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The Prevalence of Transfusion Transmitted Infections among Blood Donors in Pakistan: A Retrospective Study

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ABSTRACT

Objectives: This study aimed to determine the prevalence of blood transfusion-transmitted infections (TTIs), among blood donors in Pakistan, specifically HIV, hepatitis B virus (HBV), hepatitis C virus (HCV), syphilis, and malaria. ***Methods***: Data records of all registered blood donors (n = 120 968) during 2008–2019, at a blood transfusion center in a tertiary care hospital were assessed. Frequency of the seropositive donors for HIV, HCV, HBV, syphilis, and malaria was analyzed. ***Results:*** The overall age range of the donors was 25–65 years. Nearly all were male (99.0%). HCV, syphilis, and malaria were more prevalent among those aged 26–35 years. Most donors (81.1%) were residents of Islamabad city. The infection with the highest prevalence among the screened blood donors was HCV (1.5%; 95% CI: 0.423–0.661) followed by syphilis (0.8%; 95% CI: 1.149–1.432). HCV and syphilis were most frequently observed in blood group B positive (B+) donors while HIV was more common in those who were O+. The frequency of co-infection of syphilis with HCV and HIV was 0.02% and 0.01%, respectively. ***Conclusions:*** Among male blood donors, the most prevalent TTI infection was HCV followed by HIV; the latter is on the rise. HCV and syphilis are the most frequent co-infections.

With 120 million units of blood being donated each year globally,[1] blood donors are indeed benefactors to humanity. However, poorly screened blood may carry a high potential risk of transmitting blood-borne infections to the recipients.[2] A high seroprevalence of transfusion transmitted infections (TTIs) in donated blood is the main blood safety issue.[3] The risk of low blood safety is higher in middle- and low-income countries due to higher prevalence of TTIs among the donors and lax screening.[4,5] HIV, hepatitis B virus (HBV), hepatitis C virus (HCV), *Treponema pallidum* (pathogen causing syphilis), and malaria are the major contributors of TTIs.

In 2016, the Global Health Sector Strategy (GHSS) on viral hepatitis called for the elimination of this disease by 2030 by achieving 90% reduction in new cases and 65% reduction in related mortality.[6] The core components of the GHSS strategy are blood and injection safety, HBV vaccination, prevention of vertical transmission of HBV from mothers to children, and horizontal transmission of HBV and HCV via various routes, in addition to identifying and treating existing cases. Effective primary prevention includes ensuring blood safety through screening of blood supplies.[7]

Pakistan and Egypt together account for 80% of the viral hepatitis cases in the Eastern Mediterranean Region (EMR). Pakistan has the second highest global burden of HCV infection, with 5% prevalence (about 8 million people).[8] Regarding HBV, 2.5% of the population is infected with it.[9] Each year, there are 150 000 new cases of HBV and 250 000 new cases of HCV in Pakistan.[10,11] HCV is a leading TTI in multi-transfused thalassemia major patients; the risk of HIV is rising.[12] High frequency of HCV infection (3.52%) has been reported in blood donors in Hyderabad.[13]

In Pakistan, as in many developing countries, there is a strong reliance on replacement donors and paid donors. Research suggests that this category of donors carry higher TTI risk than voluntary donors.[1] In addition, there is problem of lax screening

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practices at the stage of collection and transfusion.[14] More than 1.5 million units of blood is donated annually in Pakistan.[15] There is high demand of blood due to the prevalence of blood disorders such as thalassemia and hemophilia, in addition to the needs for hemodialysis, pregnancy, surgeries, and accident and emergency cases.

World Health Organization (WHO) mandates that all donated blood should be screened for HIV, HBV, HCV, and syphilis. For specific countries, the WHO mandate stipulates screening for local diseases as well. Thus, all donated blood in Pakistan must be screened for malaria. In this study, we aimed to determine the prevalence of the previously mentioned TTIs among people who donated blood at a tertiary care hospital in Islamabad.

METHODS

The data for this retrospective study pertained to the years 2008–2019. We assessed the electronic records of all the blood donors registered at blood transfusion center in a tertiary care hospital in Islamabad. The study was approved by the Institutional Review Board and Ethical Committee of Shifa Tameer-e-Millat University (Ref. No. 188-678-2019). Until 2014, blood donors were screened only for HIV and HCV at this facility, but from 2015 onwards HBV, syphilis, and malaria were also added. All blood donors having body weight of ≥ 50 kg were included in the study. Anemic donors (hemoglobin < 12.5 g/dL for females and < 13.5 g/dL for males) were excluded. Exclusion criteria of American Association for Blood banking was followed. Donor records with incomplete data were also excluded.

As per the institution's practice, former malaria patients were eligible to donate blood three months after completing their anti-malarial treatment. The records revealed that the blood donors were counseled by a staff nurse prior to donation. Each potential donor was required to fill a detailed health history questionnaire. This included demographic information (name, age, sex, marital status, profession, address, and contact numbers). Also included were donor status, current or previous medical illnesses, histories of immunization, dental extraction, surgeries, previous blood transfusions and donations, places traveled, the risk of TTI, previous TTI related results and notifications, and a basic medical assessment report. The blood donors at the tertiary care hospital in Islamabad are routinely screened using gold standard methods i.e., hepatitis B core antigen (HBcAg), HCV, HIV, by nucleic acid amplification technique (NAT) on cobas 6000 series, syphilis by enhanced chemiluminescence immunoassay (ECLIA) on cobas e 601, and anti-plasmodium parasite by immunochromatographic test (ICT).

The collected data was analyzed using SPSS version 21. Descriptive and analytical statistics were applied for qualitative variables like gender, blood group, infection type, etc. The frequency and percentages were calculated for each variable.

Table 1: Year-wise frequency of HIV and hepatitis C virus (HCV) infections in blood donors (N = 120 968).

Year	HIV		HCV		Total
	Negative n	Positive n (%)	Negative n	Positive n (%)	
2008	135	0 (0.0)	135	0 (0.0)	135
2009	5471	5 (0.1)	5370	106 (1.9)	5476
2010	7771	5 (0.1)	7613	163 (2.1)	7776
2011	8642	2 (0.02)	8511	133 (1.5)	8644
2012	9493	5 (0.1)	9332	166 (1.7)	9498
2013	11 523	5 (0.04)	11 337	191 (1.7)	11 528
2014	12 947	5 (0.04)	12 753	199 (1.5)	12 952
2015	14 696	11 (0.1)	14 473	234 (1.6)	14 707
2016	13 886	21 (0.2)	13 725	182 (1.3)	13 907
2017	12 778	24 (0.2)	12 658	144 (1.1)	12 802
2018	11 540	19 (0.2)	11 414	145 (1.3)	11 559
2019	11 961	23 (0.2)	11 821	163 (1.4)	11 984

Table 2: Year-wise frequency of Hepatitis B core antigen (HBcAg), syphilis, and malaria in blood donors.

Year	HBcAg		Syphilis		Malaria		Total
	Negative n	Positive n (%)	Negative n	Positive n (%)	Negative n	Positive n (%)	
2015	1508	0 (0.0)	1508	0 (0.0)	1508	0 (0.0)	1508
2016	13845	1 (0.01)	13711	135 (1.0)	13845	1(0.01)	13846
2017	12797	2 (0.02)	12691	108 (0.8)	12798	1(0.01)	12799
2018	11559	0 (0.0)	11453	106 (0.9)	11559	0 (0.0)	11559
2019	11983	0 (0.0)	11901	82 (0.7)	11983	0 (0.0)	11983

RESULTS

Between the years 2008 and 2019, N = 120968 potential donors were registered and screened at the blood transfusion center of this tertiary care hospital. Almost all were men (119808; 99.0%) while the women numbered 1160 (1.0%). Their ages ranged from 18 to 65 years. Nearly half (47.0%) were younger than 25 years and only 0.3% were older than 56. Most donors (81.1%) were residents of Islamabad city, followed by those from Punjab province (13.8%), Khyber Pakhtunkhwa (3.5%), Azad Kashmir (1.05%), and Gilgit Baltistan (0.1%).

The overall reactive and non-reactive donors with HIV and HCV during 2008–2019 are shown in Table 1. The frequency of HCV was much higher than HIV among the blood donors. The frequency of reactive cases of HIV was highest in 2017 (24; 0.2%), while those of HCV peaked at 234 (1.6%) in 2015. Table 2 shows the year-wise frequency of HBcAg, syphilis, and malaria infections. Table 3 shows that out of 120968 total tested donors, most prevalent infection was HCV (n = 1837, 1.5%; 95% CI: 0.423–0.661) followed by syphilis (n = 437, 0.8%; 95% CI: 1.149–1.432). Compared to HBcAg and malaria, a considerable proportion of donors tested positive for syphilis during 2016–2019 [Table 2]. However, the frequency of syphilis infections decreased over time.

The predominant blood groups of the donors were B+ (37649; 31.2%), O+ (34699; 28.8%), and A+ (27257; 22.5%). In females, HCV infection was most prevalent in the blood group O+; eight cases were of O+ out of 22 HCV positive cases [Table 4]. In males, HCV was the most prevalent TTI infection, followed by syphilis and HIV. HCV and syphilis were most frequently seen in blood group B+ donors while HIV was mostly detected in O+ males. There was no significant association between blood groups and TTIs. However, age of the donor was significantly associated with the frequency of HCV and syphilis.

Table 5 shows gender distribution in different TTIs infections. HIV was positive in 125 male donors and was not detected in females. Similarly, HBcAg and malaria were positive in only males. However, HCV and syphilis positivity was seen in both sexes. Table 6 reveals age-wise positive cases of HIV, HCV, HBcAg, syphilis, and malaria among blood donors. The highest number of HIV positive cases were observed in males < 25 years of age (59; 0.05%). HCV, syphilis, and malaria positive cases were more prevalent in age group 26–35 years. We also analyzed the trend of co-infection (risk of infection by more than one pathogen) among the blood donors. The frequency of co-infection of syphilis with HCV and HIV was 10 (0.02%) and

Table 3: Overall frequency of HIV, HCV, HBcAg, syphilis, and malaria among blood donors.

Variables	Donors screened n	Time span, years	Sero-positive n (%)	95% CI
HIV	120968	2008–2019	125 (0.1)	(0.191–0.283)
HCV	120968	2008–2019	1837 (1.5)	(0.423–0.661)
HBcAg	51695	2015–2019	3 (0.01)	(0.951–1.002)
Malaria	51695	2015–2019	2 (0.004)	–
Syphilis	51695	2015–2019	437 (0.8)	(1.149–1.432)

HCV: hepatitis C virus; HBcAg: Hepatitis B core antigen.

Table 4: The prevalence of transfusion transmitted infections compared with the donors' sex and blood group.

Gender	Blood Group	HIV (n = 120968)			HCV (n = 120968)			HBcAg (n = 51695)			Malaria (n = 51695)			Syphilis (n = 51695)		
		Negative	Positive	Total	Negative	Positive	Total	Negative	Positive	Total	Negative	Positive	Total	Negative	Positive	Total
Female	A-	35	0	35	34	1	35	10	0	10	10	0	10	10	0	10
	A+	237	0	237	232	5	237	80	0	80	80	0	80	80	0	80
	AB-	9	0	9	9	0	9	2	0	2	2	0	2	2	0	2
	AB+	81	0	81	80	1	81	27	0	27	27	0	27	27	0	27
	B-	40	0	40	39	1	40	10	0	10	10	0	10	9	1	10
	B+	366	0	366	360	6	366	114	0	114	114	0	114	114	0	114
	O-	45	0	45	45	0	45	23	0	23	23	0	23	23	0	23
	O+	387	0	387	379	8	387	121	0	121	121	0	121	120	1	121
	Total	1200	0	1200	1178	22	1200	387	0	387	387	0	387	385	2	387
Male	A-	2485	1	2486	2451	35	2486	1071	0	1071	1071	0	1071	1059	12	1071
	A+	27008	27	27035	26627	408	27035	11650	1	11651	11651	0	11651	11549	102	11651
	AB-	939	1	940	922	18	940	391	0	391	391	0	391	389	2	391
	AB+	10367	12	10379	10224	155	10379	4459	0	4459	4459	0	4,459	4414	45	4459
	B-	3468	9	3477	3422	55	3477	1408	1	1409	1409	0	1409	1397	12	1409
	B+	37353	30	37383	36822	561	37383	15973	1	15974	15974	0	15974	15841	133	15974
	O-	3653	3	3656	3591	65	3656	1548	0	1548	1548	0	1548	1531	17	1548
	O+	34371	41	34412	33895	517	34412	14805	0	14805	14803	2	14805	14693	112	14805
	Total	119644	124	119768	117954	1814	119768	51305	3	51308	51306	2	51,308	50873	435	51308

HCV: hepatitis C virus; HBcAg: Hepatitis B core antigen.

Table 5: Relationship of donors' sex with prevalence of transfusion transmitted infections.

Gender	HIV (n = 120968)			HCV (n = 120968)			HBcAg (n = 51695)			Malaria (n = 51695)			Syphilis (n = 51695)		
	Negative	Positive	Total	Negative	Positive	Total	Negative	Positive	Total	Negative	Positive	Total	Negative	Positive	Total
Female	1160	0	1160	1138	22	1160	377	0	377	377	0	377	375	2	377
Male	119683	125	119808	117993	1815	119808	51315	3	51318	51316	2	51318	50883	435	51318
Total	120843	125	120968	119131	1837	120968	51692	3	51695	51693	2	51695	51258	437	51695

HCV: hepatitis C virus; HBcAg: Hepatitis B core antigen.

Table 6: Age-wise positive case frequency of HIV, HCV, HBcAg, syphilis, and malaria among blood donors.

Age group, years	Seropositive, n (%)				
	HIV (n = 120 968)	HCV (n = 120 968)	HBcAg (n = 51 695)	Syphilis (n = 51 695)	Malaria (n = 51 695)
< 25	59 (0.04)	625 (0.5)	1 (0.002)	94 (0.2)	0 (0.0)
26-35	43 (0.03)	819 (0.7)	1 (0.002)	210 (0.4)	2 (0.004)
36-45	19 (0.01)	330 (0.3)	1 (0.002)	108 (0.2)	0 (0.0)
46-55	4 (0.003)	55 (0.04)	0 (0.0)	24 (0.04)	0 (0.0)
> 55	0 (0.0)	8 (0.01)	0 (0.0)	1 (0.002)	0 (0.0)

HCV: hepatitis C virus; HBcAg: Hepatitis B core antigen.

4 (0.01%), respectively; while co-infection of HIV with HCV was 1 (0.001%).

DISCUSSION

This retrospective study sought to determine the prevalence of blood TTI, among blood donors in Pakistan. Our subjects were those who donated blood during the period 2008–2019 at a prominent tertiary care hospital in Islamabad. Blood transfusion services (BTS) at this hospital collect > 15 000 blood units every year, which are screened for HCV, HBV, malaria, syphilis, and HIV. In the present study, we have analyzed the frequency of TTIs among the donors to contribute towards formulation of evidence-based policies for improving blood safety at national level.

We analyzed the data of 120 968 donors, who were tested for viral and parasitic pathogens and showed 2.0% positivity for at least one pathogen. Other studies have reported prevalence of TTI up to 5.44% which was much higher than that observed in our study.[6,16]

Almost half of the donors over the last ten years belonged to the age group < 25 years (56 820; 47%), followed by age groups 26–35 years (47 232; 39%). This is consistent with the studies conducted within and outside Pakistan.[2,15,17,18]

In this study, 99.0% of the blood donors were male. This result was comparable with several studies from the developing world where the proportion of male donors was significantly higher than females.[2,15,17,19,20] The comparatively lower percentage of female blood donors is sometimes attributed to several physiological factors in females like menstruation, lactation, and pregnancy.[2] The most common cause of deferral for blood donation in females was reported to be low hemoglobin levels.[21]

The major influx (81.1%) of donors were from Islamabad which was the local population around the tertiary care facility from where our data were collected. Islamabad is a prosperous urban area and the low percentage of TTIs observed in our study is perhaps due to the literacy rate and awareness about clean blood among the residents compared to other parts of the country. A prospective cohort study in Pakistan over two years from 2013 to 2015 revealed that 64.02% of blood donor population belonged to urban areas while 35.98% belonged to rural areas.[15]

Considering the year-wise frequency of TTIs in our study population, we did not find any consistently falling or rising trends in positivity over time. HIV positive cases in our study were highest in the year 2017 (24; 0.2%) while 2015 saw the most HCV positive cases (234; 1.6%). The prevalence of HCV cases in our study is comparable to that of another retrospective study conducted at Rehman Medical Institute, Peshawar.[16]

HCV was the most common TTI (1837; 1.5%) among our participants, followed by syphilis (437; 0.8%). Similar results were reported by Memon et al,[13] where HCV was the most frequent TTI among blood donors (3.52%) followed by syphilis (3.01%).

The frequency of HIV in our data was 0.1% which is comparable with 0.24% reported by Siddiqui et al,[17] and 0.26% by Chandekar et al.[19] Nevertheless, our data shows a rising trend in the frequency of HIV positive donors over the last ten years.

Only three (0.01%) donors tested positive for hepatitis B which is attributable to high rates of hepatitis B vaccinations.[22-24] This is in sharp contrast with the much higher prevalence of 2.3% reported by Batool et al,[16] and 1.30% by Chandekar et al.[19]

South Asia is a malaria-endemic region and Pakistan is no exception. Cases in the Punjab province spike during summer, especially post-

monsoon.[25] However, malaria was the least common TTI reported in this study (2 cases; 0.004%), which is consistent with previous studies in Pakistan and in India.[17,20] The low incidence of malaria in our data can be attributed to the fact that blood donors were not tested for malaria until the year 2015 at the transfusion center of this hospital. Furthermore, malaria has been reported to be more prevalent in rural and low socio-economic settings while most donors in our study were residents of the city of Islamabad.[25]

In terms of TTIs with respect to blood groups of our blood donors, the overall seroreactivity during 2015–2019 the highest in the blood group B+ (365; 0.7%), similar to that reported by Arif et al.[20] The seroreactivity for O+ and A+ blood groups was (336; 0.6%) and (268; 0.5%) respectively. HCV and syphilis were most prevalent in blood group B+, followed by O+ among whom there were also more malaria cases, which was consistent with a previously published study.[26] Our finding that HIV was most prevalent in blood group O+ was in contrast with Memon et al,[13] who reported higher HIV prevalence in individuals with blood group A+. There was no significant association of HbcAg with any blood group in our study as opposed to Memon et al,[13] who reported HbcAg to be more associated with O– blood group.

The near zero prevalence of HIV and HCV co-infection in our study (0.001%) parallels a previous Iranian finding of 0.01% prevalence of such co-infection among the general population.[27] These findings contrast with those of a Western China which found co-infection of HIV/syphilis at 18.9% and HIV/HCV at 5.7%.[28] The number of cases with co-infection of HIV and syphilis and HCV and syphilis were 4 and 10, respectively in our study. Others have reported HIV and hepatitis B as the most common co-infection followed by HIV and syphilis.[19]

This study have some limitations. Firstly, women formed only 1% of our participants. Thus, our data may not reflect the prevalence of TTIs among the female population of Islamabad and its neighboring provinces. Secondly, we have only acquired the data from a single tertiary care hospital situated in the national capital, which makes it less generalizable at national level. In order to map prevalence of TTIs at national level, similar studies are warranted in other urban and semi-urban collection and transfusion centers of the country.

CONCLUSION

The prevalence of TTIs among blood donors in the current study suggests that it continues to be a significant risk to blood safety in Pakistan. B+ is the blood group with the highest prevalence of TTIs. HCV is the most prevalent TTI infection, followed by HIV in males. HCV and syphilis are the most frequent co-infections reported in our study. Many donors were youth below the age of 35 years. This highlights the necessity of following-up all seropositive donors, particularly younger men, to give them specialist treatment and counseling to prevent potentially debilitating infections from being further transmitted to their families and the society.

The prevalence of TTIs reported from other parts of the country is higher than that observed in the current study. This may be because our subjects were mostly residents of a prosperous city. There is a need for strident advocacy supported by strict monitoring to ensure that international screening standards are maintained all stages, in all centers of blood collection, storage, and transfusion, whether big or small, rural, or urban, all across Pakistan.

Disclosure

The authors declare no conflicts of interest. No funding was received for this study.

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