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Prevalence and Risk factors of HBV infection among blood donors attending selected Hospitals in Sokoto metropolis Sokoto State, Nigeria

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Abstract **Original Research Article**

Hepatitis B Virus (HBV) remains a significant global health burden, particularly in sub-Saharan Africa. Blood borne infections, including HBV pose a significant hurdle to safe transfusions, especially in HBV-endemic regions like Nigeria despite widespread vaccination efforts. This study aimed to Detect and determine the prevalence and distribution of HBV Infections as well as Determine risk factors associated with the prevalence of HBV infection among blood donors attending selected hospitals**.** A total of 347 blood samples were collected from blood donors in UDUT Hospital (UDUTH), Specialist Hospital Sokoto (SHS), Maryam Abacha Women and Children Hospital (MAWC) and Women Children Welfare Clinic (WCWC), comprising males and females aged between 18-60 years. Hepatitis B surface antigen was tested using a commercial enzyme-linked immunosorbent assay (ELISA) kit. Prevalence of 10.7% was obtained. Blood Transfusion, Intravenous Drug Abuse, Use of Sharp object and Vaccine status shows significant impact on HBV positivity, which strengthen the need for more rigorous screening and public health interventions.

Keywords: Hepatitis B virus, HBsAg, donors, blood safety, ELISA.

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1.0 INTRODUCTION

Hepatitis B virus (HBV) remains a formidable challenge to public health and transfusion medicine in Sub-Saharan Africa, particularly responsible for a major health burden in Africa due to complications associated with infection, such as cirrhosis and liver cancer (Ajuwon *et al.*, 2021). The virus is estimated to cause more than 2 billion infections worldwide, while Africa has more than 50 million that are chronically infected. Currently about 18 million Nigerians are infected and a prevalence rate of 4.3%

to 23.3% have been reported from different part of the country (Berinyuy *et al*,.2019). This may lead to diverse outcomes ranging from acute to fatal fulminant hepatitis and chronic hepatitis which may result in severe complications as liver cirrhosis (LC) and hepatocellular carcinoma (HCC) (Elkalamawy *et al.*, 2011). As the body's primary transport and defence system, blood is indispensable to life, however, the life-saving potential of modern blood transfusions is often balanced against the critical risk of transfusion-transmissible infections (TTIs), such as Hepatitis B (Quintas *et al.*,2024). Blood transfusion is an integral part of and life-saving procedure in modern medicine. However, it has the risk of transmitting life-threatening transfusion transmissible agent such as HBV (Famoni *et al*., 2024). An infected person can transmit HBV through direct contact with blood, unprotected sexual intercourse, use of contaminated needles and syringes, mother to child transmission during delivery, and transfusion of Infected blood (Quintas *et al.*,2024). Therefore, the World Health Organization (WHO) recommends that all countries provide access to screening and preventive measures such as vaccination and treatment for Hepatitis B (Quintas *et al.*,2024).

2.0 METHODOLOGY

2.1 Study Area

The study was conducted in four hospitals in Sokoto metropolis of Sokoto state, which include: Usmanu Danfodiyo University Teaching Hospital Sokoto (Wamakko local government), Specialist hospital Sokoto (Sokoto-South local government), Women and Children Welfare Clinic (WCWC) Sokoto, (Sokoto-North local government) and Maryam Abacha Women and Children Hospital Sokoto (Sokoto-North local government).

2.2 Study Design

The study is a hospital based cross sectional study among blood donors in Sokoto state, Nigeria. Systematic random sampling technique was used to select participants to be considered in the study to allow equal chances of selection. Every 10^{th} participant was recruited after consenting to participate. A total number of 347 blood donors were recruited.

2.3 Ethical Consideration

Ethical clearance was obtained from the State Ministry of Health Sokoto with Ref: No. SMH/1580/V. IV. Ethical clearance was also obtained from the ethical committee of Usmanu Danfodiyo University Teaching Hospital (UDUTH) with Registration No: NHREC/UDU-HREC/25/06/2023-PGP09

2.4 Sample Size

A total number of 347 blood donors were recruited, comprising males and females (age ranged 18 to 60 years) in Sokoto state.

2.5 Consent form and Research Questionnaire

Demographic information about patient was obtained using a questionnaire and consent of the participant was obtained using written Informed consent.

2.6 Sample collection

Venous blood samples were collected from each participant using a sterile 5ml syringe into sterilized plain vacutainer tubes and conveyed to Infectious Disease laboratory (IDL) of UDUTH Microbiology department for serum separation. The blood samples were kept at room temperature to allow for clotting. Serum samples were harvested from the clotted blood by, centrifuging at 3,000 revolutions for 10 minutes. The harvested serum samples were taking into cryotubes and stored at -20°C until further analysis.

2.7 Serological Assays

The serum samples were analyzed for the presence of HBsAg using Accu Biotech Kit catalog ABT-EIA-F5, Nancai Town, Shunyi District 101399 Beijing P.R China.

2.7.1 Principle of the Assay for HBsAg

Is a one-step enzyme immunoassay based on the principle of the sandwich type using monoclonal

antibodies and polyclonal antibodies selected for their ability to bind themselves to the various subtypes of HBsAg in serum, which is a marker of acute HBV infection now recognised by the WHO and the most part of the variant HBV strain. It is of two phases; the microtiter solid phase is coated with monoclonal antibodies and conjugate phase are based upon use of monoclonal antibodies from mouse and polyclonal antibodies from goat against HBsAg. The antibodies are bound to peroxidase.

2.7.2 Principle of sandwich ELISA

Antibodies sandwich ELISA may be most useful in detecting antigen because they are frequently more sensitive than those in which antigen is directly bound to the solid phase. To detect antigen, the wells of microtiter plates are coated with antigen. Unbound antigen was washed out and an antigen specific antibody conjugated enzyme (i.e. developing reagent) was added, followed by incubation. Enzyme labeled antibody can be produced in the same animal that produced passively adsorbed antibody or from different specie immunized with the same antigen that is captured, unbound conjugate was washed out and substrate was added. After incubation, the degree of substrate hydrolysis was measured. The amount of substrate hydrolyzed was proportional to the amount of antigen in the test solution.

2.7.3 Assay Procedure for Sandwich ELISA

The procedure was carried out in accordance with the manufacturer's instruction. Briefly, 100uI of negative control was be added into a selected wells and addition of 100uI of positive control into appropriate pre-coated wells with monoclonal antibody.

This was followed by the addition of 100ul of the test sera into the remaining wells. 50ul of conjugate solution consist of (conjugate diluent-bovine immunoglobulin and mouse immunoglobulin, and conjugate-consist of mouse monoclonal anti HbsAg antibodies and goat polyclonal antibodies) was dispensed into the wells. The plate was then covered with a new adhesive film and incubated for 1 hour 30 minutes at 37°C, which was emptied by aspiration and washed for a minimum of 5 times. The plate was dried by turning them upside down on- absorbent paper. 100ul of freshly prepared substrate solution consist of (substrate buffer-citric acid and sodium acetate; containing H_20_2 and DMSO and chromogen pink colored solution containing TMB) was then dispensed into all wells and incubated in the dark for 30 minutes at room temperature (l6 -30°C). The reaction was be stopped by the addition of 100uI of stopping solution (1N Sulphuric add) and the absorbance of the wells were read at a wavelength of 450nm, using ELISA reader (E-max reader, precision microliter plate reader MDS -Analytical technique USA).

3.0 RESULTS

The highest prevalence of HBsAg (14%) was recorded at Specialist Hospital Sokoto (SHS), followed by Usmanu Danfodiyo University Teaching Hospital Sokoto (UDUTH) HBsAg (10%). In contrast, Maryam Abacha women and children Hospital Sokoto (MAWC) HBsAg (14%) and Women and Children Welfare Clinic (WCWC) HBsAg (4%) recorded much lower positivity rates. Of the 347 participants 287 (82.7%) of them were males, 60 (17.3%) were females aged between 18-20 (13.8%), 21-30 (42.7%), 31-40 (33.7%), and >41 (9.9%). The Hausa tribe was predominant with 274 (79%) followed by Yoruba 37 (10.7%), Fulani 17 (4.9%), Igbo 14 (4%), and Others (1.4%). One hundred and seventy-six of them were married men and women 50.7%, 158 (28.4%) were singles while 13 (3.7%) were separated. Two hundred and seventy-one of them were Traders (78.1%), 23 (6.6) were House wives, 13 (3.7%) were Farmers, and 40 (11.5%) were civil servants. One hundred and thirty-three attended Secondary schools (38.3%), 72 (20.7%) Tertiary institutions, 92 (28.0%) Primary schools while 45 (13.0%) attended non-formal school only (Table 4.1). A slightly higher prevalence was observed among males/females. However, Married individuals showed the highest seropositivity rates (11.9%), followed by singles and separated groups. Individuals with lower educational attainment showed a higher rate of HBsAg positivity. This may suggest gaps in

knowledge about transmission prevention or limited access to vaccination services among less educated populations. There was no significant difference in the prevalence of HB_SAg in blood donors based on their occupation. Those in civil service and Trading were most infected 5(12.5%) and [28 (10.3%) followed in decreasing order of prevalence by House wives 3 (13%) and Farmers [1 (7.7%)] % respectively. Among ethnic groups, the Hausa had the highest prevalence of HBsAg (29.4%), followed in decreasing order of prevalence by Fulani (10.2%), Yoruba (16.2%) and Igbo (14.3%). The differences were statistically significant (p = 0.054), indicating possible ethnic or regional disparities in HBV transmission. Logistic regression analysis of potential risk factors shows blood transfusion with increases odds of HBV positivity (p = <0.001), intravenous drug abuse (p = 0.007473), Use of Sharp object (p = 0.000201) , while vaccine status (p = 0.031437) all show unexpectedly lower odds but are statistically significant, while factors including Multiple sexual partners, HBV knowledge, and knowledge on mode of transmission are not statistically significant.

Table 1 Prevalence and Demographic distribution of blood donors

Parameter	Frequency	Percentage (%)
Negative samples	310	89.3
Positive samples	37	10.7
Total	347	100

Table 2 Association between specific participant parameters with Hepatitis B Surface Antigen

		HBsAg	
Demographic factors	Variable	Positives	Negatives
Age (years)	18-20	6 (12.5)	42 (87.5)
	21-30	13 (8.8)	135 (91.2)
	31-40	13 (11.1)	104 (88.9)
	≥ 41	5 (14.7)	29 (85.3)
	Chi square	1.327	
	p-value	0.622	

Gender	Male	28 (9.8)	259 (90.2)
	Female	9 (15)	51 (85.0)
	Chi Square	1.433	
	P-value	0.231	
Marital status	Married	21 (11.9)	155(88.1)
	Separated	3 (23.1)	10(76.9)
	Single	13 (8.2)	145(91.8)
	Chi Square	3.384	
	P-Value	0.093	
Educational background	Non formal	6 (13.3)	39(86.7)
	Primary	9 (9.3)	88(90.7)
	Secondary	16 (12)	117(88.90)
	Tertiary	6 (8.3)	66(91.7)
	Chi Square	1.203	
	P-value	0.715	
Occupation	Trading	28 (10.3)	243(89.7)
	Civil service	5 (12.5)	35(87.5)
	Farming	1 (7.7)	12(92.3)
	Others	3 (13)	20(87.0)
	Chi Square	0.430	
	P-value	0.934	
Ethnicity	Fulani	5 (29.4)	12(70.6)
	Hausa	28(10.2)	250(91.2)
	Igbo	2 (14.3)	12(85.7)
	Yoruba	6 (16.2)	31(83.8)
	Others	0(0)	5(100.0)
	Chi Square	9.303	

P-value	0.054

Table 3: Distribution of serological findings based on sample location

	HBsAg	
Location of the facility	**Positives**	**Negatives**
UDUTH	14(10.3)	122(89.7)
SHS	14 (14.4)	83(85.6)
MAWC	5 (7.5)	62(92.5)
WCWC	4 (8.5)	43(91.5)
Chi Square	2.42	
P-value	0.491	

Table 4: logistic regression analysis of potential risk factors

Variable	Responses (n =)	Positive (%)	Odd ratio	S.E	*p*-value
BLOOD TRANSFUSION					
NO (baseline)	304	95			---
YES	43	20	-3.272	0.467	<0.001
MULTIPLE SEX PARTNERS					
NO (baseline)	296	90			---
YES	51	44	0.614	0.586	0.295183
INTRAVENOUS DRUG ABUSE					
NO (baseline)	339	90			---
YES	8	5	-2.789	1.043	0.007473
SHARP OBJECT					
NO (baseline)	321	93			---
YES	26	13	-2.402	0.646	0.000201
VACCINE STATUS					
NO (baseline)	314	89			---
YES	33	31	2.028	0.943	0.031437
KNOWLEDGE ON HBV					
NO (baseline)	279	80			---
YES	68	20	1.016	0.527	0.976
MODE OF TRANSMISSION					
NO (baseline)	325	94			----
YES	22	6	0.597	0.736	0.483

HBV SCREENING					
NO (baseline)	313	90			----
YES	34	10	0.569	0.521	0.279

DISCUSSION

This study investigated the prevalence of Hepatitis B surface antigen (HBsAg) among a selected hospitals in Sokoto metropolis, Sokoto State, western Nigeria. Blood donors attending Usmanu Danfodiyo University Teaching Hospital Sokoto, Specialist Hospital Sokoto, Maryam Abacha women and children Hospital Sokoto and Women and Children Welfare Clinic Sokoto in the Sokoto metropolis, comprised of males and females, aged between 18 and 60 years were involved in the study, response rates were recorded for the questionnaire survey.

The study identified a prevalence of 10.7% among blood donors in the Sokoto metropolis. According to World Health Organization (WHO) criteria, which categorize HBsAg positivity >8% as high endemicity, these findings confirm that Sokoto remains a high-burden region (WHO, 2010).

The wild-type prevalence observed here (10.7%) sits within the mid-to-high range of recent Nigerian data, though it shows notable geographic and temporal variations, it is lower than studies in Osogbo (14.52%) and other donor pools (13.1%) reported by Foluke *et al.*, the prevalence is higher than recent 2025 data from Sokoto (9.6%; Babandina *et al.*,). Federal Medical Centre Azare (8.3%), and 2024 data from Mogadishu, Somalia (9.7%; Mohamud *et al.*,). It also exceeds the 7.88% reported in Southern Ethiopia (Maria *et al.*, 2022). These variations likely stem from localized differences in risk factor exposure, vaccine coverage, and the specific demographics of the study populations. While gender distribution did not reach statistical significance, a higher absolute number of cases occurred in males. This aligns with findings by (Pennap *et al.*, 2011) and (Isah *et al.*, 2015), potentially due to higher male engagement in high-risk activities (e.g., body piercing, unprotected sex) and biological factors that favor viral chronicity in men. This contrasts with Mustapha and Jibrin (2004), who found higher rates in females, highlighting how gender dynamics in infection can shift over time and location.

The 21-30 and 31- 40 age group had the highest number of dual positive cases 13 (8.8%) and 13 (11.1%) likely reflecting cumulative lifetime exposure. The high infection rate in young adults is concerning, as this age by group represents the most sexually active and economically productive population, thus increasing the risk of HBV transmission to sexual partners and the risk of horizontal and vertical transmission. This was in an agreement with the research carried out among blood donors in South-west Nigeria by Mabayoje *et al.*, who reported that the prevalence of HBV did not differ significantly with gender or age group. This also aligns with findings from Ogundeji (2018) and Abuja-based studies (2023), which identified the 20–39 age bracket as having the highest HBsAg prevalence. Similarly, Babandina *et al.*, (2025) noted that young adults in Sokoto remain the most affected demographic. The high rate in this group is often attributed to sexual debut and increased horizontal transmission through multiple partners or occupational exposure. In contrast, studies among older populations often show a decline in HBsAg but an increase in HBcAb (total core antibody), reflecting a transition from active infection to cumulative lifetime exposure or "resolved" status. The high prevalence in this "economically productive" age group is a significant public health concern as it drives both the community viral load and the risk of vertical (mother-to-child) transmission. Participants with non-formal education had the highest positivity (13.3%), a clear inverse relationship between educational attainment and HBV positivity, with the highest rates among those with non-formal education (13.3%). likely due to limited awareness of transmission routes and lower vaccination uptake. This aligns with the

findings in secondary school studies (2023) where lower socioeconomic classes were more heavily affected. It also mirrors a Zhejiang (2025) cross-sectional study where educational level was a primary influencing factor. Reasons for Variation could be due to Health Literacy: higher education is frequently linked to better awareness of transmission routes (e.g., the danger of sharing sharp objects or unprotected sex), vaccine Access: Individuals with formal education are more likely to have participated in workplace or school-based vaccination programs and Traditional Practices: Populations with non-formal education in rural or informal urban sectors may be more exposed to traditional practices involving unsterilized equipment (e.g., traditional scarring or uvulectomy), which are documented risk factors in North-Western Nigeria. Married individuals showed higher seropositivity (11.9%), suggesting that intrafamilial and horizontal transmission between partners is a significant, this aligns with research by Olayinka *et al.,* (2016) and Okunade *et al.,* (2015), who reported that having an infected spouse significantly increases the odds (OR = 5.03) of HBV positivity. Conversely, some studies (e.g., Agbamu *et al.,* 2024) found no statistical association, likely due to differences in sample size. The high prevalence in married subjects suggests that sexual transmission and close household contact are major drivers. Unlike western countries where HBV is often managed, in endemic regions like Sokoto, many spouses remain unscreened and unvaccinated, facilitating transmission within the family unit. The Hausa ethnic group exhibited the highest prevalence (29.4%), which may point toward specific regional cultural practices or disparities in healthcare access. This finding is consistent with Okwesili *et al.,* (2015), who found that the Hausa ethnic group constituted the majority of HBsAg-positive cases in North-Western Nigeria. Similarly, Babandina *et al.,* (2025) observed that ethnicity was a significant predictor of infection markers in the Sokoto metropolis. This could be attributed to traditional practices such as uvulectomy, tribal scarring, and the use of unsterilized equipment by traditional barbers (wanzamai), while the disparities may also stem from lower uptake of the HBV vaccine in certain rural or traditional clusters due to suspicion or lack of access to primary healthcare.

Facility-based differences showed higher HBV prevalence among participants from Specialist Hospital Sokoto (SHS) followed in decreasing order by Usmanu Danfodiyo University Teaching Hospital Sokoto, Maryam Abacha Women and Children Hospital and Women and Children WC Sokoto. This may reflect gaps in public health interventions and limited access to vaccination services in those areas. However, some differences may arise from variations in sample size, or local interventions in place (e.g., vaccination programs). Study by Egbe *et al.,* (2023) have shown that secondary health facilities (like SHS) often record higher seropositivity rates because they serve a broader, more rural, and lower-socioeconomic demographic compared to tertiary teaching hospitals (like UDUTH), which often see more urbanized or "referral" patients. The reason could be patients at Specialist Hospital Sokoto (SHS) may have less access to preventive care and vaccinations than those attending UDUTH, which is often used by civil servants and students with higher health literacy.

Logistic Regression analysis for potential risk factors identified Blood Transfusion ($p < 0.001$), Intravenous Drug Abuse ($p = 0.007$), and the use of sharp objects ($p < 0.001$) as statistically significant predictors of HBV positivity. These findings strongly align with Musa *et al.,* (2015) and Olayinka *et al.,* (2016), who established that parenteral exposure (blood-to-blood contact) remains a primary driver of the Nigerian HBV epidemic. The significance of "sharp objects" is particularly consistent with research in Northern Nigeria regarding traditional scarring and unsterile barbering tools (Babandina *et al.,* 2025). The "Odds" Paradox: You noted "unexpectedly lower odds" despite statistical significance. This often occurs in highly endemic regions where the virus is so widespread that specific "high-risk" events do not stand out as much as they would in a low-prevalence country. This variation suggests that horizontal transmission (community spread) may be just as influential as discrete medical or behavioral

events. Vaccination status (p = 0.031) was significant but also showed unexpectedly lower odds of protection.

CONCLUSION

This study revealed HBV prevalence rate of 10.7 % of HBV Infection among blood donors in public hospitals in Sokoto metropolis. The highest prevalence of HBsAg (14%) was recorded at Specialist Hospital Sokoto (SHS), followed by Usmanu Danfodiyo University Teaching Hospital Sokoto (UDUTH) HBsAg (10%) enous drug Abuse, use of sharp object, while vaccine status shows unexpectedly lower odds.

RECOMMENDATIONS

1. Strengthening Blood Safety Protocols

Since blood transfusion was identified as a significant risk factor, the current screening process needs an upgrade. Move Beyond HBsAg: While ELISA for HBsAg is standard, it can miss "Occult Hepatitis B" (infections where HBsAg is undetectable but DNA is present). Hospitals should consider incorporating Nucleic Acid Testing (NAT) or testing for Anti-HBc (Hepatitis B core antibody) to catch donors in the window period. Ensure that smaller clinics (like WCWC or MAWC) have the same high-standard ELISA or molecular testing capabilities as larger centers like UDUTH to prevent transmission by infected donors also enhance the pre-donation questionnaire to more aggressively screen for the high-risk behaviors identified in the study, such as intravenous drug use and recent use of unsterilized sharps.

2. Targeted Vaccination & Awareness: The "Vaccine status" impact suggests that either coverage is low or the vaccine's efficacy is being bypassed by high-risk exposures. Implement a targeted vaccination drive specifically for the donor-age population (18–60 years) who may have missed the childhood Expanded Programme on Immunization (EPI).

3. Public Health Campaigns: Launch awareness programs in Sokoto focusing on the dangers of sharing sharp objects (barbing salons, traditional scarring, or needle sharing) and the importance of completing the full three-dose HBV vaccine series. Address the "Intravenous Drug Abuse" factor by collaborating with social services for harm reduction programs, as this is a high-velocity route for viral transmission.

4. Counseling and Referral: Donors who test positive should not just be deferred; they need a clear clinical pathway for treatment. Establishing a referral system from the blood bank to hepatology clinics ensures these individuals receive care and don't unknowingly continue the chain of transmission.

CONFLICT OF INTEREST

The authors declare no conflict of interest associated with this work

AUTHOR CONTRIBUTIONS

All authors contributed substantially to this work

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