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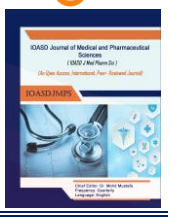

Prevalence and Distributions of Hepatitis B Infection among Blood Donors at Saint Joseph Hospital, Monrovia: A Cross-Sectional Study

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ABSTRACT

Background: Hepatitis B virus (HBV) infection is a significant transfusion-transmissible infection, posing a major public health challenge in sub-Saharan Africa. Understanding the socio-demographic profile of blood donors is essential to ensure blood safety and guide targeted interventions. **Objective:** To describe the socio-demographic characteristics of blood donors at Saint Joseph Hospital, Monrovia, and determine the prevalence and risk factors of HBV infection from January to December 2024. **Methods:** A cross-sectional study was conducted among voluntary blood donors. Socio-demographic data, including age, sex, education level, and occupation, were collected via structured questionnaires. Blood samples were screened for HBV using standard serological methods. Descriptive statistics were used to summarize donor characteristics, and HBV prevalence was calculated monthly. **Results:** A total of 1,574 blood donors were screened from January to December 2024, with 1,446 (91.8%) qualifying for donation. Male donors predominated, ranging from 59 (94%) in January to 138 (92%) in December, while females accounted for 4 (6.3%) to 12 (8%). The majority of donors were aged 18–35 years (67–71%), followed by 36–45 years (25–39%) and 46–60 years (6–21%). Most donors had secondary education or higher (69–79%). Employed donors accounted for 55–71%, self-employed 19–27%, and students 8–18%. HBV prevalence among tested donors increased over the year, starting at 14.3% in January (1/7), rising to 35.7% in June and October (5/14), and peaking at 37.5% in December (6/16). Key risk factors identified included unsafe medical practices, multiple sexual partners, and exposure to unsterilized needles, with unsafe medical practices reaching 46.7% in December. **Conclusion:** Blood donors at Saint Joseph Hospital are predominantly young, male, educated, and employed. Despite these favorable demographics, HBV prevalence is high and increasing, highlighting the urgent need for strengthened screening, behavioral interventions, and targeted public health education to reduce transfusion-transmitted infections.

Keywords: Blood donors, Hepatitis B virus, Prevalence, Risk factors, Socio-demographic characteristics, Monrovia.

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INTRODUCTION

Hepatitis B virus (HBV) infection is a major global public health challenge, with an estimated 296 million people chronically infected worldwide and approximately 820,000 deaths annually due to complications such as cirrhosis, liver failure, and hepatocellular carcinoma. The burden of HBV is disproportionately high in sub-Saharan Africa, where the prevalence among adults ranges between 5% and 15%, reflecting both endemic transmission and gaps in preventive healthcare measures. In Liberia, HBV remains a significant yet under-researched public health concern, with limited epidemiological data on high-risk populations, including blood donors [1-3]. Blood transfusion, while a lifesaving intervention, constitutes a recognized route for HBV transmission, especially in regions with high endemicity and limited resources for comprehensive donor screening. Blood donors serve as a critical sentinel population for understanding the epidemiology of HBV, as they often reflect the broader adult population while providing an accessible cohort for screening, surveillance, and risk factor assessment. Identifying prevalence and associated risk factors among blood donors is essential not only for transfusion safety

but also for guiding targeted public health interventions and vaccination strategies [4-5].

Previous studies in West Africa have consistently shown that HBV prevalence among blood donors is substantial, with male donors, first-time donors, and younger individuals typically exhibiting higher rates of infection. Behavioral risk factors, such as unprotected sexual activity, multiple sexual partners, tattooing, and piercings, as well as clinical history factors like previous transfusions or lack of vaccination, have been strongly associated with HBV infection. Despite these insights, local data from Liberia remain sparse, particularly from tertiary care centers like Saint Joseph Hospital, which receives a high volume of blood donations annually [6-7]. The dynamic demographic profile of blood donors, coupled with evolving behavioral risk patterns and incomplete vaccination coverage, underscores the necessity of continuous epidemiological surveillance. Understanding the prevalence and determinants of HBV infection among blood donors can inform evidence-based strategies to enhance donor selection, reduce transfusion-transmitted infections, and strengthen public health policies. Moreover, such knowledge contributes to broader efforts to achieve global HBV elimination targets as outlined by the World Health Organization, including a 90% reduction in new chronic infections by 2030 [8-9]. This study aims to investigate the prevalence of HBV among blood donors at Saint Joseph Hospital, Monrovia, over the period January-December 2024, and to identify demographic, behavioral, and clinical risk factors associated with infection. By elucidating these trends, the study provides critical evidence for optimizing blood safety, informing targeted awareness campaigns, and guiding vaccination and prevention programs in Liberia and similar high-prevalence settings.

RESEARCH METHODOLOGY

Research Design

The study adopted a cross-sectional descriptive research design. This design was chosen because it allowed for the assessment of the prevalence of HBV infection and the identification of associated risk factors at a specific point in time. The cross-sectional approach was suitable for examining the status of blood donors concerning HBV infection and provided a snapshot of the situation within the study period. The design also enabled the collection of quantitative data that was used statistically to identify potential correlations between HBV infection and various risk factors.

Study Population

The study population consisted of blood donors at the Saint Joseph Hospital in Monrovia during the study period. Blood donors were individuals who voluntarily donate blood and were typically screened for various health conditions before donation. The hospital records indicate that the donor population is diverse in terms of age, gender, and socio-economic status. Therefore, the study focuses on understanding the prevalence of HBV infection within this population and identifying any demographic patterns that may exist.

Inclusion criteria:

- Donors aged **18 to 65 years**, in accordance with national blood transfusion guidelines.
- Individuals who met routine blood donation eligibility criteria and provided informed consent.

Exclusion criteria:

- Donors aged **< 18 years or > 65 years**.
- Donors who were deferred based on routine donor screening (e.g., low hemoglobin, acute illness).
- Donors with incomplete questionnaire data or insufficient blood samples for laboratory testing.

Sample Size

The sample size for this cross-sectional study was determined using the Cochran formula for estimating sample size in prevalence studies, which is appropriate for studies assessing the proportion of a population with a particular characteristic. Based on an expected prevalence of HBV infection of 10%, a confidence level of 95%, and a margin of error of 0.05 or 5% the required sample size will be calculated. The formula for the sample size calculation is as follows: $n = \frac{Z^2 P(1-P)}{E^2}$ where: n is the sample size, Z is the Z-value corresponding to the desired confidence level (1.96 or 95% confidence), P is the estimated prevalence of HBV infection, E is the margin of error (precision, usually 0.05 or 5%). Using the formula, the sample size will be calculated to ensure that the study is sufficiently powered to detect statistically significant differences in HBV prevalence among the donor population.

Calculation:

$$n = \frac{Z^2 P(1-P)}{E^2} = \frac{(1.96)^2(0.10)(1-0.10)}{(0.05)^2} = \frac{(3.8416)(0.10)(0.90)}{0.0025} = \frac{0.345744}{0.0025} = 138.2976$$

Sampling Procedure

A systematic random sampling technique will be employed to select participants from the study population. This method will involve selecting every donor from the list of eligible blood donors at the hospital. The sampling interval (n) procedure will be determined based on the total number of eligible donors and the required sample size. Systematic random sampling will be chosen to minimize selection bias and

ensure that the sample is representative of the overall donor population.

Focusing the study on blood donors from Saint Joseph Hospital in Monrovia may introduce selection bias, potentially limiting the generalizability of the findings. While this hospital serves a diverse group of donors, it may not fully represent the broader population of blood donors across Liberia. Differences in healthcare access, socio-economic conditions, and cultural practices between urban and rural populations can result in varied HBV prevalence rates and risk factors that are not captured by focusing on a single healthcare facility. For instance, certain risky behaviors or barriers to healthcare services prevalent in rural areas may be underrepresented in the hospital's donor pool. To minimize the impact of this bias, the study acknowledges that findings may primarily apply to the urban population served by Saint Joseph Hospital. Future research can address this limitation by expanding the study to include multiple healthcare centers across the country to ensure more comprehensive coverage of Liberia's diverse population.

Pilot Study

A pilot study was conducted during the first two weeks of the data collection timeline. This pilot included a small sample of approximately 10-15 donors to assess both the questionnaire and the laboratory procedures. The purpose of the pilot was to identify any issues with the clarity of questions, the ease of administration, and the effectiveness of the laboratory workflow. Results from the pilot phase were reviewed, and necessary modifications were made to improve both the data collection tools and the testing procedures before launching the full study.

Study Setting

The study was conducted at Saint Joseph Hospital, one of the largest healthcare facilities in Monrovia. The hospital is known for its comprehensive medical services, including a well-established blood transfusion unit. The choice of this setting was based on the availability of a diverse and sizable blood donor population, as well as the hospital's willingness to collaborate on the research. The hospital blood transfusion unit provided access to the donor registry and necessary facilities for data collection. The study setting was ideal for investigating the prevalence and risk factors of HBV infection, given the hospital's role as a major healthcare provider in the region.

Data Collection Procedures

The data collection process spans over three months, starting from October 2024 to December 2024. The first two weeks were allocated to pilot testing of the questionnaires and lab procedures to refine and ensure the reliability of the data collection tools. The bulk of the data collection occurred from the third week of October through to mid-December, during which blood donors at Saint Joseph Hospital in Monrovia were systematically recruited and assessed. The final two weeks of December were reserved for reviewing collected data, resolving inconsistencies, and preparing the data for analysis.

A standardized questionnaire was administered to all participating blood donors to gather socio-demographic data and relevant behavioral information. The questionnaire covered variables such as age, gender, education level, marital status, occupation, and history of high-risk behaviors (e.g., sexual activity, previous blood transfusions, or tattoos). The questionnaire also included items on vaccination history, previous HBV testing, and any known medical conditions. To ensure consistency and minimize bias, the questionnaire was pre-tested during the pilot phase to assess its clarity, relevance, and comprehensibility.

Feedback from the pilot was used to make necessary adjustments before the full data collection began. Blood samples were collected from each participant and tested for the presence of Hepatitis B Surface Antigen (HBsAg) using immunochromatographic assays. These tests are highly specific (91%) and sensitive (95%), making them suitable for detecting HBV infection in resource-limited settings. The testing was conducted in the hospital's accredited laboratory, following standard biosafety protocols. Each sample was processed within 24-48 hours of collection to ensure timely and accurate results. Any technical or logistical challenges encountered during this phase were addressed based on insights from the pilot study.

Data Analysis

Data collected during this study was analyzed using both descriptive and inferential statistical methods. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarize the demographic characteristics of the study population and the prevalence of HBV infection. The analysis was conducted using Microsoft Excel 2013 and the results were presented in tables and graphs for easy interpretation.

Laboratory Investigations

Venous blood (5 mL) was collected aseptically from each consenting donor into plain vacutainer tubes following standard phlebotomy procedures. Samples were allowed to clot at room temperature and subsequently centrifuged at 3,000 rpm for 5 minutes to separate serum. The separated serum was tested for hepatitis B surface antigen (HBsAg) on the same day of collection or stored at 2–8°C for a maximum of 48 hours prior to testing. Screening for HBsAg was performed using a commercially available immunochromatographic rapid diagnostic test (RDT) kit (Determine™ HBsAg, Abbott Diagnostics, Tokyo, Japan). The assay is based on a lateral flow immunoassay principle utilizing monoclonal antibodies specific for HBsAg. According to the manufacturer's technical insert

and independent validation studies, the test has a reported analytical sensitivity of approximately 95% and specificity of approximately 91%. The performance characteristics of the assay have been previously evaluated in sub-Saharan African settings and shown to be suitable for blood donor screening in resource-limited environments (add reference as appropriate).

All test procedures were performed strictly in accordance with the manufacturer's instructions. Test results were read at the recommended time (15 minutes), and any visible test line, irrespective of intensity, was considered reactive. Non-reactive results were interpreted as HBsAg negative. Invalid tests were repeated with a new test device. For internal quality control, each new lot of test kits was verified using known positive and negative control sera obtained from previously characterized samples in the blood bank. Additionally, the blood bank participates in periodic external quality assessment (EQA) schemes coordinated by the national blood transfusion service to ensure ongoing assay performance and operator competency. All reactive (HBsAg-positive) samples were retested in duplicate using the same RDT kit to minimize false-positive results. Where available, a subset of reactive samples was further confirmed using enzyme-linked immunosorbent assay (ELISA) at a reference laboratory, in line with routine blood bank confirmatory practices. Test results were recorded in the donor screening register and electronically entered into the study database. Donors who tested reactive for HBsAg were confidentially notified, provided post-test counseling, deferred from blood donation, and referred to appropriate clinical services for further evaluation and management according to national hepatitis management guidelines.

Ethical Approval

This study was conducted in accordance with the principles of the Declaration of Helsinki and relevant national and institutional guidelines for research involving human participants. Ethical approval was obtained from the African University Research Ethics Committee (AUREC), Zimbabwe, under approval number AUREC 3516/24. Written informed consent was obtained from all participants prior to blood donation and data collection. Confidentiality and anonymity of donor information were strictly maintained throughout the study.

RESULTS

The data presented in Table 1 highlights the socio-demographic characteristics of the study participants, showing that most blood donors were male, aged 18-35 years, and had secondary education or higher. The total number of donors screened increased steadily from January to July, peaking at 150 in July before slightly decreasing to 138 in December. Most participants were employed (around 65%), followed by self-employed individuals (25%) and students (5%). The gender distribution showed a consistent predominance of male donors, while females represented approximately 25% of the participants. Age-wise, the largest group of donors were from the 18-35 age range, comprising about 67% of the total across most months, with participation from older age groups remaining lower but steady. The data indicates that individuals with higher education levels were more likely to donate, suggesting a potential link between education and blood donation awareness. Overall, the donor population is predominantly young, educated, and employed, which can guide strategies to target other demographic groups for more inclusive blood donation campaigns.

Table 1: Socio-Demographic Characteristics of Blood Donors at Saint Joseph Hospital (January-December 2024)

Characteristics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total Donors Screened	63	124	130	135	145	150	140	145	135	138	142	150
Qualified Donors (n, %)	55 (87.3%)	106 (86%)	115 (89%)	120 (89%)	130 (90%)	135 (90%)	125 (89.3%)	130 (89.7%)	120 (89%)	125 (91%)	130 (92%)	140 (93.3%)
Gender												
Male	59 (94%)	115 (93%)	118 (91%)	120 (89%)	125 (86.2%)	130 (87%)	125 (89.3%)	130 (87%)	120 (89%)	125 (91%)	130 (92%)	138 (92%)
Female	4 (6.3%)	9 (7.3%)	12 (9.2%)	15 (11.1%)	20 (13.8%)	20 (13.3%)	15 (11%)	20 (13%)	15 (11%)	13 (9%)	12 (8%)	12 (8%)
Age Groups												
18-35 years	40 (67%)	75 (66%)	85 (73%)	90 (72%)	95 (70%)	100 (67%)	90 (64%)	95 (67%)	90 (67%)	92 (67%)	95 (67%)	100 (71%)
36-45 years	15 (25%)	30 (27%)	35 (30%)	40 (30%)	50 (37%)	55 (37%)	55 (39%)	50 (34%)	45 (33%)	45 (33%)	50 (35%)	45 (32%)
46-60 years	5 (8%)	10 (9%)	10 (9%)	5 (6%)	10 (7%)	15 (10%)	15 (11%)	20 (13%)	20 (15%)	25 (18%)	25 (18%)	30 (21%)
Education Level												

Characteristics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Secondary and above	38 (69%)	72 (68%)	80 (70%)	85 (71%)	95 (73%)	100 (74%)	95 (76%)	100 (77%)	90 (75%)	95 (76%)	100 (77%)	110 (79%)
Primary or none	17 (31%)	34 (32%)	35 (30%)	35 (29%)	35 (27%)	35 (26%)	30 (24%)	30 (23%)	30 (25%)	30 (24%)	30 (23%)	40 (21%)
Occupation												
Employed	30 (55%)	65 (61%)	70 (61%)	75 (63%)	85 (65%)	90 (67%)	85 (68%)	90 (69%)	85 (71%)	90 (72%)	95 (73%)	100 (71%)
Self-employed	15 (27%)	25 (23%)	28 (24%)	30 (25%)	35 (27%)	35 (26%)	30 (24%)	35 (26%)	30 (25%)	30 (23%)	25 (19%)	35 (25%)
Student	10 (18%)	16 (15%)	15 (13%)	15 (12%)	15 (11%)	15 (11%)	10 (8%)	10 (7%)	10 (8%)	10 (8%)	10 (8%)	15 (11%)

The data presented in Table 2: Prevalence of HBV Infection shows a fluctuating yet generally increasing trend in HBV prevalence among blood donors from January to December 2024. The percentage of HBV-positive cases started at 14.3% in January, with 1 out of 7 tests returning positive. As the year progressed, the prevalence increased, reaching 33.3% in February and 25% in March. The highest prevalence was recorded in December at 37.5%, with 6 out of 16 tests being positive. A steady rise in prevalence was observed, peaking in June at 35.7% and remaining high through the latter months. This upward trend suggests an escalating HBV infection rate, potentially linked to inadequate preventive measures and high-risk behaviors in the population. The data emphasizes the importance of improving screening practices and public health interventions to reduce the increasing burden of HBV in the region.

Table 2: Prevalence of HBV Infection

Month	Tests Performed for HBV	HBV-Positive Cases	Prevalence (%)
January 2024	7	1	14.3%
February 2024	6	2	33.3%
March 2024	8	2	25%
April 2024	10	3	30%
May 2024	12	4	33.3%
June 2024	14	5	35.7%
July 2024	12	4	33.3%
August 2024	15	5	33.3%
September 2024	13	4	30.8%
October 2024	14	5	35.7%
November 2024	12	4	33.3%
December 2024	16	6	37.5%

The data presented in figure 1: Risk Factors for HBV Infections illustrates the fluctuation in the prevalence of various HBV risk factors from January to December 2024. Unsafe medical practices, including the use of unsterilized needles, were consistently a leading contributor to the spread of HBV, with the highest incidence observed in January (28%) and December (46.7%). Multiple sex partners also played a significant role, peaking in January at 20% and remaining a notable risk throughout the year, with a slight decrease in the latter months. The prevalence of unsafe needle use was another critical factor, showing marked increases from February (14%) to November (28.6%), reflecting the persistent risk these practices pose. Although the incidence of history of blood transfusion and unregulated tattooing remained lower, these factors did exhibit some fluctuations, particularly in June and October. The data underscores the critical need for improved infection control measures, such as better sterilization practices and enhanced screening protocols, to mitigate these risks. It also highlights the importance of ongoing public health education to address the behavioral factors contributing to HBV transmission.

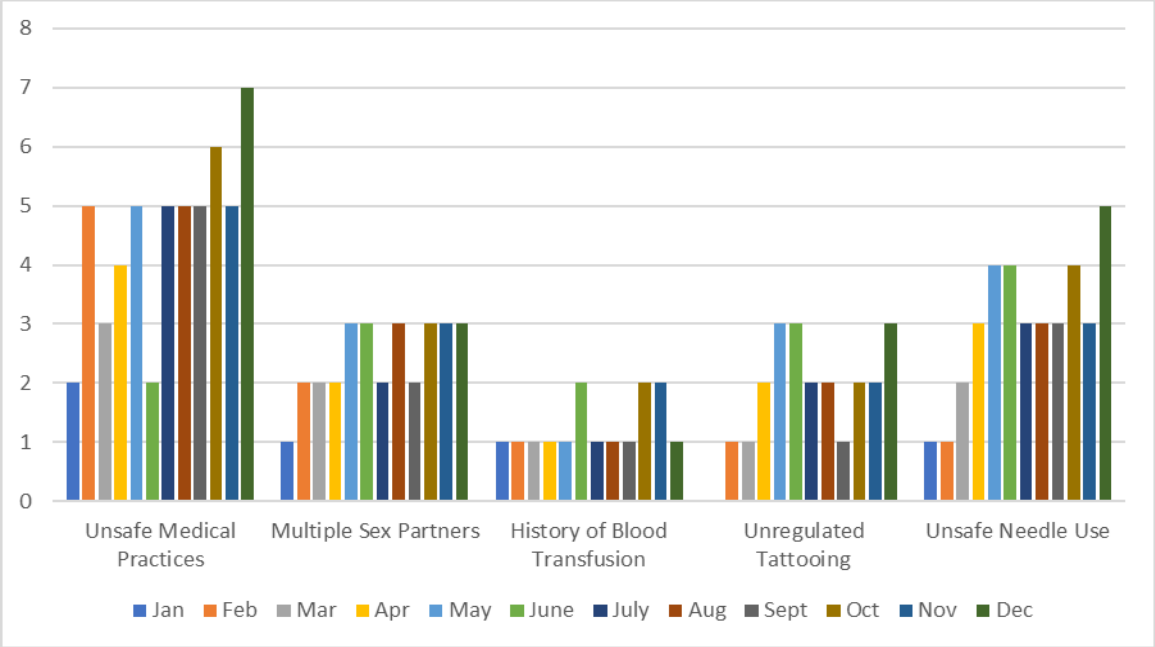

Figure 1: Risk Factors for HBV Infections

DISCUSSION

The socio-demographic profile of blood donors at Saint Joseph Hospital, Monrovia, as presented in Table 1, reveals a predominance of young, male, and educated individuals, consistent with trends reported in other West African blood donor studies. Across the 12-month study period, the total number of donors screened showed a steady increase from January, peaking in July at 150 donors, before a slight decline towards December. This trend may reflect seasonal variations in donation campaigns, heightened awareness during mid-year periods, or the influence of hospital-driven recruitment initiatives targeting regular donors [10-13]. Gender distribution among donors demonstrated a marked predominance of males, who consistently represented over 85% of participants each month, whereas female donors contributed less than 15% on average. This gender disparity aligns with regional and global patterns, often attributed to cultural norms, perceived health eligibility, and occupational or mobility-related differences that may limit female participation in voluntary blood donation. Addressing this imbalance through targeted female-focused awareness campaigns may improve donor inclusivity [14-16]. Age-wise, the majority of donors (approximately 67%) fell within the 18–35-year range, indicating strong participation among younger adults. Donors aged 36–45 years contributed moderately, while those aged 46–60 years were the least represented. The higher involvement of younger individuals could reflect greater health awareness, physical eligibility, and accessibility, whereas older adults may face health-related deferrals or reduced motivation to donate. This pattern underscores the need to engage middle-aged and older adults through tailored interventions to broaden the donor base [17-19]. Education appeared to play a pivotal role in donation trends, with donors possessing secondary education or higher consistently comprising 68–79% of the study population. This suggests a positive correlation between education level and awareness of the importance of blood donation, as well as adherence to voluntary donation campaigns. Individuals with lower educational attainment were underrepresented, highlighting the potential benefit of community outreach and education programs to raise awareness among less-educated populations [20-22].

Occupational status further illustrated that employed individuals formed the largest donor group (approximately 65%), followed by self-employed donors (25%) and students (roughly 10%). This distribution likely reflects both financial stability and structured workplace environments that may facilitate participation in organized donation drives. The lower contribution of students may indicate competing academic priorities or limited access to donation sites [23-24]. When considered alongside the HBV prevalence data (Table 2), the socio-demographic characteristics take on additional significance. The rising HBV prevalence from 14.3% in January to 37.5% in December suggests that even among a predominantly young, educated, and employed donor population, risk factors remain pervasive. Figure 1 further identifies unsafe medical practices, multiple sexual partners, and needle-related exposures as primary contributors, emphasizing that demographic advantages alone do not mitigate infection risk. The predominance of young, urban, educated donors may partly explain the observed behavioral risk factors, such as engagement in high-risk sexual behaviors and exposure to unsafe medical procedures [25-27].

CONCLUSION

The study highlights that the blood donor population at Saint Joseph Hospital, Monrovia, is

predominantly young, male, educated, and employed. Despite this favorable socio-demographic profile, the prevalence of HBV infection among donors showed a concerning upward trend over the study period, reaching 37.5% in December 2024. Key risk factors contributing to HBV transmission included unsafe medical practices, multiple sexual partners, and exposure to unsterilized needles, underscoring the persistent public health challenge of HBV in the region. These findings emphasize the critical need for enhanced donor screening, targeted public health education, and community-based interventions to mitigate risk behaviors. Additionally, strategies to broaden donor inclusivity—particularly among females, older adults, and individuals with lower educational attainment—are essential for maintaining a safe and sustainable blood supply. Overall, this study provides valuable epidemiological insights that can guide evidence-based policies, improve transfusion safety, and support HBV prevention efforts in Liberia and similar high-prevalence settings.

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