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Seroprevalence of Transfusion-Transmitted Infections among Voluntary and Replacement Blood Donors at the Peshawar Regional Blood Centre, Khyber Pakhtunkhwa, Pakistan

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Abstract

Introduction Blood transfusion is linked to several risks, most notably the transmission of transfusion-transmitted infections (TTIs), including hepatitis B virus (HBV), hepatitis C virus (HCV), human immunodeficiency virus (HIV), syphilis, and malaria. The risk posed by these blood-borne infectious agents is high in developing countries, including Pakistan. This fact stresses the need for regular surveillance of TTIs. Therefore, the present study was undertaken to assess the seroprevalence of TTIs at a regional blood center.

Material and Methods This was a retrospective 4-year descriptive study undertaken at the Regional Blood Centre in Peshawar, Khyber Pakhtunkhwa Province of Pakistan, on the blood donor data from June 2016 to May 2020. A total of 41,817 donors donated blood during the study period and were screened for HBV, HCV, HIV, syphilis, and malaria. To ensure donor privacy, donors were identified via codes and no personal information was available. The data were extracted from the ZAAVIA blood transfusion information system database.

Results The study included a total of 41,817 donors—41,493 (99.22%) males and 324 (0.78%) females. Of them, 22,343 (53.43%) were voluntary donors while 19,474 (46.57%) were replacement donors. An overall TTI prevalence rate of 4.61% was found. The TTI prevalence rate in voluntary donors was 3.90% while 5.42% in replacement donors. The overall prevalence of HBV, HCV, HIV, syphilis, and malaria was 1.95, 1.38, 0.23, 0.91, and 0.14%, respectively.

Keywords
- transfusion
- blood
- donors
- infection
- seroprevalence

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Conclusion The current study documented a high prevalence (1,929 out of 41,817, 4.61%) of TTIs, especially in replacement donors (1,057 out of 19,474, 5.42%), and low participation of female donors. The recommendations include the promotion of voluntary blood donors, enrolment of female blood donors, and screening of donated blood through highly sensitive screening assay (i.e., nucleic acid testing).

Introduction

The transfusion of blood has a key role in health-care services. According to the World Health Organization (WHO), 118.2 million blood donations are collected globally with 58% in low- and middle-income countries.[1] Even though blood donation can improve the quality of patients' lives, it remains one of the main sources of the transmission of infectious agents. Transfusion-transmitted infections (TTIs) are still a leading concern for the patients, physicians, and policymakers who wish to see a safe blood supply. The TTIs mainly include human immunodeficiency virus (HIV), hepatitis B virus (HBV), hepatitis C virus (HCV), *Treponema pallidum* (causative agent of syphilis), and malarial parasite.[2] The WHO recommends that all blood donations must be tested for these five infectious agents.

Transfusion of infected blood and blood components increases the likelihood of morbidity and mortality related to blood transfusion. This has very in-depth consequences, both for the patient and the families and their communities. The financial implications of TTIs include, but are not limited to, the need for medical care, increased levels of dependency, and the loss of useful workforce, placing great burdens on the already overstrained health and social services and on the national budget.[3]

There is a substantial need to supply safe blood and blood components, and this necessitates improved quality blood transfusion service and modulated infrastructure along with appropriately trained staff. The prevention of TTIs in low-income countries is a big challenge mainly due to the fact that resources needed are not always accessible even when policies, legislation, guidelines, and strategies are implemented. In Pakistan, although legislation[4] exists on the mandatory screening of TTIs but transmission of diseases still follows, mainly due to the failure of the screening assay to detect the infection in the window phase. Therefore, complete surveillance and subsequent control of TTIs among the blood donors is vital to guarantee blood safety, especially with the changing trend in the prevalence of TTIs in Pakistan in the last two decades.[5,6]

Pakistan is a developing country of 220 million inhabitants with a fragmented demand-driven transfusion system. The greater odds of contracting TTIs in the country is due to numerous challenges, such as rampant use of poor-quality screening kits,[7] suboptimal hemovigilance system,[8] a preponderance of replacement donors,[9] and the increased incidence of blood-borne hepatitis in the general public.[10]

The blood transfusion system in the country is in the process of reformation into centralized supply-driven blood transfusion services.[11] This included the establishment of a network of Regional Blood Centres across the country connected with existing hospital blood banks. In the province of Khyber Pakhtunkhwa, one center has been established in the capital city of Peshawar which began operations in May-June 2016. The Peshawar Regional Blood Center is located approximately 180 km west of the federal capital, Islamabad. It is an independent center within the compound of Hayatabad Medical Complex that is a tertiary care health facility. The functions of the Centre include mobilization, motivation, and retention of voluntary nonremunerated blood donors (VNRBD), screening for TTIs, processing, distribution to hospital blood banks, hemovigilance, quality assurance, research, and development.

In spite of the well-recognized significance of assessing the epidemiology of TTIs, available data on TTI's burden in Khyber Pakhtunkhwa is scanty. In Peshawar for example, there has been no published study on TTIs prevalence in blood donors during the last decade. The only available study is regarding the prevalence of HCV in blood donors, published in 2018[12] on a sample size of 1,400 but with no information on the study site. It is evident that during this period, the incidence of HBV, HCV, HIV, syphilis (sharing common modes of transmission with HIV) and malaria, are likely to have altered. Hence, it is prudent to measure the risk of TTIs linked with transfusions at regular intervals.

Therefore, the present study was conducted to provide an updated information on the epidemiology of TTIs among blood donors who attended the Regional Blood Centre in Peshawar. To the best of our knowledge, no previous study of TTI prevalence has been performed in the current study population during the same period.

Material and Methods

This was a retrospective 4-year descriptive study conducted at the Regional Blood Centre in Peshawar, Khyber Pakhtunkhwa Province, on the blood donor data from June 2016 to May 2020. The Centre serves a total population of approximately 4.26 million of Peshawar city, which is 12% of the provincial population. To supply blood to attached hospital blood banks, the Centre collects blood from VNRBD as well as from replacement donors. The Centre provides TTI-screened blood and blood components to eight referral

tertiary care hospitals in the city. The Centre is comprised of various sections namely donor management section, TTI screening section, immunohematology section, processing section, quality management/hemovigilance section, and data management/BTMIS section.

A total of 41,817 donors donated blood during the study period and were selected on the basis of standard predonation screening procedure, which particularized age (18–60 years), weight (>50 kg), hemoglobin (>12.5 g/dL), medical history, and physical examination. These donors belonged to either VNRBD category 53.43% (n = 22,343) or replacement donor category 46.57% (n = 19,474). The majority of the blood donations were collected through blood donation camps or from blood collection sites, 37,729 (90.22%), while the remaining were collected at the Regional Blood Centre, 4,088 (9.78%).

The screening tests were performed by following the current national guidelines[13] and the manufacturer's instructions. The TTI screening section used the electrochemiluminescence immunoassay (Roche Diagnostics, Basel, Switzerland) to screen for HBsAg, anti-HCV, HIV ½ Ag/Ab, and anti-TP. The screening for malarial parasite was performed by enzyme-linked immunosorbent assay (Bio-Rad Laboratories, California, United States).

To ensure donor privacy, donors were identified via the use of codes and no personal information was available. The process of de-linking donor identification was performed entirely by an IT expert from the Regional Blood Centre.

The data was extracted from the ZAAVIA blood transfusion information system (BTIS) database. The data expropriated from the database included number and type of donation, gender of donor, and TTI positivity status. Data retrieved from the ZAAVIA BTIS database was transferred to the Microsoft Excel spreadsheet. Afterward, the data were cleaned, recorded, and analyzed through Statistical Package for the Social Sciences (SPSS) version 23.0 (IBM Corp., Armonk, New York). The prevalence of HBsAg, anti-HCV, HIV ½ Ag/Ab, anti-TP (syphilis), and malarial parasite was stated as the number of seropositive specimens and expressed in percentages. The association between dependent and independent variables was evaluated by the Chi-square test. A p-value of less than 0.05 was considered statistically significant. The year-wise data were then compared with national and international studies.

Ethical approval was obtained from the Ethical Committee of the Regional Blood Centre. The study applied previously collected data and no study participants were included at any point. Informed consent was not sought as the study was performed on secondary data.

Results

The study included a total of 41,817 donors—41,493 (99.22%) males and 324 (0.78%) females. Of them, 22,343 (53.43%) were voluntary donors, while 19,474 (46.57%) were replacement donors. The most common age group of donors was found to be 18 to 29 years (45.6%) followed by age group of 30 to 39 years (28.5%), while the least age group was 50 to 59 years (8.6%) (►**Table 1**). Further, 28.3% of the blood donors belonged to type A blood group, 32.1% had type B, 28.2% had type O, while 11.1% had type AB. In addition to this, 91.8% of the donors were Rhesus positive, while 8.1% were Rhesus negative.

Out of 41,817 blood donations collected during the study period, 1,929 blood units screened positive for one of the TTIs, giving an overall prevalence rate of 4.61%. No co-infection was reported during the study period. Of all the TTIs, HBV formed majority of the infections 815/41,817 (1.95%), followed by HCV 579 (1.38%), while the least percentage was of malaria 59 (0.14%), HIV 96 (0.23%), and syphilis 380 (0.91%). There were no significant sex differences as the number of female donations was too low. The prevalence of HBV, HCV, HIV, syphilis, and malaria among replacement blood donors was 2.15% (n = 418), 1.67% (n = 325), 0.28% (n = 54), 0.10% (n = 220), and 0.20% (n = 40), respectively, whereas in voluntary blood donors it was 1.77% (n = 397), 1.13% (n = 254), 0.19% (n = 42), 0.71% (n = 160), and 0.08% (n = 19), respectively. The difference in the prevalence of TTIs among replacement and voluntary blood donors was significant ($p < 0.05$) (►**Table 2**).

The prevalence of TTIs was comparatively higher in 2018 to 2019 and 2019 to 2020 (4.74%), and lowest in 2016 to 2017 (2.22%). The most prevalent type of TTI throughout the 4-year study period was HBV. Over the 4-year period, the Chi-square test demonstrated a significant increase ($p < 0.00$) in TTI trends from 2016 to 2017 (2.22%) to 2019 to 2020 (4.74%). A high percentage of HBV was reported in the third (2.15%) and fourth years (2.0%), while the least was reported in 2016 to 2017 (1.45%). A high percentage of HCV was reported in 2019 to 2020 (1.47%) and 2018 to 2019 (1.40%), while the least was reported in 2016 to 2017 (0.28%). The percentage prevalence of syphilis was high in year four (1.10%) while it was lowest in year one (0.07%). Similarly, the prevalence of malaria was high in year two (0.56%) while it was not reported in year one (0%). There was statistically significant (p-value = 0.02) change in seropositivity from year 2016–2017 to 2019–2020 (►**Table 3**).

Table 1 Socio-demographic characteristics of blood donors from June 2016 to May 2020 at the Peshawar Regional Blood Centre, Khyber Pakhtunkhwa (n = 41,817)

Age group	Number of donations	Percentage (%)
18–29 y	19,065	45.6
30–39 y	11,909	28.5
40–49 y	7,254	17.3
50–59 y	3,589	8.6
Total	41,817	100.0
Sex		
Male	41,493	99.22
Female	324	0.78
Total	41,817	100.0
Types of donation		
VNRBD	22,343	53.43
Replacement	19,474	46.57
	41,817	100.0

Abbreviation: VNRBD, voluntary nonremunerated blood donor.

Table 2 Comparison of TTIs prevalence in voluntary and replacement blood donors from June 2016 to May 2020 at the Peshawar Regional Blood Centre, Khyber Pakhtunkhwa (n = 41,817)

Donation category	HBV	HCV	HIV	Syphilis	Malaria	Total
Voluntary	397 (1.77%)	254 (1.13%)	42 (0.19%)	160 (0.71%)	19 (0.08%)	872 (3.90%)
Replacement	418 (2.15%)	325 (1.67%)	54 (0.28%)	220 (0.10%)	40 (0.20%)	1,057 (5.42%)
Total	815 (1.95%)	579 (1.38%)	96 (0.23%)	380 (0.91%)	59 (0.14%)	$p < 0.05$

Abbreviations: HBV, hepatitis B virus; HCV, hepatitis C virus; HIV, human immunodeficiency virus.

Table 3 Year-wise infected cases of HBV, HCV, HIV, syphilis, and malaria from June 2016 to May 2020 at the Peshawar Regional Blood Centre, Khyber Pakhtunkhwa (n = 41,817)

Year	Total screened	HBV	HCV	HIV	Syphilis	Malaria	Total
2016–2017	1,442	21 (1.45%)	04 (0.28%)	06 (0.41%)	01 (0.07%)	0 (0%)	32 (2.22%)
2017–2018	9,128	150 (1.64%)	124 (1.35%)	24 (0.26%)	65 (0.71%)	52 (0.56%)	415 (4.54%)
2018–2019	12,611	272 (2.15%)	177 (1.40%)	35 (0.28%)	109 (0.86%)	05 (0.04%)	598 (4.74%)
2019–2020	18,636	372 (2.0%)	274 (1.47%)	31 (0.16%)	205 (1.10%)	02 (0.01%)	884 (4.74%)
							$p = 0.02$

Abbreviations: HBV, hepatitis B virus; HCV, hepatitis C virus; HIV, human immunodeficiency virus.

Discussion

Transfusion of blood and blood components is a life-saving intervention and supports countless patients globally. At the same time, however, transfusion of contaminated blood has a key role in the transmission of blood-borne infectious agents. In low-income countries, the prevalence of TTIs is relatively high and quite far from achieving a zero-risk level.[1] The likelihood of TTI transmission in the transfusion of every blood unit is estimated to be approximately 1%.[14] This estimation is a relatively high rate for transmission of blood–borne diseases because some of these infections are severe, life-endangering ones that are incurable or have a difficult treatment process. Thus, TTIs are an important challenge for blood transfusion services across the globe and require defined precautions. There is a direct connection between the economic situation of countries and TTI prevalence. Countries with higher incomes can more easily offer preventive and vaccination programs for the public than countries with lower incomes.[1,15] During the last two decades, vaccination for HBV has greatly reduced the rate of TTIs in different countries. Education is another vital factor that can considerably decrease the rate of TTIs among blood donors, mostly by decreasing risky behaviors.[16]

Pakistan is facing serious challenges in blood safety and availability. The high incidence of TTI, including HBV, HCV, HIV, syphilis, and malaria continue to be a major concern. Although epidemiological reports published in recent years indicate that significant progress has been made to achieve blood safety through an overall system reform[11] and implementation of hemovigilance practices,[8] the risk of acquiring TTIs still remains an issue in Pakistan. Therefore, to monitor the prevalence trends of a spectrum of TTIs in the donor population remains a valuable index to assess the effectiveness of existing intervention strategies. The present study impacts the curbing of infectious diseases that are transmitted by blood and blood components. These are frequently the source of impoverishment as a result of ruinous health expenditure and loss of earnings on account of serious illness. If the percentage of people living in poverty in the population is to be permanently reduced, integrated, and sustainable measures to lessen infectious diseases are necessary.

In the current study, we established that the overall collective prevalence of TTIs in donated blood was 4.61%. This finding compares favorably to an earlier study from Lahore, Pakistan which reported a percentage prevalence of 4.0%.[6] However, it is less than the results reported from previous local studies in the country. For example, earlier studies from Karachi, Islamabad, and Faisalabad reported a seroprevalence of 5.8,[17] 14.34,[18] and 6.55%,[19] respectively. In contrast, lower prevalence was reported in two earlier studies both undertaken in Islamabad (3.72%)[20] and (3.27%).[21]

When compared globally, studies from Nigeria (14.96%),[22] Albania (7.4%),[23] Ethiopia (11.5%),[24] and Sudan (20.1%)[25] reported a higher overall TTI prevalence rate comparatively. Whereas studies from Qatar (1.85%),[26] India (0.6%),[27] Eritrea (3.6%),[28] Saudi Arabia (0.80%),[29] and Iran (0.25%)[30] have reported a lower prevalence rate compared with our findings.

Another significant outcome of the present study was that the frequency of TTIs in replacement donors was comparatively higher (5.42 vs. 3.90% for voluntary blood donors). A similar finding has been reported by scientists working elsewhere.[23,24,27,31] Therefore, the replacement donors are

considered potentially at high risk of transmitting TTIs. This fact has been attributed to numerous predisposing factors, for example, the likelihood of providing false answers to a history questionnaire by family replacement donors, hence hiding information on matters that result in further inquiry so restraining the protection level of behavioral screening.[32]

Substantial differences related to seroprevalence and trends of specific TTIs was witnessed, e.g., the most common type of TTI in our study was hepatitis B whereas earlier studies had observed higher prevalence for hepatitis C. According to the present study, the overall frequency of hepatitis C was 1.38%. This was lower than results from earlier national studies which displayed 1.7,[6] 1.7,[17] 8.34,[18] 3.24,[19] and 2.62%.[33] The possible reason could be the high percentage of voluntary blood donors in our study. When compared with global studies, the prevalence was lower when compared with those reported from Egypt (4.3%),[34] Kenya (3.21%),[35] and Sudan (3.4%)[36] while it was higher when compared with studies from Iran (0.07%),[37] Ethiopia (0.6%),[15] Saudi Arabia (0.40%),[38] and India (0.06%).[27]

The overall prevalence of hepatitis B in our study was 1.95%. This was higher when compared with some local studies which displayed 0.9,[6] 1.84,[17] 1.29,[20] and 1.10%.[33] This finding may indicate the likelihood that the prevalence of HBV in the general healthy population is relatively high. Our findings were on the lower side when compared with studies from Sudan (11.7%),[25] and Tanzania (8.8%),[39] and slightly higher from Iran (0.13%),[37] Brazil (1.63%),[40] and Bangladesh (1.4%).[41]

The overall prevalence of HIV in the present study was 0.23%. This percentage is significantly higher when compared with previous local studies which have reported a prevalence of 0.04,[17] 0.16,[21] 0.02,[33] 0.07,[42] and 0.13%.[43] Two studies even reported a zero prevalence for HIV in blood donors.[6,18] Similarly, studies from Iran (0.002%),[37] Saudi Arabia (0.13%),[38] Bangladesh (0.03%),[41] Libya (0.014%)[44]and Egypt (0.00%)[45]reported a low prevalence of HIV comparatively. Our findings were on the lower side when compared with studies from Ethiopia (2.6%),[46] Cameroon (4.44%),[47] and South Africa (1.13%).[48]

The positivity of syphilis in our study was 0.91%. This finding compares favorably to earlier local studies 0.89[18] and 0.91%.[49] However, the finding was comparatively lower compared with other local studies which reported a rising prevalence trend for syphilis 1.1,[6] 2.1,[17] and 1.55%.[33] A national survey recently conducted by the national blood transfusion program, however, reported a low prevalence rate of 0.72%.[50] Studies from several African countries have observed a high prevalence, for instance, Burkina Faso (1.5%),[51] Nigeria, (3.1%),[22] and Angola (20.0%)[52] while data from developed countries indicate a low prevalence comparatively, Qatar (0.43),[26] Iran (0%),[37] United States of America (0.16%),[53] and Italy (0.031%).[54]

The malaria positivity in the present study was 0.14%. Earlier studies from Pakistan have reported a comparatively similar results of 0.1[6] and 0.10%.[33] A slightly lower prevalence was reported by Arshad et al 0.07%[17] from Karachi while a high prevalence (0.89%) was witnessed from Faisalabad.[19] The current lower prevalence finding validates the presumption that malaria poses less risk to blood safety in the Peshawar region by virtue of lesser frequency. Nevertheless, it has to be screened and proper medical history taken before the donation.

Conclusion

Although the current trends of TTIs are fluctuating from year to year, the high prevalence necessitates additional studies to detect the main risk factors and formulate intervention strategies. To limit the risk of TTIs recommendations include the promotion of voluntary blood donation, sensitization, and recruitment of more female donors, screening of donated blood through highly sensitive screening assay, and further research utilizing nucleic acid technology. The current data generated is expected to support the policymakers to prepare a plan of action and introduce the concept of good governance in blood establishments. As blood donors are considered to represent a healthy population, the prevalence of TTIs in donors is a clear indication of these infectious agents in our population.

Limitations

In the present study, blood donors' samples were screened through serological testing. However, the screened seronegative donations are still at risk for hepatitis B, hepatitis C, and HIV transmission and thus, need for a sensitive screening test arises to decrease this possible risk. The introduction of nucleic acid testing (NAT) in addition to serological screening reduces the risk of TTI transmission by narrowing the window period in early-stage infection. Consequently many developed countries have introduced NAT as a mandatory measure in the routine blood donor screening. Even in Pakistan, eight blood centers are using NAT technology for hepatitis B and C screening (though not a mandatory requirement) and has demonstrated greater efficacy when compared with serological testing only. However, it is pertinent to mention some of the major impediments in implementing routine NAT testing in Pakistan such as higher cost and dearth of technical expertise in majority of the blood centers.

Conflict of Interest

The authors declare no potential conflict of interest.

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