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Corresponding Author
S. Aditya Keswani,
Department of Pathology, Swami Ramanand Teerth Rural Government Medical College and Hospital, Ambajogai. India

Author Designation
[1]Junior Resident
[2-4]Assistant Professor
[5-6]Associate Professor
[7]Professor

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Seroprevalence of Transfusion-Transmissible Infections in a Rural Tertiary Care Centre a Ten-Year Study

[1]Aditya Sureshkumar Keswani, [2]Vinay Changdeorao Nalpe, [3]Nitin Gautam Kamble, [4]Vaibhav Vilasrao Deshmukh, [5]Dnyaneshwar Shivajirao Jadhav, [6]Sheela Laxmanrao Gaikwad and [7]Arvind Namdeorao Bagate

[1-7]Department of Pathology, Swami Ramanand Teerth Rural Government Medical College and Hospital, Ambajogai.India

ABSTRACT
This study examines the seroprevalence of transfusion-transmissible infections (TTIs) including HIV, HBV and HCV among voluntary blood donors at a rural tertiary care centre over a decade, to evaluate trends and effectiveness of screening protocols. Utilizing a retrospective cross-sectional approach, data were compiled from voluntary donors at the Blood Centre of SRTR GMC Ambajogai between January 2013 and December 2022. The center annually collects an average of 5397 units of blood, primarily through donation campaigns. Data Collection and Data underwent descriptive analysis to identify overall and annual seroprevalence trends of TTIs among donors. Prevalence rates were compared between genders using a chi-square test for proportions. The study reveals a relatively low and declining seroprevalence of TTIs among the donor population, with notable annual trends indicating the effectiveness of current screening measures. Gender disparity in donation rates was observed, suggesting the need for targeted strategies to encourage female participation. This decade-long analysis highlights the critical role of continuous monitoring and adaptation in blood donation and screening practices to maintain blood safety. The findings underscore the necessity for enhanced community engagement and gender-inclusive policies to support voluntary blood donation in rural healthcare settings.

INTRODUCTION

Blood is a type of fluid that is produced and synthesized within the body serving various essential functions. Despite advancements, in science there still isn't a man-made alternative to human blood. This is why blood donations continue to hold importance for individuals. A well-organized Blood Transfusion Service (BTS) is essential, addressing various medical needs such as anemia, blood loss, pregnancy-related complications and hereditary hemoglobinopathies like Thalassemia and Sickle Cell Anemia[1,2]. These genetic conditions are prevalent across Africa, the Middle East and countries in the Mediterranean basin forming what is often referred to as the "Thalassemic Belt[3]. Blood donor screening in India began in 1947, with the current program screening for HIV, HBV, HCV, malaria and syphilis[4]. Despite a substantial number of annual blood donations, rural areas face challenges due to factors like illiteracy and limited healthcare access[5,6].

In 2017, the National Blood Transfusion Council of India (NBTC) advocated for the disclosure of Transfusion Infection (TTI) test results to blood donors[7]. Currently, blood centres must secure written consent from donors at the time of blood donation if they desire information about TTI reactive test results. Donors testing HIV reactive are directed to designated Integrated Counselling and Testing Centres (ICTC) for disclosure, counselling and referral. Those reactive to hepatitis B or hepatitis C are informed and subsequently referred to a gastroenterologist for further management. For cases of syphilis and malaria, donors are directed to sexually transmitted disease (STD) clinics or physicians, respectively. The study's objective is to assess the prevalence of TTIs among blood donors and explore changing trends in these infections.

MATERIALS AND METHODS

Study Design: A retrospective cross-sectional study was carried out using a decade's worth of data from voluntary blood donors who contributed between January 2013 and December 2022 at the Blood Centre of SRTR GMC Ambajogai. On average, 5397 units of blood are collected annually, mainly from volunteers in blood donation campaigns.

Inclusion Criteria: Blood donors meeting the eligibility criteria were individuals aged between 18 and 60 years, with a hemoglobin concentration of 12.5 g% or higher, a body weight of 45 kg or more, no previous occurrences of hepatitis B, hepatitis C, or sexually transmitted diseases (STDs) and no instances of jaundice within the last year. These criteria aligned with the standard blood donation requirements outlined in the Drug and Cosmetic Act, India, as per the amendment implemented in March 2020.

Serological Investigations: Third-generation enzyme-linked immunosorbent assay (ELISA) was utilized for screening HIV and HCV antibodies (replaced by fourth generation ELISA kits starting in 2021), while HBV surface antigens were screened using sandwich ELISA.

Data Collection and Statistical Analysis: Analyzed data was subjected to descriptive analysis. Assessment of the overall prevalence during the specified period and the annual prevalence trends were conducted using the gathered data. The percentage of positive cases among male and female donors was calculated and a chi-square test for proportions was performed to identify any noteworthy differences between them.

RESULTS AND DISCUSSIONS

At the blood center, donors underwent screening before donation through a standardized questionnaire. Anthropometric and physical examinations, including vital signs, were conducted. Prior to blood donation, consent for both blood donation and screening tests was obtained. Donors received counseling before the donation process, educating them about the necessity and significance of regular voluntary donations and the importance of screening for high-risk diseases. Only those deemed fit for donation were assigned unique identification numbers and directed to the blood collection area. Others, based on various reasons, were either temporarily or permanently deferred. Detailed information about donors was recorded in appropriate registers. Following the phlebotomy procedure, blood samples were collected in vials for infectious diseases screening and the results were documented in registers. Totally 53966 blood donors had donated during the study period. Among them, 530 (0.98%) blood donors were found to be TTI marker reactive.

The gender wise distribution of Total donors was as follows: There were 52560 (97.39%) male donors and 1406 (2.61%) female donors. Moreover, among the seropositive donors 513 were male and 17 were female. As per the age wise distribution of seropositive donors 22 donors were in 18-20 years of age group, 268 were in 21-30 years of age group, 164 were in 31-40 years of age group, 46 in 41-50 years of age group, 30 were in 51-60 years of age group and no donors were above the age group of 60 years.

Among these 530 reactive donors, 42 (7.9 % of all reactive donors) were HIV 1 and 2 reactive, 469 (88.4 % of all reactive donors) were reactive for HBsAg and 19 (3.7% of all reactive donors) were HCV reactive. Over the ten-year period from 2013-2022, a total of 53,966 blood donations were recorded. The annual break-down reveals variations in reactivity for specific transfusion-transmissible infections (TTIs). In 2013, out of 4,324 donations, 13 cases showed reactivity to HIV, 40 to HBsAg and 3 to HCV, resulting

in a total TTI positivity of 56. Subsequent years saw fluctuations in these figures, with 2014 having 10 HIV-reactive cases, 72 HBsAg-reactive cases and 6 HCV-reactive cases, totalling 88 TTI-positive cases among 4,968 donations. The year 2015 recorded 2 HIV-reactive cases, 63 HBsAg-reactive cases and 2 HCV-reactive cases, amounting to 67 TTI-positive cases out of 5,421 donations. Similar patterns continued in the following years, with the total TTI positivity reaching 530 cases over the entire period. Notably, 2018 had the highest total donations at 6,194, while 2013 had the lowest at 4324. The highest prevalence of TTI was observed in 2014 which is 1.7% (88 out of 4968) and the lowest prevalence in 2022 which is 0.5% (31 out of 5917). Throughout this timeframe, efforts were made to monitor and manage HIV, HBsAg and HCV reactivity, contributing to an overall understanding of transfusion safety.

The confidence intervals offer insights into the estimated proportions of reactivity for HIV, HBsAg and HCV over a span of ten years. For HIV reactivity, the intervals indicate that the proportion of reactive cases falls within the range of 0.02-0.69% in 2013, 0.18-0.54% in 2014 and progressively smaller ranges in subsequent years until 2022, where it is estimated to be between 0.01 and 0.12%. Regarding HBsAg reactivity, the intervals suggest that the proportion of cases with reactivity spans from 1.04-1.70% in 2013, increasing to 1.56-2.20% in 2014 and then showing a gradual decrease in the following years, with an estimated range of 0.51-1.17% in 2022. For HCV reactivity, the confidence intervals imply that the proportion of reactive cases ranges from 0.07-0.24% in 2013, 0.14-0.36% in 2014 and subsequently diminishes, reaching an estimated range of 0-0.05% in 2022.

The decreasing width of the intervals over the years indicates a potential trend of reduced uncertainty in the estimates as the sample sizes increase or as the observed proportions become more stable. The findings of this ten-year analysis shed light on the seroprevalence of transfusion-transmissible infections (TTIs) among voluntary blood donors in a rural tertiary care center, providing valuable insights into transfusion safety in resource-limited settings. The discussion focuses on the key findings, implications and potential strategies for improving blood safety and donor diversity. The study reveals a relatively low overall prevalence of TTIs among blood donors, with HIV, HBsAg and HCV reactivity rates over the ten-year period[10,11]. The total TTI positivity rate of 0.98% indicates that a small proportion of blood donors carry infections that can be transmitted through transfusion. Notably, HBsAg reactivity accounted for the highest proportion of TTI cases, followed by HIV and HCV. These findings underscore the importance of robust screening protocols to detect and manage TTIs among

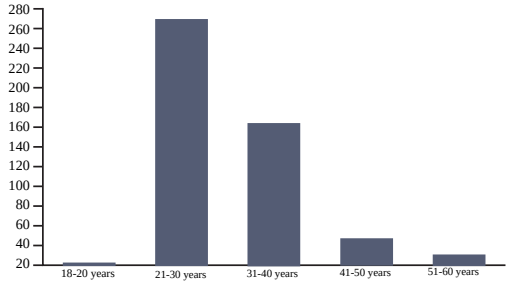

Fig. 1: Age Distribution of TTI reactive blood donors. TTI: Transfusion-transmissible infection

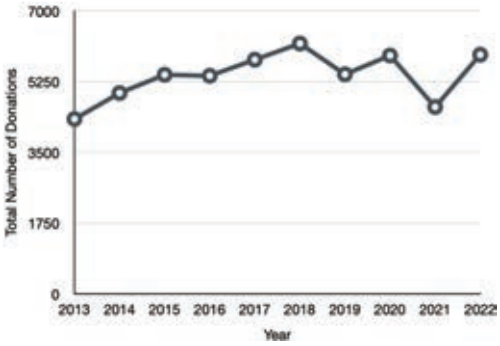

Fig. 2: Trend of Total Blood Donations from year 2013 to 2022

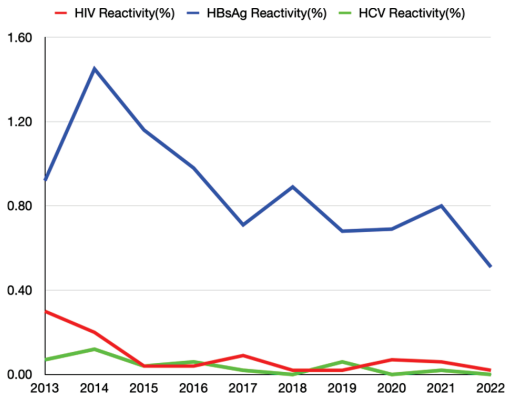

Fig. 3: Trend of Transfusion Transmitted Infections (%)

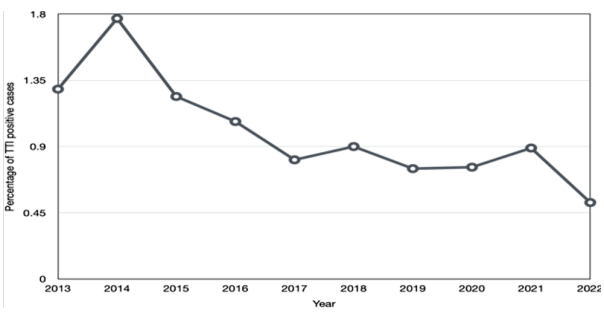

Fig. 4: Trend of Transfusion Transmitted Infections (%)

Table 1: Year-wise distribution of Total donations and HIV, HBsAg and HCV positive cases.

Year	Total Donations	HIV Reactivity	HBsAg Reactivity	HCV Reactivity	Total TTI positivity
2013	4324	13	40	3	56
2014	4968	10	72	6	88
2015	5421	2	63	2	67
2016	5395	2	53	3	58
2017	5794	5	41	1	47
2018	6194	1	55	0	56
2019	5432	1	37	3	41
2020	5898	4	41	0	45
2021	4623	3	37	1	41
2022	5917	1	30	0	31
Total	53966	42	469	19	530

Table 2: Year-wise calculation of Confidence interval of HIV, HBsAg and HCV Reactivity.

Year	HIV Reactivity Interval	HBsAg Reactivity Interval	HCV Reactivity Interval
2013	(0.0023, 0.0069)	(0.0104, 0.0170)	(0.0007, 0.0024)
2014	(0.0018, 0.0054)	(0.0156, 0.0220)	(0.0014, 0.0036)
2015	(0.0003, 0.0020)	(0.0112, 0.0187)	(0.0004, 0.0027)
2016	(0.0003, 0.0021)	(0.0095, 0.0164)	(0.0005, 0.0025)
2017	(0.0007, 0.0033)	(0.0091, 0.0162)	(0.0000, 0.0012)
2018	(0.0002, 0.0015)	(0.0084, 0.0150)	(0.0000, 0.0009)
2019	(0.0002, 0.0018)	(0.0068, 0.0131)	(0.0007, 0.0033)
2020	(0.0005, 0.0024)	(0.0068, 0.0130)	(0.0000, 0.0006)
2021	(0.0004, 0.0028)	(0.0070, 0.0133)	(0.0000, 0.0013)
2022	(0.0001, 0.0012)	(0.0051, 0.0117)	(0.0000, 0.0005)

Table 3: Ttrend of decreasing TTI positivity rates, particularly for HIV, HBsAg and HCV

Year	HIV Reactivity(%)	HBsAg Reactivity(%)	HCV Reactivity(%)	Total positivity(%)	TTI
2013	0.30	0.92	0.07	1.29	
2014	0.20	1.45	0.12	1.77	
2015	0.04	1.16	0.04	1.24	
2016	0.04	0.98	0.06	1.07	
2017	0.09	0.71	0.02	0.81	
2018	0.02	0.89	0	0.90	
2019	0.02	0.68	0.06	0.75	
2020	0.07	0.69	0	0.76	
2021	0.06	0.80	0.02	0.89	
2022	0.02	0.51	0	0.52	

blood donors[8,9]. The analysis demonstrates variations in TTI prevalence over the years, with fluctuations observed in the number of reactive cases for specific infections. Despite these fluctuations, there is a notable trend of decreasing TTI positivity rates, particularly for HIV, HBsAg and HCV. The narrowing confidence intervals suggest improved stability in estimates and reflect the effectiveness of screening protocols and public health interventions implemented over the study period. study highlights a significant gender disparity among blood donors, with the vast majority being male. Understanding and addressing barriers to female blood donation are crucial for enhancing overall donor diversity and increasing blood supply. Efforts should focus on raising awareness, addressing cultural and social norms and providing adequate support to encourage female participation in voluntary blood donation programs[12,13].

The findings have important implications for blood safety in rural settings. Maintaining a robust Blood Transfusion Service (BTS) is essential for ensuring the safety of blood transfusion recipients. Continuous monitoring and adaptation of blood donation policies and practices are necessary to address emerging challenges and mitigate risks associated with TTIs[14,15]. Strengthening donor screening, counseling and testing protocols, along with fostering community engagement, are key strategies for promoting voluntary blood donation and enhancing transfusion safety[16,17]. It is essential to acknowledge the limitations of the study, including its retrospective design and reliance on data from a single tertiary care center. Future research should explore factors contributing to TTI prevalence, such as behavioral risk factors, socioeconomic status and geographical variations. Longitudinal studies tracking changes in TTI prevalence and evaluating the impact of interventions are warranted to inform evidence-based strategies for improving blood safety[18].

CONCLUSION

In conclusion, this retrospective cross-sectional study spanning a decade at the Blood Centre of SRTR GMC Ambajogai provides valuable insights into the seroprevalence and trends of transfusion-transmissible infections (TTIs) among voluntary blood donors. Our findings underscore the ongoing importance of maintaining a robust Blood Transfusion Service (BTS) in rural settings, where access to healthcare and literacy levels present significant challenges. Throughout the study period, we observed a consistent commitment to donor screening and counseling, reflecting a proactive approach to transfusion safety. Despite fluctuations in

the annual number of blood donations, our data reveals a relatively low overall prevalence of TTIs among donors, with HIV, HBsAg and HCV reactivity rates remaining within manageable ranges. Noteworthy trends emerge from our analysis, including a gradual decline in the proportion of reactive cases for HIV, HBsAg and HCV over the years, as evidenced by narrowing confidence intervals. These trends suggest improved stability in estimates and potentially reflect the effectiveness of screening protocols and public health interventions. It is crucial to acknowledge the gender disparity among blood donors, with the vast majority being male. Understanding and addressing barriers to female blood donation could help enhance overall donor diversity and increase blood supply. Our study contributes to the body of knowledge on transfusion safety in rural settings, highlighting the importance of continuous monitoring and adaptation of blood donation policies and practices. Moving forward, efforts should focus on sustaining high standards of donor screening, counseling and testing, as well as fostering community engagement to promote voluntary blood donation and ensure the safety of blood transfusion recipients.

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