



Original Research Article

Seroprevalence of syphilis among blood donors in a tertiary care hospital in and around Koodapakkam, Puducherry, India

Purshotam Paudel^{1*}, Manoharan Arumugam², Pammy Sinha²¹Dept. of Transfusion Medicine, Sri Lakshmi Narayana Institute of Medical Sciences, Puducherry, India²Dept. of Pathology, Sri Lakshmi Narayana Institute of Medical Sciences, Puducherry, India

ARTICLE INFO

Article history:

Received 12-06-2024

Accepted 02-07-2024

Available online 12-09-2024

Keywords:

Blood donor

Prevalence

Syphilis

South India

Transfusion transmitted infections

ABSTRACT

Context: Transfusions Transmissible Infections (TTIs) are infections that can transfer from one individual to another through the use of contaminated blood or blood products. In India, it is mandatory to test TTIs before blood transfusion including HBV, HCV, HIV-I/II, malaria, and syphilis. This study was carried out to observe the trend of syphilis among blood donors around Koodapakkam, Puducherry India.

Aim: To find out the seroprevalence of syphilis in healthy blood donors.

Settings and Design: Retrospective epidemiological study.

Materials and Methods: A retrospective analysis was conducted on all blood donation and TTI test records from January 2021 to December 2023 at the blood centre of a private medical college and hospital in Puducherry. All positive cases of syphilis were collected. The details of the donor were taken from the donor register. Different variables like blood group, occupation, education status, and type of donor were analyzed.

Results: Out of 1652 blood donors, 27 samples were TTI reactive resulting in TTI % of 1.63. Whereas only 10 donors (0.60%) were found to be syphilis-positive using a rapid card test. None of the syphilis-positive samples were positive for other TTI viz HBV, HCV, HIV, and malaria.

Conclusions: The prevalence of syphilis was 0.60% among the blood donors from the Koodapakkam area. This study concludes that syphilis is in an increasing trend in this area among blood donors. Stringent donor screening is highly recommended to ensure maximum safe blood transfusion.

This is an Open Access (OA) journal, and articles are distributed under the terms of the [Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License](https://creativecommons.org/licenses/by-nc-sa/4.0/), which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: reprint@ipinnovative.com

1. Introduction

Syphilis is a preventable and curable bacterial sexually transmitted infection caused by the bacteria *Treponema pallidum*. According to WHO estimates, 8 million persons worldwide between the ages of 15 and 49 contracted syphilis in 2022 with more than 90% in developing regions of the world.¹ Furthermore, in the last 30 years, syphilis has gained a new potential for morbidity and mortality due to its link to a higher chance of acquiring the human immunodeficiency virus (HIV).² Syphilis is

typically contracted through sexual contact or from mother to child whereas endemic can be transmitted by non-sexual contact in places with poor hygienic conditions. Apart from sexual transmission, blood transfusion is the other common route of transmission for Syphilis.

The first case of transfusion-transmitted syphilis was reported in 1915. By 1941, 138 cases had been reported in the literature.² Since treponemes are delicate and sensitive to cold, there is very little chance of transmission when transfusion blood that has been kept below 20 C for longer than 72 hours.³ There is a greater chance of syphilis transmission with platelet concentrates because they are typically transfused within a few hours of collection or kept

* Corresponding author.

E-mail address: purusiom2065@gmail.com (P. Paudel).

at room temperature (22°C). In underdeveloped nations with limited blood supplies, the risk of transfusion-transmitted syphilis is very significant, as blood is obtained from family donors and transfused within hours.

The prevalence of *T. pallidum* infection has decreased in affluent nations in both the general population and blood donors. However, the scenario is different in developing countries of the sub-Saharan region where the prevalence may reach 25%.⁴ Transfusion-transmitted syphilis is closely associated with older age, male-to-male intercourse, two or more sexual partners, a history of syphilis treatment, and HIV seropositivity.² Prostitution, bisexuality (men having sex with both men and women), intravenous drug use, and skin scarification (tattooing, blood rituals) are additional risk factors linked to transfusion-transmitted syphilis.⁵

Both Treponemal and Non-Treponemal assays can be used to test for syphilis. Enzyme immunoassay (EIA) and Treponema Pallidum Haemagglutination Assay (TPHA) are examples of treponemal assays. They are typically employed for confirmatory diagnostic testing that identifies treponemal antibodies. As with blood donors, non-treponemal assays like Venereal Diseases Research Laboratory (VDRL) and Rapid Plasma Reagin (RPR) are used for screening purposes. In India, screening donated blood for transfusion-transmitted illnesses is mandatory under the Drug and Cosmetics Act and Rules 1945. The blood must test negative for syphilis, malaria, hepatitis B, hepatitis C and HIV. Currently, only one screening test for syphilis is mandatory. According to the WHO, blood banks may choose VDRL, RPR, or treponemal-based EIA due to cost constraints. The U.S. Centres for Disease Control and Prevention continues to recommend the traditional algorithm.⁶

The Seroprevalence of syphilis infection reported in Indian blood donors ranges from 0.03% to 2.6% in different states.⁷ However, the seroprevalence of syphilis in blood donors in the rural areas adjoining our institute is little documented. This study was carried out to observe the trend of syphilis among healthy blood donors around the Puducherry area and also to determine the frequency of syphilis seroreactivity and its co-infection with other TTI in blood donors in our region.

2. Materials and Methods

This was a retrospective epidemiological study conducted in the blood centre of a private medical college and hospital in Puducherry, India. A review of all blood donor records from January 2021 to December 2023 was conducted, including records of all the blood donations as well as the outcomes of their TTI tests. Donors were screened based on national guidelines and departmental standard operating procedures, including a medical examination and finger prick test to assess their haemoglobin and blood groups. Informed consent was obtained from all the donors. All five

tests, mandatory for every donor/or blood unit i.e. HIV 1 and 2, HCV, HBsAg, Syphilis and Malaria were performed in our laboratory. The testing of the donor sample for syphilis was done using a rapid card kit by Reckon Diagnostics.

2.1. Principle of the test

The Syphilis Rapid Test Device is a qualitative membrane-based immunoassay for the detection of TP antibodies (IgA, IgM, IgG) in whole blood/serum or plasma. This process involves immobilising recombinant syphilis antigen (17KDa, 15KDa, 47KDa) in the device's test line region. When a specimen is put into the device's specimen well, it reacts with syphilis antigen-coated particles in the test. The mixture migrates chromatographically along the test strip, interacting with the immobilised Syphilis antigen. The double antigen test can identify IgA, IgG, and IgM antibodies in specimens. A pink-purple line in the test line region indicates a positive TP antibody test result. If the specimen lacks TP antibodies, a pink-purple line won't appear in the test spot, indicating a negative result. An additional line of goat anti-mouse IgG has been immobilised on the card for procedural control purposes. If the test is conducted correctly, the conjugate will create a pink-purple line as a control line. The interpretation of the test is shown in Figure 1.

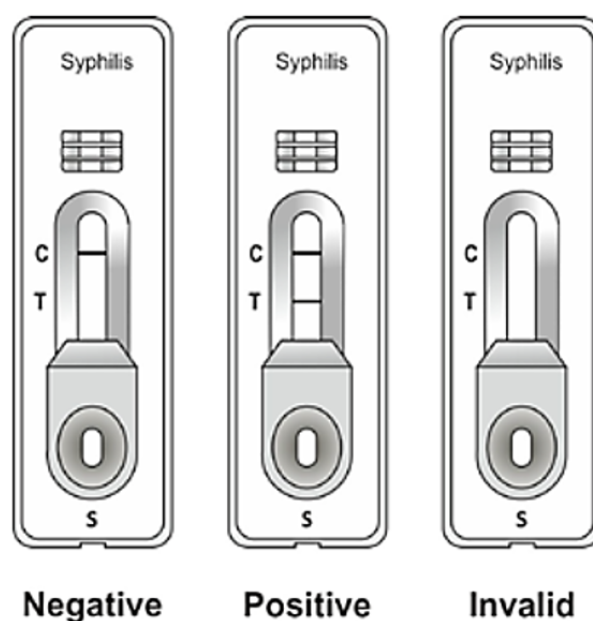


Figure 1: Interpretation of rapid card test for syphilis screening in blood donors

Allow the reaction to continue for up to 20 minutes or until the positive and control lines develop and are reported as reactive or non-reactive against the respective donor's identification number and entered in the TTI register.

All positive cases of syphilis were collected. Using SPSS version 22.0 (IBM Corp., Armonk, NY), all data were entered in Microsoft Excel and analyzed. Different variables like blood group, occupation, education status, and type of donor were analyzed. The number of Syphilis reactive donors in the overall donor population was used to determine seroprevalence, which was subsequently calculated and reported as a percentage (%). The qualitative variables like blood group, occupation, education status and types of donors were expressed using frequency and percentages.

3. Results

Out of 1652 blood donors, 27 donors were TTI reactive resulting in TTI % of 1.63. Out of 27 TTI reactive, 10 were reactive for syphilis. 16 samples were reactive for Hepatitis B and 1 sample was reactive for HIV. None of the samples were reactive for the hepatitis C virus. The prevalence of syphilis was found to be 0.60%. None of the syphilis-positive samples were positive for other TTI viz HBV, HCV, HIV, and malaria.

All reactive donors were male. The mean age of the reactive donor was 33.10 ± 11.31 . The lower limit of age was 20 years, whereas the maximum was 52 years. More than 50% of the reactive donors were in the age group between 18 and 24 years. Blood group O had the highest seropositivity followed by B and A groups. 80% of reactive donors were Rh positive and 20% were Rh negative. The demographic details of the syphilis-reactive donors are shown in Table 1. The prevalence of TTI and syphilis is shown in Table 2. The trend of TTI and syphilis is shown in Table 2.

Table 1: Demographic details of syphilis reactive donors

Participant's characteristics	Frequency, n (%)
Age	
18-30 years	5 (50)
31-40 years	3 (30)
>=41 years	2 (20)
Occupation	
Student	4 (40)
Business	3 (30)
Farmer	3 (30)
Blood group-ABO	
A	1 (10)
B	2 (20)
O	7 (70)
AB	0 (0)
RH Group	
Positive	8 (80)
Negative	2 (20)

4. Discussion

The current study shows that the overall seroprevalence of syphilis (n=10/1652) and TTIs (25/1652) is 0.6% and 1.51%, respectively. The percentage of syphilis among all positive TTI is 40% (10/25). The global incidence of syphilis among blood donors is variable. Syphilis incidence was 7.5% among Ghanaian donors in research by Adjei et al; however, Matee et al. reported an incidence of 12.7% among Tanzanian donors, while Bhatti et al. reported an incidence of 0.75% among Pakistani donors.² In our study we got a prevalence of 0.60% which is nearer to the findings of Prajapati et.al.⁷

The Seroprevalence of syphilis infection reported in Indian blood donors ranges from 0.03% to 2.6% in different states.⁷ In India, it was found that the prevalence of syphilis was lower in Telangana, Madhya Pradesh, Jharkhand, and Andhra Pradesh, and higher in Delhi and Chhattisgarh.⁷ Geographic variations in the incidence of syphilis as well as some methodological variations may be the cause of the discrepancy in syphilis prevalence seen in various studies. High prevalence may be attributed to having multiple sexual partners, intravenous drug consumption, increase in the number of aesthetic procedures. whereas decreased prevalence may be attributed to donor selection criteria that are more stringent, greater public knowledge, the self-exclusion of high-risk groups from blood donation, etc.

Some study report shows the risk of TTI infection has no significant association with ABO and Rh D blood group.⁸ While other research has shown that group O donors have a higher risk of TTI.¹³ The current study's findings indicate a correlation between the ABO blood group antigen and syphilis infection. Donors with blood group O, which lacks the A and B antigens, had a significantly higher prevalence of syphilis than donors with these antigens. This is similar to the study by Thakur et al.¹⁴ Donors with blood group O had higher VDRL infection rates than donors with antigens A, B, and AB (OR=1.8158, CI=1.0302 to 3.2004, z statistics = 2.063, p=0.0391).¹⁴ In contrast, Mohammadali F et al. found no significant association between ABO and Rh blood groups and syphilis infection.¹⁵ The higher prevalence of syphilis in group O donors in our study could be because a higher percentage of donors were in group O leading to more positivity in that group.

In our study, 50% of the reactive donors were in the age group of 18-25. This age predisposition may be observed because the majority of our centre's donors are college students. They are in a period of high sexual activity, where they tend to be ambitious, putting themselves at risk for infections. The correlation of HIV infection with HBV, HCV, and syphilis has been well-established in patients, but data on donors are limited. We found no evidence of co-infection with HIV, HCV, HBV, or malaria, despite syphilis being known to increase susceptibility to other TTIs. Kumar

Table 2: Prevalence of TTI and syphilis in the study period

	Total Units Tested	No (%)	TTI Positive units			Syphilis Positive units
			HIV	HCV	HBV	No. (%)
2021	397	9	0	0	7	2
2022	587	8	0	0	6	2
2023	668	10	1	0	3	6
Total	1652	27	1	0	16	10

Table 3: Comparison of seroprevalence rate of syphilis in blood donors of the present study to other recent studies

Studies from India	States	Study Period	Total Donors	Syphilis reactive donors	Prevalence (%)
Kumar et al ⁸	Chhattisgarh	2011-2013	12680	134	1.05
Yadav et al ⁹	Madhya Pradesh	2012-2013	4007	2	0.04
Das et al ¹⁰	Karnataka	2013	10000	45	0.45
Fatima et al ¹¹	Telangana	2010-2016	55291	22	0.14
Prajapati et al ⁷	Gujrat	2012-2016	6360	48	0.75
Singhal et al ¹²	Gwalior	2012-2019	146032	392	0.26
Present Study	Puducherry	2021-2023	1652	10	0.60

et al.⁸ reported a 3.7% and 2.9% co-infection rate with HBV and HIV, respectively, while Makroo et al. observed 3% for HIV and 18.7% for HCV.¹⁶ This could be due to a smaller donor population in our study.

Blood transfusion plays an important role in the prophylactic and therapeutic management of several critical health problems. The screening of blood among the donors provides a wide range of protection against various diseases like HIV, HBsAg, HCV, syphilis, and malaria. The majority of people consider syphilis to be a sexually transmitted disease. However, other high-risk factors for syphilis infection include sharing razors, ear piercings, and tattoos. Currently, aesthetic procedures like piercings, tattoos, liposuction, lasers, injections, and rhinoplasty have significantly elevated. A study conducted by Liu et al. concluded that sharing cosmetic surgery instruments can spread blood-borne infections.¹⁷ Consequently, one should not disregard the blood-transmission route for syphilis.

Although several tests are available for diagnosing syphilis, there is currently no gold standard technique because no test is ideal for all stages of the disease. The ideal test for syphilis should have both high sensitivity and specificity. Various conditions can give false positive reactions during the testing of donor samples for syphilis. The concomitant illnesses or diseases include mononucleosis, leprosy, malaria, lupus erythematosus, vaccination, viral pneumonia, collagen diseases, measles, rubella, HIV, pregnancy, narcotic addiction, and autoimmune diseases.⁷ Therefore, Syphilis serology data must be interpreted carefully, taking into account both laboratory and clinical findings. Newer tests, such as recombinant antigen-based EIA and Rapid Immunochromatographic Strip, can accurately diagnose and treat syphilis in a single visit, reducing the possibility of false positives and negatives.

For recipients' safety, it is strongly advised to perform thorough donor screening, use highly sensitive methods for TTI detection, and enhance pre-donation screening as well as promote regular voluntary donations. Nonetheless, the establishment of structured blood donation facilities, a high-quality system, infection control initiatives, and compliance with standard operating procedures are the first steps toward ensuring blood safety. Public awareness, proper counselling, medical examination, and testing can help to minimize TTIs including syphilis.

5. Conclusion

An increasing trend of syphilis positivity was seen among blood donors. Our study results show ABO blood group has an association with syphilis infection. However, a bigger sample is recommended to prove the association between the ABO blood group and syphilis reactivity. Increasing volunteer blood donors' knowledge, attitude, and behaviour towards risk factors can improve public health and boost blood safety and quality.

6. Limitations

1. The rapid screening test kits used for this study are in vitro qualitative methods, not confirmative ones. However, the positivity of Syphilis could not be further validated by confirmatory tests.
2. Our study had a very skewed female population, so we could not establish gender distribution.
3. Being a single-centre hospital-based study, its results cannot be generalized.

7. Abbreviations

TP-treponema pallidum, TTI- transfusion-transmitted infection, EIA- enzyme immunoassay, VDRL- venereal disease research laboratory, RPR- rapid plasma reagin.

8. Source of Funding

None

9. Conflict of Interest

Nil.

References

- World Health Organization. Syphilis . World Health Organization. Accessed: 22 May 2024. Available from: <https://www.who.int/news-room/fact-sheets/detail/syphilis>.
- Kaur G, Kaur P. Syphilis testing in blood donors: an update. *Blood Transfus*. 2015;13(2):197–204.
- Orton S. Syphilis and blood donors: what we know, what we do not know, and what we need to know. *Transfus Med Rev*. 2001;15(4):282–91.
- Tagny CT, Owusu-Ofori S, Mbanya D, Deneys V. The blood donor in sub-Saharan Africa: a review. *Transfus Med*. 2010;20(1):1–10.
- Vera L, Milka D, Nurith SL, Eilat S. Prevalence and Incidence of Syphilis among Volunteer Blood Donors in Israel. *J Blood Transfus*. 2014;2014:154048.
- CDC. Discordant results from reverse sequence syphilis screening – five laboratories, United States, 2006-2010. *MMWR Morb Mortal Wkly Rep*. 2011;60(5):133–7.
- Prajapati DR, Parmar BH. Syphilis in blood donors: Pre-transfusion serological screening by Rapid Plasma Reagin (RPR) Test at the blood bank of a Teaching Medical Institute in North Gujarat, India. *Indian J Pathol Oncol*. 2018;5:18–24.
- Kumar A, Jyoti V, Prajapati S, Baghel R, Gangane N. Changing trends of syphilis among blood donors in Bastar region, Chhattisgarh: A retrospective study. *Community Acquir Infect*. 2015;2:51–6.
- Yadav BS, Varma AV, Singh P, Kumar R, Bandi PK. Seroprevalence of transfusion-transmitted infections (TTIs) in blood donors: a study from central India. *Int J Med Sci Public Health*. 2016;5:1158–62.
- Das S, Kumar ML. Seroprevalence of syphilis among voluntary blood donors: an institutional study. *Int J Basic Appl Med Sci*. 2014;4(1):198–203.
- Fatima A, Begum F, Kumar KM. Seroprevalence of Transfusion Transmissible Infections among Blood Donors in Nizamabad District of Telangana State - A six years study. *Int Arch Integr Med*. 2016;3(8):73–8.
- Singhal S, Rai S, Gupta P, Arya A, Sharma D. Seroprevalence and Risk Factors of Syphilis among Blood Donors. *JCMS Nepal*. 2021;17(2):185–94.
- Khan MY, Sijjeel F, Khalid A, Khurshid R, Habiba UE, Majid H. Prevalence of ABO and Rh blood groups and their association with Transfusion-Transmissible Infections (TTIs) among Blood Donors in Islamabad. *Pakistan Bio Scientific Review*. 2021;3(4):14–26.
- Thakur SK, Singh S, Negi DK, Sinha AK. Prevalence of TTI among Indian blood donors. *Bioinformation*;19:582–591.
- Mohammadali F, Pourfathollah A. Association of ABO and Rh Blood Groups to Blood-Borne Infections among Blood Donors in Tehran-Iran. *Iran J Public Health*. 2014;43(7):981–9.
- Makroo RN, Hegde V, Chowdhry M, Bhatia A, Rosamma NL. Seroprevalence of infectious markers & their trends in blood donors in a hospital-based blood bank in north India. *Indian J Med Res*. 2015;142(3):317–22.
- Liu S, Luo L, Xi G, Wan L, Zhong L, Chen X, et al. Seroprevalence and risk factors on Syphilis among blood donors in Chengdu, China, from 2005 to 2017. *BMC Infect Dis*. 2019;19(1):509.

Author biography

Purshotam Paudel, Senior Resident

Manoharan Arumugam, Professor

Pammy Sinha, Professor

Cite this article: Paudel P, Arumugam M, Sinha P. Seroprevalence of syphilis among blood donors in a tertiary care hospital in and around Koodapakkam, Puducherry, India. *Indian J Pathol Oncol* 2024;11(3):243-247.