RJNMSR
Review Journal of Neurological & Medical Sciences Review

Volume 3, Issue 4, 2025

SEROPREVALENCE OF TRANSFUSION TRANSMITTED SYPHILIS AMONG PAKISTANI BLOOD DONORS AND ITS RELATED DEMOGRAPHIC VARIABLES -AN UPDATE

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DOI: https://doi.org/10.5281/zenodo.16963184

Received	Accepted	Published
22 May, 2025	09 July, 2025	26 August, 2025

ABSTRACT

Background: *Syphilis, caused by Treponema pallidum, is a sexually transmitted bacterial infection that remains a significant risk for transfusion-transmitted infections (TTIs), especially in developing countries. Accurate data on the prevalence of transfusion-transmitted syphilis (TTS) and its association with donor demographics in Pakistan are limited.*

Objective: *To determine the seroprevalence of syphilis among voluntary blood donors in Pakistan and to analyze its association with demographic factors including age, gender, weight, ethnicity, residence, education, and occupation.*

Methodology: *A cross-sectional study was conducted from March 2022 to February 2023 at a tertiary care hospital blood bank in Karachi. A total of 18,843 voluntary blood donors aged 18–55 years, weighing >50kg, were screened using Chemiluminescent Immunoassay (CIA). Donor demographic and behavioral data were collected using standardized forms. Statistical analysis included chi-square tests and binary logistic regression to assess associations and odds ratios.*

Results: *The overall seroprevalence of syphilis was 1.4% (n=258). Majority of donors were males (99.6%) with a mean age of 29.78±7.39 years; 78% were ≤35 years. Significant associations were observed between syphilis positivity and age ($p<0.001$), ethnicity ($p<0.001$), residence ($p=0.042$), and education level ($p<0.001$). Donors aged ≤35 years had lower odds of syphilis infection (OR=0.502, $p<0.001$). Higher risk was noted among Sindhi and Baloch ethnic groups, rural residents, and donors with lower education levels. Occupation also influenced odds, with businessmen, private employees, laborers, and unemployed donors showing higher prevalence compared to students.*

Conclusion: *This study highlights a relatively higher prevalence of transfusion-transmitted syphilis among Pakistani blood donors compared to neighboring countries. Demographic variables such as age, ethnicity, education, and occupation are significantly associated with seropositivity, underscoring the need for targeted donor screening protocols and public health interventions to enhance blood safety and reduce TTS risk.*

Keywords: *Syphilis, transfusion-transmitted infections, seroprevalence, blood donors, demographic variables, Pakistan, Treponema pallidum, Chemiluminescent Immunoassay, blood safety.*

INTRODUCTION

Syphilis is a sexually transmitted bacterial illness (STI) which is preventable as well as treatable. Often, transferred through pregnancy and blood transfusion, in addition to sexual contact [1] and if left untreated, it can cause serious health complications. A meta study reported the global load of Syphilis has increased from 160.03 to 178.48 per 100,000 persons from 1990 to 2019 and these incidences were associated with high and high-middle sociodemographic indices, males and peaked among 20 and 30 years of age [2]. The WHO anticipated that 7.1 million persons had syphilis in 2020 [1] with a significant rise in cases among neonates and homosexual men which estimates 7.5% compared to 0.5% of men in the overall population[3,4]. Among others, South Asia had the highest age standardized incidence rate in the Asia,[2] of which Pakistani blood donors has still higher prevalence (0.8%, 0.9%)[5,6] than the neighboring countries i.e.: 0.31%, 0.33% and 0.41% in India, China and Bangladesh respectively [7-9]. The spirochaete Treponema pallidum (T. pallidum) causes syphilis and is mostly asymptomatic and is often reported in primary and secondary stages of disease. The bacteremia is usually short lived, even after recent infection. T. pallidum found in bloodstream are weak and sensitive to cold so the risk of transmission through blood transfusion stored below 20 °C for more than 72 hours is very low. In contrast, Platelet concentrates are usually stored at room temperature (22 °C) or transfused within a few hours of collection so they carry a higher risk of transmitting syphilis [10]. The risk of transfusion-transmitted syphilis (TTS) is especially significant in developing nations with limited resources where the blood is collected from family donors and transfused within hours. Thereby, a screening test is considered mandatory to prevent TTS and this universal blood donor testing has contributed gravely to the elimination of disease. Other noteworthy measures include: discontinuing direct donor-to-recipient transfusion; inactivation of T. pallidum in refrigerated blood components; deferral of potential donors found to have high-risk behavior for acquiring syphilis infection (e.g., sex workers, homosexuals) through the donor eligibility screening process; and widespread use of antibiotics among transfusion recipients to reduce overall disease burden [11].

There is currently a scarcity of detailed data on the occurrence and correlation of TTS with demographic parameters of blood donors. The purpose of this study was to assess the prevalence of transfusion-transmitted Syphilis and its association with donors' age, weight, ethnicity, gender, education levels, urban or rural location and employment. This component of demographic data will reveal which groups are more likely to suffer from TTS. It will provide a scientific foundation for developing effective screening and control techniques.

METHODS AND MATERIALS

The study was done on voluntary blood donors visiting the Department of Blood Bank at a tertiary care hospital in Karachi for one year, from March 2022 to February 2023, with a total of n=18,843 samples collected. All donors between the ages of 18 and 55 with a body weight greater than 50kg and hemoglobin levels greater than 12.5gm/dl were eligible. Donors with a history of jaundice, recent blood transfusion, blood donation or surgery, intravenous drug abusers, tattooed individuals, and those with non-marital sexual connections were discouraged from donating blood and were thus excluded from the research. Performa was used as a data gathering tool, including fields for name, gender, age, education level, kind of donor, residence, and contact number. Screening tests for syphilis were carried out using the Chemiluminescent Immunoassay (CIA) technique on an Architect i2000 (Abbot Diagnostic, USA). Qualifying donors were asked for written consent. All patients who met the included criteria underwent behavioral screening and a physical examination. Data from patients were collected and analyzed using the IBM Statistical Package for Social Sciences (SPSS) Version 27. Mean and standard deviation were reported for quantitative variables. Frequency and percentages were reported for qualitative variables. Association between qualitative variables were determined by using chi-square/ fisher exact test. Odds ratio were calculated by binary logistic regression. P value less than equal to 0.05 were considered significant.

RESULTS

Total n=18,843 voluntary blood donors were included in the study; majority were males n=18771 (99.6%). Average age of donors was 29.78±7.39 years with preponderance of age ≤35 years n=14706 (78%). Average weight of donors was 75.93±13.05 kg. Other demographic factors like occupation, education and ethnicity is also represented graphically in Figure-1,2 and 3 respectively. In our study, n=258 (1.4%) donors were seropositive for syphilis as presented in Table-1. with significant association of syphilis with age

(p<0.001), ethnicity (p<0.001), residence (p=0.042) and education level (p<0.001) as presented in Table-2. By univariate logistic regression, we found that male donors are less likely to have syphilis as compared to female donors (OR=0.484, p=0.313). It was also found that donors have age ≤35 years are less likely to have syphilis in comparison of donors have age above 35 years (OR=0.502, p<0.001). Detailed results of odds by univariate and multivariate binary logistic regression are presented in **Table-4**

Table-1: Descriptive statistics of study population

	n (%)
Gender	
Male	18771 (99.6)
Female	72 (0.4)
Age (years)	
Mean ± Std. dev	29.78±7.39
Group	
≤35 years	14706 (78)
>35 years	4137 (22)
Weight (kg)	
Mean ± Std. dev	75.93±13.05
Group	
≤80 kg	13117 (69.6)
>80 kg	5726 (30.4)
Syphilis	
Positive	258 (1.4)
Negative	18585 (98.6)

Table-2: Association of Syphilis with demographic factors

	Syphilis n (%)		p-value
	Positive	Negative	
Gender↕			
Male	256 (99.2)	18515 (99.6)	0.259
Female	2 (0.8)	70 (0.4)	
Age (years)			
≤35 years	166 (64.3)	14540 (78.2)	<0.001
>35 years	92 (35.7)	4045 (21.8)	
Weight (kg)			
≤80 kg	179 (69.4)	12938 (69.6)	0.935
>80 kg	79 (30.6)	5647 (30.4)	
Occupation↕			
Businessmen	41 (15.9)	2933 (15.8)	0.062
Private employee	20 (7.8)	1295 (7)	
Labour	170 (65.9)	11461 (61.7)	
Housewife	1 (0.4)	31 (0.2)	
Unemployed	6 (2.3)	334 (1.8)	
Govt. employee	11 (4.3)	1020 (5.5)	
Student	9 (3.5)	1511 (8.1)	
Ethnicity			
Sindhi	71 (27.5)	2837 (15.3)	<0.001
Baloch	15 (5.8)	404 (2.2)	
Punjabi	22 (8.5)	2113 (11.4)	

Pukhtoon	40 (15.5)	2742 (14.8)	
Urdu Speaking	110 (42.6)	10489 (56.4)	
Residence			
Urban	218 (84.5)	16458 (88.6)	0.042
Rural	40 (15.5)	2127 (11.4)	
Education Level			
No formal education	33 (12.6)	1790 (9.6)	<0.001
Primary	51 (19.8)	1887 (10.2)	
Secondary	92 (35.7)	3847 (20.7)	
Intermediate	34 (13.2)	3510 (18.9)	
Graduation	48 (18.6)	7551 (40.6)	

Chi-Square test was applied.
↕Fisher exact test was applied.
Significant at 0.05 level.

Table-3: Odds ratio for Syphilis

	Un Adjusted			Adjusted		
	p-value	Odds ratio	95% CI	p-value	Odds ratio	95% CI
Gender						
Male	0.313	0.484	0.118-1.984			
Female®		1				
Age (years)						
≤35 years	<0.001	0.502	0.388-0.649	<0.001	0.502	0.387-0.650
>35 years®		1			1	
Weight (kg)						
≤80 kg	0.935	0.989	0.758-1.291			
>80 kg®		1				
Occupation						
Businessmen	0.021	2.347	1.138-4.842			
Private employee	0.018	2.593	1.177-5.714			
Labour	0.008	2.49	1.271-4.879			
Housewife	0.114	5.416	0.666-44.066			
Unemployed	0.037	3.016	1.066-8.531			
Govt. employee	0.188	1.811	0.748-4.385			
Student®		1				
Ethnicity						
Sindhi	<0.001	2.386	1.766-3.225			
Baloch	<0.001	3.54	2.046-6.127			
Punjabi	0.975	0.993	0.627-1.573			
Pukhtoon	0.076	1.391	0.966-2.002			
Urdu Speaking®		1				
Residence						
Urban	0.043	0.704	0.501-0.990	0.396	0.860	0.607-1.218
Rural®		1			1	
Education Level						
No formal education	<0.001	2.900	1.856-4.531	<0.001	2.85	1.811-4.486
Primary	<0.001	4.252	2.858-6.326	<0.001	4.334	2.907-6.462
Secondary	<0.001	3.762	2.648-5.345	<0.001	3.723	2.619-5.292
Intermediate	<0.001	1.524	0.98-2.369	0.037	1.603	1.03-2.493

Graduation®		1			1	

® Reference group, CI; confidence interval
Binary logistic regression was applied.
Significant at 0.05 level.

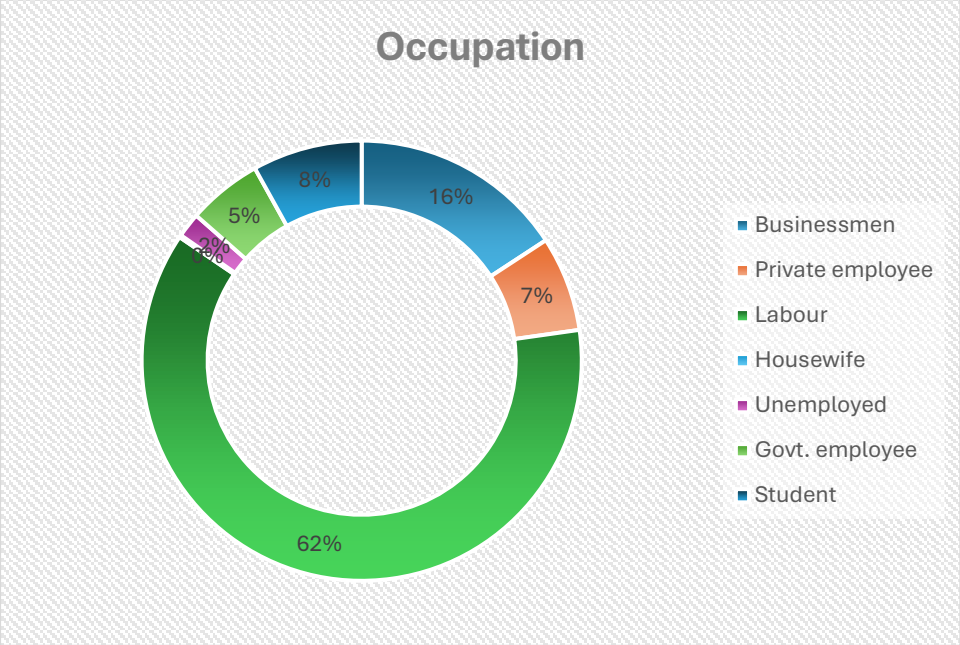

FIGURE 1: Pie chart representing occupation of Blood Donors visiting blood bank.

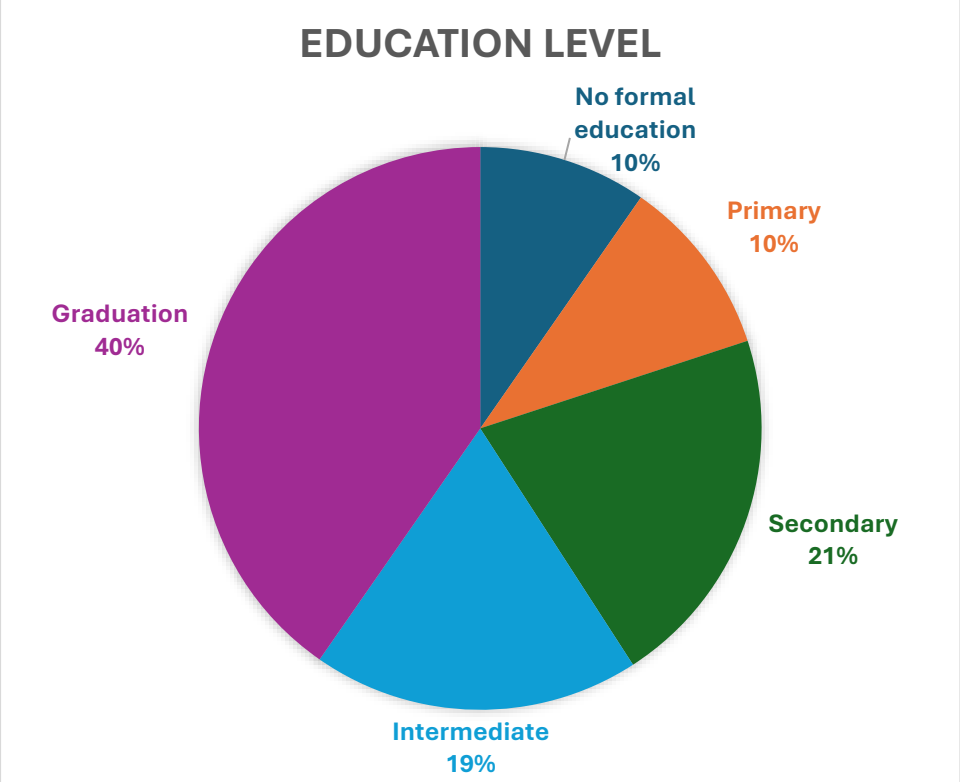

FIGURE 2: Pie chart representing education levels of Blood Donors visiting blood bank.

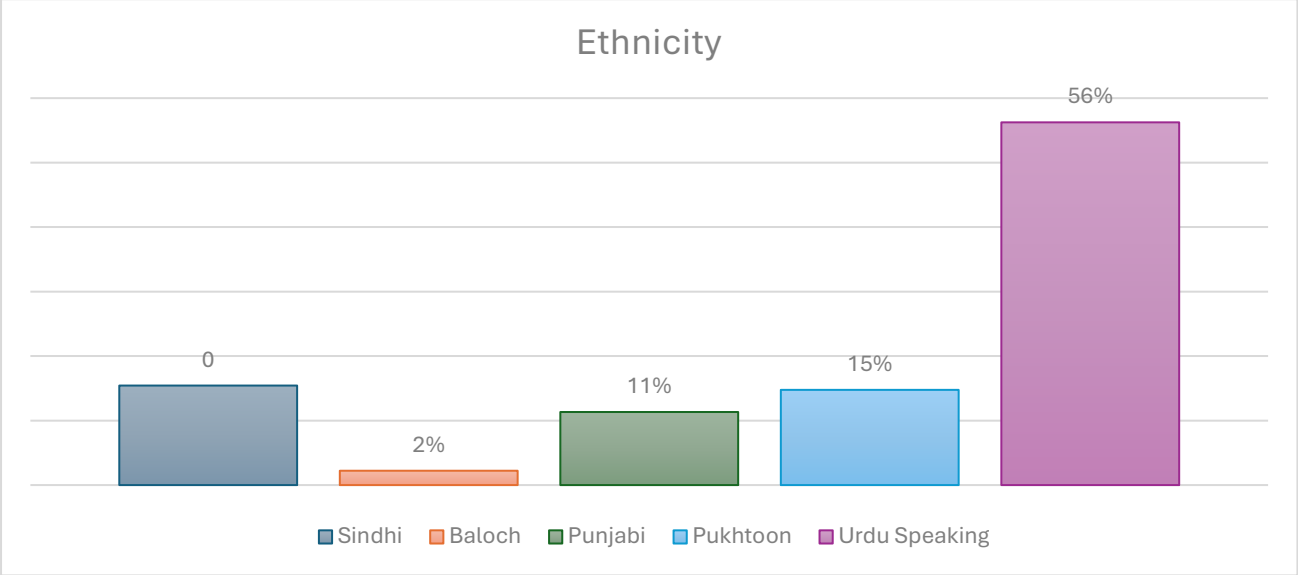

FIGURE 3: Bar graph representing education levels of Blood Donors visiting blood bank.

DISCUSSION:

The incidence of seropositive cases of Syphilis is higher in our region, not only as compare to the neighboring countries as stated in introduction but also from other nearby Muslim countries as represented by the data. (0.0% in Egypt and Iranian blood donors, 0.02% in Turkey, 0.1% reported in Port Harcourt, 0.2% among blood donors in Niger delta of Nigeria).[17-20] which reflects a relative higher burden of disease and even higher chances of transmission of disease via blood transfusion.

The transfusion-related adverse events, including transfusion-transmitted infections (TTIs), are always a possibility with blood transfusions, despite the fact that they are essential for the treatment of several illnesses. Since there is currently no screening technique that can completely eliminate the risk of transfusion-transmitted diseases, it is imperative to implement stringent donor selection guidelines and avoid giving unneeded transfusions.[12,13]. Syphilis being a sexually transmitted illness, those who have been diagnosed with it may also have a chance to exposure to other STDs. Furthermore, studies also suggest that males are more likely to get syphilis, which may be caused by unhygienic working conditions and shared bedding. Thus, it's crucial to screen donated blood for syphilis. Therefore, screening patients for syphilis also serve as a surrogate test to identify donors who may exhibit high-risk behavior [14-16].

Regional studies have shown the seropositivity of syphilis to be 0.89% in Islamabad[21], 2.1% in Karachi[22] and 1.10% in Faisalabad[23], 3.1% Lahore [24] pointing out the prevalence relatively higher in densely populated cities of the country which can be attributed to the life style, hygienic conditions, lack of awareness and availability of facilities. The risk of transfusion-transmitted syphilis is linked to risk factors in the blood donor specifically the sexual behavior. In 2004, National AIDS control program carried out a survey reporting a syphilis prevalence of 60% among Hijra (transgender) and 36% between male sex workers (MSM)[25]. Unsafe sexual practices have, undoubtedly, increased the prevalence of syphilis[26]. Such practices are common in the villages due to lack of awareness which may be a reason of a high prevalence of syphilis among the blood donors of Ghurki Trust Teaching Hospital which is surrounded by 1112 villages[27]. Intravenous drug abuse, tattooing and bisexuality are some other risk factors associated with transfusion-transmitted syphilis. Such donors with a high-risk profile can only be filtered out by using thorough questionnaires.

In a study, a low prevalence has been attributed to a compulsory interview and filling of a questionnaire before donation in Norway[28]. Through the selection of low-risk groups and efficient laboratory screening prior to donation, the spread of the disease via transfusion can be controlled. Overall, Pakistan faces the challenge of availability of safe and efficacious blood to donate owing to increased demand, escalating rate of TTIs, inadequate screening and suboptimal blood transfusion services.[21].

LIMITATIONS OF THE STUDY:

- ✓ The study was conducted at a single tertiary care hospital blood bank in Karachi, which may limit the generalizability of the findings to the broader population of Pakistan or other

regions with different demographic profiles and risk factors.

- ✓ The overwhelming majority of donors were male (99.6%), limiting the ability to assess gender-specific differences in syphilis prevalence adequately.
- ✓ Behavioral risk factors such as detailed sexual history and other high-risk behaviors were self-reported and may be underreported due to social desirability or stigma, potentially leading to information bias.
- ✓ The study utilized Chemiluminescent Immunoassay (CIA) for screening but did not include confirmatory tests or follow-up, which might affect the accuracy of syphilis diagnosis.
- ✓ Donor exclusion criteria based on high-risk behaviors and medical history may have reduced the prevalence rates, thus underestimating the true burden of transfusion-transmitted syphilis among the general population.
- ✓ Ethnic representation was uneven, and some ethnic groups had relatively small sample sizes, which could affect the robustness of ethnicity-based conclusions.

CONCLUSION:

This study revealed a relatively higher prevalence (1.4%) of transfusion-transmitted syphilis among Pakistani blood donors compared to neighboring countries, indicating a significant public health concern. The seropositivity was significantly associated with demographic variables such as age, ethnicity, residence (urban or rural), education level, and occupation, with younger donors (≤35 years) showing lower odds of infection, and higher risk observed among Sindhi and Baloch ethnicities, rural residents, and donors with lower education levels. These findings highlight the need for targeted donor screening protocols and public health interventions tailored to high-risk groups to enhance blood safety and reduce the risk of transfusion-transmitted syphilis in Pakistan. Strict adherence to donor selection criteria combined with efficient laboratory screening remains essential for controlling transfusion-associated syphilis transmission.

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