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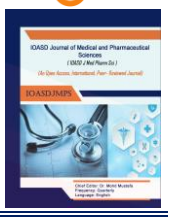

Prevalence of Hepatitis B Virus Infection Among Blood Donors at University Teaching Hospital in Lusaka, Zambia

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ABSTRACT

Hepatitis B virus (HBV) infection remains a major transfusion-transmissible infection in sub-Saharan Africa. Blood donor surveillance is essential for maintaining a safe blood supply. This study assessed the prevalence of HBV infection and associated risk factors among blood donors at the University Teaching Hospital (UTH) in Lusaka, Zambia. A cross-sectional retrospective study was conducted among 140 blood donors screened for hepatitis B surface antigen (HBsAg). Socio-demographic, behavioural, and clinical information was extracted from routine blood bank records. Associations between HBV seropositivity and donor characteristics were analyzed using chi-square tests, while significant variables were further assessed using multivariate logistic regression. The overall HBV prevalence was 10.0% (14/140). Donors were predominantly male (75.0%), aged 18–22 years (42.1%), urban residents (78.6%), with secondary (52.9%) or tertiary education (35.9%). HBV prevalence was higher among males (10.5%) than females (8.6%), though not statistically significant (p=0.735). Rural donors recorded significantly higher prevalence (20.0%) compared to urban donors (7.3%; p=0.038). HBV infection was most common among donors with primary education (25.0%; p=0.047). Behavioural factors showed strong associations: history of surgery/transfusion (25.0%; p=0.016), tattooing/scarification (33.3%; p=0.001), and multiple sexual partners (23.3%; p=0.007). None of the vaccinated donors were HBsAg-positive (0.0%; p=0.009). Multivariate analysis identified tattooing/scarification (AOR=6.8; p=0.004), multiple sexual partners (AOR=4.1; p=0.023), and vaccination status (AOR=0.001; p=0.002) as independent predictors of HBV infection. HBV prevalence among UTH blood donors remains substantial. Rural residence, low education level, invasive procedures, tattooing, and high-risk sexual behaviour increased risk, while vaccination provided full protection. Strengthened HBV vaccination, community-level health education, and rigorous donor risk assessment are recommended for improving blood safety.

Keywords: Hepatitis B virus; blood donors; prevalence; transfusion-transmissible infections; Zambia.

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INTRODUCTION

Hepatitis B virus (HBV) infection continues to pose a major global health challenge, with a substantial burden in low- and middle-income countries where surveillance and preventive strategies remain limited. HBV is a highly infectious, hepatotropic DNA virus transmitted through contact with infected blood or bodily fluids. It is responsible for a spectrum of disease ranging from acute hepatitis to chronic infection, cirrhosis, and hepatocellular carcinoma [1-2]. According to the World Health Organization (WHO), approximately 296 million individuals were living with chronic HBV infection in 2021, resulting in nearly 820,000 deaths annually from HBV-related liver diseases. Sub-Saharan Africa and the Western Pacific regions account for the highest prevalence rates of chronic HBV infection, with estimates ranging between 6% and 12%. Despite the availability of an effective vaccine since 1982, HBV transmission persists due to gaps in immunization coverage, inadequate screening programs, and ongoing horizontal and vertical transmission [3-4].

Zambia is considered a high-endemicity country for HBV, with population-based prevalence

estimates ranging from 5% to 10%, depending on the region and population studied. Several studies in Zambia have demonstrated that HBV remains widespread among both the general population and high-risk groups, including healthcare workers, pregnant women, and individuals requiring frequent medical interventions. Despite ongoing public health efforts to expand vaccination coverage—particularly through the Expanded Programme on Immunization (EPI)- a substantial proportion of adults remain unvaccinated, leaving them vulnerable to infection through sexual exposure, unsafe medical procedures, and contact with infected individuals. The persistent community reservoir of HBV increases the likelihood of transmission through medical procedures, including blood transfusion, which remains a critical clinical intervention in the management of trauma, obstetric emergencies, severe anemia, and surgical procedures [5-6]. Blood transfusion safety is a vital component of national health systems, especially in resource-constrained environments where the demand for blood continues to increase. Transfusion-transmissible infections (TTIs) such as HBV, hepatitis C virus (HCV), human immunodeficiency virus (HIV), and syphilis represent significant threats to blood safety if not adequately screened. Although the adoption of enzyme-linked immunosorbent assay (ELISA) and rapid diagnostic tests has significantly reduced the risk of TTI transmission, residual risk persists due to the window period, occult infections, and technological limitations. In sub-Saharan Africa, where voluntary non-remunerated blood donation rates remain low and replacement or family donation is common, the risk of TTIs is comparatively higher. Young adults, who constitute the bulk of blood donors, often present with variable HBV exposure histories, further complicating risk profiles [7-8].

The University Teaching Hospital (UTH) in Lusaka serves as the largest tertiary referral and academic medical center in Zambia, providing comprehensive clinical services and serving as a major national blood collection hub. Donors presenting at UTH include first-time donors, repeat voluntary donors, and family-replacement donors, each with distinct demographic and risk characteristics. Monitoring HBV prevalence among these donor subgroups provides critical insights into the burden of infection within the donor population and the potential risk to transfusion recipients. Such data are essential for guiding policy decisions, improving pre-donation counseling, enhancing screening algorithms, and developing targeted preventive strategies, including prioritized HBV vaccination for high-risk donors [9-10]. This study was therefore conducted to determine the prevalence of HBV infection among blood donors at the University Teaching Hospital Blood Bank in Lusaka, Zambia, and to evaluate its association with key demographic characteristics such as age, sex, and donor category. The findings are expected to inform strategies for strengthening blood transfusion safety, improving donor recruitment and retention protocols, and supporting national efforts aimed at HBV prevention and control.

RESEARCH METHODOLOGY

Research Design

This study utilized a descriptive cross-sectional design, analyzing data from routine blood donor screenings conducted by the University Teaching Hospital (UTH) in Lusaka, Zambia. The target population included both first-time and repeat blood donors aged 16–65 years. Data collection encompassed demographic variables (age, gender, marital status, occupation, donor type) and serological testing, specifically hepatitis B surface antigen (HBsAg) for HBV detection. The study evaluated donor records from August 2024 to August 2025, allowing for a robust analysis of HBV prevalence.

Population

The study population consisted of voluntary blood donors meeting the World Health Organization (WHO) eligibility criteria for blood donation. Donors aged 18–30 years with a minimum hemoglobin level of 12.5 g/dL and deemed medically fit based on history and examination were included. Both male and female donors were considered; however, the donor pool was predominantly male during the 2024–2025 donation period at UTH.

Sample Size Determination

Sample size was calculated using the standard single-proportion formula:

$$N = Z^2 \cdot P(1 - P) / d^2$$

Where:
n = required sample size
Z = Z-score for 95% confidence (1.96)
P = estimated HBV prevalence among donors (0.096 or 9.6%)
d = margin of error (0.05)
Substituting values:

$$n = (1.96)^2 \times 0.096 \times (1 - 0.096) / (0.05)^2$$
$$n = 3.8416 \times 0.096 \times 0.904 / 0.0025$$
$$n = 3.8416 \times 0.086784 / 0.0025$$
$$n = 0.333414144 / 0.0025$$
$$n = 133.37$$

The computed minimum sample size was therefore 134, rounded up to the nearest whole number. To account for possible missing or incomplete data, additional records (up to 140) were considered where feasible.

Sampling Technique

A structured data extraction method was employed using standardized templates designed to capture relevant laboratory and sociodemographic variables from donor records. Each form included fields for age, sex, donor number, occupation, screening results, and other critical indicators. Trained personnel

manually reviewed and entered data from laboratory records.

Sampling Procedure

This study used a retrospective sampling approach, drawing on pre-existing records from UTH. The sampling frame included all eligible donor records between January 2024 and August 2025. Records were assessed for inclusion based on the presence of complete demographic information and documented HBV test results. Records lacking essential data or indicating co-infection with other transfusion-transmissible infections were excluded.

Data Collection Procedure

A retrospective quantitative approach was used to extract data from electronic health records (EHR) and laboratory information systems at UTH. A predefined extraction protocol guided the process, ensuring consistency and accuracy. Variables included donor demographics (age, sex, marital status, education, occupation, residence), HBsAg test results, and related screening data. The process ensured confidentiality and minimized transcription errors through cross-checking and validation steps.

Data Analysis

Data were analyzed using descriptive and inferential statistics. Descriptive measures such as frequencies, means, and proportions summarized demographic and HBV screening data. Seroprevalence of HBV was expressed as a percentage of the total sample. Year-wise and gender-wise trend analyses were conducted. Chi-square tests assessed the significance of differences in HBV prevalence across demographic groups, with $p < 0.05$ considered statistically significant. Linear regression evaluated prevalence trends over time.

Ethical Considerations

Ethical approval for this study was granted by the Africa University Research Ethics Committee under approval number AUREC 4013/25. Additional permission was obtained from the University Teaching Hospital to access donor records. Confidentiality and anonymity were strictly upheld throughout data handling and reporting. No identifying information was extracted, and results were used solely for academic and public health purposes.

RESULTS

The study analyzed data from 140 blood donors to determine the prevalence and associated factors of hepatitis B virus (HBV) infection at the University Teaching Hospital. Table 1 summarizes the socio-demographic characteristics of the donors. The donor population was predominantly male, accounting for 75.0% (n=105), while females represented 25.0% (n=35). The majority of donors were within the younger age groups, with 42.1% aged 18–22 years, followed by 32.9% aged 23–26 years, and 25.0% aged 27–30 years. Most participants resided in urban areas (78.6%), whereas 21.4% were from rural settings. Regarding educational attainment, more than half (52.9%) had completed secondary education, 35.9% had tertiary-level education, and 11.4% had only primary-level education. In terms of marital status, 64.3% were single, 32.1% were married, and 3.6% were divorced or separated.

Table 1: Socio-Demographic Characteristics of Blood Donors

Characteristic	Category	Frequency (n)	Percentage (%)
Gender	Male	105	75.0%
	Female	35	25.0%
Age Group(years)	18-22	59	42.1%
	23-26	46	32.9%
	27-30	35	25.0%
Residence	Urban	110	78.6%
	Rural	30	21.4%
Education level	Primary	16	11.4%
	Secondary	74	52.9%
	Tertiary	50	35.9%
Marital Status	Singal	90	64.3%
	Married	45	32.1%
	Divorced/separated	5	3.6%

Table 2 presents the distribution of HBV infection across socio-demographic groups. The overall HBV prevalence among donors was 10.0% (14 out of 140). Although HBV prevalence was slightly higher in males (10.5%) compared to females (8.6%), the difference was not statistically significant (p=0.735). Age-specific analysis revealed a declining trend in prevalence with increasing age, with the highest prevalence observed among donors aged 18–22 years (13.6%), followed by 23–26 years (8.7%) and 27–30 years (5.7%); however, this trend did not reach statistical significance (p=0.452). Residence showed a notable association with HBV infection, as donors from rural areas recorded a significantly higher prevalence (20.0%) compared to urban residents (7.3%) (p=0.038). Educational level was also significantly associated with HBV status (p=0.047), with donors who attained only primary education showing the highest prevalence at

25.0%, followed by secondary (10.8%) and tertiary (4.0%) education levels. Marital status exhibited no statistically significant relationship with HBV infection (p=0.538), although prevalence was slightly higher among married donors (13.3%) compared to single donors (8.9%).

Table 2: Distribution of HBV Infection by Socio-demographic Factors

Characteristic	Category	Total Donors	HBsAg Positive (n)	Prevalence (%)	p-value
Overall Prevalence		140	14	10.0%	
Gender	Male	105	11	10.5%	0.735
	Female	35	3	8.6%	
Age Group (Years)	18-22	59	8	13.6%	0.452
	23-26	46	4	8.7%	
	27-30	35	2	5.7%	
Residence	Urban	110	8	7.3%	0.038
	Rural	30	6	20.0%	
Education Level	Primary	16	4	25.0%	0.047
	Secondary	74	8	10.8%	
	Tertiary	50	2	4.0%	
Marital Status	Singal	90	8	8.9%	0.538
	Married	45	6	13.3%	
	Divorced	5	0	0.0%	
Statistically Significant at p<0.05					

Behavioral and clinical risk factors associated with HBV infection are outlined in Table 3. A significant association was observed between previous history of surgery or blood transfusion and HBV positivity (p=0.016), with donors who reported such history showing a 25.0% prevalence compared to 7.5% among those without prior surgical or transfusion exposure. Tattooing or scarification emerged as a major predictor of HBV infection, with individuals reporting such practices recording a prevalence of 33.3%, significantly higher than the 6.6% among those without these practices (p=0.001). Donors reporting multiple sexual partners also showed significantly higher HBV prevalence (23.3%) compared to those with a single partner (6.4%) (p=0.007). Importantly, HBV vaccination status demonstrated a strong protective effect; none of the vaccinated donors tested positive for HBsAg, whereas 14.0% of the unvaccinated donors were positive (p=0.009).

Table 3: Distribution of HBV Infection by Behavioural and Clinical Factors

Risk Factor	Category	Total Donors	HBsAg Positive (n)	Prevalence (%)	p-value
History of Surgery/Transfusion	Yes	20	5	25.0%	0.016
	No	120	9	7.5%	
History of Tattooing/Scarification	Yes	18	6	33.3%	0.001
	No	122	8	6.6%	
Multiple Sexual Partners	Yes	30	7	23.3%	0.007*
	No	110	7	6.4%	
HBV Vaccination Status	Vaccination	40	0	0.0%	0.009*
Vaccinated	Not vaccinated	100	14	14.0%	
***Statistically significant at p < 0.05**					

Multivariate logistic regression analysis (Table 4) identified key independent predictors of HBV infection. After adjusting for potential confounders, tattooing or scarification remained a strong and statistically significant predictor of HBV infection (AOR = 6.8; 95% CI: 1.8–25.4; p = 0.004). Donors with multiple sexual partners were also significantly more likely to be infected (AOR = 4.1; 95% CI: 1.2–14.0; p = 0.023). Moreover, vaccination against HBV demonstrated a substantial protective effect, with vaccinated individuals showing an almost negligible likelihood of HBV infection compared to their unvaccinated counterparts (AOR = 0.001; 95% CI: 0.000–0.09; p = 0.002). Other variables—including rural residence, primary education, and history of surgery or transfusion—showed elevated odds ratios but did not achieve statistical significance in the adjusted model.

Table 4: Independent Predictors of HBV Infection (Multivariate Logistic Regression)

Predictor Variable	Adjusted Odds Ratio (AOR)	95% Confidence Interval	p-value
Rural Residence (vs. Urban)	2.5	0.7-9.2	0.156
Primary Education (vs. Tertiary	3,9	0.6-25.8	0.198
History of Surgery/Transfusion	2.5	0.6-10.1	
History of Tattooing/Scarification	6.8	1.8-25.4	0.004*
Multiple Sexual Partners	4.1	1.2-14.0	0.023*
HBV Vaccinated (vs. Not)	0.001	0.000-0.09	0.002*
***Statistically significant at p < 0.05**			

DISCUSSION

This study assessed the prevalence and determinants of hepatitis B virus (HBV) infection among blood donors at the University Teaching Hospital in Lusaka, Zambia. The overall HBV prevalence of 10.0% observed in this study confirms that HBV continues to represent a significant transfusion-transmissible infection (TTI) within the donor population. Although somewhat lower than figures previously documented in certain regions of Zambia, the prevalence reported here remains consistent with the WHO categorization of Zambia as a high-endemicity country and underscores the continued public health importance of HBV screening in blood transfusion services [11-12]. The predominance of young donors aged 18-22 years, who also demonstrated the highest HBV prevalence (13.6%), suggests that early adulthood remains a critical period for HBV exposure. This pattern mirrors observations from other sub-Saharan African studies, which indicate that risky sexual behaviors, low vaccination coverage among adolescents and young adults, and limited awareness of HBV transmission pathways may contribute to heightened vulnerability in this age group. Although age differences in prevalence were not statistically significant in this study, the trend toward higher infection rates in younger donors is epidemiologically important and signals a need for targeted HBV prevention strategies among youth [13-14].

The study also found that male donors constituted the majority of participants and recorded a slightly higher HBV prevalence compared to females, although the association was not statistically significant. Similar gender patterns have been reported in Zambia and other African countries, where males typically dominate the blood donor population and frequently exhibit higher HBV risk profiles. Cultural norms, reduced healthcare-seeking tendencies among men, and greater likelihood of engaging in certain high-risk behaviors may partly explain this difference, although the lack of statistical significance here suggests the need for more robust, gender-stratified analyses [15-16]. Socio-demographic characteristics such as education and residence showed strong associations with HBV infection. Donors with only primary education had the highest prevalence (25.0%), significantly higher than among those with tertiary education. This gradient suggests that higher education may serve as a protective factor, likely through enhanced health literacy, greater access to preventive information, and reduced engagement in high-risk behaviors. Similarly, rural residence was significantly associated with higher HBV prevalence in the bivariate analysis. Rural populations may face barriers such as limited access to vaccination, reduced availability of health facilities, and persistent cultural practices that predispose individuals to HBV exposure. Although rural residence did not retain statistical significance in the multivariate model, the elevated odds ratio suggests an underlying, context-dependent vulnerability warranting further investigation [17-18]. Behavioral and clinical risk factors showed strong and statistically significant associations with HBV infection. History of tattooing or scarification emerged as one of the most prominent risk factors in both bivariate and multivariate analyses. The strong association (AOR = 6.8) aligns with extensive literature documenting non-sterile traditional practices as major contributors to HBV transmission in Africa. Similarly, donors reporting multiple sexual partners had significantly increased odds of infection, reinforcing sexual transmission as a critical route of HBV spread among young adults. The association between HBV infection and prior surgery or blood transfusion, although not significant in multivariate analysis, supports long-standing evidence that invasive procedures-particularly those performed under suboptimal infection-control conditions-can contribute to viral transmission [19-20].

One of the most important findings of this study is the protective role of HBV vaccination. None of the vaccinated donors were HBsAg positive, and vaccination remained a strong, independent protective factor in the adjusted model (AOR = 0.001). This finding reiterates the efficacy of HBV vaccination and highlights a critical gap in adult vaccination coverage in Zambia. While the national Expanded Programme on Immunization (EPI) successfully vaccinates infants, adult uptake remains low due to cost, limited awareness, and a lack of routine adult immunization platforms. These results strongly advocate for expansion of HBV vaccination beyond childhood and prioritize high-risk adults, including potential blood donors, healthcare workers, and individuals engaging in high-risk behaviors [21-24]. The findings of this study have important implications for blood transfusion safety. The 10.0% HBV prevalence observed underscores the continuing risk of TTIs, even with routine ELISA screening. High-prevalence donors, particularly first-time donors, young donors, and those from rural areas or

with limited education, may contribute disproportionately to transfusion risks. Strengthening donor selection processes, improving pre-donation counseling, and increasing reliance on low-risk repeat voluntary donors remain essential strategies for reducing transmission. Furthermore, the strong associations with behavioral practices highlight the need for enhanced health education campaigns, both within the donor population and in the general public [25-27]. While ELISA screening is effective, residual risk remains due to the window period and occult HBV infection. Countries with comparable epidemiological profiles have increasingly adopted nucleic acid testing (NAT) to enhance diagnostic sensitivity; however, cost and infrastructure limitations continue to constrain implementation in Zambia. Nevertheless, the data presented here support the long-term value of transitioning to more advance screening methods where feasible [28-30].

CONCLUSION

This study provides a comprehensive assessment of the prevalence of Hepatitis B virus infection among blood donors at the University Teaching Hospital in Lusaka, Zambia, and underscores the ongoing public health challenge posed by HBV within the donor population. The findings indicate that HBV remains a significant transfusion-transmissible infection, reflecting both the endemicity of the virus in the general population and the persistent risk of silent, asymptomatic carriers presenting for donation. The demographic patterns observed-particularly the distribution across age groups and sex-reinforce the need for continued vigilance, targeted education, and enhanced preventive strategies. The results highlight the importance of maintaining stringent donor screening protocols and expanding the use of sensitive diagnostic assays to detect occult infections that may escape routine testing. In addition, the study emphasizes the value of integrating HBV vaccination status assessments and promoting vaccination campaigns, particularly among first-time and high-risk donors. Strengthening pre-donation counselling, improving public awareness about HBV transmission, and addressing barriers to vaccination uptake remain critical components of an effective prevention strategy. This research contributes meaningful evidence to guide national blood safety policies and reinforces the imperative of sustained HBV surveillance in Zambia. Continuous monitoring of prevalence trends, coupled with periodic evaluation of screening technologies, is essential to safeguard the blood supply and reduce the risk of transfusion-associated HBV transmission. Continued investments in prevention, education, and laboratory capacity will be instrumental in advancing Zambia's progress toward achieving long-term HBV control and ensuring a safer transfusion environment.

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