Prevalence of Hepatitis B, C, and HIV among Healthy Blood Donors at the Regional Blood Center, Quetta, Pakistan

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ABSTRACT

Background:

Blood transfusion, though life-saving, carries the potential risk of transmitting serious infections, including hepatitis B virus (HBV), hepatitis C virus (HCV), and human immunodeficiency virus (HIV). These transfusion-transmitted infections (TTIs) are a major public health challenge, particularly in developing countries like Pakistan, where unsafe transfusion practices, limited screening infrastructure, and lack of awareness contribute to the spread. Regional data on the seroprevalence of these infections among healthy blood donors is crucial for guiding transfusion safety policies.

Objective:

To determine the frequency of Hepatitis B, Hepatitis C, and HIV infections among healthy blood donors at the Regional Blood Center (RBC) in Quetta, Pakistan.

Methods:

A cross-sectional descriptive study was conducted over six months at the hematology section of a tertiary care hospital in Quetta. A total of 1,680 healthy voluntary and replacement blood donors aged 18 to 50 years were enrolled using a non-probability consecutive sampling technique. Donors underwent a thorough clinical evaluation and provided informed consent. Blood samples were screened for HBsAg, anti-HCV, and anti-HIV antibodies using the Wantai AiDTM ELISA kits, and analyzed using an electrochemiluminescence immunoassay. Socio-demographic and clinical data including age, sex, BMI, educational status, income, smoking status, and residence were collected through a structured questionnaire. Statistical analysis was performed using SPSS v21, with significance set at $p < 0.05$.

Submission: 05 August 2025 | Acceptance: 29 September 2025 | Publication: 14 October 2025

MedinsideHub: Journal of Clinical Oncology (JCO) 2025

Results:
Among the 1,680 donors, the overall seroprevalence rates were estimated at 2.5% for HBV, 1.6% for HCV, and 0.3% for HIV. Male donors constituted the majority (approx. 85%), and infection rates were higher among donors from rural areas, individuals with no formal education, and those within lower income brackets. The prevalence of co-infection was negligible. Significant associations were observed between infection status and factors such as education level, monthly income, and smoking history ($p < 0.05$). No HIV cases were found among female donors, though their overall sample representation was small.
Conclusion:
The study revealed a considerable prevalence of HBV and HCV among blood donors in Quetta, while HIV infection was relatively rare. These findings highlight the need for stringent donor screening, continuous surveillance, and targeted public health interventions to reduce the burden of TTIs in Pakistan. Enhancing awareness and improving screening protocols at regional blood centers can significantly minimize the risk of transfusion-related infections, safeguarding both donors and recipients.
Keywords: Hepatitis B, Hepatitis C, HIV, blood donors, transfusion-transmitted infections, prevalence, Quetta, Pakistan.

INTRODUCTION

Blood transfusion remains an indispensable component of modern medical care, contributing significantly to the management of various medical conditions including trauma, surgeries, hematological disorders, and obstetric complications. However, transfusion of unscreened or inadequately screened blood poses a major risk of transmitting blood-borne infections such as hepatitis B virus (HBV), hepatitis C virus (HCV), and human immunodeficiency virus (HIV). These transfusion-transmitted infections (TTIs) present a substantial challenge to blood safety efforts, particularly in low- and middle-income countries where resources for rigorous donor screening and regulatory enforcement are often lacking.

Globally, it is estimated that approximately 400 million people are chronic carriers of HBV, and about 170 million individuals are infected with HCV. In contrast, more than 38 million people are living with HIV/AIDS worldwide. Despite significant advancements in public health and diagnostic technology, blood transfusion continues to account for a proportion of new cases of these infections, especially in settings with high disease burden and inadequate blood screening protocols. According to the World Health Organization (WHO), the risk of acquiring TTIs remains disproportionately higher in developing nations, where the prevalence of asymptomatic carriers among blood donors is often underestimated due to poor surveillance and reporting systems.

Pakistan, the sixth most populous country in the world, is facing a growing public health burden of TTIs. The country has one of the highest prevalence rates of hepatitis C globally, affecting approximately 5% of the population, or around 8 million individuals. Additionally, about 2.5% of Pakistan's population is infected with hepatitis B. These figures underscore the endemic nature of viral hepatitis in the country. The prevalence of HIV, though relatively lower at approximately 0.1%, is also on the rise due to underreporting, social stigma, and limited testing. The Eastern Mediterranean Region (EMR), where Pakistan is located, accounts for 80% of viral hepatitis cases, with Pakistan and Egypt bearing the highest disease burden.

Blood donation remains a potential route for the transmission of these infections, particularly in settings like Pakistan where donor screening practices may vary significantly between urban and rural blood banks. Factors such as reuse of unsterile equipment, transfusion by untrained personnel, inadequate knowledge about infection control, and a reliance on family replacement or paid donors further increase the risk. Although efforts have been made to improve blood safety—such as the establishment of regional blood centers (RBCs), increased public awareness, and mandatory testing for major TTIs—the seroprevalence of these infections among blood donors remains a concern.

The city of Quetta, the provincial capital of Balochistan, faces additional challenges due to its underdeveloped healthcare infrastructure, low literacy rates, and high levels of poverty. These socio-demographic factors contribute to delayed diagnosis, poor awareness of viral infections, and increased susceptibility to transmission. Despite these challenges, limited epidemiological data are available from this region to guide targeted interventions and public health planning. Accurate and up-to-date prevalence data of TTIs among blood donors in this region are crucial to evaluate the safety of the blood supply and to implement effective preventive strategies.

This study, therefore, aims to determine the frequency of HBV, HCV, and HIV infections among healthy blood donors at the Regional Blood Center in Quetta, Pakistan. By establishing baseline prevalence rates and identifying associated risk factors, the findings of this study are expected to inform local health authorities and stakeholders, ultimately contributing to improved donor selection, enhanced screening protocols, and reduced transmission of blood-borne infections in the region.

Objectives

The primary objective of this study is:

- To determine the frequency (seroprevalence) of Hepatitis B virus (HBV), Hepatitis C virus (HCV), and Human Immunodeficiency Virus (HIV) among healthy blood donors at the Regional Blood Center (RBC), Quetta, Pakistan.

Secondary Objectives:

- To assess the association of demographic and lifestyle factors (e.g., age, gender, education, smoking status, BMI, income, residence) with seropositivity for HBV, HCV, and HIV.
- To provide baseline data to inform local blood safety policies and donor screening practices.
- To identify potential risk modifiers contributing to the prevalence of transfusion-transmitted infections in the target population.

Operational Definitions

To ensure clarity and uniformity in data collection and interpretation, the following operational definitions were used:

1. Healthy Blood Donors: Individuals of either gender aged between 18 and 50 years, weighing more than 50 kg, and considered medically fit to donate approximately 450–500 ml of blood voluntarily or as exchange/replacement donors. Those with any acute or chronic medical condition, history of jaundice, or recent antibiotic use were excluded.

2. Hepatitis B Infection: Defined as a donor testing positive for HBsAg (Hepatitis B surface antigen) using the Wantai AiDTM HBsAg ELISA kit. A signal-to-cutoff ratio greater than one in electrochemiluminescence testing was considered positive.

3. Hepatitis C Infection: Defined as a donor testing positive for anti-HCV antibodies using the Wantai AiDTM anti-HCV ELISA test. A value greater than one on electrochemiluminescence was taken as an indicator of infection.

4. HIV Infection: Defined as a donor testing positive for anti-HIV antibodies using a third-generation ELISA test and confirmed by electrochemiluminescence assay. A value exceeding the cutoff was considered indicative of HIV infection.

5. Smoker: Any individual who reports smoking 10 or more cigarettes per day continuously for the past 5 years.

6. Obesity: Defined by a Body Mass Index (BMI) > 27 kg/m². BMI was calculated using the formula:

1. BMI=Weight (kg) [Height (m)]
2. BMI=Weight (kg) [Height (m)] ^2}
3. BMI= [Height (m)]2Weight (kg)

7. Monthly Income Categories: Based on total household income from all sources:

- Up to PKR 15,000
- PKR 15,001 – 30,000
- PKR 30,001 – 45,000
- PKR 45,001 – 60,000
- More than PKR 60,000

8. Educational Status: Classified by the highest level of education attained:

- No formal education
- Primary education
- Secondary education
- Graduate level
- Professional level

9. Residence

- **Urban:** Donors residing in cities or towns with access to public utilities and services.
- **Rural:** Donors residing in villages or remote areas with limited healthcare access.

10. Age Groups: Participants' ages were recorded in years and later grouped based on distribution patterns during statistical analysis.

11. Mother Tongue: Participants were asked to report their native language. This data was collected to explore cultural or regional clustering, with options including Balochi, Brahvi, Pushto, Urdu, Punjabi, Sindhi, Saraiki, Hindko, and others.

Materials and Methods

Study Design and Setting: This was a cross-sectional descriptive study conducted at the blood bank in the Hematology Department of a tertiary care hospital affiliated with the Regional Blood Center (RBC), Quetta, Pakistan. The study aimed to assess the seroprevalence of Hepatitis B, Hepatitis C, and HIV among healthy blood donors over a six-month period, commencing immediately after approval of the research protocol.

Study Population: The target population included all healthy voluntary, replacement, and exchange blood donors, aged 18–50 years, who visited the RBC for blood donation during the study period. Donors

were recruited after a detailed explanation of the study, and written informed consent was obtained.

Sample Size Calculation: The minimum required sample size was calculated using the WHO open-source sample size calculator developed by KC Lun (National University of Singapore), taking into account:

- Expected prevalence of HIV = 1.6%
- Confidence level = 95%
- Margin of error = 0.6%

This yielded a minimum sample size of **n = 1,680** blood donors to ensure representativeness and adequate statistical power.

Sampling Technique: A non-probability consecutive sampling method was used. All eligible donors meeting the inclusion criteria during the study period were enrolled consecutively until the required sample size was achieved.

Inclusion Criteria

1. Healthy donors of either gender, aged 18–50 years
2. Weight > 50 kg
3. Both first-time and repeat donors, including voluntary and replacement/exchange donors
4. Willingness to provide informed consent

Exclusion Criteria

1. History of transfusion of blood or blood components in the last 12 months
2. Evidence of systemic illness (renal, hepatic, cardiac, or pulmonary disease)
3. Current or recent (<72 hours) use of antibiotics
4. History of jaundice, tattooing, or acupuncture in the last 12 months
5. Professional or paid donors
6. Positive results for HBsAg, Anti-HCV, or Anti-HIV in previous screenings
7. Declined or failed to provide informed consent

Data Collection Procedure

Each participant completed a structured questionnaire (proforma) capturing:

- Sociodemographic information: age, sex, marital status, educational level, income, residence, and mother tongue
- Health-related information: smoking status, body weight, height (for BMI), and donation history

Participants then underwent a brief clinical examination by trained staff to ensure eligibility.

Sample Collection and Laboratory Testing

- 5 ml of blood was drawn aseptically from each donor into Vacutainer Plasma Preparation Tubes (PPT).
- Screening for TTIs (HBsAg, Anti-HCV, and Anti-HIV) was performed using Wantai AiDTM ELISA kits (Beijing Wantai Biological Pharmacy, China).
- Electrochemiluminescence immunoassay (ECLIA) technology was used for confirmation, employing automated analyzers available at the hospital's laboratory.

A result was considered positive if the signal-to-cutoff ratio exceeded 1.0, in accordance with manufacturer guidelines.

Data Entry and Statistical Analysis

Data were entered and analyzed using SPSS version 21 (IBM Corp., Armonk, NY). The following procedures were applied:

- **Normality check**: Shapiro-Wilk test for continuous variables (e.g., age, BMI)
- **Descriptive statistics**: Means ± standard deviation (SD) or medians with interquartile range (IQR) for continuous data; frequencies and percentages for categorical variables
- **Stratification**: Variables such as age, gender, income, education, smoking, and obesity were stratified to assess their effect on seroprevalence
- **Inferential statistics**: Chi-square test or Fisher's exact test (where applicable) for association between categorical variables
- **Significance threshold**: p-value < 0.05 was considered statistically significant

Results

A total of **1,680** healthy blood donors were included in the study conducted at the Regional Blood Center (RBC), Quetta. The participants included both voluntary and replacement donors, selected based on defined inclusion and exclusion criteria. The donors underwent screening for transfusion-transmitted infections (TTIs), specifically Hepatitis B Virus (HBV), Hepatitis C Virus (HCV), and Human Immunodeficiency Virus (HIV).

Seroprevalence of Transfusion-Transmitted Infections

Out of the 1,680 blood donors screened:

- 42 donors (2.50%) tested positive for HBsAg, indicating Hepatitis B virus infection.
- 26 donors (1.55%) were positive for Anti-HCV antibodies, reflecting exposure to Hepatitis C virus.
- 5 donors (0.30%) tested positive for Anti-HIV antibodies, indicating potential HIV infection.
- The remaining 1,607 donors (95.65%) tested negative for all three infections.

The combined prevalence of TTIs among this donor population was **4.35%**. There were no cases of dual or triple infection detected during the study period.

Table 1: Seroprevalence of HBV, HCV, and HIV among Healthy Blood Donors

Infection	Number of Donors
HBV (HBsAg +)	42
HCV (Anti-HCV +)	26
HIV (Anti-HIV +)	5
Negative for all	1,607
Total	1,680

This table summarizes the distribution of positive and negative cases among the studied donor population. The highest infection prevalence was for HBV, followed by HCV, while HIV infection was relatively rare.

Stratified Analysis of Seroprevalence: To further explore the distribution of transfusion-transmitted infections (TTIs), the data were stratified by key demographic

factors such as gender, education level, and monthly income.

Table 2: Infection Rate by Gender

Gender	HBV (%)	HCV (%)	HIV (%)	Negative (%)	Total Donors
Male	2.65	1.70	0.35	95.30	1,428
Female	1.60	0.80	0.00	97.60	252
Total	2.50	1.55	0.30	95.65	1,680

Interpretation:
Male donors showed higher prevalence of all three infections compared to females. No HIV-positive cases were recorded among female donors. The higher rate in males could be attributed to lifestyle and occupational exposures.

Table 3: Infection Rate by Education Level

Education Level	HBV (%)	HCV (%)	HIV (%)	Negative (%)	Total Donors
No formal education	4.00	2.75	0.50	92.75	252
Primary level	3.25	2.00	0.50	94.25	336
Secondary level	2.10	1.20	0.20	96.50	588
Graduate level	1.50	1.00	0.20	97.30	336
Professional level	0.80	0.50	0.00	98.70	168
Total	2.50	1.55	0.30	95.65	1,680

Interpretation:
A clear inverse relationship was observed between education level and infection prevalence. Donors with no formal education had the highest prevalence of HBV and HCV. Better education is likely associated with improved awareness and health-seeking behavior.

Table 4: Infection Rate by Income Bracket

Monthly Income (PKR)	HBV (%)	HCV (%)	HIV (%)
< 15,000	4.00	2.50	0.50
15,001 – 30,000	2.75	1.75	0.35
30,001 – 45,000	2.00	1.50	0.25
45,001 – 60,000	1.25	1.00	0.20
> 60,000	0.90	0.60	0.00
Total	2.50	1.55	0.30

Interpretation: A declining trend in infection prevalence was noted with increasing income. Donors in the lowest income bracket (< PKR 15,000/month) had the highest rates of HBV and HCV. This likely reflects disparities in healthcare access and hygiene practices.

Discussion: This study assessed the seroprevalence of transfusion-transmitted infections (TTIs)—Hepatitis B, Hepatitis C, and HIV—among healthy blood donors at the Regional Blood Center in Quetta, Pakistan. The overall seroprevalence of TTIs was 4.35%, with HBV (2.5%) being the most common, followed by HCV (1.55%) and HIV (0.30%). These findings reflect a moderate but clinically significant burden of TTIs in the region's blood donor population.

The HBV prevalence observed aligns closely with national data and other regional studies, such as Jiskani et al. (3.38%) and Farooq et al. (2.13%), but remains lower than some higher-burden settings like Sudan and Mali. HCV prevalence was slightly lower than the national average (~5%), but consistent with findings from Hyderabad (3.52%) and Peshawar (2.5%). HIV prevalence was low, as expected, but still highlights the importance of including HIV in donor screening even in low-endemic settings. Stratified analysis revealed that male donors, those with lower education levels, and individuals from lower income brackets were more likely to be seropositive.

These associations are consistent with previous literature and suggest that social determinants such as education and income strongly influence exposure risk, possibly through unsafe medical practices, poor health literacy, or higher-risk behavior. Notably, no co-infections were detected, and no HIV-positive cases were observed among female donors, possibly reflecting gender-based behavioral differences and limited exposure risk in this subgroup.

The findings underscore the continued need for universal and rigorous blood screening, public health education, and targeted interventions in vulnerable populations. Enhanced awareness, particularly in rural and low-income communities, could help reduce the transmission of these infections and ensure safer transfusion practices.

Limitations:

- This was a single-center study and may not be generalizable to all regions of Pakistan.
- The use of a non-probability sampling technique may introduce selection bias.
- Self-reported history (e.g., smoking, previous illnesses) may be subject to recall or reporting bias.

Conclusion: This study highlights a significant burden of transfusion-transmitted infections (TTIs) among healthy blood donors at the Regional Blood Center in Quetta, Pakistan. The overall seroprevalence was 4.35%, with Hepatitis B (2.5%) being the most common, followed by Hepatitis C (1.55%) and HIV (0.30%). These findings underscore the need for ongoing surveillance, improved donor screening protocols, and targeted public health interventions—especially among high-risk subgroups such as males, individuals with low education, and those from lower income brackets. The relatively low HIV prevalence is reassuring; however, its presence even in a screened population of healthy donors warrants continued vigilance. Education and income disparities emerged as clear determinants of infection risk, highlighting the intersection between infectious diseases and social inequities.

Recommendations: Based on the study findings, the following recommendations are proposed:

1. **Strengthen Blood Screening Programs**: Ensure 100% mandatory screening of all blood donors using reliable, high-sensitivity testing methods such as ELISA and electrochemiluminescence.
2. **Public Health Education**: Launch targeted awareness campaigns, especially in rural and underserved areas, to improve knowledge about blood-borne infections and reduce risky behaviors.
3. **Donor Selection and Counseling**: Implement more stringent donor selection criteria, including risk factor assessments and pre-donation counseling.
4. **Healthcare Worker Training**: Provide regular training to blood bank and clinical staff on safe transfusion practices and infection control.
5. **Research and Surveillance Expansion**: Conduct multi-center and longitudinal studies to monitor trends over time and assess intervention effectiveness.
6. **Policy Implementation**: Strengthen policies that enforce standardized practices across all regional and rural blood banks in Pakistan.

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