ORIGINAL ARTICLE

Demographic Characteristics and Burden of Transfusion-Transmissible Co-Infections in HBsAg-Positive Blood Donors at a Tertiary Care Hospital in North India.

Emmanuel Jabakumar[1], Sanjib Gogoi[2], Sangeeta Pahuja Sindhwani[3], Amit Kumar Sharma[4], Manoj B Jais[5]

[1,2,5]Department of Microbiology, Lady Hardinge Medical College, New Delhi
[3]Department of Immunohematology and Blood Transfusion, Lady Hardinge Medical College, New Delhi
[4]Department of Medicine, Lady Hardinge Medical College, New Delhi

CORRESPONDING AUTHOR
Dr. Emmanuel Jabakumar, Junior Resident Doctor, Department of Microbiology, Lady Hardinge Medical College, New Delhi.
Email: dremanjrpeter@gmail.com

CITATION
Jabakumar E, Gogoi S, Sindhwani SP, Sharma AK, Jais MB. Demographic Characteristics and Burden of Transfusion-Transmissible Co-Infections in HBsAg-Positive Blood Donors at a Tertiary Care Hospital in North India. Journal of the Epidemiology Foundation of India. 2026;4(1):122-127.
DOI: https://doi.org/10.56450/JEFI.2026.v4i01.015

ARTICLE CYCLE
Received: 19/12/2026; Accepted: 16/02/2026; Published: 31/03/2026

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Abstract

Introduction: Chronic hepatitis B infection remains a major public health issue in India, and asymptomatic blood donors can constitute an important reservoir for silent transmission. Epidemiological profiling of HBsAg-positive donors helps in identifying high-yield groups for enhanced screening and targeted preventive interventions within blood transfusion services. **Methods:** This cross-sectional observational study was conducted on 150 HBsAg-positive blood donors between April 2024 and August 2025. Sociodemographic data, donor type and donation frequency, ABO/Rh blood group, and serological status for HIV and syphilis were extracted and summarized. **Results:** All 150 HBsAg-positive donors were male, predominantly aged 21–40 years (92.0%), with most residing in rural areas (57.0%) and educated up to higher secondary level (92.0%). B blood group (34.9%) and O blood group (26.8%) were most frequent, and nearly two-thirds (62.0%) were first-time donors, with only 4.6% having more than five lifetime donations. Co-infection with HIV was detected in 6.7% and syphilis in 2.7%, including 2.7% with combined HIV–syphilis infection, while the vast majority were negative for other TTIs. **Conclusion:** Although overall TTI co-infection prevalence was modest, the presence of HIV and syphilis among these donors underlines the importance of strict pre-donation screening, universal serological testing, and post-test linkage to care for infected individuals.

Keywords

Hepatitis B virus, blood donors, clinical staging, linkage to care, viral hepatitis, transfusion-transmissible infections.

Introduction

Hepatitis B virus (HBV) infection remains a major global health concern, particularly in

blood transfusion safety(1,2).HBV is a partially double-stranded, hepatotropic, enveloped DNA virus of the *Hepadnaviridae* family(3).Transmission occurs via various routes, and hepatitis B surface antigen (HBsAg) has been detected in semen, saliva, and serum, with serum being the most infectious(3). Despite improved awareness, preventive strategies, and vaccination programs, HBV remains one of the most common transfusion-transmissible infections (TTIs)(4,5).HBV contributes significantly to chronic liver disease, cirrhosis, and hepatocellular carcinoma (HCC)(6). Approximately 5% of adult-acquired infections progress to chronic hepatitis B (CHB), while infection in infancy or childhood carries a substantially higher risk of chronicity(3,7). Biochemical markers (ALT, AST) and non-invasive fibrosis assessment, particularly FibroScan, aid in identifying individuals at risk of progressive liver disease and guide treatment decisions(8).Globally, about 240 million people are chronically infected(7). In India, HBsAg prevalence ranges from 3–4.2%, with over 40 million carriers(9). Among blood donors, HBsAg positivity varies by regional endemicity, ranging from 0.2–2.3%(10,11). HBV in apparently healthy donors has been linked to adverse outcomes, including complications, delayed recovery, and mortality(12,13). Among TTIs, HBV remains challenging because of its long incubation period, asymptomatic carriers, and occult infections that may evade conventional serological screening(14–18)

Material & Methods

Study Design and Setting: This cross-sectional observational study was conducted between April 2024 and August 2025 in the Department of Microbiology, in collaboration with the Department of Immunohematology and Blood Transfusion, Lady Hardinge Medical College and associated hospitals, New Delhi. Demographic information including age, gender, residence, education, occupation, and marital status was collected. Donor classification into first-time, replacement, and voluntary donors was documented along with donation frequency history. ABO and Rh blood grouping were performed according to standard protocols.

Study Population: All voluntary or replacement blood donors who tested positive for hepatitis B surface antigen (HBsAg) during routine donor screening were included in the study.

Inclusion Criteria: Donors confirmed to be HBsAg-reactive by chemiluminescent immunoassay (CLIA) were included. Donors with incomplete demographic data or insufficient serum volume for extended testing were excluded.

Sample Size: Among all the other serological markers in hepatitis B surface antigen–positive blood donors, the most constant marker is total antibody to the core antigen (Total anti-HBc), as mentioned by WHO[14]. So, considering total anti-HBc positivity as 90% in HBsAg-positive blood donors at the 95% level of significance, as reported by Mona Seyed Attaran et al.[18] in HBsAg positive blood donors at 95% level of significance and 5 % of relative error, the sample size is calculated by using following formula:

$N = \{Z^2(1-\alpha/2)\, pq\} / L^2$

Replacing the following values in the above-mentioned formula,

P (prevalence) = 90%

q=10%

L^2= (allowable error) = 5 % of p (90%) = $(4.5)^2$ =20.25

$\{Z^2(1-\alpha/2)\, pq\}/L^2 = 3.84 \times 90 \times 10/20.25 = 170$

Thus, the proposed sample size for the study is 170 as per the calculation.

For the present study, convenient sample of size of **150** Hepatitis B surface antigen positive blood donors was taken.

Sample collection & transport: A blood sample of approximately 5 ml was drawn from each study participant into a properly labelled serum separator tube. Within one hour of collection, the sample was centrifuged at 3,000 revolutions per minute for 15 minutes(19).Serological screening for co-infections included HIV and syphilis confirmed by Abbott ARCHITECT i System operates on the Chemiluminescent Microparticle Immunoassay (CMIA) principle(20). Data analysis involved descriptive statistics and chi-square tests to explore associations between

transfusion-transmissible infections (TTIs) and donor characteristics, with statistical significance set at p<0.05.

RESULTS

Demographic and Donation Characteristics: All enrolled donors were male, with mean age 31.8 ± 6.4 years, primarily falling in the 21–40 years range (92%). Majority (57%) resided in rural areas and were married (93.3%). Education status predominantly ranged up to higher secondary (92%), with over 97% employed. Blood group distribution showed B group as most frequent (34.9%), followed by O (26.8%) and A (22.8%). Most donors (62%) were first-time donors, with only 3.3% reporting more than 6 donations.

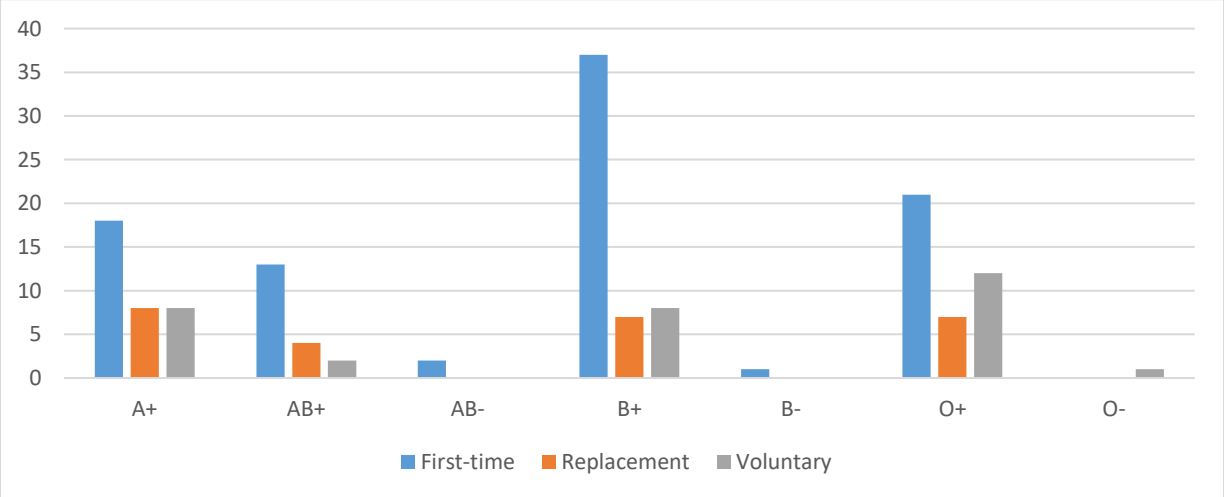
Table 1: Sociodemographic Profile of HBsAg positive blood donors (N=150):

Variable	Category	Total N (%)
Gender	Male	150 (100.0)
	Female	0 (0)
Age Group	21–30	73 (48.7)
	31–40	65 (43.3)
	41–50	9 (6.0)
	51–60	3 (2.0)
	Rural	86 (57.0)
	Urban	64 (43.0)
Marital Status	Single	10 (6.7)
	Married	140 (93.3)
Educational Status	Illiterate	4 (2.6)
	Primary	4 (2.6)
	Higher Secondary	138 (92.0)
	Degree	4 (2.6)
Occupational Status	Unemployed	4 (2.7)
	Employed	146 (97.3)

Table 2: Blood Group and donor type distribution of HBsAg positive blood donors (N=150):

Blood Group	First-time	Replacement	Voluntary	Total	Total (%)
A+	18	8	8	34	22.80
AB+	13	4	2	19	12.80
AB-	2	0	0	2	1.30
B+	37	7	8	52	34.90
B-	1	0	0	1	0.70
O+	21	7	12	40	26.80
O-	0	0	1	1	0.70
Total	92	26	31	150	100

Figure 1 Blood Group and donor type distribution of HBsAg positive blood donors (N=150)



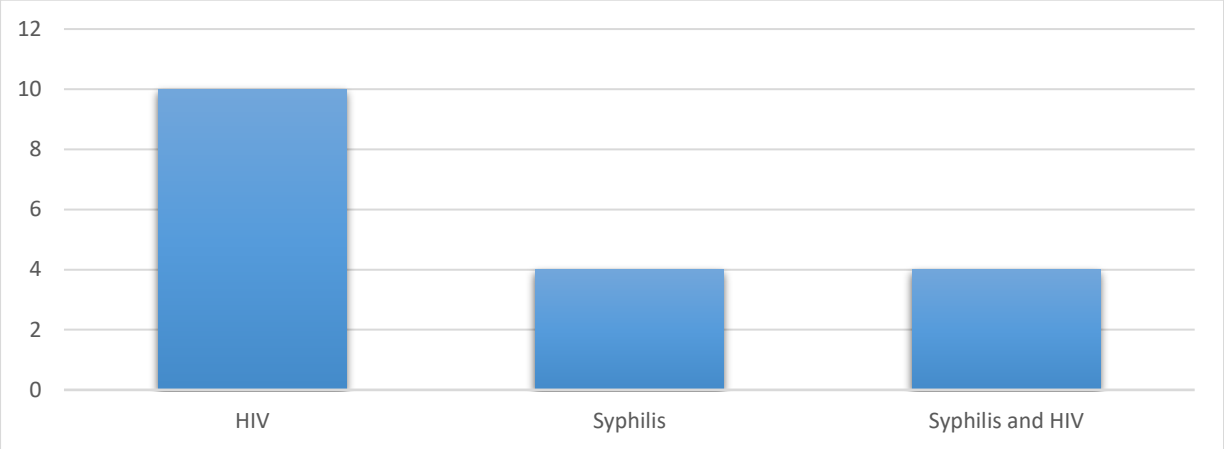
Co-infection Prevalence

Among HBsAg-positive donors, 6.7% tested positive for HIV and 2.7% for syphilis; four donors (2.7%) harbored both HIV and syphilis co-infections. The vast majority (over 86%) were negative for these TTIs. These infections were distributed across donor types without significant association.

Table 3: TTIs co-infection distribution among the HBsAg positive blood donors (N= 150)

	HIV		Syphilis		Syphilis and HIV	
	n	%	n	%	n	%
POSITIVE	10	6.7	4	2.7	4	2.7
NEGATIVE	140	93.3	146	86.7	146	86.7

Figure 2: **TTIs co-infection distribution among the HBsAg positive blood donors (N= 150)**



DISCUSSION

All study participants were males, and this resonates with the nationwide underrepresentation of women in blood donation—primarily due to anemia and low hemoglobin as reported in other studies(21,22). Most donors were aged 21-40 years (mean age: 31.8), consistent with national trends where over 90% of donors are between 18 and 40 years(3).

In the present study, 62% were first-time donors, 33.3% had given blood 1–5 times, and only 4.6% had given blood more than 5 times. This pattern aligns with earlier Indian research, where Makroo et al.(10) and Badhan et al.(21) both found that most donors are either first-time or occasional donors. The study conducted by Pathak et al.(22) also reported that few people in India are willing to donate blood more than once.This high number of first-time donors is frequently observed in hospital-based and replacement donor environments throughout India and South Asia, constituting a recognized risk factor for elevated rates of transfusion-transmissible infections (TTIs) within donor populations. According to WHO guidelines, repeat voluntary donors are less likely to get transfusion-transmissible infections (TTIs) because the selection and screening processes are stricter and happen more often(4,5). In contrast, first-time donors are more likely to test positive for infections such as HBV. Consequently, our findings highlight the challenges of sustaining a dependable cohort of secure repeat voluntary donors, as emphasized in these studies(10,22). In the HBsAg-positive group (n=150), 6.7% tested HIV-positive, 2.7% had syphilis, and 2.7% were co-infected with both; no hepatitis C cases were detected. Conversely, these co-infection rates are notably higher than those observed in earlier studies from North India, such as by Makroo et al.[10] and Yadav et al.(23), which reported lower prevalence rates in the general donor population, i.e. HIV (0.1–0.3%), syphilis (0.2–0.5%) and hepatitis C (0.53%). This difference is likely due to a higher baseline risk for other TTIs in HBV-infected donors in the present study, highlighting the need for rigorous screening and enhanced voluntary

donor programs. The overlap highlights shared risk factors, especially unsafe sexual practices and other high-risk exposures. Notably, our literature search did not identify prior studies examining TTI co-infection specifically in this high-risk group, underscoring the unique value of the present work in filling this knowledge gap.

Conclusion

This study provides a detailed epidemiological snapshot of HBsAg-positive blood donors within a tertiary care setting, highlighting a predominance of young, rural, married males with moderate educational attainment. The high proportion of first-time donors underlines the need for robust pre-donation counseling and screening at first contact to mitigate HBV transmission risk. Co-infection prevalence for HIV and syphilis, though modest, underscores the necessity for comprehensive TTI screening to ensure transfusion safety. The lack of significant associations between donor characteristics and TTIs may be reflective of the homogeneity of the donor pool or limited sample size. These findings support continued vigilance and enhanced screening protocols, alongside health education among potential donors.

Further longitudinal studies with larger cohorts and molecular epidemiology integration could elucidate transmission dynamics more effectively. Limitations of this study include the single-center design and absence of female donors, restricting generalizability.

Recommendation

The findings of this study highlight the need for strengthening donor selection strategies, standardized pre-donation risk assessment, comprehensive serological and molecular screening, and targeted retention of repeat voluntary non-remunerated donors, particularly in view of the predominance of first-time donors and the presence of HIV and syphilis co-infections among HBsAg-reactive donors.

Limitation of the Study

The limitations of this study include its single-center, hospital-based design and the exclusive inclusion of male donors, which may limit the external validity and generalizability of the findings to broader, more diverse blood donor populations.

Relevance of the Study

This study adds clinically relevant epidemiological data on HBsAg-reactive blood donors in a tertiary care transfusion setting in North India, where data on this specific high-risk donor subgroup remain limited.

Authors Contribution

All authors have contributed equally.

Financial Support and Sponsorship

Nil

Conflict of Interest

There are no conflicts of interest.

Acknowledgement

We acknowledge the support offered by virology lab technical staff of the Department of Microbiology at Lady Hardinge Medical College.

Declaration Of Generative AI And AI Assisted Technologies In The Writing Process

During the preparation of this work, the authors used a generative artificial intelligence tool developed by OpenAI to refine language and improve clarity. The authors reviewed and edited the content as needed and take full responsibility for the final manuscript.

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