: 2, middle class: 1, and low socio-economic class: 10 ( $p < 0.05$ ).

On further statistical analysis of significant variables using bivariate analysis, the following risk factors were found to be statistically significant as shown in Table 4: social class ( $p = 0.001$ ), scarifications/tattooing ( $p = 0.005$ ), circumcision ( $p = 0.046$ ) and history of previous surgery ( $p = 0.024$ ).

## DISCUSSION

The seroprevalence of hepatitis B infection in the current study is 3.1%. It is lower than most reported prevalence in similar studies in Nigeria considering that it is a hyper-endemic setting, for HBV [6–10], and higher than the 2.1% reported among HIV-uninfected children in Tanzania [22] in Southern Africa and 0.5% in Ibadan, Southwest Nigeria, respectively [5].

**Table 1. Sociodemographic characteristics of the study population**

	Frequency (N420)	Percent (100.00%)
Age (years)		
10–12	140	33.3
13–15	140	33.3
16–18	140	33.3
Sex		
Male	210	50.0
Female	210	50.0
Social class		
1	39	9.3
2	97	23.1
3	109	26.0
4	93	22.1
5	82	19.5

The study population in the current study was children aged 10–18 years while most of the other studies cited cut across the entire childhood age-groups from 0 to 18 years. The implication here is that from the three main chronological phases of the natural history of HBV infection: of immune tolerance, immune clearance and low replication phases [23], particularly in the older children and adolescents. This may partly be the reason for the seemingly low prevalence of HBV infection observed in the current study despite the fact that Nigeria is a hyper-endemic country. Similar finding in a previous cohort study in sub-Saharan Africa showed that about one-third of young HBV carriers cleared their HBsAg and subsequently progressed to immune clearance phases in 10 years of HBV infection. The other remaining two-thirds of infected HBV children tested positive for HBsAg and continued to tolerate the virus [23].

Other reports of co-infections with HBV have shown higher seroprevalence for hepatitis B infection. While an HBV prevalence of 2.9% has been reported in a cohort of uninfected children aged 1 month to 18 years, it was a staggering 7.0% among those who were HIV infected [23]. Similar findings have been reported by various workers in Nigeria [24, 25].

Also, there is increased incidence of hepatitis B markers in children with sickle cell anaemia as reported by several workers in Nigeria including Abiodun and colleagues [18, 26].

More males tested positive to HBsAg compared with females though not statistically significant. Similar findings have been reported by other workers [6, 10]. There was no age difference between the ages of the subjects who tested positive to HBsAg in

**Table 2. Prevalence of Hepatitis B according to sex**

Sex	HBsAg		
	Negative (N = 407)	Positive (N = 13)	Total (N = 420)
Male	202 (96.2)	8 (3.8)	210 (100.0)
Female	205 (97.6)	5 (2.4)	210 (100.0)
Total	407 (96.9)	13 (3.1)	420 (100.0)

**Table 3. Distribution of risk factors of Hepatitis B infection among the HBsAg positive cases**

Risk factors	Hepatitis B			
	Negative		Positive	
	Yes	No	Yes	No
Previous blood transfusion	7.6	92.4	7.7	92.3
Native uvulectomy	12.8	87.2	15.4	84.6
Sharing of toothbrush	18.2	81.8	7.7	92.3
Sharing razor blades or clippers	62.9	37.1	76.9	23.1
Traditional scarification/tattooing	11.5%	88.5	38.5	61.5
Injections from quacks	58.5	41.5	61.5	38.5
Circumcision	45.0	55.0	76.9	23.1
Previous surgery	3.7	96.3	15.4	84.6
Intravenous drug use	6.9	93.1	7.7	92.4
Use of alcohol	2.2	97.8	0.0	100.0
Multiple sex partners	2.2	97.8	0.0	100.0
History of jaundice/liver disease	4.2	95.8	15.4	84.6

the current study. This has been corroborated in a previous study [10].

However, the risk of developing chronic HBV infection has been observed to be inversely related to the age of acquisition. And so, while the risk of chronic HBV infection is 90% in infections acquired in infancy, it is 2% for older children and adults [12]. Our study subjects were adolescents aged 10–18 years, hence the seemingly low seroprevalence in them.

None of the study subjects had received HBV vaccines as it became universally accessible in Nigeria through the National Programme on Immunization in 2004 [17, 27, 28].

Socio-economic status was found to be associated with hepatitis B positivity in the current study as previously reported by Ugwuja *et al.* [6]. Others have reported varying findings showing that social class does not influence HBV infection in children [28]. It is possible that children from low socio-economic backgrounds are more likely to be exposed to most sources of HBV acquisition including vertical and horizontal routes like circumcision and scarifications with un-sterilized/contaminated blades among others.

**Table 4. Bivariate analysis of probable risk factors for HBV infection**

Risk factors	Coefficient of regression (r)	p
Social class	0.134	0.007
Previous blood transfusion	0.05	0.920
Native uvulectomy	0.000	0.845
Sharing of tooth brush	0.065	0.682
Sharing of razor blades/hair clippers	−0.046	0.340
Traditional scarification/tattooing	−0.142	0.005
Injection from quacks	0.030	0.546
Circumcision	−0.098	0.046
Previous surgery	−0.112	0.024
Alcohol use	0.060	0.229
History of jaundice/liver disease	−0.069	0.161
Multiple sex partner	0.052	0.382

Circumcision, scarification/tattooing and past surgeries were the other putative risk factors significantly associated with hepatitis B positively in the current study. It has been shown that most HBV infections in Nigeria occur by horizontal transmission as well as blood transfusion [29, 30].

Injection from untrained community health providers, body scarifications, sharing of sharps, body-piercing instruments, sharing of tooth brushes and uvulectomy have been implicated as possible horizontal routes of HBV spread in our setting [31, 32]. Some of these cultural practices like circumcision, ear piercing, scarifications/tattooing have the potential of causing bleeding or ulceration and ultimately increase the likelihood of percutaneous transmission of HBV [20, 24, 25, 32, 33].

Traditional scarifications particularly practised in the community as part of therapeutic care by traditional healers are potentially septic and instruments are usually used and reused without recourse to observation of standard sterilization procedures, with high possibilities of infection(s) transmission including hepatitis B.

HBV acquisition through previous surgical procedure could be a source of its transmission in our setting as previously reported [34]. In a cohort of pregnant women attending antenatal care in Kano,

abortions was among the possible risk factor [34]. Such act could be a possible mode of acquisition of HBV infection among the female study population.

### CONCLUSION

The hepatitis B seroprevalence among unvaccinated school children is still high in Nigeria as observed in the current study. The important risk factors were low social class, scarifications/tattooing, circumcision and history of surgery.

Hepatitis B infection screening in school children should be incorporated into school health services in our setting while awareness campaigns and health education on its modes of transmission and prevention should be promoted and strengthened.

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*Competing interests:* ROCHE Pharmaceuticals Nigeria provided part of the test kits only for the HBsAg screening of all the subjects. Every other costs of the study were borne solely by the authors. The authors therefore declare that we have no other competing interests other than what has been stated.

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