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Sero-Prevalence of Hepatitis B Virus Infection Among Individuals in Zamfara State, North Western Nigeria

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ABSTRACT

Background and Objective: Hepatitis B virus (HBV) infection is a global problem of public importance. About 2 billion people are said to be infected worldwide with about 240 million chronic carriers most of which are from Asia and sub-Saharan African countries. Knowing the HBV status of our population is essential for effective management and control of the disease. This study seeks to determine HBV susceptibility and serological patterns among the study subjects. **Materials and Methods:** The 310 participants were enrolled for the study. Blood samples were collected by venipuncture, processed and tested for hepatitis B surface antigen (HBsAg) using a first response card and serological markers of HBV using a one-step HBV multi-5 test kit. The Chi-square was used to determine a significant association between the data obtained. **Results:** A prevalence of 6.7% HBsAg was obtained. Among the socio-demographic factors considered there was a significant association between gender, marital status of the participants and seropositivity. All the risk factors considered were not statistically associated with the seropositivity in this study. A substantial number of the participants 28.6% had detectable antibodies to envelope antigen (Anti-HBe) correlating to decreased infectivity. However, 42.9% of the participants had detectable antibodies to HBV core antigen (anti-HBc) an indication of low immunity and probably chronic infection with a risk of horizontal or vertical transmission. **Conclusion:** It was concluded that there was a significant association between the gender and marital status of the participants and the infection.

KEYWORDS

Seroprevalence, hepatitis B virus, immunity, infection, HBV core antigen, serological markers

INTRODUCTION

Hepatitis is an inflammatory disease of the liver caused by viral infection, toxic agents, autoimmune diseases or metabolic diseases[1]. The causative agent of viral hepatitis type B is the hepatitis B virus (HBV). The virus is highly infectious and remains one of the most important human pathogens of global

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importance[2]. Transmission occurs by several routes through horizontal, perinatal and vertical transfer[3]. However, infection acquired through close sexual contact is far more common than that acquired through needles or transfusions[4]. Besides blood and blood products, saliva and semen, can transmit the infection[5].

There are an estimated two billion people with serological markers of present or past hepatitis B virus infection globally with about 250 million chronic carriers[6]. Most of these carriers are not aware of their status due to the asymptomatic nature of the infection at the onset and its slow development[7]. The virus is distributed worldwide and its prevalence varies significantly across different populations[8]. Over time, the prevalence among children (< 5 years) was reported to be 2.6%[6]. However, the trend in the burden of infection has overwhelmingly increased to 7.7[9] and 11.1%[10].

Hepatitis B virus is a global health problem of public importance[11]. Most of the burden of HBV infections occurs in developing countries where access to screening, vaccination and treatment is limited[7]. Current diagnostic tools for HBV infection such as serological testing and viral load assay have limitations particularly in resource-limited settings[5]. However, despite the introduction of a safe and effective vaccine against the hepatitis B virus and the advent of antiviral therapies that can suppress HBV and delay the progression of liver diseases the burden of hepatitis B is on the increase[12]. Nigeria has the highest number of individuals living with HBV in sub-Saharan Africa[13].

The concept of HBV prevalence has assisted healthcare professionals in better managing and treating HBV cases, including early detection, monitoring and implementing appropriate vaccination programs. Nigeria has a significant population and contributes substantially to the global burden of HBV[14]. Conducting this study is essential for improving public health outcomes, reducing the burden of disease and advancing scientific knowledge in the field of viral hepatitis[6]. This study will yield valuable data on the distribution and risk factors associated with HBV in the study area. This is hoped it will aid in developing targeted interventions and public health strategies. The present study aims to determine the prevalence and risk factors associated with hepatitis B virus among individuals in Zamfara State, North Western Nigeria.

MATERIALS AND METHODS

Study area: This study was conducted from February, 2023 to December, 2023 in Zamfara State Northwestern Nigeria. The state is located at 12° 101 N 6°151E with an area of 39,762 km^2 and an estimated population of 9,838,160 (2011 census). Until 1996, the area was part of Sokoto State. Zamfara comprises 14 Local Government Areas with three senatorial districts i.e., the Central senatorial district comprising four Local Government Areas (Tsafe, Gusau, Bungudu and Maru), the East senatorial district comprising four Local Government (Kaura, Shinkafi, Zurmi and Birnin Magaji) and the West senatorial district comprising six Local Government (Mafara, Maradun, Bakura, Gummi, Bukuyyum and Anka). Most inhabitants of the area are predominantly Hausa's whose major source of livelihood is farming and rearing domestic animals.

Study population: This consists of a total of 310 individuals adult, male, female, outpatients and inpatients who visited the hospitals during the period of the study (February, 2023 to December, 2023) and who willingly gave consent for the study.

Inclusion and exclusion criteria: The inclusion criteria used include adult individuals who attended the hospitals during the period of the study and whose consent was obtained. However, persons who did not give consent to participate, children not older than five years and persons who are too ill to understand the procedures involved in the study were excluded.

Sample size determination: The sample size was calculated using a single proportion formula:

$$N = \frac{Z^2PQ}{D^2}$$

Where:

N = Minimum sample size
Z = Constant, standard normal deviation (1.96 for 95% confidence interval)
P = Local prevalence rate of a previous study on hepatitis B virus among patients = 23.4% = 0.234
Q = 1-P
D = Acceptable margin of error (5% or 0.05)

$$N = \frac{1.962 \times 0.234 \times 0.864}{0.052}$$

$$N = 310$$

Sample collections: The 4 mL of blood samples were aseptically collected from each 310 participants by venipuncture into an appropriately labeled sterile plain tube. This was allowed to clot at room temperature and spun for 5 min at 3000 rpm. The resultant serum was harvested and transferred into well-labeled sterile cryovials. Thereafter, the samples were transported from the sampling hospitals to the Antimicrobial Resistance (AMR) Fleming's laboratory, Veterinary Teaching Hospital of Usmanu Danfodiyo University Sokoto. Subsequently, the sera samples were stored at −20°C before analysis.

Antigenic detection using first response rapid kit: All serum samples were tested for HBsAg using a first response rapid test kit (Premier Medical Corporation Limited India). The test kit uses solid-phase immune chromatographic technology for the qualitative detection of HBsAg in serum or plasma. The test is a two-site immune-metric assay in which a combination of monoclonal and polyclonal antibodies is used to selectively detect HBsAg in serum or plasma with a high degree of sensitivity. Each device has a reading window with an upper control area a lower test area and a sample well. The 25 µL of serum or plasma sample was added to the sample well and allowed to soak in. The results were read after 10 min.

Detection of other markers of HBV infection: The HBsAg-positive samples were further retested for serological markers for HBV antigens (HBsAg, HBeAg) and antibodies (anti-HBc, anti- HBs and anti HBe) using HBV-5 panel immunoassay test kits. The one-step cassette-style hepatitis B virus marker test is one of the rapid tests conducted based on the principle of immunoassay combined with conjugated colloid gold technology. The specimens with reactive HBV were further screened to detect other markers of the infection. A few drops of plasma were added to each of the wells of the specimen. The readings were taken after 15 mins.

Ethical consideration: Ethical approval to carry out the study was obtained from Ethical Committees of Federal Medical Center (FMC) Gusau (FMC/2021/985/008/NHREC/TR/19/03/2016), Ahmad Sani Yariman Bakura Specialist Hospital (ASYBSH) Gusau (ASYBSH/SUB/205/VOL.1) and Ethical Committee of the Zamfara State Ministry of Health (ZSHREC04112022/101). Individual consent was obtained from all the participants. Adequate information was given to all participants on the purpose of the study and confidentiality of all information obtained was assured.

Statistical analysis: All results obtained and responses to questionnaires were subjected to descriptive statistics using Statistical Package for Social Sciences (SPSS) questionnaire database. Frequencies and percentages of the identified virus are presented in tables and charts. The Chi-square test was employed to determine the relationships between the socio-demographic data and the rate of infection. Values obtained were considered statistically significant at $p \leq 0.05$.

RESULTS

Out of a total of 310 serum samples of individuals attending selected hospitals in Zamfara State were screened for hepatitis B virus infection using rapid test kits. The 21 of the screened serum samples were positive for hepatitis B virus antigen resulting in a calculated prevalence of 6.70% (Fig. 1) while 289 serum samples were negative for the virus.

The distribution of hepatitis B serological markers in HBsAg reactive samples was analyzed and the result is shown in (Fig. 2). Out of the 21 reactive samples the result indicates 42.9% (9/21) had detectable antibodies to hepatitis B core antigen (Anti-HBc), 28.6% (6/21) had antibodies to hepatitis B envelope antigen (Anti-HBe), 19.0% (4/21) had detectable hepatitis B envelope antigen (HBeAg), while 9.5% (2/21) had detectable antibodies to hepatitis B surface antigen (Anti-HBs). The distribution of hepatitis B virus infection among participants according to age group was analyzed and the result is shown in (Fig. 2). Participants in the age group 16-20 years have the highest rate of infection 11.7% (6/51) followed by participants in the age group 31-35 years with 7.2% (8/111). Participants in the age group 21-25 years and 36-40 years have a prevalence of 5.9 and 5.7%, respectively. Participants in the age group of above >41 years have a low infection rate of 2.4% (1/42). There was no significant association ($p = 0.6021$) between the age group and the seropositivity.

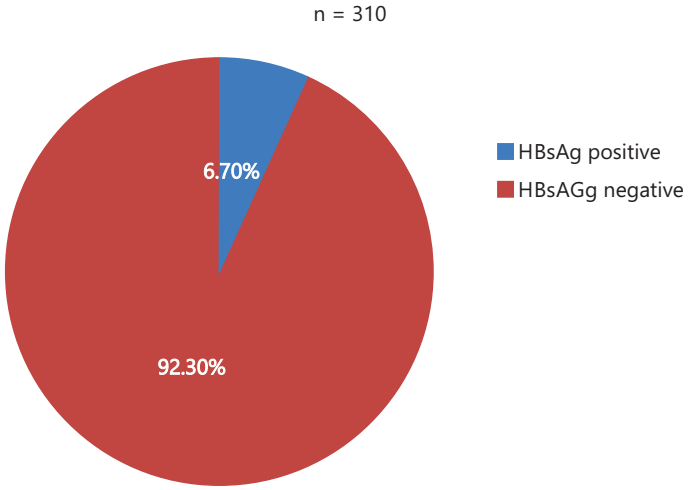

Fig. 1: Prevalence of hepatitis B virus

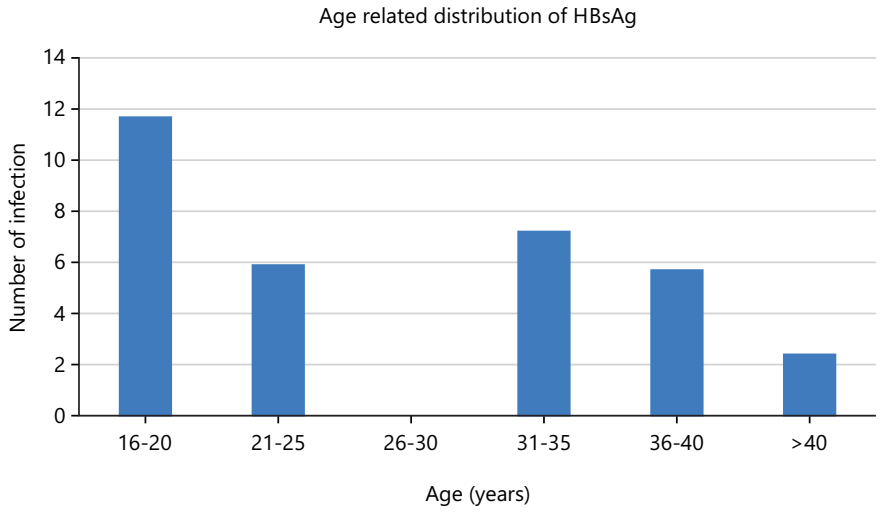

Fig. 2: Distribution of HBsAg according to age

Table 1: Distribution of serological markers of hepatitis B virus

Variable	HBsAg positive samples (n=21)	
HBV markers	Present (%)	Absent (%)
Anti-HBs	2 (9.5)	19 (90.5)
HBeAg	4 (19.0)	17 (81)
Anti-HBe	6 (28.6)	15 (71.4)
Anti-HBc	9 (42.9)	12 (57.1)

Anti-HBs: Antibody to hepatitis B surface antigen, HBeAg: Hepatitis B envelop antigen, Anti-HBe: Antibody to hepatitis B envelop antigen and Anti-HBc: Antibody to hepatitis B core antigen

Table 2: Demographic data related distribution of hepatitis B virus infection among participants

Variable	Number of specimens	Serological status of HBsAg		
Gender	(n)	Reactive (%)	Non-Reactive	p-value
Male	217	13 (5.9)	204 (94.1)	
Female	93	8 (8.6)	85 (91.4)	0.0004
Educational qualification				
Primary	77	7 (9.0)	70 (91.0)	
Secondary	145	5 (3.4)	140 (96.5)	
Tertiary	88	9 (10.2)	79 (89.8)	0.4235
Marital status				
Single	78	10 (12.8)	68 (87.2)	
Marriedq	203	8 (3.9)	193 (95.1)	
Divorced	29	3 (10.3)	28 (96.7)	0.0469
Family type				
Monogamy	201	15 (7.5)	186 (92.5)	
Polygamy	109	6 (5.5)	103 (94.5)	0.6757
Occupation				
Civil servant	83	4 (4.8)	79 (95.2)	
Farmer	66	6 (9.0)	60 (91.0)	
Trader	63	2 (3.2)	61 (96.8)	
Student	55	5 (9.0)	50 (91.0)	
House wife	43	4 (9.3)	39 (90.7)	0.5156
Tribal mark				
Yes	106	9 (8.5)	97 (91.5)	
No	204	12 (5.8)	192 (94.2)	0.5296

Table 3: Distribution of hepatitis B virus infection according to the risk factors

Variable	Number of specimens	Serological status of HBsAg		
History of blood transfusion	(n)	Reactive (%)	Non-reactive (%)	p-value
Yes	106	4 (3.7)	102 (96.3)	
No	204	17 (8.3)	187 (92.7)	0.1979
History of STDs				
Yes	92	14 (15.2)	78 (84.8)	
No	218	7 (3.2)	211 (96.8)	0.8946
Drug abuse				
Yes	87	3 (3.4)	84 (96.6)	
No	223	18 (8.1)	205 (91.9)	0.2286
Use of unsterile sharp objects				
Yes	172	11 (6.4)	161 (93.6)	
No	138	10 (7.2)	128 (92.7)	0.9450

The distribution of hepatitis B viral infection among participants according to demographic factors was analyzed and the result is shown in (Table 1). Female study subjects had the highest rate of infection 8 (8.6%) while 13 (5.9%) male study subjects tested positive. The highest seropositivity was obtained in participants that are single 12.8% (10/78) while participants that are divorced had 10.3% (3/29). Participants who are married had a seropositive rate of 3.9% (8/21). Statistical analysis using Pearson Chi-square analysis indicated that there was a significant association ($p<0.05$) between

gender, marital status and the seropositivity of the participants. The highest seropositivity was obtained in participants with tertiary education 10.2% (9/88) while participants with primary education had a seropositivity of 9.0% (7/77). Participants with secondary education had a seropositivity of 3.4% (5/145). The highest seropositivity was obtained in participants who practice monogamy 7.5% (15/201) while polygamy had 5.5% (6/109). There was no significant association (p = 0.6757) between family type and seropositivity. The highest seropositivity was obtained in housewives 9.3% (4/43) while students and farmers had a seropositivity rate of 9.0% (6/66) and (5/55), respectively. Civil servants had the lowest seropositivity 4.8% (4/83). Statistical analysis using Pearson Chi-square analysis indicated that there was no significant association (p>0.05) between education, family type, occupation and the seropositivity of the participants.

The distribution of hepatitis B virus based on risk factors was analyzed and the results shown in Table 3. A highest sero-positivity was obtained in participants with no history of blood transfusion 8.3% (17/204) while those with history of blood transfusion had sero-positivity of 3.7% (4/106). A highest sero-positivity was obtained in participants with history of sexually transmitted diseases 15.2% (14/92) while participants with no history of STDs had 3.2% (7/218). A highest sero-positivity was obtained in participants with no history of drug abuse 8.1% (18/223) while participants with history of drug abuse had 3.4% (3/87). A highest sero-positivity was obtained in participants that do not use unsterile sharp objects 7.2% (10/138) while those that used unsterile sharp objects had 6.4% (11/172). A highest sero-positivity was obtained in participants with no history of previous surgery 7.5% (18/235) while participants with history of previous surgery had 4.0% (3/75). Statistical analysis using Pearson Chi-square test indicated that there was no significant association (p = 0.8946) between blood transfusion, history of sexually transmitted diseases, history of drug abuse, use of unsterile sharp objects, history of previous surgery and sero-positivity of the participants.

DISCUSSION

This study was conducted to determine the seroprevalence of hepatitis B virus infection among individuals in Zamfara State Nigeria. A prevalence of 6.7% for HBsAg was obtained. Detection of HBsAg in the participants is an indication the persons are infectious. The seroprevalence rate is slightly lower than 7.7% reported by Habibu *et al*.[9] among blood donors in Gusau Metropolis, lower than 13.6% reported by Musa *et al*.[8], lower than 12.2% reported by Olayinka *et al*.[15] and lower than 26.2% among Fulani nomads in Toro, Bauchi State, Northeastern Nigeria. The seroprevalence rate obtained in this study is higher than 2.1% reported among women at the point of delivery at the University of Benin Teaching Hospital, Benin City, Nigeria and higher than 4.3% reported among pregnant women in Port Harcourt, Rivers State. The ultimate reason for these differences in the reported prevalence is not clear. However, variations in population, sample size, geographical variation, differences in cultural practices, sexual behavior and the differences in test methods employed in the detection of the infection may be contributory factors.

The distribution of HBV markers in HBV reactive participants indicates that only 2(9.5%) of the participants had detectable (Anti-HBs) which is an indication of clearance and immunity from HBV infection either from exposure or by immunization which occurs within six (6) months of acquiring the virus. Anti-HBs generally persist for a lifetime in over 80% of patients[16].

However, the remaining 19 (96.8%) of the reactive participants did not have detectable anti-HBs, indicating that they were in an active infection phase. The 4 (19.0%) of the reactive participants had detectable (HBeAg) presence which is an indication that the virus is actively replicating, hence a highly infectious phase. The 28.6% of the participants had detectable anti-HBe an indication of long term clearance in patients undergoing antiviral therapy, while 42.9% of the reactive participants had detectable anti-HBc an indicator of previous or ongoing infection.

Out of the 310 participants in this study, the number of males (217) outweighs the number of females (93). This showed that more men were tested than females hence inconsistent with sex distribution as documented in the majority of treatment centers even though females are more sensitive to changes in their health. The obvious reason for this is due to the high percentage of sample obtained from male participants. Female participants had a high prevalence of 8.6% (8/93) as against 5.9% (13/217) for male. This finding does not translate to more females being infected with HBV in the population[17]. But this may be related to hormonal factors. Estrogen, the primary female sex hormone, has been shown to modulate the immune response, potentially making females more susceptible to certain infections. Additionally, hormonal fluctuations during menstruation, pregnancy and menopause can also affect the immune system's ability to respond to infections, potentially increasing the risk of hepatitis B virus infection in females. However, it's important to note that the exact mechanisms underlying this gender disparity in hepatitis B virus infection rates may be complex and multifactorial, involving a combination of biological, behavioral and socioeconomic factors.

Although there was no statistically significant difference in the distribution of HBV infection among various age groups, the seropositivity was highest among participant in the age group 16-20 years with a prevalence of 11.7% while a prevalence of 2.4% was recorded in participants between the age group >41 years. The obvious reason could be young adults may engage in riskier behaviors such as unprotected sex, multiple sexual partners or injection drug use, which can increase their likelihood of exposure to hepatitis B virus. Young adults may be less likely to seek routine healthcare or vaccinations, leading to a high prevalence of undiagnosed or untreated hepatitis B virus seropositivity.

Although there was no statistically significant difference in the distribution of HBV infection among participants based on level of education, a seropositive rate of 10.2% was detected in participants with tertiary education and observation earlier reported by Buseri *et al.*[18], while lowest seropositivity of 3.4% was obtained among participants with secondary education. One possibility is that people with tertiary education might have more opportunities for international travel and live or work in environments with higher exposure to hepatitis B. Additionally, they may engage in riskier behaviors, such as unprotected sex and factors like higher income or access to certain social circles place them at risk.

The findings of this study reveal a high seropositivity of 9.3% among housewives while traders had seropositivity of 3.2% even though there was no statistically significant association between the occupation of the participants. The finding of this study, however, disagreed with the findings of Magaji *et al.*[19] who reported a high rate in farmers. The disparity in hepatitis B virus seropositivity between housewives and civil servants can be attributed to several factors. Housewives may have increased exposure to the virus due to close contact with family members, including children who may not yet be vaccinated. Additionally, household tasks such as cleaning and cooking may involve contact with potentially contaminated surfaces or materials. In contrast, civil servants typically work in environments with stricter hygiene protocols and may have less direct contact with infectious agents. However, it's important to note that individual risk factors and behavior also play a significant role in transmission.

In relation to a history of blood transfusion a high seropositivity of 8.3% was observed in participants with no history of blood transfusion as against 3.7% among participants who had been transfused. The obvious reason for this was HBV is transmitted through body fluids; unprotected sexual affairs with an infected partner was a more culpable risk factor. This result was however, in disagreement with Aba and Aminu[20] who identified blood transfusion as a major risk factor for HBV. This finding is however similar to that of Habibu *et al.*[9] who reported a higher seropositivity among individuals who have not undergone a blood transfusion.

Regarding tribal marks, participants with tribal marks had a high seropositivity of 8.5% while those who had no tribal marks had a seropositivity of 5.8%. The finding was similar to Ifeorah *et al.*[21] who identify tribal marks as a risk factor. However, the finding was inconsistent with Aba and Aminu[20] who reported a high prevalence in women with no tribal mark, implying that tribal mark is not a risk factor. The finding of the study implies that there was a significant association between the gender and marital status of the participants and the infection. It is recommended that there is a need for continuous screening and awareness as well as vaccination of the populace to reduce the menace of the infection. The study subject is limited to in and outpatients attending Federal Medical Center (FMC) Gusau and Ahmad Sani Yariman Bakura Specialist Hospital Gusau and give consent to participate.

CONCLUSION

Hepatitis B virus prevalence of 6.7% was recorded. Among the socio-demographic factors considered there was a significant association between gender, marital status of the participants and the infection. The risk factors considered were not statistically associated with the infection in this study. A substantial number of the participants 28.6% had developed envelope antibodies correlating to decreased infectivity. The 42.9% of participants had anti-HBc and hence did not have immunity and probably had chronic infections with reduced risk of horizontal or vertical transmission.

SIGNIFICANT STATEMENT

The concept of HBV prevalence has assisted healthcare professionals in better managing and treating HBV cases, including early detection, monitoring and implementing appropriate vaccination programs. Nigeria has a significant population and contributes substantially to the global burden of HBV. Conducting this study is essential for improving public health outcomes, reducing the burden of disease and advancing scientific knowledge in the field of viral hepatitis. In this study, a prevalence of 6.7% HBsAg was obtained. Among the socio-demographic factors considered there was a significant association between gender, marital status of the participants and seropositivity. This data on the distribution and risk factors associated with HBV in the study area will aid in developing targeted interventions and public health strategies.

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