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Seroprevalence of Transfusion-Transmissible Infections in Blood Donors: Insights from Public and Private Blood Centers in Jaranwala

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Abstract

The aim of this study is to explore how common transfusion-transmitted illnesses are in Jaranwala, Punjab, Pakistan among the donors. TTIs have proven to be one of the greatest threats to blood transfusion safety, and hence better donor-screening procedures necessitate understanding its prevalence.The present study was a cross-sectional study involving 491 voluntary blood donors from both urban and rural sectors. ICT-based testing for HIV, syphilis, malaria, HBsAg, and anti-HCV was performed for all donors. Confirmatory testing was done by an ELISA-based test.Hepatitis C was the most common cause of infection at 46, followed by syphilis at 5, malaria at 4, and Hepatitis B at 33. No cases of HIV were reported. Hepatitis C was more common among rural donors while Hepatitis B was more common among urban donors. The study points to the need for better screening and selection of donors and recommends additional research in underdeveloped areas.

Keywords: Transfusion-Transmitted Infections, Blood Donors, Hepatitis B, Hepatitis C, Syphilis, Malaria, Screening

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Abstract

The aim of this study is to explore how common transfusion-transmitted illnesses are in Jaranwala, Punjab, Pakistan among the donors. TTIs have proven to be one of the greatest threats to blood transfusion safety, and hence better donor-screening procedures necessitate understanding its prevalence.The present study was a cross-sectional study involving 491 voluntary blood donors from both urban and rural sectors. ICT-based testing for HIV, syphilis, malaria, HBsAg, and anti-HCV was performed for all donors. Confirmatory testing was done by an ELISA-based test.Hepatitis C was the most common cause of infection at 46, followed by syphilis at 5, malaria at 4, and Hepatitis B at 33. No cases of HIV were reported. Hepatitis C was more common among rural donors while Hepatitis B was more common among urban donors. The study points to the need for better screening and selection of donors and recommends additional research in underdeveloped areas..

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Contents

Introduction

According to Kebede et al. (2020), blood transfusions are an integral part of modern medical practice, providing life-saving support in a wide range of clinical settings, from trauma care and surgery to obstetric emergencies and hematological conditions. However, careful screening of donated blood to prevent the transmission of infectious diseases is essential to the safety of blood transfusions. Among the most serious transfusion-transmissible illnesses threatening public health around the world, but particularly in low- and middle-income countries, are transfusion-transmissible illnesses like Human Immunodeficiency Virus (HIV), Hepatitis B Virus (HBV), Hepatitis C Virus (HCV),

malaria, and syphilis (Albshri et al., 2023). Ensuring the safety of blood transfusion services is a vital element of healthcare systems, and successful screening procedures should be in place to achieve the goal. Inadequate blood screening and transfusion procedures expose millions of people each year to this persistent risk to world health.

The WHO estimates that there are 118.5 million blood donations yearly across the world, but both high and low-income countries significantly vary with the percentage of blood safely screened (Ayele et al., 2023). While resource-poor environments often face barriers such as outdated infrastructure, limited availability of the latest diagnostic technology, and irregular application of screening techniques, almost complete screening of blood donations is observed in developed countries for TTIs (Peliganga et al., 2021). TTIs are far more common among blood donors in underdeveloped countries like Pakistan than in developed ones and pose a scary threat to patients and healthcare systems (Siraj et al., 2018). Okoroiwu et al. (2018) assert that this high rate is due to several factors including ignorance among donors, unregulated procedures of donating blood, and under-applications of the national regulation on blood safety.

Blood donations are predominantly replacement and family-based with voluntary unpaid donations making only a very minuscule fraction (Barton et al., 2019). This dependency on substitute donors can threaten the safety and purity of the donated blood, mostly during emergency situations. It is highly probable that TTIs spread through family donors because such donors may not undergo proper screening procedures before donating their blood (Busch et al., 2019). This complicates the picture of transfusion safety as commercial and public blood facilities run side by side with differing screening procedures and standards of service. With an estimated 7-9% of the population infected with HBV and/or HCV, Pakistan has one of the highest rates of viral hepatitis in the world (Wolfe et al., 2019). The nation is also classified as an HIV-concentrated epidemic zone, mainly targeting high-risk populations like intravenous drug users and men who have sex with males, according to White et al. (2018). Syphilis and malaria are among the leading causes of TTIs, but they have a relatively lower prevalence due to poor management methods, according to Valerian et al. (2018).

Because different blood centers conduct screening tests differently, various epidemiological studies have documented different prevalence rates of TTI among blood donors (Obeagu et al., 2024). The systematic review and meta-analysis reported a seroprevalence of HBV, HCV, and HIV among the blood donors, which varied geographically across the nation at 2-7%, 3-8%, and 0.1-0.6%, respectively. This variation highlights the importance of regional-level data to calibrate screening tools and implement targeted interventions (Jary et al., 2019). Socioeconomic factors like income, educational level, and healthcare access have considerable impacts on TTIs and blood donation. It results in an overwhelming number of such infections within the low-income environs because people have inadequate knowledge of the ways in which TTIs spread as well as the procedures safe enough for donation (Ugwu et al., 2018). People are further demotivated from involving themselves in the voluntary donation process due to the stigma attached and myths associated with donating blood; the system, therefore, turns a large proportion of people towards replacement donors. A microcosm of these challenges is Jaranwala, which is growing rapidly (Dodd et al., 2020).

This region can be explored for differences in demographics of donors, screening protocols, and TTI occurrence because public and private blood centers coexist in this region. However, there is a lack of adequate information specific to this region that warrants in-depth study to guide evidence-based policy decisions. Even though diagnostic technology has improved, there are considerable disparities in the implementation of effective screening methods in Pakistan. Public blood centers often lack the resources required to implement advanced molecular or serological screening methods. Meanwhile, private blood centers may let profit motives override patient interests, thus compromising national as well as international standards set for such facilities. These differences indicate how desperately all blood centers need to implement standardized, legally enforceable policies. Despite the best efforts, there are still significant knowledge gaps regarding Pakistan's TTI burden.

Most studies have focused on national-level data or on specific geographic regions, often neglecting the subtle variations between public and private blood centers. Moreover, very few studies have been conducted on the association of socioeconomic factors with TTIs occurring among blood donors. To identify what needs to be improved, there is also a need for an all-around review of the effectiveness of the current screening processes. The objective of the Study This study aims to fill these gaps by evaluating the seroprevalence of TTIs among Jaranwala blood donors

and investigating the socioeconomic and demographic characteristics of the donor population. The study aims to assess the efficacy of current screening techniques and pinpoint areas for improvement and standardization by contrasting public and commercial blood facilities. The research also looks to assess the TTI seroprevalence of HIV, HBV, HCV, malaria, and syphilis among Jaranwala blood donors. We are assessing the relationship between the prevalence of TTI and demographic factors such as age, gender, and socioeconomic status.

Public and private blood banks are currently assessing the effectiveness of their screening techniques.

Methodology Study Design: The aim of this descriptive cross-sectional study was to determine the prevalence of transfusion-transmitted infections (TTI) among healthy blood donors. Study Site: The study was conducted at Government College University in Faisalabad, Pakistan, in the Department of Microbiology.

Study Duration: After the research proposal was approved, the study was conducted over a six-month period, from October 2023 to March 2024.

Study Population: There were five hundred blood donors from both public and private blood transfusion facilities in Jaranwala, Punjab, Pakistan.

Inclusion Criteria: Age between 18 and 60 years, hemoglobin level > 12.5 g/dL, pulse rate between 50 and 100 beats per minute, weight ≥ 50 kg, normal blood pressure, and skin free of lesions at the venipuncture site were the criteria used to choose donors.

Exclusion Criteria: Donors with a recent history of blood-borne illnesses or those who did not fit the inclusion criteria were not accepted.

Sample Screening for Transfusion-Transmitted Infections: Blood samples were examined for human immunodeficiency virus (HIV), syphilis, malarial parasites, hepatitis B virus (HBsAg), and hepatitis C virus (anti-HCV antibodies). The Immunochromatographic Test (ICT) was used for initial screening, and the Enzyme-Linked Immunosorbent Assay (ELISA) was used to confirm positive results.

Laboratory Methods

HBsAg Detection: it was accomplished using the one-step quick ICT kits (Healgen Scientific LLC, China). Centrifugation was used to prepare serum samples for three minutes at 2000 RPM. Color bands appeared on both the test and control zones of the ICT strip, indicating positive results.

HCV Detection: Anti-HCV antibodies were found using ICT kits (Healgen Scientific LLC, China). Color lines that appeared on both the control and test sections were indicative of positive outcomes.

Malaria Detection: Plasmodium lactate dehydrogenase (pLDH) and histidine-rich protein-II (HRP-II) were found using ICT fast test kits. Color bands on the control, Pan, and Pf areas of the test equipment indicated the presence of particular Plasmodium species. Thick and thin blood smears were also made in order to identify Plasmodium under a microscope. Thin smears allowed for species-level identification, but thick smears offered greater sensitivity.

ICT for Syphilis Detection: The idea behind ICT for syphilis was to detect Treponema pallidum antibodies (IgG and IgM) in serum or plasma using a membrane-based qualitative immunoassay. Colored lines that appeared in the test zone showed positive findings. Non-hemolyzed samples were kept at 2–8°C for short-term usage or below -20°C for long-term storage, ensuring proper specimen management.

Specimen Gathering and Management: Two to three milliliters of blood were drawn and placed in tubes that contained anticoagulants such as citrate, heparin, or EDTA. Samples that were hemolyzed were not included in the study. Before testing, samples were allowed to come to room temperature after being kept between 2 and 8°C.

ELISA (Enzyme-Linked Immunosorbent Assay) Principle: Antigens, antibodies, and proteins or peptides were quantitatively estimated using ELISA. An enzyme-substrate reaction that generated a detectable signal was required for detection. The procedures involved applying the antigen to the wells, blocking them with substances to stop nonspecific binding, using certain antibodies to probe them, and measuring the signal.

HBsAg Identification Making use of ELISA: After adding 100 μL of serum samples to microwell plates coated with anti-HBsAg antibodies, the plates were incubated for two hours at 37°C. After five rounds of washing, a conjugated anti-HBsAg monoclonal antibody was added to the plates, and they were incubated for an hour. After that, enzyme-labeled antibodies were added, and the mixture was incubated for a further hour. After adding a substrate and incubating for five to twenty minutes, a stop solution was used to halt the reaction. A spectrophotometer was used to measure absorbance at 450 nm.

Statistical Analysis: Frequencies and percentages were calculated from the data. To assess the accuracy of screening tests, positive and negative predictive values were computed. Descriptive statistics were used to provide the results for additional analysis.

Results

Data from 491 donors was examined during a six-month research at a blood bank. At 93.5% (n=459) of the sample, male donors made up the majority, whilst female donors made up 6.4% (n=32). The biggest occupation category consisted of job holders (35%, n=172), followed by housewives (6.1%, n=30), farmers (29.5%, n=145), students (16.7%, n=82), and businesspeople (12.6%, n=62). With 246 donors (50.1%) from rural regions and 245 donors (49.9%) from urban areas, the distribution of donors was nearly equal. While 18.3% (n=90) and 16.3% (n=80) were second and third-time donors, respectively, the majority of donors (65.4%, n=321) were giving blood for the first time. In terms of marital status, the bulk of the sample (82.3%, n=404) consisted of married donors, whereas 17.7% (n=87) were single donors.

Table 1

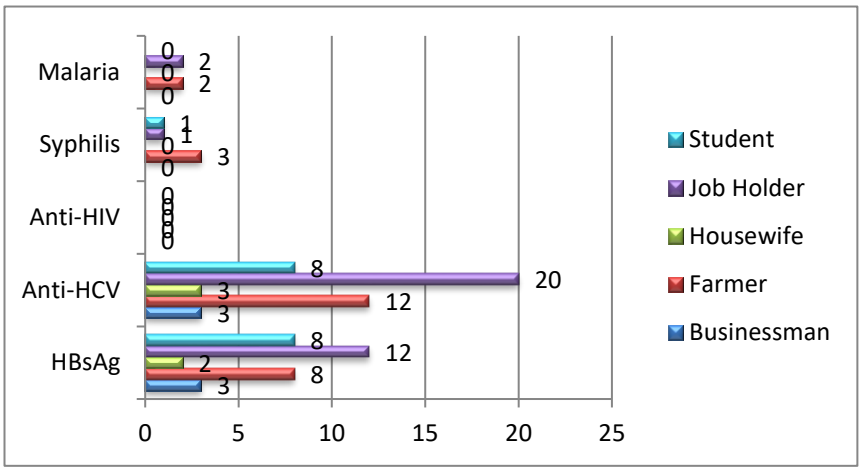
Frequency of Donors by Gender, Occupation, Residence, and Marital Status

Demographic Data	Frequency (n)	Percent (%)
Gender		
Female	32	6.4
Male	459	93.5
Occupation		
Businessman	62	12.6
Farmer	145	29.5
Housewife	30	6.1
Job Holder	172	35.0
Student	82	16.7
Residence		
Rural	246	50.1
Urban	245	49.9
Number of Donations		
First	321	65.4
Second	90	18.3
Third	80	16.3
Marital Status		
Married	404	82.3
Single	87	17.7

The most common transfusion-transmitted infection (TTI) among the 491 donors who were examined was hepatitis. Thirty-three donors tested positive for HBsAg, while forty-six donors had anti-HCV antibodies. Through VDRL screening, five syphilis cases were discovered, and four instances of Plasmodium malaria were discovered in donors who had fever symptoms. Interestingly, there were no documented AIDS cases in the research cohort. The majority of TTIs were seen in male donors because of their greater involvement. Only two of the female donors had positive HBsAg and three had positive anti-HCV antibody tests. Among female donors, no incidences of malaria or syphilis were documented. Farmers had the second-highest number of TTI cases, after job holders. Three farmers, one employee, and one student were found to have syphilis. Only farmers and workers were affected by malaria. Figure 1 shows detailed distributions by profession.

Figure 1

Occupation-Wise Distribution of TTIs



Rural donors (n=26) had a higher prevalence of hepatitis C than urban donors (n=20). Conversely, there were marginally more HBsAg instances among urban donors (n=17) compared to rural donors (n=16). Four incidences of syphilis were recorded among rural donors. The incidence of TTI was shown to be influenced by educational background. The greatest number of TTI instances were found among donors with lower educational attainment, especially those with fewer than ten years of education. Table 2 shows the specific distribution of TTIs according to educational attainment.

Table 2

Distribution of TTIs Based on Educational Status

Education Level	HBsAg	Anti-HCV	Anti-HIV	Syphilis	Malaria
Under 10 years	8	12	0	2	2
Matric	0	2	0	1	0
FA	5	7	0	1	0
BA	8	5	0	0	0
BS	7	4	0	0	0
Masters	5	10	0	1	1

With 25 testing positive for anti-HCV and 21 for HBsAg, first-time donors had the greatest frequency of TTIs. The proportion of second and third-time donors was relatively lower, which could be due to the advantages of routine screening. Table 3 provides the specifics.

Table 3

Number of Donations and TTIs

No. of Donations	HBsAg	Anti-HCV	Anti-HIV	Syphilis	Malaria
First	21	25	0	3	2
Second	9	11	0	1	1
Third	3	10	0	1	1

The frequency of TTIs was greater in married donors than in single donors. Of the 46 donors who tested positive for anti-HCV, 37 were married, while 24 of the 33 donors who tested positive for HBsAg were married. All four cases of malaria were married donors.

Discussion

The conclusion of this study indicates the frequency of TTIs among blood donors in Faisalabad, Pakistan, along with the most common disorder of HBsAg and anti-HCV antibodies. The TTI prevalence among blood

donors was found in this study to be in line with other research indicating that the rates of transmission were relatively high for hepatitis in places lacking sufficient access to screening and medical treatment (Ehsan et al., 2020). Past studies indicate that settings not having adequate donor screening protocols coupled with a lack of awareness amongst the masses about the possibility of infections through blood transfer are highly susceptible to TTIs (Haass et al., 2019). It finds that the TTIs more usually occur in male donors because, in most other literature, a gender gap within blood donation is established considering that males are more popular blood donors generally (Denner et al., 2019; Anyiam et al., 2023).

This trend may increase the chances of infections due to the higher number of male donors. Males are more likely to indulge in riskier behavior such as unprotected sex, thereby leading to a higher rate of prevalence of hepatitis and other infections. Behavioral and socioeconomic factors can explain the gender difference in infection rates (Chell et al., 2018; Hm et al., 2020). The study found the frequency and occurrences of TTIs, particularly syphilis and hepatitis C, among job holders. Because the jobs may be associated with increased rates of risky behaviors resulting in blood-borne diseases, lifestyle choices or exposure to risks might account for this.

For example, prevalence among the farmer population might be attributed to the increased exposure to diseases, such as sickness through vectors by farmers (Hm et al., 2020). In addition, the results show that hepatitis C was more prevalent among donors from rural areas than donors in urban areas. This aligns with earlier studies that documented the existence of geographical heterogeneity in the prevalence of TTI, which is largely attributed to differences in the availability of screening services, public health consciousness, and healthcare systems of both the rural and urban regions (Dodd et al., 2020). Limitations of the studies: This study is representative, as its sample size; still, being small and focused solely on a region, may be specific and hence not generalize throughout Pakistan donor populations. What is more, the cross-sectional nature of this research makes it inadequate to reveal some cause-effect linkages.

Although useful for rapid testing, the use of ICT for preliminary screening may not be as sensitive and specific as more advanced diagnostic methods such as PCR, which may lead to false positives or negatives.

Another disadvantage is the lack of comprehensive risk factor information, including sexual behavior, past transfusion history, or other medical issues, that may well explain the reasons behind the apparently high incidence of TTIs in certain groups of demographic. Additionally, the study could have underrated the entire scope of TTIs in the population since only donors of blood, screened within the transfusion sites, and others who could contribute via the other routes have been omitted. Future Suggestions: Subsequent studies can focus more on larger, multicenter prevalence studies involving a wider variety of geographical settings that incorporate both urban and rural environments to establish better profiling of TTIs among donors of blood. Through longitudinal research, it might be possible to better understand how the prevalence of TTI varies over time and if improvements in donor screening procedures affect the rate of infection. To give a more complete picture of the burden of disease in blood donor populations, greater study should be done on other risk variables that could possibly contribute to the transmission of TTIs, including socioeconomic status, sexual behavior, and medical history. In addition, better diagnostic methods, such as NAT for HIV and hepatitis, might improve the detection of infections, especially in cases of low-level viremia that conventional screening methods may miss.

Conclusion This study was conducted at Jaranwala, Punjab, Pakistan, where 491 donors were involved to measure the prevalence of TTIs. Among all the infections, Hepatitis C, syphilis, malaria, and Hepatitis B were on the top. Hepatitis B was more prevalent among urban donors, but Hepatitis C was slightly more prevalent in rural donors. The present study is not a big one, but results still indicate that frequent testing could diminish the TTIs frequency.

The result stresses that there is a requirement for better screening methods and heightened stricter donor selection in order to reduce the risk of TTI transmission.

Further study in Pakistan's less developed areas is essential to further comprehend the entire impact of TTIs.

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