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Original Research Article

Assessment of Transfusion Transmitted Infections Among Blood Donors from Peshawar: A Cross-Sectional Study

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Abstract: *Blood transfusion is life-saving yet carries the risk of transfusion-transmitted infections (TTIs)—notably hepatitis B (HBV), hepatitis C (HCV), HIV infection, syphilis, and malaria—risks that are disproportionately higher in many low- and middle-income settings. Robust local surveillance among blood donors is crucial for informing screening policies and donor recruitment strategies.* ***Objective:*** *To estimate the prevalence and pattern of TTIs among blood donors at the Regional Blood Centre (RBC), Peshawar, and to describe donor characteristics, ABO distribution, and co-infections.* ***Methods:*** *This cross-sectional study was conducted at the RBC in Peshawar, Pakistan, from January 1 to June 30, 2023. A total of 1,700 consecutive, apparently healthy blood donors were included in the study. Donor demographics (age, sex), donor type (regular vs replacement), haemoglobin (Hb), ABO blood group, and TTI screening results were extracted from routine records. All donations were screened for HBV, HCV, HIV, syphilis, and malaria according to the RBC's standard serologic screening algorithm; reactivity was defined according to the manufacturer's instructions. We summarised data using proportions with 95% confidence intervals (CIs). Group differences were explored with χ^2/Fisher's exact tests; two-sided $p<0.05$ was considered statistically significant.* ***Results:*** *Among 1,700 donors, 99.8% (1,697/1,700) were male and 0.2% (3/1,700) were female. Most donors were aged 18–26 years (46.5%, 790/1,700) or 27–35 years (40.7%, 691/1,700); the remainder were 36 years or older (12.9%, 219/1,700). Replacement donors predominated (99.6%, 1,693/1,700) with only 0.4% (7/1,700) regular donors. The overall prevalence of any TTI was 4.9% (84/1,700; 95% CI, 3.9–6.0). By pathogen, prevalence was: HBV 2.6% (45/1,700; 95% CI, 1.9–3.4), HCV 1.0% (17/1,700; 95% CI, 0.5–1.5), syphilis 0.9% (15/1,700; 95% CI, 0.4–1.3), and HIV 0.4% (7/1,700; 95% CI, 0.1–0.7). No donor screened positive for malaria (0/1,700; upper 95% CI ≈0.18%). One donor (0.06%) had dual reactivity for HBV and HCV. ABO distribution was A 28.9% (491/1,700), B 32.8% (559/1,700), AB 10.5% (179/1,700), and O 27.7% (471/1,700); the distribution was significantly non-uniform (χ^2, $p<0.0001$). Hb concentrations were <13 g/dL in 0.06% (1/1,700), 13–14 g/dL in 1.7% (29/1,700), 15 g/dL in 60.5% (1,028/1,700), 16 g/dL in 30.9% (525/1,700), and 17 g/dL in 6.9% (117/1,700).* ***Conclusion:*** *TTIs were detected in approximately one in twenty donations, with HBV contributing the largest share. The near-exclusive reliance on replacement donors highlights a critical need to strengthen voluntary, non-remunerated donor recruitment, maintain rigorous and standardised screening with quality assurance, and provide post-donation counselling and linkage to care to reduce TTI risk further and enhance blood safety in this setting.*

Keywords: TTIs, Replacement blood donors, Hep B, Hep C, HIV, malaria, Blood groups

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Introduction

Blood transfusion is a lifesaving and important element of healthcare services. However, there is a potential risk of acquiring transfusion-transmitted infections (TTIs) (1). The World Health Organisation (WHO) states that access to safe blood is a fundamental right for everyone. Safe blood transfusion from donors to recipients is possible when essential requirements such as donor education, selection, and retention are strictly considered (4).

The common infectious agents transmitted from donor to recipient include Hepatitis B virus (HBV), Hepatitis C Virus (HCV), Human Immunodeficiency virus (HIV), West Nile virus, syphilis, and protozoal pathogens (2,3). In developed countries, the risk of TTI transmission in blood donation has markedly reduced (3). The increased prevalence of TTI and the risk of unscreened blood transfusion are more common in developing countries (6,7). A meeting held by the Global Health Sector Strategy (GHSS) called for the eradication of these viral diseases by 2030, targeting HBV vaccination, injection, and blood safety, as well as the prevention of vertical and horizontal transmission of Hep B and Hep C through various sources, and the identification of existing cases. The primary preventive measures include safe blood transfusion and screening of blood products (8).

In Pakistan, blood donors are mainly replacement donors, and an estimated 1.5 million blood units are donated annually. In most cases, donors typically give blood to blood relatives or close friends with the intention of helping in an emergency. However, due to poor blood screening, the donated blood may carry a high risk of transmitting transfusion-transmitted infections to the recipients (5).

Pakistan has the highest burden of hepatitis infections, and an estimated 150,000 new cases of HBV and 250,000 new cases of HCV have been reported (6,9). Like other developing countries, Pakistan relies heavily on paid and replacement donors. Studies have reported that the above category may carry a higher risk of TTIs in comparison to voluntary donors (10). The WHO has mandated that donated blood must be screened for transfusion-transmitted infections to prevent their transmission. In our population, there is a lack of accurate data on TTIs, primarily due to the unavailability of screening tests, inadequate understanding and surveillance systems, and limited access to healthcare facilities (4). This study aimed to investigate the prevalence of TTIs among individuals who donated blood at the Regional Blood Centre in Peshawar.

Methodology

This cross-sectional study was conducted among blood donors attending the Regional Blood Centre (RBC) in Peshawar, KPK, from January to June 2023. The RBC operates under the Health Department of KP and supplies screened blood and its products to various referral hospitals in Peshawar. It includes sections for donor management, processing, immunohematology, TTI screening, data management, and quality management. Informed consent was obtained from all the donors. The participants' demographic information, including age, gender, marital status, profession, and contact numbers, was recorded. A detailed questionnaire of health history was filled out by each donor, which included information on the individual's general health, past or current illness, chronic diseases, lifestyle, weight loss, history of drugs, previous blood donation and transfusion, dental history, risk behaviour and sexual history, and history of travel or immigration. After a detailed history was taken, short private interviews were conducted, and the participants' vitals and weight were also recorded. Furthermore, the donors were inspected for skin lesions or drug abuse marks at the site of venipuncture.

All donors aged 18-55 years who were physically fit and fulfilled the pre-established criteria were included in the current study. Those potential donors were excluded if they were anaemic (Haemoglobin <12.5 g/dl) or had thrombocytopenia, were underweight, had a history of malaria, asthma, jaundice, engaged in unsafe behaviour, were apparently unhealthy or malnourished, or had a previous history of HIV-I, HIV-II, HBV, HCV, or Syphilis.

Sample collection and processing:

Blood specimens were collected in EDTA and Gel tubes for CBC and TTI screening. The CBC was performed on an automated haematology analyser, Sysmex. HIV-I and HIV-II Ag/Abs, HBsAg, anti-HCV, and anti-TP were determined using the chemiluminescent micro-particle immunoassay (CMIA) method on the Architect i2000SR (Abbott Diagnostics, USA). The immunochromatographic test (ICT) techniques and thick blood film were used for screening of malaria. After screening, donors who fit the pre-established criteria were selected for donation. Proper aseptic condition was used for blood collection and stored as per guidelines.

Ethical permission was obtained from the Institutional Ethics Board of the Institute of Paramedical Sciences, Khyber Medical University. Informed consent was obtained from all the donors, and records were kept strictly confidential.

The SPSS software version 26 (IBM Inc. Was used. The data of various variables were expressed in percentages. Using chi-square, a p-value <0.05 was considered significant.

Results

Altogether, seventeen hundred (n=1700) healthy donors were screened for five TTIs at the Regional Blood Centre, Peshawar, from January to June 2023. The majority of the donors were males,99.8% (n=1697), replacement donors 99.6%(n=1694), and fell in the age group of 18-26 years:46.5%(n=790/1700), followed by 27-35 years: 40.6%(n=691/1700), as shown in Table 1. The distribution of ABO blood group in blood donors was as follows: Group A:28.9: 28.9% (n=491), Group B:32.8: 32.8% (n=559), Group O: 27.7% (n=471), and Group AB:10.6%(n=179); ($p < 0.0001$). The majority of the blood donors were Rh-positive (92%, n = 1565), whereas the remaining 8% (n = 135) were Rh-negative. The concentration of hemoglobin (Hb) among blood donors were <13g/dl: 0.06%(n=1),13-14g/dl: 1.7%(n=29),15g/dl: 60.47%(n=1028),16g/dl: 30.8%(n=525) and 17g/dl: 6.8%(n=117) respectively. Age-wise, the Hb levels of the majority of donors were 15g/dl and above, as shown in Table 1.

In total, 84 donors, representing 4.9% (n = 84/1700) of the sample, screened positive for at least one of the TTIs. There was only one case of co-infection (i.e., Hepatitis B and Hepatitis C) reported in the study. The distribution of TTIs was as follows: Hepatitis B virus, 2.6% (n=45/1700), followed by Hepatitis C virus, 1% (n=17/1700), Syphilis, 0.9% (n=15/1700), and Human Immunodeficiency virus, 0.4% (n=7/1700), whereas no positive cases were observed for malaria. All positive cases were reported among replacement donors; no cases were observed in voluntary donors. Furthermore, high percentages of positive cases were observed in the age groups 18-26 years (41.6%, n = 35/84) and 27-35 years (38%, n = 32/84), respectively.

Table 1: Age-wise distribution of donor types, HB concentrations, and TTIs among blood donors attended the Regional Blood Centre, Peshawar

Variables	**Age-wise distributions (years), %(n)**				
Hb concentrations	18-26	27-35	36-44	45-55	Total
<13 g/dl	0.0	0.1(1)	0.0	0.0	0.1(1)
13-14 g/dl	0.6(10)	0.9(16)	0.2(3)	0.0%	1.7(29)
15 g/dl	28.6(486)	24.6(418)	5.5(94)	1.7(30)	60.4(1028)
16 g/dl	15.1(257)	11.5(195)	3.4(57)	0.9(16)	30.9(525)
17 g/dl	2.2(37)	3.6(61)	0.8(15)	0.3(4)	6.9(117)
Transfusion Transmitted Infections %(n)					
	2.05(35)	1.8(31)	0.58(10)	0.85(8)	4.9 (84)
Donors distributions %(n)					
	46.5(790)	40.6(691)	9.9(169)	2.9(50)	100(1700)
Donors Blood groups %(n)					
Group A	28.8(491)				
Group B	32.8(559)				
Group O	27.8 (471)				
Group AB	10.6 (179)				
Rh Positive	92.1 (1565)				
Rh Positive	7.9 (135)				

Discussion

Millions of lives are saved by transfusion medicine every year. However, due to unsafe blood transfusion practices, the risk of blood-borne infections exists. The risk is comparatively higher in developing countries despite screening, which needs awareness, education, and improved technology to achieve a completely safe blood transfusion. It is estimated that there is 1% chance of transfusion-related issues, including TTIs, with every single unit of blood. Furthermore, the risk of TTIs positivity is more

common in high-risk behaviour donors such as commercial sex workers, homosexuals, drug addicts, and professional donors (11).

Our study reported that 4.9% (n=84/1700) of donors were screened positive for at least one of the screened TTIs, and 99.6% (n=1694) were replacement donors. The donors were either replacement or voluntary donors; there were no professional donors, which is in accordance with the previous study (4). Usually, the replacement donors are either blood relatives or close friends. Due to social constraints, replacement donors may conceal their medical history and lifestyle information, especially if they engage in high-risk activities. That might be one reason these donors have high seropositivity. Apart from this, several factors contribute to TTI from screened blood, including the sensitivity of the screening test, the timing of donation during window periods, the safety of the donor population, and strain mutation (11). Moreover, it was previously observed that most blood donors in Pakistan were donating blood for the first time, which may reflect the actual burden of these specific infections in the community (12). The above statement is somewhat weak, as most donors are young or middle-aged males, which further underestimates the actual prevalence. In our study, the female donors were only 0.18% (n=3/1700). It is pertinent to mention that the Pakistani population comprises more than 50% females, and genuine efforts are required to increase and encourage the number of female donors. The prevalence in our study is higher than the rates reported from other studies (3,13). This increased rate could be related to socioeconomic status, donor selection criteria, awareness, and lifestyle among the study population. Moreover, the data further suggest that donor selection criteria and blood screening procedures should be tightened to strengthen the safety of blood transfusion.

This study reported the prevalence of Syphilis (0.9%), whereas previously in Pakistan it was 2.1% and 0.89% respectively (4,14). Similar findings have been observed in Iran (15). It has been reported that 12.2% blood donors' deferrals are due to syphilis positivity (16).

There is a paucity of HIV surveillance data in Pakistan, and we observed 0.4% in our study. This observed percentage is comparatively higher than that reported in previous studies (4, 17-20). The incidence of HIV is steadily increasing in the donor population. The risk factors for the prevalence of HIV include the reuse of syringes for drug administration, blood transfusion, and heterosexual high-risk sexual behaviour, and poor screening in blood donations (21). Furthermore, the screening of HIV should be done using a combination of HIV antigen-antibody immunoassay, and confirmation should be carried out using advanced molecular tools.

The prevalence of the Hep B virus and Hep C virus was 2.6% and 1% respectively, in this study. Globally, an estimated 530 million individuals are infected with both HBV and HCV. Pakistan, as a developing country, bears a significant burden, and a consistent increase over time has been observed (22). Previously reported prevalence of HBV and HCV in Pakistan was 4.6% and 4.9%, which is comparatively higher than our findings (23). The present study also reported a co-infection rate of approximately 0.05%, observed in cases of HBV and HCV. The co-occurrence of Hepatitis B & C in blood donors suggests that these viruses are also likely to be prevalent in the general population. Pakistan had launched the Hepatitis control program and started extensive vaccination among children (22). However, this increase in Hepatitis infection may be due to behavioural risks such as drug abuse and sharing skin piercing objects, etc..

The current study showed that only 1.77% of the donors had an Hb concentration of 14g/dl or less, which is higher than the WHO cut-off of 13g/dl. Overall, the remaining donors fall in the range of 15g/dl or above. These concentrations are higher than those reported in a previous study in Libya, where 27.2% of the donors had a lower Hb concentration than the WHO cut-off (24). These variations in Hb concentrations may be due to haematological diseases, nutritional status, or Genetic makeup. Certain haematological diseases are more prevalent in the Mediterranean region, which may be one of the reasons for the low Hb levels among the Libyan donor population.

In our study, the ABO blood group distribution of the donors was as follows: Group A, 28.9%; Group B, 32.8%; Group O, 27.7%; Group AB, 10.6%; and RhD positive, 92%. Previously, similar findings regarding blood groups among donors have been reported (25). A case of 40-year-old asymptomatic male blood donor was unexpectedly found to be co-infected with HIV, HBV, and Plasmodium falciparum during pre-donation screening (26). The distribution of blood group analysis may highlight the balance between demand and supply, with the direction to select donors with underrepresented blood groups.

This study has certain limitations, including a limited number of donors, a specific geographical area, and limited molecular data available for any of the evaluated pathogens. The accuracy of the data primarily depends on the blood bank's collected data, records, and screening processes. Despite the above limitations, the study highlighted risk factors and the proportion of the TTIs in a specific setting. Furthermore, large-scale multi-centre studies should be conducted to screen large populations and identify the cost-effectiveness of TTIs and associated factors.

In our study, the seropositivity rate was higher than previous reports from Pakistan, suggesting that transfusion-transmitted infections continue to be a risk for safe blood transfusion in Pakistan. HBV was the predominant TTI, followed by HCV, Syphilis, and HIV, whereas no single case was positive for malaria. This highlights the need for counselling and specialised treatment to prevent the potential transmission of these infections to their families and society.

Conclusion

TTIs were detected in approximately one in twenty donations, with HBV contributing the largest share. The near-exclusive reliance on replacement donors highlights a critical need to strengthen voluntary, non-remunerated donor recruitment, maintain rigorous and standardised screening with quality assurance, and provide post-donation counselling and linkage to care to reduce TTI risk further and enhance blood safety in this setting.

Declarations

Data Availability statement

All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department concerned. (IRBEC--24)

Consent for publication

Approved

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Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

MU

Manuscript drafting, Study Design,

AM

Review of Literature, Data entry, Data analysis, and drafting articles.

WA & M

Conception of Study, Development of Research Methodology Design,

IU & MU

Study Design, manuscript review, and critical input.

HI & SAAS

Manuscript drafting, Study Design,

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Conception of Study, Development of Research Methodology Design,

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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