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Original Research Paper

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PATTERNS OF SEROPREVALENCE FOR TRANSFUSION-TRANSMISSIBLE INFECTIONS AMONG BLOOD DONORS IN A BLOOD CENTRE OF NORTHEAST INDIA

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ABSTRACT

Introduction: Transfusion– Transmissible Infections (TTIs) are the infections resulting from the introduction of a pathogen into a person through blood transfusion. In an attempt to mitigate the inherent risk of TTIs, the demographic information of blood donors including knowledge on local prevalence of infections and its pattern in the donor population is important for formulating recruitment strategies and planning other precautionary measures. **Materials & Methods:** This cross-sectional study was conducted in the Blood Centre, Jawaharlal Nehru Institute of Medical Sciences, Imphal between January 2019 and December 2022. All donated blood units were tested for the mandatory TTI markers for HIV 1 & 2, Hepatitis B, Hepatitis C, Syphilis and Malarial parasite. The prevalence and patterns of seropositivity for TTIs were studied based on the donor demographic characteristics such as donation type, gender and age group. **Results:** The overall seroprevalence among blood donors (n=31,563) was 1.79%. The seroprevalence was lower among voluntary donors (1.08%) than the replacement donors (2.10%). Seropositivities among female and male donors were 0.79% and 1.93% respectively. The lowest TTI seropositivity was seen among female voluntary donors (0.59%) and highest among male replacement donors (2.24%). The seroprevalence for specific TTI markers among the blood donors were 0.15% for HIV; 0.57% for HBV; 0.93% for HCV; 0.14% for Syphilis and no donor was found positive for Malaria. The frequency of TTI seropositivity was increased with increase in the age groups of donors in both sexes. There were 9 (0.029%) donors who had co-infection of TTIs. The patterns of TTI markers for co-infections were HCV+HIV=3; HCV+HBV=3; HCV+Syphilis=2 and HIV+ Syphilis=1. **Conclusion:** The measures to provide safe blood may include collection of blood from the targeted low risk donor population, using more sensitive testing methods, implementing pathogen reduction technologies and other public health measures.

KEYWORDS : Seroprevalence, Blood donors, TTI

INTRODUCTION:

Transfusion –Transmissible Infections (TTIs) are the infections resulting from the introduction of a pathogen into a person through blood transfusion. A wide variety of organisms, including bacteria, viruses, prions, and parasites can be transmitted through blood transfusion.[1] As many as 68 numbers of infectious disease agents were identified in 2009 that were capable of being transmitted by blood transfusion. However, the list of disease agents will keep expanding as the rate of emergence of new agents.[2] Blood Transfusion Services (BTS) implemented various measures to get rid of the risk of TTI by practicing donor selection criteria, using more sensitive testing methods in quality environments and pathogen reduction technology etc.

There are some established TTIs of great concern that have long asymptomatic latent periods and can cause chronic diseases with possible serious consequences. WHO recommended universal screening of all donations in all countries for four specific transfusion–transmissible infectious agents i.e. HIV, HBV, HCB and syphilis by using at least one suitable serological marker for each of these four infections. Screening of additional markers for these infections and for other TTI agents could be considered, depending on the residual risk, logistics, and local epidemiological evidence.[3] The list of mandatory laboratory tests for screening of blood donors in India, as per the Drugs & Cosmetics Act (1940) & Rules (1945) include HIV 1 & 2 antibodies, Hepatitis B surface antigen (HBsAg), Hepatitis C Virus antibody, test for syphilis and malaria.

The number of people living with HIV in India was 24.01 lakhs with adult HIV prevalence of 0.21% in 2021.[4] Approximately 40 million people in India are chronically infected with Hepatitis B and 6-12 million people with Hepatitis C. Hepatitis B surface Antigen (HBsAg) positivity in the general population ranges from 1.1% to 12.2% and anti-Hepatitis C virus antibody prevalence in the general population was estimated to be between 0.09% and 15%.[5] Current laboratory testing strategies minimize the risk of TTIs and the risk of HIV, HCV and HBV transmission through blood transfusion is extremely rare. In an attempt to mitigate the inherent risk of TTIs, the demographic information of blood donors including knowledge on local prevalence of infections and its pattern in the donor population is important for formulating donor recruitment strategies and planning other precautionary measures.

MATERIALS AND METHODS:

This retrospective cross-sectional study was conducted in the Blood Centre, Jawaharlal Nehru Institute of Medical Sciences, Imphal between January 2019 and December 2022. Majority of the blood donors (>90%) were resident of the state where the study was conducted.

Five milliliters of whole blood samples were collected from each blood donors in a pilot tube at the time of blood collection and serum was separated by centrifugation. The separated sera were used for TTI screening on the same day or were kept frozen (≤ -30°C) for testing on a later date.

All donated blood units were tested for the mandatory TTI markers for HIV 1 & 2, Hepatitis B, Hepatitis C, Syphilis and Malarial parasite. TTI screening of blood donors were done as per departmental SOPs that were formulated in compliance with the guidelines of WHO and Drugs and Cosmetic Act & Rules.[3,6] Samples were analysed for antibodies to HIV-1,2 and HIV $_{p}$24 antigen, HB$_{s}$Ag, antibodies to HCV by ELISA, rapid immunochromatographic assay for detection of Malarial parasite and Rapid Plasma Reagin (RPR) card test for Syphilis. The validity of the test was checked as per manufacturer's instructions. Quality control of each run of ELISA was done on Levy-Jennings chart. The Blood Centre participated in various external quality programs to ensure

quality of laboratory practices including proficiency testing for HIV from State reference Laboratory under NACO, and External Quality assurance Scheme (EQAS) under CMC Vellore and Indian Red Cross Society, Blood Centre, Mumbai. The prevalence and patterns of seropositivity for TTIs were studied based on the donor demographic characteristics such as donation type, gender and age group. Descriptive statistics was used to measure the frequency, percentage and distribution of the variables.

RESULTS:

The overall seroprevalence of TTI markers among blood donors in the study was 1.79%. The seropositivity rates among voluntary and replacement donors were 1.08% and 2.10% respectively. Seroprevalence was lower in female donors (0.79%) than in male donors (1.93%). The lowest TTI seropositivity was seen among female voluntary donors (0.59%, 9/1521) and highest among male replacement donors (2.24%, 439/19594). However, majority (62.08%) of the blood collection was from male replacement donors and least number of collections was from female voluntary donors (4.82%).

The seroprevalence for specific TTI markers among the blood donors were 0.15% for HIV; 0.57% for HBV; 0.93% for HCV; 0.14% for Syphilis and no donor was found positive for Malaria (Table 2). The seropositivity for HIV, HBV, HCV and syphilis in male donors were 0.16%, 0.60%, 1.02% and 0.14% respectively and corresponding figures for female donors were 0.05%, 0.39%, 0.23% and 0.10% respectively. The overall seroprevalence in males and females were 1.94% and 0.79% respectively. (Table 1 & Chart 1)

The overall seropositivity among male donors of different age groups was 1.80% in 18-30 years; 2.01% in 31-40 years; 2.28% in 41-50 years and 3.46% in ≥51 years. In female donors, the seropositivity rates were 0.69% in 18-30 years; 0.93% in 31-40 years; 0.95% in 41-50 years and 3.80% in ≥51 years. Majority (60.05%) of the blood donors were in age group of 18-30 years and least number of blood donation was from the age group of ≥51 Years (1.81%). (Table 3)

There were nine (0.029%) donors who had co-infection of TTIs. All co-infected donors were males and had two positive TTI markers. Co-infections among male donors were 4 (0.024%) in 18-30 years, 3 (0.039%) in 31-40 years, 1 (0.037%) in 41-50 years and 1 (0.20%) donor in ≥51 years. The patterns of TTI markers for co-infections were HCV+HIV=3; HCV+HBV=3; HCV+Syphilis=2 and HIV+ Syphilis=1.

Table 1: Seroprevalence among voluntary and replacement donors.

Donor Type	Number of donors		No. of seropositive donors		No. of donors in both sex	No. of seropositive donors in both sex (%)
	Male	Female	Male (%)	Female (%)		
Voluntary	8159	1521	96 (1.18%)	9 (0.59%)	9680	105 (1.08%)
Replacement	19594	2289	439 (2.24%)	21 (0.92%)	21883	460 (2.10%)
Total	27753	3810	535 (1.93%)	30 (0.79%)	31563	565 (1.79%)

Table 2: Comparison of TTI seroprevalence of current study and other studies in India.

Category	HIV	HBV	HCV	Syphilis	Malaria	Overall seroprevalence
Current study	0.15%	0.57%	0.93%	0.14%	Nil	1.79%
Sundaramurthy R et al, Madurai [8]	0.13 %	0.42%	0.56 %	Nil	0.01%	1.12%
Chauhan SC et al, Gujarat [10]	0.52 %	0.68%	0.11 %	0.81 %	Nil	2.12%
Cheema S et al, North India [7]	0.03 %	0.49%	0.50 %	0.05 %	0.009%	1.07%
Karmakar PR, Kolkata [11]	0.60 %	1.41%	0.59 %	0.23 %	Nil	2.79%
Sulhyan KR et al, Maharastra [9]	0.24 %	1.15%	0.11 %	nil	Nil	1.5%
Singh P et al, Delhi [14]	0.19 %	0.80%	0.40 %	0.06 %	0.01%	1.45%

Table 3: Patterns of seroprevalence among different age groups in males and females.

Age group	Number of Male	Seropositivity in males	Number of Female	Seropositivity In females
18-30 years	16793	303 (1.80%)	2160	15 (0.69%)
31-40 years	7615	153 (2.01%)	857	8 (0.93%)
41-50 years	2723	62 (2.28%)	423	4 (0.95%)
≥51 years	492	17 (3.46%)	79	3 (3.80%)
Total	27753	535 (1.93%)	3810	30 (0.79%)

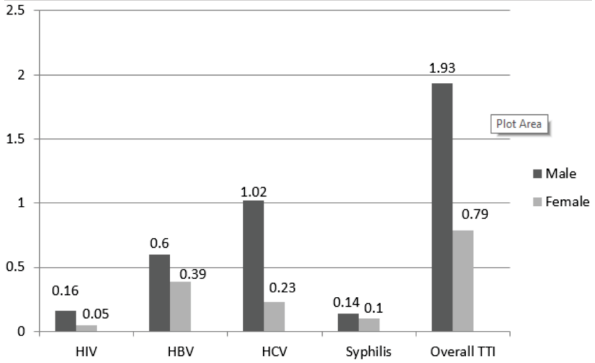

Chart 1: Patterns of TTI seroprevalence (in percentage) between males and females.

DISCUSSION:

The overall seroprevalence for TTI markers among blood donors in our study was 1.79%. The finding was comparable with other studies in India that ranged from 1.07% to 2.79%.[7-11] A high seroprevalence rate (11.88%) of TTI among blood donors was reported by Otu TI et al in their study in Nigeria.[12] The population of the state under our study was severely affected by drugs. The number of people who inject drugs (PWID) in the state was one of the highest in the country though it counted only a fraction (0.24%) of the total population of India.[13] Use of drugs through injecting route is a serious concern because of its associated risk of spread for TTIs. As per the NACO estimate on HIV in 2021, Manipur had the third highest HIV prevalence rate (1.05%) among adults in the country (national average 0.21%).[4] Therefore, during donor selection the most stringent criteria were applied to defer donors with the slightest risk of TTIs. Donors were also encouraged to self-defer from blood donation if they realized that they had risk exposure. The small number of TTI positive blood donors in the study population indicated the effectiveness of the donor selection.

The findings in our study for specific TTI markers (Table 2) were comparable with other studies in India. The seroprevalence of TTI markers among blood donors in India were in the range of 0.03% to 0.52% for HIV, 0.42% to 1.73% for HBV, 0.11% to 0.59% for HCV, 0 to 0.81% for Syphilis and 0 to 0.01% for malaria.[7-11] In our study HCV had the highest seroprevalence (0.93%), that accounted 52.04% of overall seropositivity. In most of the other studies in India HbsAg was the commonest TTI marker among the blood donors.[9,11,14] In a few studies in India, HCV was the leading seropositive marker

as reported by Cheema S et al in North India (0.50%); Sundaramurthy R et al in Madurai (0.56%).[7,8]

HCV seropositivity was comparatively higher in our study (0.93%) than most of the other studies in India (Table 2). This may be due to the variation of HCV prevalence in the general population among different states of the country based on their geographical location and ethnicity. HCV seroprevalence in general population was higher in northeastern part, tribal populations and Punjab which may represent HCV hotspot. High prevalence was seen in intravenous drug users.[15] In a study for hepatitis C virus infection in Northeast India, the major risk factors were IVDU (34.6%), multiple sex partners (20%) and contact with professional barbers (38.6%).[16] A study in Egypt reported that informal practioners particularly midwives, ear piercing, hair cut at local barbar shop, dental treatment, hospitalization in temporary clinics were associated risk of HCV infection;[17] which were also a common practice in the state. Iatrogenic causes remain one of the leading risk factors for the transmission of HCV in nondrug users in developing countries.[17]

No donor was positive for Malaria in our study. Studies in India reported near negligible (0-0.01%) malaria positivity among blood donors (Table 2). Malaria has typical signs and symptoms during acute illness which prevent them for qualifying blood donation and individuals with history of malaria were deferred from donations for 3 months following full recovery.

The seroprevalence was lower among voluntary blood donors (1.08%) than the replacement donors (2.10%). A number of studies have reported lower prevalence of TTI markers among voluntary donors compared with other type of donors. WHO adopted a policy to achieve 100% voluntary blood donation of all collected units by the year 2020.[18] Government of India implemented the National Blood Policy in April 2002 which aims to develop a nationwide system to ensure easy access to adequate and safe good quality blood supply. NACP IV targeted to achieve 90% voluntary blood donation at the end of NACP IV.[19] However, the number of voluntary blood donation was low (30.67%) in our study in spite of efforts to maximize it, by various organizations in the state. Low voluntary blood donation rates were also reported in North India (21.65%), in Madurai (31.3%), and in Gujarat (15.31%).[7,8,10] However, a study in Maharastra, reported 100% voluntary donations.[9] In 2016, the government launched an initiative called E-Raktkosh, a web-based mechanism that integrates all blood banks into a single network, providing information about blood camps and availability of blood in the hospitals throughout the country. A mobile application for the E-Raktkosh portal was launched in 2020 to improve accessibility.[20] However; there still remains a long way to go in achieving the objective of 100% VBD. A better allocation of resources for strengthening infrastructure, human and financial resources may help to increase VBD.

TTI seropositivity among female donors (0.79%) was lower than male donors (1.93%) in the current study which was in concordance with other studies in India.[9,10,14] A few other studies reported that gender showed no significant difference in the overall seroprevalence rates of TTIs.[11,12] The probable reason of low seropositivity in females in our study could be due to lower seroprevalence of TTIs among females in the general population. Adult (15-49 years) HIV prevalence was lower in females (0.19%) than in males (0.22%) in India.[4] A population-based study in Southern India reported that males had higher prevalence of HBV (77% of seropositivity) and HCV (73% of seropositivity).[21]

The lowest seroprevalence was seen among female voluntary donors (0.59%) and highest among male replacement donors (2.24%). However, the maximum number of blood collections was from male replacement donor who had the highest TTI seroprevalence whereas female voluntary donors were the least (Table 1). A better strategy for donor recruitment has to be developed for future blood collection to ensure safety of blood supply and to reduce discards due to TTI seropositivity. Female constituted only 12.07% of total blood donation in the present study. Other studies in India also reported lower participation of females in blood donations that ranged from 0.76% to 15%.[7,8,11] Lower donation rate in female gender may be due to multiple factors associated with social, cultural, physical, physiological and medical reasons. The accepted donation interval between two consecutive donations is longer in females. Globally 33% of blood donations are given by women, although this ranges widely. In 15 of the 113 countries reported to WHO, less than 10% of donations were given by female donors.[22]

Among the different age groups, we found an increase in the frequency of seropositivity with increase in the age group of blood donors in both sexes (Table 3). Other studies also reported higher TTI seroprevalence in the older age groups. Karmakar PR found an increased in seropositivity with age up to 50 years and Chauhan SC also reported that seropositive donations was highest in the age group of >50 years.[10,11] A decreasing frequency of seropositivity in later age group was seen in a study in Maharastra.[9] The increased in the frequency of seropositivity with increased in the age group of donors in the current study may be due to the longer period of environmental exposure to the risk factors of TTI in the older population. A population-based, cross sectional survey of injecting drug users (IDU) from 2014 to 2015 found that the mean age of initiation (first exposure of any drug and injecting drug) were ≥ 30 years of age in 60% of IDUs in Manipur.[23]

HCV seropositivity rate was increased by more than fourfold in males (1.02%) compared to females (0.24). Male gender preponderance of HCV infection can be viewed from different angles. Males are probably more exposed to HCV risk including PWID, occupational exposure, alcohol consumption etc. Worldwide, the prevalence of IDU among men was far higher (70-90% PWID) than in women in all regions. It was estimated that 52.3% of PWID had been exposed to Hepatitis C.[24]Research from 1990s found that people with alcohol abuse disorders had higher rates of HCV than the control group. Alcohol impairs the function of certain components of the body's immune system.[25] Remarkable gender differences exist in pattern of alcohol use; while 27.3% of men in India use alcohol, the corresponding figure for women were 1.6%.[26] Moreover, after initial infection, women are more likely to clear the virus spontaneously. Estrogens have immune stimulating effect, while androgens have immune suppressing effect resulting in stronger humoral and cellular immune responses to viral infections in females.[27]

All co-infected donors were males and highest in the age group of ≥51 years (0.20%) followed by 31-40 years (0.039%). HCV was the commonest co-infection (8/9).

CONCLUSION:

The measures to provide safe blood is a multidimensional approach that may include rigid donor selection criteria, collection of blood from the targeted low TTI risk population, using more sensitive testing methods like NAT and implementing pathogen reduction technologies (PRT) etc. Public health measures like universal immunization for hepatitis B, universal precautions, infection control measures, prevention of iatrogenic transmission of TTIs and other social measures to reduce TTI risk behavior in the general population may greatly help in improving transfusion safety. A

more proactive response rather than reactive response will help in mitigating the threat to safe blood supply.

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