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ORIGINAL RESEARCH

# Seroprevalence of Transfusion Transmissible Infections Among Voluntary Blood Donors at an Indian Hospital

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**Abstract**

**Background:** The knowledge of the incidence of blood Transfusion Transmissible Infections (TTIs) such as Hepatitis B, Hepatitis C, Human Immunodeficiency Virus infection, malaria and syphilis is essential for monitoring the safety of blood supply.

**Objective:** To describe the prevalence of TTIs for monitoring blood supply safety and evaluating the efficacy of screening procedures.

**Methods:** A five-year retrospective study spanning January 2016 to December 2020 was carried out on voluntary blood donors at blood donation camps organised by Adesh Medical College and Hospital, Kurukshetra, Haryana, India, and from donors at the hospital's blood bank. The donated blood was tested for Hepatitis-B, Hepatitis-C, Human Immunodeficiency Virus (HIV), malaria and syphilis.

**Results:** There were a total of 10,468 voluntary blood donors during the period of study. Out of all the donors, 0.4% tested positive for at least one of the TTIs, including 0.06% testing positive for HIV, 0.21% for Hepatitis-B virus (HBV) infection (Hepatitis-B Surface Antigen) and 0.13% for Hepatitis-C virus (HCV) infection (Anti HCV Antibodies). None of the voluntary donors was positive for malaria or syphilis. There were no co-infections.

**Conclusions:** The prevalence of TTIs among voluntary blood donors was low hence the advocation for blood from this group of donors. Donated blood specimens should be more effectively screened, and blood should be rationally used.

***Keywords: Blood donors, Blood transfusion, Seroprevalence, Transfusion Transmissible Infections.***

## Introduction

Transmission of infectious diseases through donated blood is a major concern for blood safety as transfusion forms an integral part of medical and surgical treatment in the hospital. [1] Though improved screening and testing of blood donors have significantly reduced Transfusion Transmissible Infections (TTIs) in most developed countries, the challenges posed by TTIs persist in the developing countries. Common examples of TTIs include the Human Immunodeficiency Virus, Hepatitis B Virus, Hepatitis C Virus, malaria, and syphilis. Poor health education and lack of awareness contribute to the formation of a reservoir of infections in the general population in developing countries. [2] Disease burden

estimation based on sound epidemiological research provides the foundation for public health policies. Accurate estimates of the risk of TTIs are essential for monitoring blood supply safety and evaluating the efficacy of currently employed screening procedures. [3] There is a scarcity of information about the seroprevalence of TTIs in the Northern Haryana region of India. This study was aimed at describing the prevalence of TTIs for monitoring the safety of blood supply and evaluating the efficacy of screening procedures. This may facilitate the control and prevention of these TTIs. An attempt was also made to compare the present study's findings with other similar studies from other parts of the country.

## Methods

It is an observational retrospective study. Hospital records of all the blood donors who donated blood voluntarily at Blood Donation Camps organised by the Adesh Medical College and Hospital, Shahabad, Kurukshetra, Haryana or those donating blood voluntarily at the blood bank of the hospital between 01 January 2016 and 31 December 2020 were perused. The research team obtained approval of the Ethics Committee of the hospital before conducting the study. Informed consent was obtained from the blood donors before the donation, and pre-donation counselling was done. The doctor did a detailed physical examination of the donors before blood donation. The donors were screened as per the National AIDS Control Organization (NACO) Guidelines. [4] The following inclusion and exclusion criteria were observed for both male and female blood donors.

**Inclusion Criteria:**

1. Age between 18 and 65 years.
2. Weight more than 45 Kg.
3. Haemoglobin level of at least 12.5g per 100 ml.

**Exclusion Criteria:**

1. History of febrile or debilitating illness, weight loss, jaundice, hepatic or cardiovascular or pulmonary derangement, malignancy, epilepsy, bleeding diathesis, past blood transfusion, recent blood donation, consumption of illicit drugs, surgeries, pregnancy or lactation.
2. History of high-risk behaviours.
3. Commercial, professional or paid donor; any skin marks suggestive of drug abuse or previous venepuncture.

Five millilitres of venous blood were collected from each blood donor into a plain sterile vacutainer tube. The blood sample was allowed to clot for 50 minutes at room temperature. Serum was separated after centrifugation, and then it was subjected to serological tests. Fourth generation, commercially available, ELISA technique-based kits (ELISA machine manufactured by Transasia, Erba Lisa Scan EM. The kits were manufactured by J Mitra and Co. Pvt. Ltd®.) were used for serodiagnosis of Hepatitis B Virus infection (HBV), Hepatitis C Virus infection (HCV), and Human Immunodeficiency Virus infection (HIV). A rapid card test was used to screen for malaria (Kit manufactured by OSCAR®). Venereal Disease Research Laboratory (VDRL) test kit was used to screen for syphilis (Kit manufactured by AVECON®). Blood units that tested positive for TTIs were rejected. All reactive samples were repeat tested using different ELISA kits before being labelled seropositive. HIV reactive results were disclosed to the donors following post-test counselling. Such patients were referred to the Integrated Counselling and Testing Centre for further care. The patients that tested positive for other TTIs were referred to the Medicine Department of the Hospital.

The data were processed using the Microsoft Excel® worksheet. The quantitative data were described as frequencies and percentages.

## Results

There was a total of 10,468 voluntary donors in the study period, and 0.4% of the donors tested positive for at least one of the TTIs, as depicted in Table I. The breakdown showed that 0.06% tested positive for HIV, 0.21% for Hepatitis-B Surface Antigen (HBsAg) and 0.13% for HCV. No donor tested positive for malaria or syphilis.

**Table I: Table showing number of voluntary blood donors testing positive for TTIs**

| *Donor-related details* | *Year of study* | | | | | |
|---|---|---|---|---|---|---|
| | **2016** | **2017** | **2018** | **2019** | **2020** | **Total** |
| Number of donors | 1066 | 1935 | 2209 | 2567 | 2691 | 10468 |
| Number of donors positive for HIV | 2 (0.19%) | 2 (0.19%) | 1 (0.05%) | 1 (0.05%) | 0 (0.00%) | 6 (0.06%) |
| Number of donors positive for HBsAg | 1 (0.09%) | 10 (0.52%) | 5 (0.22%) | 2 (0.07%) | 4 (0.14%) | 22 (0.21%) |
| Number of donors positive for HCV | 2 (0.19%) | 6 (0.31%) | 5 (0.22%) | 1 (0.05%) | 0 (0.00%) | 14 (0.13%) |
| Number of donors positive for Malaria | 0 | 0 | 0 | 0 | 0 | 0 |
| Number of donors positive for Syphilis | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total TTIs** | **5** | **18** | **11** | **4** | **4** | **42 (0.40%)** |

There was no case with co-infections. A decreasing trend was observed over the last three years of study. After the initial rise from 0.47% of patients testing positive for at least one TTIs in 2016 to 0.93% in 2017, the rate decreased to 0.50% in 2018 with a further decrease to 0.16% in 2019 and 0.15% in 2020. Table II shows that the peak age range of blood donors with TTIs was 26-45 years, as shown in Table II. Table III shows the relative proportions of replacement and voluntary blood donors in various studies in India. The seropositivity rates for the various TTIs among replacement and voluntary donors in the previous studies in India are depicted in Table IV.

**Table II: Age distribution of voluntary blood donors testing positive for various TTIs**

| *Age Group (Years)* | *Number of Blood donors* | | | |
|---|---|---|---|---|
| | **HBV** | **HCV** | **HIV** | **Total** |
| 18 – 25 | 4 | 3 | 1 | 8 (19.1%) |
| 26 – 35 | 11 | 6 | 3 | 20 (47.6%) |
| 36 – 45 | 5 | 4 | 2 | 11 (26.2%) |
| > 45 | 2 | 1 | 0 | 3 (7.1%) |
| **Total** | **22** | **14** | **6** | **42** (100.0%) |

**Table III: Distribution of replacement and voluntary blood donors in various studies in India**

| *Study* | *Replacement Donors (%)* | *Voluntary Donors (%)* |
|---|---|---|
| Singh *et al.* [9] | 82.4 | 17.6 |
| Kaur *et al.* [7] | 55.0 | 45.0 |
| Arora *et al.* [5] | 68.6 | 31.4 |
| Unnikrishnan *et al.* [10] | 77.2 | 22.8 |
| Kulkarni [11] | 42.0 | 58.0 |
| Sidhu *et al.* [12] | 91.9 | 8.1 |
| Chandra *et al.* [3] | 93.8 | 6.2 |
| Sharma *et al.* [6] | 34.7 | 65.3 |
| Karmakar *et al.* [13] | 6.5 | 93.5 |
| Dobariya *et al* [14] | < 1 | > 99 |
| Fatima *et al* [15] | 90.0 | 10.0 |
| Mandal *et al.* [16] | 26.0 | 74.0 |
| Arya *et al.* [17] | 13.0 | 87.0 |
| Agrawal *et al.* [18] | 68.7 | 31.3 |
| Chandekar *et al.* [19] | 21.5 | 78.5 |
| Arora *et al.* [20] | 67.6 | 32.4 |
| Sundaramurthy *et al.* [21] | 68.7 | 31.3 |
| Present Study | 0.0 | 100.0 |

## Discussion

Transfusion Transmissible Infection (TTI) was first observed in the process of blood transfusion in 1940. [5] The diseases frequently transmissible by blood include Human Immunodeficiency Virus (HIV) infection, Hepatitis-B virus infection (HBV) infection, Hepatitis-C virus (HCV) infection, syphilis, malaria and infrequently cytomegalovirus, Epstein Barr Virus, and brucellosis. [5] As per the National AIDS Control Organisation (NACO) guidelines in India, it is mandatory to screen every blood unit for HIV, anti-HCV, Hepatitis-B Surface Antigen (HBsAg), syphilis and malaria. [6]

TTIs are a perpetual threat to safe transfusion practices. Professional or commercial donors and donors with high-risk behaviours such as drug addicts, homosexuals and commercial sex workers are the major risk population. [7] They mainly come under the category of replacement donors (those donors who donate blood in exchange for receiving blood units for their patients). Replacement donors have higher seroreactivity rates for TTIs than voluntary donors (those who donate blood without incentive for the cause) due to several factors, including concealing high-risk behaviour and paid donors posing as relatives. [7] On the other hand, voluntary donors have significantly less infectivity rate. [8]

Considerable variations in the proportions of voluntary blood donors in the various previous studies were observed. However, in accordance with the WHO target of achieving 100% voluntary blood donation by the year 2020, we derived all our blood requirements from voluntary blood donors in the present study. Ninety-two per cent of blood donors in the present study were males. A similar male predominance has been reported in nearly all other series, perhaps due to blood donation being considered a male activity in Indian culture.

**Table IV: Percentage of Seropositive Blood Samples in Different Studies in India**

| | *Percentage of Overall/Replacement Donors* | | | | | | *Percentage of Voluntary Donors* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Study*** | **HBsAg** | **HCV** | **HIV** | **Malaria** | **Syphilis** | **Total** | **HBsAg** | **HCV** | **HIV** | **Malaria** | **Syphilis** | **Total** |
| Chandra *et al.* [8] | 1.960 | 0.850 | 0.230 | - | 0.010 | 3.050 | - | - | - | - | - | - |
| Sood *et al* [22] | 0.870 | 0.280 | 0.350 | - | - | 1.500 | - | - | - | - | - | - |
| Kaur *et al.* [7] | 1.070 | 0.500 | 0.440 | - | 0.480 | 2.490 | 0.650 | 0.300 | 0.150 | - | 0.190 | 1.290 |
| Arora *et al.* [1] | 1.700 | 1.000 | 0.300 | - | 0.900 | 3.900 | - | - | - | - | - | - |
| Unnikrishnan *et al.* [10] | 0.870 | 0.360 | 0.280 | - | 0.070 | 1.580 | - | - | - | - | - | - |
| Kulkarni [11] | 3.200 | 0.350 | 0.960 | - | 0.040 | 4.490 | - | - | - | - | - | - |
| Leena *et al.* [5] | 0.710 | 0.140 | 0.270 | 0.130 | 0.100 | 1.350 | - | - | - | - | - | - |
| Deshpande *et al.* [2] | 2.820 | 0.220 | 0.380 | - | 0.220 | 3.640 | - | - | - | - | - | - |
| Giri *et al.* [23] | - | - | - | - | - | - | 1.090 | 0.740 | 0.070 | - | 0.070 | 1.970 |
| Sidhu *et al.* [12] | 0.650 | 0.200 | 0.080 | - | - | 0.930 | 0.500 | 0.170 | 0.000 | - | - | 0.670 |
| Chandra *et al* [3] | 1.670 | 0.490 | 0.150 | 0.009 | 0.010 | 2.329 | 0.240 | 0.001 | 0.080 | 0.010 | 0.008 | 0.339 |
| Patel [24] | 0.380 | 0.060 | 0.140 | - | 0.140 | 0.720 | - | - | - | - | - | - |
| Karmakar *et al.* [13] | 1.410 | 0.590 | 0.600 | - | 0.230 | 2.790 | - | - | - | - | - | - |
| Dobariya *et al* [14] | 0.980 | 0.098 | 0.081 | 0.024 | 0.160 | 1.340 | - | - | - | - | - | - |
| Fatima *et al* [15] | 0.690 | 0.010 | 0.200 | - | 0.030 | 0.930 | - | - | - | - | - | - |
| Suresh *et al.* [25] | 1.670 | 0.560 | 0.360 | - | - | 2.590 | - | - | - | - | - | - |
| Mandal *et al.* [16] | 1.240 | 0.620 | 0.420 | 0.004 | 0.650 | 2.934 | - | - | - | - | - | - |
| Arya *et al* [17] | 1.900 | 0.510 | 0.250 | 0.030 | 0.710 | 3.400 | 1.560 | 0.130 | 0.080 | 0.040 | 2.120 | 3.930 |
| Agrawal *et al.* [18] | 0.840 | 0.000 | 0.150 | 0.100 | 1.200 | 2.290 | - | - | - | - | - | - |
| Chandekar *et al.* [19] | 1.300 | 0.250 | 0.260 | - | 0.280 | 2.090 | - | - | - | - | - | - |
| Chougale *et al.* [4] | - | - | - | - | - | - | 1.310 | 0.080 | 0.540 | 0.000 | 0.540 | 2.470 |
| Arora *et al* [20] | 0.300 | 0.030 | 0.000 | - | - | 0.330 | - | - | - | - | - | - |
| Sundaramurthy *et al* [21] | 0.420 | 0.560 | 0.130 | 0.010 | 0.000 | 1.120 | - | - | - | - | - | - |
| Lakshmikumar *et al.* [26] | - | - | - | - | - | - | 0.550 | 0.100 | 0.120 | 0.000 | 0.000 | 0.770 |
| Present Study | - | - | - | - | - | - | 0.390 | 0.220 | 0.090 | 0.000 | 0.000 | 0.700 |

Most of the blood donors seropositive for various TTIs in the present study were from the sexually active group of 26 to 45 years. This pattern is similar to the report of other authors. Some researchers have found a significantly higher prevalence of all TTIs in rural populations than in the urban population. [4] Among the various TTIs, Hepatitis B Virus had the maximum seropositivity rate (0.21%) among blood donors in the present study. This is similar to the reports in the previous studies, with seropositivity rates varying from 0.24% [3] to as high as 3.2%. [11]

The frequency of HBV infection is higher in the present study than in other infectious diseases, probably because of asymptomatic carriers. Even though an effective vaccine against Hepatitis B Virus has been available for approximately three decades, the prevalence of the disease in India remains high, especially in the Andaman Islands and in Arunachal Pradesh. [22] This infection carries significant morbidity and mortality due to acute illness and chronic sequelae such as chronic hepatitis, liver cirrhosis and hepatocellular carcinoma.

Hepatitis C Virus has the second-highest seropositivity rate (0.13%) of TTIs among blood donors in this series. The seropositivity rate for Hepatitis C Virus reported by other authors in India varied from 0% [18] to 1.0%. [1] The present study's seropositivity rate for Hepatitis C Virus (0.13%) is not as high as the rate reported from Southern Haryana (1%). [1] The major channels of HCV transmission are all related to exposure to blood and blood products. [22] The long-term risk of developing liver cirrhosis and hepatocellular carcinoma is greater in HCV patients than in those with HBV. [11] Since no vaccine is presently available against HCV infection, transfusion-transmitted HCV infection remains a significant threat to the safety of the blood supply. [27]

At 0.06%, the seroprevalence rate of HIV in this study is lower compared to HBV and HCV. The rate for other Indian series varied from 0% (for

voluntary donors) [12] to 0.9%. [11] Even though the predominant mode of HIV transmission in India is through heterosexual contact, transmission through blood transfusion remains a significant risk. [22] It constitutes 2.0% to 4.0% of all cases of HIV transmission. [25] The incurrence rate of HIV through blood transfusion approaches 100%. [1]

None of the blood donors in this series tested positive for syphilis or malaria. The zero seroprevalence rate for both infections is similar to the report of Lakshmikumar *et al.* [8] It is remarkable to note that none of the blood donors in the present study tested seropositive for more than one TTI.

There was a progressive decrease in the prevalence of TTIs in the last three years of the present study. A similar trend has been observed in some other studies. [3, 16, 17, 24] The decreasing trend has been attributed to various reasons, such as the availability of diagnostic kits and increasing awareness of TTIs among blood donors. In recent years, higher proportions of voluntary donors, besides better donor screening, also contributed to reduced seroprevalence of TTIs among blood donors. [14, 19] The availability of effective vaccines for Hepatitis B has contributed to its reduced incidence in recent years. However, there has been a report of the rising incidence of Hepatitis C from Central India.[28] Yet, another study reported a mixed trend for various TTIs. [6]

Recently, determining the seroprevalence of HBV, HCV, and HIV based on the Nucleic Acid Amplification Technique (NAT) has been introduced and is recommended to detect infections earlier during the window period. [11] NAT reduces the window period effect by direct detection of viral nucleic acid sequences. It reduces the time for effective detection from 19 days of serological identification to 5 days for HIV, from 65 days to 7 days for HCV and from 38 days to 16 days for HBV. [15, 29] It also detects donors with chronic occult infections, which are negative by routine serological screening methods. [29] However, the high cost of this technique is a limiting factor in India. Occasionally, HIV sero-yield donors may be non-reactive by NAT, possibly due to being aviraemic at the time of blood donation. Therefore, blood screening by both serology and NAT is ideal for reducing the threat of TTIs. [29]

## Conclusion

According to the National Blood Policy in India, voluntary blood donations should be encouraged to minimise the risk of TTIs. Public awareness and education would play a big part in curbing the prevalence of these infections and increasing blood safety. It is crucial to have an effective screening of donated blood for TTIs. The introduction of NAT can reduce TTIs further by detecting cases in the window period of infections. However, as no testing can render blood transfusion 100% safe, there is always a need for rational use of blood to minimise unnecessary blood transfusions.

Donor selection is crucial. The time and cost involved in screening donated blood can be reduced by educating donors so that donors at risk of TTIs exclude themselves from the donation.

There is a need to motivate females to be more visible in donating blood as, at present, more than 90% of donors are males.

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