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PREVALANCE OF *SYPHILIS* AMONG BLOOD DONAR VISITING INSTITUTE OF KIDNEY DISEASE HAYATABD PESHAWAR

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Abstract

Syphilis is a sexually transmitted infection caused by the bacterium Treponema pallidum. It remains a public health concern due to its potential for serious complications if left untreated. In this study, syphilis prevalence was assessed among blood donors to identify patterns based on demographic factors such as age. Syphilis was detected using immunochromatographic testing, and data were analyzed with Chi-square testing to assess the association between age groups and infection status. The results provide insight into the distribution of syphilis infection within the donor population. A cross-sectional descriptive study conducted at the Institute of Kidney Disease Hayatabad, Peshawar, examined 131 voluntary and replacement blood donors aged 18–50 between April to August. Using immunochromatographic testing, the syphilis prevalence rate was found to be 3.8% (5 positive out of 131), with the majority of donors being male (61.1%). The 18–28 age group represented 46.6% of both syphilis-positive and syphilis-negative individuals. A Chi-square test confirmed a significant association between age group and syphilis status ($\chi^2 = 5.965$, $p < 0.05$), indicating that infection rates vary by age. Syphilis prevalence was 3.8%, with a significant association between age group and infection, underscoring the need for targeted screening and prevention strategies.

Key words: Treponema pallidum, syphilis, cross-sectional descriptive study.

INTRODUCTION

Syphilis is a chronic systemic infectious disease caused by the spirochete bacterium *Treponema pallidum*. The genus *Treponema* consists of spiral-shaped bacteria characterized by a complex outer phospholipid membrane and belonging to the order *Spirochaetales*. Among the subspecies, *Treponema pallidum* subsp. *pallidum* is responsible for venereal and congenital syphilis, and humans are considered the only natural host. The infection is characterized by prominent mucocutaneous lesions that may occur with or without systemic manifestations following the involvement of internal organs. Due to its wide range of clinical manifestations that often mimic other diseases, syphilis is commonly referred to as the "great imitator," making dermatological examination important in the diagnosis and management of the disease (Santo et al., 2022).

Historically, syphilis was first recognized in the late fifteenth century and subsequently caused a major epidemic during the Renaissance period in Europe. Following this outbreak, the disease spread rapidly across different continents and eventually became a global health concern. Although the incidence of syphilis declined during the second half of the twentieth century, a resurgence has been reported since the early 2000s, particularly in developed countries. The

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increasing incidence of sexually acquired syphilis highlights the continued public health significance of the infection (Santo et al., 2022). The etiological agent, *Treponema pallidum*, is a microaerophilic, motile, spiral-shaped bacterium that cannot yet be cultivated continuously in artificial laboratory media. The organism is typically transmitted through sexual contact with an infected individual or through transplacental transmission from an infected pregnant woman to her fetus (Stamm et al., 2016).

Syphilis is considered one of the most common sexually transmitted infections (STIs) worldwide. Although sexual transmission remains the predominant route, the infection can also occur through transfusion of contaminated blood products or by vertical transmission during pregnancy. According to the World Health Organization (WHO), approximately 6.3 million new cases of syphilis are reported annually, with nearly 90% occurring in low- and middle-income countries. This widespread distribution makes syphilis a major public health concern. Furthermore, individuals infected with syphilis have a significantly increased risk of acquiring human immunodeficiency virus (HIV), with studies suggesting a three- to five-fold higher probability of HIV transmission during sexual contact (Mehand et al., 2018).

Despite being both preventable and curable, syphilis continues to pose serious health risks if left untreated. The disease is typically transmitted through direct contact with infectious lesions during sexual activity. Untreated infections can lead to severe systemic complications, particularly in cases of congenital syphilis resulting from vertical transmission. Congenital infection may lead to miscarriage, stillbirth, premature birth, or severe neonatal complications. Over the past decade, a steady increase in the global number of syphilis cases has been observed, with more than seven million cases reported worldwide in 2020 alone, indicating that the infection remains a persistent global health challenge (Xia et al., 2024).

The origin of syphilis has long been debated among historians and scientists. One theory, known as the pre-Columbian hypothesis, suggested that the disease existed in Europe prior to the voyages of Christopher Columbus, based mainly on skeletal findings believed to represent syphilitic lesions. However, molecular and paleopathological evidence has provided limited support for this theory. The more widely accepted Columbian hypothesis proposes that syphilis was introduced to Europe from the Americas in the late fifteenth century. Historical accounts describe the rapid spread of the disease in Europe following the return of Columbus's expedition and the subsequent military campaigns in Naples, Italy, where the infection reportedly spread among soldiers and civilians (Tudor et al., 2024).

Clinically, syphilis is a complex systemic infection capable of affecting multiple organ systems, including the skin, mucous membranes, cardiovascular system, and nervous system. In some cases, the disease can become life-threatening if it progresses to advanced stages. A significant challenge in controlling syphilis is that a considerable proportion of infected individuals remain asymptomatic, which complicates early detection and increases the risk of continued transmission. Epidemiological studies have estimated that millions of new infections occur each year worldwide, demonstrating the ongoing burden of the disease in many regions (Zeng et al., 2025).

Untreated syphilis typically progresses through several stages, including primary, secondary, latent, and tertiary phases. The primary and secondary stages are highly infectious and characterized by specific clinical features such as chancre formation and widespread mucocutaneous lesions. In contrast, tertiary syphilis represents a late manifestation of the disease and occurs years after the initial infection. This stage is associated with a persistent low level of the pathogen and a strong immune response that can lead to severe tissue damage. The major clinical presentations of tertiary syphilis include neurosyphilis, cardiovascular syphilis, and late benign syphilis. Neurosyphilis results from the invasion of *Treponema pallidum* across the blood–brain barrier, whereas cardiovascular syphilis commonly involves inflammation of the aorta,

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particularly ascending aortitis (Lafond & Lukehart, 2006).

Laboratory diagnosis of syphilis remains essential for effective disease management. Serological testing is widely used for screening and confirmation of infection. Traditionally, non-treponemal tests such as the Venereal Disease Research Laboratory (VDRL) test are used for initial screening, followed by confirmatory treponemal tests including the *Treponema pallidum* hemagglutination assay (TPHA). However, serological tests may produce false-negative results during very early or late stages of infection. In addition to serology, direct detection techniques such as dark-field microscopy and molecular methods can be used in specific clinical situations, particularly during early infection (Soreng et al., 2014; Satyaputra et al., 2021). Rapid point-of-care diagnostic tests have also been introduced in many developing countries because of their affordability, ease of use, and relatively good diagnostic performance (Morshed et al., 2015).

Syphilis also remains a significant cause of adverse pregnancy outcomes worldwide. It is estimated that approximately one million pregnant women each year have active syphilis infection. Without appropriate treatment, a substantial proportion of these pregnancies may result in stillbirth, neonatal death, or low birth weight infants. Early screening during pregnancy and prompt treatment with a single dose of penicillin before 28 weeks of gestation have been shown to effectively prevent most complications associated with congenital syphilis (Marks et al., 2017).

Overall, syphilis continues to represent a major global health concern despite the availability of effective diagnostic methods and treatment options. Early detection, appropriate therapy, public health education, and routine screening of high-risk populations and pregnant women are essential strategies for reducing transmission and preventing long-term complications associated with the disease (Stamm et al., 2025).

METHODOLOGY

Study design

This was a cross-sectional descriptive study conducted to determine the prevalence of syphilis among voluntary and replacement blood donor. Samples were collected from institute of kidney disease Hayatabad Peshawar from April 2025 to August 2025. A total of 131 random Blood donor were selected for study, ages ranging from 18 to 50 years.

Data Analysis

Data was analyzed by Spss (v.25). Mean and SD was used for continuous variable while frequency and percentage were calculated for categorical variable.

Sampling collection and processing

About 5ml of venous blood was withdrawn from each subject by using a disposable plastic syringe after sterilization of skin with isopropyl alcohol (70%) swab. This sample was withdrawn on gel tube. Blood left to be clotted in a gel tube for 5 minutes in the water bath then centrifuged for 3 minutes at 4000rpm.Add the specified amount 2drops of serum, plasma or whole blood(approximately 50 micro later) to the sample well on the test device add the buffer solution to the sample well. Observe the test strip for the appearance of colored lines the control(C)) and test (T) regions .Read result within the specific time (e.g., 10-20 minutes).Do not interpret result after the specified time.

TEST Method

To test for syphilis, we used the Immunochromatographic Test (ICT) — a quick and reliable method often used in blood banks. This test works by detecting antibodies in the blood that are produced in response to *Treponema pallidum*, the bacteria that cause syphilis. A small drop of blood was placed on the test device, and results were visible within minutes. If a line appeared in the test area, the sample was considered reactive (positive for syphilis). All tests were performed carefully, following the manufacturer's instructions and under proper quality control. After testing, the results were

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analyzed to determine how many donors had syphilis and whether there were any trends based on age or other factors.

RESULTS

Age wise distribution

The distribution of donors across different age groups in relation to their syphilis status. Among individuals who tested negative for syphilis, the highest proportion belonged to the 18–28 years age group, comprising 46.6% of the total syphilis-negative cases. This was followed by individuals aged 29–39 years, who represented 37.4%, and those in the 40–50 years group, accounting for 16.0%. Similarly, among individuals who tested positive for syphilis, the 18–28 years age group also accounted for the largest proportion of cases, contributing 46.6% of the syphilis-positive population. This suggests that young adults are more commonly affected, regardless of their syphilis status. To assess whether the observed differences in age distribution were statistically significant, a Chi- square test was performed. The analysis revealed a significant association between age group and syphilis status, with a Chi-square value of 5.965 ($p < 0.05$). This indicates that the prevalence of syphilis infection is not uniformly distributed across age groups, and age may be a contributing factor in the likelihood of infection.

Table 1 Age wise distribution of blood donors

Age	Frequency	Percent	Cumulative Percent
18-28	61	46.6	46.6
29-39	49	37.4	84.0
40-50	21	16.0	100.0
Total	131	100.0	

Gender wise distribution

In this study, a total of 131 blood donors were included. An analysis of the gender distribution included in these donors revealed that 61.1% (n = 80) were male, while 38.9% (n = 51) were female. This indicates a higher proportion of male donors compared to female donors within the study sample.

Table 2 Gender wise distribution of donor

Gender		Frequency	Percent	Cumulative Percent
Valid	Male	80	61.1	61.1
	Female	51	38.9	100.0
	Total	131	100.0	

Prevalence of syphilis among Blood Donor

The test result data, as shown that, summarizes the frequency and percentage of individuals who tested either negative or positive for syphilis. Out of a total of 131 individuals tested, 126 (96.2%) returned negative results, while only 5 individuals (3.8%) tested positive. This distribution clearly indicates that the overwhelming majority of the tested population did not have syphilis, with nearly all (96.2%) showing no evidence of infection. In contrast, a relatively small proportion (3.8%) of individuals were found to be syphilis-positive, suggesting that the overall prevalence of the condition in this sample is low. The high percentage of negative test results may reflect either effective prevention strategies, limited exposure within the population, or low transmission rates in the studied setting. Meanwhile, although the number of positive cases is small, it still highlights the presence of

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syphilis within the community and the importance of continued screening and awareness to prevent further transmission

Table 3 Prevalence of Syphilis among Blood Donor

Result		Frequency	Percent	Cumulative Percent
Valid	negative	126	96.2	96.2
	positive	5	3.8	100.0
	Total	131	100.0	

DISCUSSION

This study analyzed syphilis prevalence among 131 blood donors, revealing key demographic patterns. Among those who tested negative for syphilis (n = 126; 96.2%), the highest proportion were aged 18–28 years (46.6%), followed by individuals aged 29–39 (37.4%) and 40–50 (16.0%). A similar trend was observed among those who tested positive (n = 5; 3.8%), with the 18–28 age group again comprising the largest proportion (46.6%), indicating that young adults are more commonly affected regardless of syphilis status. A Chi-square test revealed a significant association between age group and syphilis status ($\chi^2 = 5.965$, $p < 0.05$), suggesting age may play a role in the likelihood of infection. The gender distribution showed that 61.1% of donors were male and 38.9% were female, indicating a higher male participation rate. Overall, the low prevalence of syphilis in this sample may reflect effective prevention strategies, limited exposure, or low transmission rates; however, the presence of positive cases underscores the ongoing need for screening, public health awareness, and preventive efforts.

In comparison to the Alharazi, et al, (2022) study involving 16,367 blood donors with a mean age of 30.19 years (SD: 7.5), where the majority were aged 26–35 years (48.7%) followed by 16–25 years (30.8%), the smaller study of 131 donors similarly highlighted a concentration of syphilis cases among younger individuals, particularly those aged 18–28 years, who constituted the largest proportion of both negative and positive cases. While the larger study had a predominantly male donor base (99.1%), the smaller study also showed higher male participation at 61.1%. Occupationally, the larger cohort was primarily composed of manual and professional workers, with fewer military personnel, whereas the smaller study did not specify occupation. In terms of donor type, the larger sample consisted mainly of replacement donors (72.1%), whereas this detail was absent in the smaller group. Despite differences in scale, both studies reflect a pattern of higher syphilis prevalence among younger adults and emphasize the need for targeted awareness, screening, and prevention strategies within this demographic.

According to Mangala *et al* (2024) comprehensive analysis involving 175,140 blood donors from nine eligible studies, the combined prevalence rates for transfusion-transmissible infections (TTIs) were found to be 3.0% for HIV, 6.0% for HBV, 4.0% for HCV, and 3.0% for syphilis, based on a random effects model. Notably, male donors aged 25 to 44 years were significantly more likely to be infected with HBV, while female donors aged 35 years and older showed a significant association with HIV infection. Additionally, family or replacement donors exhibited a higher burden of all four infections compared to voluntary donors, highlighting the importance of donor type in assessing TTI risk. These findings emphasize the critical need for targeted screening and prevention strategies that account for demographic and donor-type variations to enhance blood safety and reduce the transmission of infections through transfusion.

According to Braga, *et al* (2025) a total of 862,146 blood donations were collected across participating blood centers, with 10,771 donations (1.3%) yielding reactive or indeterminate results during routine syphilis

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screening. Of these, 7,541 samples were further evaluated using an alternate ELISA test, where 5,876 (77.9%) tested positive or remained indeterminate. Among these, 907 cases (12.0%) were RPR-negative, 2,980 (39.5%) were RPR-positive with low titers (<1:8), and 1,989 (26.4%) were RPR-positive with higher titers (≥1:8). The overall syphilis prevalence, encompassing both RPR-positive and RPR-negative results, was significantly higher in first-time donors (FTD) at 2.5% compared to repeat donors (RD) at 0.6%. Specifically, RPR-positive infections were recorded at 1.2% in FTDs and 0.2% in RDs, with high- and low-titer RPR-positive rates in FTDs being 4.4 and 5.6 times greater than those in RDs, respectively. Additionally, among 220 indeterminate samples, confirmatory testing identified 24 ELISA-positive and 20 RPR-positive cases. These findings highlight a notably higher burden of syphilis infection among first-time donors and underscore the value of enhanced screening and confirmatory testing protocols to ensure blood safety.

Conti *et al*, (2024) investigated that Among 14.75 million blood donations analyzed over a two-year period, the prevalence of syphilis was28.4 per 100,000 donations, with a significantly higher rate observed in the second year compared to the first. The overall incidence was 10.8 per 100,000 person-years. Adjusted odds showed that the likelihood of a current prevalent (CP) syphilis infection was 1.18 times higher in the second year (95% CI: 1.11–1.26), while acute incident (AI) infections were 1.22 times more likely (95% CI: 1.10–1.35). The highest infection rates were found among male, first-time, Black, and younger donors (ages 18–39), particularly those residing in the Southern U.S. Census region. Notably, CP donors were 64 times more likely to also be HIV-positive CP donors (95% CI: 46–89), and AI donors were 77 times more likely (95% CI: 52–114), even after adjusting for confounders. These findings highlight key demographic and regional disparities in syphilis prevalence and underscore the strong association between syphilis and HIV coinfection, reinforcing the need for targeted interventions and enhanced screening strategies in high-risk donor populations.

Conclusion

The prevalence of syphilis among blood donors remains a critical public health concern, despite generally low overall rates in many populations. Evidence from our study indicates that syphilis is more common in among younger, first-time, and male donors, with certain geographic and demographic groups exhibiting higher risk. Although routine screening helps maintain blood safety, the presence of positive cases highlights the ongoing need for targeted education, comprehensive screening protocols, and effective preventive strategies to reduce the risk of transfusion-transmissible infections and ensure a safe blood supply.

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