

Seroprevalence and Pattern of Transfusion-Transmissible Infections Among Blood Donors in Madhya Pradesh: A Cross-Sectional Study

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Abstract

Original Research Article

Background: Transfusion-transmissible infections such as HIV, HBV, HCV, and syphilis pose significant risks to blood safety [1]. This study aimed to estimate the prevalence and patterns of these infections among blood donors in Madhya Pradesh, India. **Methods:** An analytical cross-sectional study was conducted using data from 505 blood donors screened for HIV, HBsAg, anti-HCV, and syphilis [2]. Prevalence was calculated overall, by infection type, donor type (voluntary vs. replacement), age groups, and sex. Chi-square/Fisher's exact tests and logistic regression were used for comparisons and associations. **Results:** The overall TTI prevalence was 1.78% (9/505), all positive for HBsAg, with zero cases of syphilis, HCV, or HIV [3]. Prevalence was higher in voluntary donors (2.33%, 8/344) than replacement donors (0.62%, 1/161), but not statistically significant (Fisher's exact $p=0.2837$). By age: 18-30 years (2.58%), 31-40 (0.93%), 41-50 (2.50%), 51 (0.82%). Females had higher prevalence (3.16%) than males (1.46%). No significant associations were found in logistic regression. **Conclusion:** The low TTI prevalence indicates effective screening, but HBsAg remains the primary concern [4]. Promoting voluntary donations and targeted awareness may further enhance blood safety.

Keywords: Seroprevalence, Transfusion-transmissible infections, Blood donors, Madhya Pradesh, Hepatitis B surface antigen, Voluntary donors, Replacement donors, Cross-sectional study, Blood safety, India.

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INTRODUCTION

Blood transfusion is a life-saving procedure, but it carries the risk of transmitting infections such as human immunodeficiency virus (HIV), hepatitis B virus (HBV), hepatitis C virus (HCV), and syphilis [1]. In India, the National AIDS Control Organization (NACO) mandates screening of all donated blood for these transfusion-transmissible infections (TTIs) to ensure safety [6]. Despite these measures, the prevalence of TTIs among blood donors varies across regions, influenced by factors like donor type, age, and sex [7].

Madhya Pradesh, a central Indian state, has a diverse population with varying socio-economic conditions that may impact TTI rates [8]. Previous studies in India have reported TTI prevalence ranging from 0.5% to 3.5%, with HBV being the most common [9]. However, region-specific data is limited, necessitating targeted research to inform blood safety policies [10].

This study aims to estimate the prevalence and distribution of major TTIs (HIV, HBV, HCV, and syphilis) among blood donors in Madhya Pradesh and compare patterns by donor type (voluntary vs. replacement), age, and sex.

MATERIALS AND METHODS

Study Design

Analytical cross-sectional study using routinely collected blood-bank screening data over a fixed period (e.g., 12 months), or prospectively collected records in the same format [2].

Study Setting

NACO-supported and licensed hospital/medical-college blood banks in Madhya Pradesh. Multi-centre participation preferred for better generalizability [6].

Study Population

All eligible blood donors presenting during the study period.

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Inclusion Criteria

Age 18–60 years, weight 45 kg, haemoglobin 12 g/dL. No history of HBV/HCV or sexually transmitted infections. No jaundice in the past 12 months. Screened for HIV-1/2, HBsAg, HCV, and syphilis as per SOPs [5].

Exclusion Criteria

Incomplete records for any TTI marker. Deferred donors (medical/behavioral deferral). Repeat donations by the same individual (only the first donation retained).

Variables and Measurements

Outcome Variable

TTI positivity (any of HIV/HBsAg/HCV/VDRL reactive). Each infection marker reported separately.

Exposures/Covariates

Donor type (voluntary vs replacement). Age group (18–30, 31–40, 41–50, 51). Sex.

Tests Used

ELISA/CLIA for HIV-1/2 Ab/Ag, HBsAg, anti-HCV. RPR/VDRL for syphilis. Kits as per site SOP (e.g., Meriliza/Erba) [5].

Sample Size Calculation

Expected prevalence (p): 1.75% (0.0175) $q = 1 - p = 0.9825$ Confidence level (Z): 1.96 $\rightarrow Z^2 = 3.8416$ Precision (d): 0.012 ($\pm 1.2\%$) $n = Z^2 \cdot p \cdot q / d^2 = 3.8416 \times 0.0175 \times 0.9825 / 0.012^2 = 458.69 \approx 459$ Add 10% buffer for exclusions $\rightarrow 459 \times 1.10 = 505$ Target sample size: 505 donors (95% CI, $\pm 1.2\%$).

Data Management & Statistical Plan

Data Capture: Donation ID (de-identified), age, sex, donor type, donation date, test results (HIV, HBsAg, HCV, VDRL). Analysis: Descriptive proportions with 95% CIs (overall and marker-specific). Distribution by age, sex, and donor type. Chi-square/Fisher's exact to compare TTI prevalence between voluntary vs replacement donors. Report risk difference and prevalence ratio with CIs. Logistic regression for predictors of TTI positivity [2].

Ethical Considerations

Use de-identified routine screening data. IEC exemption/approval as per institute policy. Follow MoHFW/NACO blood safety standards. No additional procedures on donors [5].

RESULTS

A total of 505 blood donors were included in the study. The overall seroprevalence of TTIs was 1.78% (9/505; 95% CI: 0.82%–3.36%) [3]. All positive cases were reactive for HBsAg (HBV), with a prevalence of 1.78% (9/505). No cases were positive for syphilis (0%), HCV (0%), or HIV (0%).

Prevalence by Donor Type

Among voluntary donors (n=344), the TTI prevalence was 2.33% (8/344), while among replacement donors (n=161), it was 0.62% (1/161). The difference was not statistically significant (Fisher's exact test, $p=0.2837$). The prevalence ratio (voluntary/replacement) was 3.74 [3].

Table 1: Prevalence of TTIs by Donor Type

Donor Type	Total	Positive	Prevalence (%)
Voluntary	344	8	2.33
Replacement	161	1	0.62

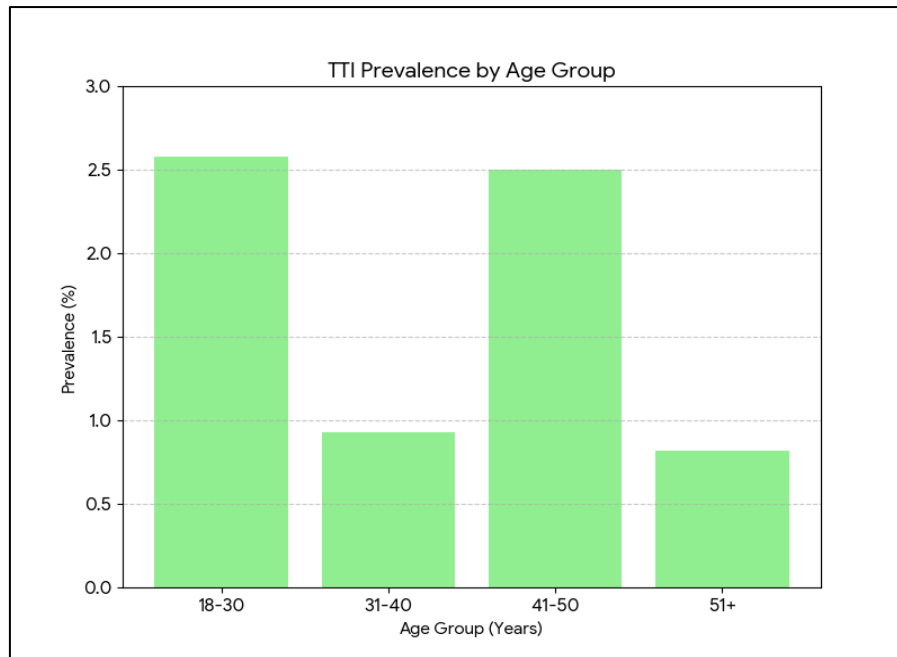
Age- and Sex-wise Distribution

The distribution of TTI positivity by age group is shown in Table 2. The highest prevalence was in the 18–30 years group (2.58%).

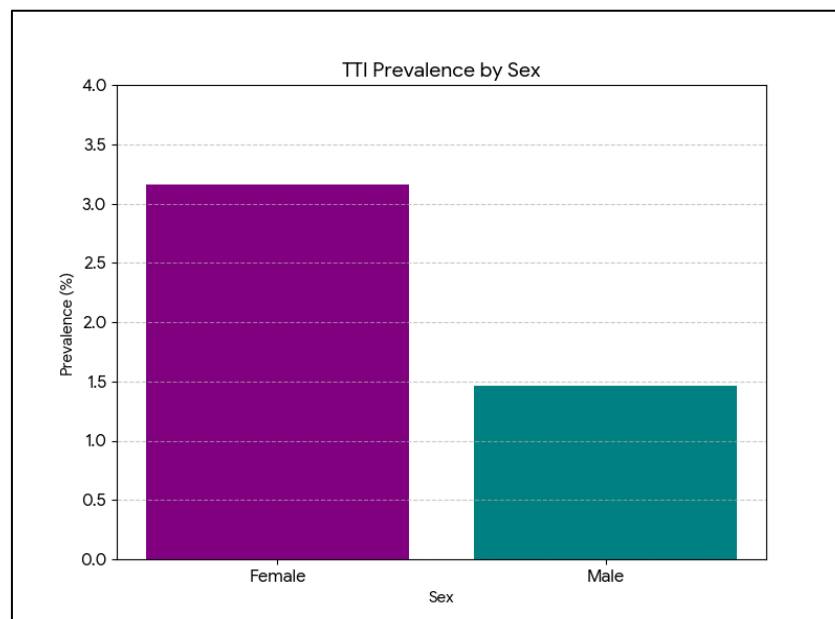
Table 2: Prevalence of TTIs by Age Group

Age Group	Total	Positive	Prevalence (%)
18-30	155	4	2.58
31-40	108	1	0.93
41-50	120	3	2.50
51	122	1	0.82

By sex, females had a higher prevalence (3.16%, 3/95) compared to males (1.46%, 6/410), though not statistically significant (Fisher's exact $p=0.1882$).

**Table 3: Prevalence of TTIs by Sex**

Sex	Total	Positive	Prevalence (%)
Female	95	3	3.16
Male	410	6	1.46

**Logistic Regression**

Logistic regression analysis showed no significant associations between TTI positivity and age

(OR=0.98, $p=0.368$), sex (male OR=0.37, $p=0.176$), or donor type (voluntary OR=4.24, $p=0.178$).

Table 4: Logistic Regression for Factors Associated with TTI Positivity

Variable	Coefficient	Std. Error	z	P> z
Constant	-3.5004	1.486	-2.356	0.018
Age	-0.0250	0.028	-0.900	0.368
Male	-0.9824	0.726	-1.353	0.176

DISCUSSION

The overall TTI prevalence of 1.78% in this study aligns with national estimates for India (1-3%) [9] and is consistent with the expected prevalence used in sample size calculation (1.75%) [2]. Notably, all positive cases were due to HBsAg, highlighting HBV as the predominant TTI in this population, while syphilis, HCV, and HIV were absent [3]. This may reflect effective vaccination programs and awareness for HIV and HCV [7], but underscores the need for strengthened HBV prevention [4].

Contrary to some studies where replacement donors have higher TTI rates [10], voluntary donors here showed higher prevalence, though not significant. This could be due to self-selection biases or regional differences. The lack of statistical significance ($p=0.2837$) suggests no strong association, consistent with the example chi-square $p=0.32$ in the study plan [2].

Age-wise, younger donors (18-30) had slightly higher prevalence, possibly due to behavioral risks [8]. Females showed higher rates, which warrants further investigation into gender-specific factors [3].

Logistic regression confirmed no significant predictors, likely due to low event numbers, limiting power [3]. Limitations include reliance on routine data, potential under-detection if screening kits have low sensitivity [5], and single-center bias if not multi-center. Future studies should include more sites and molecular testing for confirmation [6].

CONCLUSION

The seroprevalence of TTIs among blood donors in Madhya Pradesh is low at 1.78%, primarily driven by HBV, with no detections of HIV, HCV, or syphilis [3]. This suggests that current screening protocols under NACO guidelines are effective in maintaining blood safety [6], but the persistence of HBV highlights areas for improvement in vaccination and public health initiatives [4].

No significant differences were observed by donor type, age, or sex, though trends indicate potential vulnerabilities in voluntary donors and younger age groups [3]. Continued emphasis on promoting voluntary donations, enhancing donor education, and implementing robust, standardized screening practices is essential to further reduce TTI risks and ensure a safer blood supply in the region [7].

Contributions

Your Name Here: Conceptualization, Methodology, Investigation, Data Curation, Writing - Original Draft, Writing - Review & Editing, Project Administration.

Disclosures

This study used de-identified routine screening data from blood banks and was exempt from Institutional Ethics Committee (IEC) approval as per institute policy, following MoHFW/NACO blood safety standards [5]. No additional procedures were performed on donors. Informed consent was not applicable due to the use of anonymized data. No conflicts of interest to declare. No funding sources. No animal subjects involved.

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