Original article

Trends in Transfusion-Transmissible Infections Among Blood Donors at the National Blood Transfusion Service, Guyana

Francine Leitch [1], Letisha Pooran [1], Rajini Kurup [1*], Pedro Lewis [1], Cecil Boston [1]

[1] University of Guyana

*Corresponding author: Rajini Kurup, rajini.kurup@uog.edu.gy

Abstract

Aim: The most adverse effect of blood transfusion is the acquisition of transfusion-transmissible infections (TTIs), which poses a serious threat in developing countries. This study aims to identify the trends of transfusion-transmissible infections among blood donors.

Materials and Methods: This study was a laboratory-based retrospective study conducted using blood donors' records from January 2015 to December 2018, collected at the National Blood Transfusion Service, Guyana (NBTS). Analysis of data was performed using the Statistical Package for the Social Sciences (SPSS) version 22.0 software and the results were presented in tables and graphs. Chi-square and logistic regression were used to identify trends and influencing factors.

Results: A total of 39,308 blood donors were included in this study, of whom 2,418 (6.2%) donors tested positive to at least one pathogen. Among those donors, 4.4% were coinfected with at least one of the sixteen dual infection combinations. The overall seroprevalence of HIV, HTLV, syphilis, HBV, HCV, Chagas, microfilaria, and malaria was 0.8%, 0.8%, 0.6%, 1.5%, 1.3%, 1.2%, 0.0%, and 0.0%, respectively. Trends of transfusion-transmissible infections showed an overall increase from the lowest prevalence, 5.1%, in 2015 to 7% in 2016, followed by decreases in 2017 (6.8%) and 2018 (5.8%).

Conclusions: Even though 98.6% of the donor population are volunteers, this study has shown that a significant percentage of blood donors harbour transfusion-transmissible infections. Stringent screening and preventive measures are very important to ensure the safety of the transfusion recipient.

(Leitch F, Pooran L, Kurup R, Lewis P, Boston C. Trends in Transfusion-Transmissible Infections Among Blood Donors at the National Blood Transfusion Service, Guyana. SEEMEDJ 2022; 6(1); 92-104)

Received: Feb 14, 2022; revised version accepted: Mar 22, 2022; published: Apr 27, 2022

KEYWORDS: transfusion-transmissible infections, blood bank

Introduction

Globally, transfusion of human blood is an essential medical procedure. Although it can save lives, blood and/or its products are not 100 percent safe for transfusion. In some cases, there is about one percent (1%) chance of adverse immunological, physiological, and infectious complications in the recipients. Of all adverse effects of transfusion, transfusion-transmissible infections (TTI) are the most significant and represent a risk for blood safety in developing countries like Guyana. TTIs include human immunodeficiency virus (HIV), human T-cell lymphotropic virus (HTLV), hepatitis B virus (HBV), hepatitis C virus (HCV), malaria parasite (MP), microfilaria parasite (MFP), Trypanosoma cruzi (Chagas), and syphilis. As a result, the World Health Organization (WHO) recommends that all donated blood be tested for TTIs caused by these pathogens (1). In addition to serological screening, all campaigners for blood donation should be submitted to clinical screening, which consists of an interview with a trained professional, in order to establish the clinical history and life of the donor concerning exposure to risk factors for TTIs.

In Guyana and other countries around the world, voluntary donors and replacement donors represent the main source of blood for transfusion. For better patient safety, the World Health Organization (WHO) recommends that before blood is released for clinical use, it should be screened for evidence of any possible infection. Countries with stringent routine serological screening have achieved a very impressive reduction of TTI cases. However, the risks persist due to the limited virus detection techniques (2–4). The magnitude of the TTI problem varies from country to country; even within a country, the magnitude could vary between different regions depending on the load of transfusion-transmissible infections in that particular population. Blood transfusion, in general, is a very expensive process, both as the entire procedure and in case any infection. Any infected blood that might reach a patient could lead to morbidity and mortality risks. This could pose an economic burden on the recipients themselves, as well as their families (5). TTIs have a higher chance of reaching a wider population since some infections have a long asymptomatic period or some persons could act as the carrier. The costs that would be added to such transmission include an aggressive treatment plan and short or long-term dependency, further burdening the country's economy (6).

Viruses like HIV, HBV, and HCV can cause long-term carrier states, prolong viremia and infectivity, lead to chronic disorders with high rates of morbidity and mortality because of chronicity, liver cirrhosis, hepatoma, and other opportunistic infections (7–9). These viruses have a direct transmission route with blood products during transplantation, hemodialysis, intravenous drug use, tattooing as well as sexual intercourse (10). The chance of transmission of those viruses through transfusion of infected blood is higher than with other routes of transmission, mainly due to transmission of a high viral load per transfusion. Regardless of whether the viral load is low within the blood, the possibility of infection remains high (9). However, currently, transfusion has a relatively low contribution to the transmission of virus infections since the obligation of screening blood donations for viral infections before transfusion is of the highest priority (2).

Similarly, parasites are rare, but commonly recognized infectious microbes worldwide, and several protozoans are known to be transmitted through blood transfusion. Parasites such as Plasmodium spp. (P. falciparum, P. vivax, P. malariae, and P. ovale) and Trypanosoma cruzi are causative agents of malaria and Chagas disease, respectively (11). The prevalence of these infectious agents among blood donors varies from nation to nation, depending on the specific population from which the blood units are collected. In sub-Saharan Africa, 5–10% of HIV infections are caused by transfusion of infected blood and 12.5% of patients who receive such blood transfusions are at risk of developing post-transfusion hepatitis (12). The choice of blood donors with low TTI risk was followed by

effective laboratory screening of blood transfusion units (8, 13). Those activities were extremely effective; however, the transmission of diseases nevertheless rose due to the incapacity of laboratory testing to detect the donors with an infection during the window period, a lack of budget for all general laboratories for TTI testing and trained manpower, the presence of immunologically variant viruses, the presence of non-seroconverting silent carriers, laboratory testing errors and poor quality control of laboratory tests (14, 15).

Variations in donor screening strategies and the predominance of risk factors in society might explain the changes in prevalence rates of TTIs over time. It is, therefore, necessary to assess the prevalence of these TTIs among blood donors at regular intervals to estimate the current most prevalent risk factors and to evaluate the effectiveness of blood safety strategies employed in the blood banks (16). Evaluation of trends in the prevalence of TTIs among blood donors is not only essential for estimating the effectiveness of blood safety strategies (10, 13); it also provides information to policymakers for the purpose of improving strategies for minimizing the potential risk of acquiring such infections through blood transfusion (17).

As a result, to our knowledge, there are no comprehensive data to determine the trends of transfusion-transmissible infections among blood donors at the NBTS, Guyana. Therefore, the primary objective of this study was to determine the prevalence and trends of major TTIs among blood donors at the NBTS, Guyana.

Subjects and Methods

The study was carried out at Guyana's main blood bank, the National Blood Transfusion Service (NBTS) in Georgetown, Guyana, by extracting data from the NBTS database. NBTS is the only blood bank in Georgetown, the capital city of Guyana. All blood donors are screened for infectious diseases at the NBTS. The facility provides TTI-tested blood and blood products for many referral hospitals in the region. The center has several departments, sections, and subsections. It comprises the Donor Clinic, Laboratory (sub-sections: TTI, Immunohematology and Component Preparation), Quality Management and Data Management sections. This research used the retrospective descriptive study method, in which the donor data were collected from the period between January 2015 and December 2018.

Screening Methods

The donors' blood was screened for TTIs after donation. Blood samples were tested using two kits, based on the recommendation by WHO, using two different testing strategies involving enzyme-linked immunosorbent assay (ELISA) and/or simple or rapid assays for surveillance. Cortez Diagnostic Inc. RPR test was used for screening for syphilis. The positive RPR test was confirmed by a quantitative RPR test. The presence of malaria and microfilaria parasites was established using the peripheral blood smear test. The hepatitis B surface antigen (HBsAg) was detected using the Murex HBsAg Confirmatory Version 3.0 ELISA infectious disease; the kit had a sensitivity of 100% and specificity of 99.97%. Antibodies to HCV were detected using the Murex anti-HCV version 4.0 ELISA infectious disease, which had a sensitivity of 100% and specificity of 99.88%. Antibodies to HIV types 1 and 2 were screened using the Murex HIV Ag/Ab combination ELISA infectious disease. The kit had a sensitivity of 100% and a specificity of 99.78%. Antibodies to HTLV types 1 and 2 were screened using the Murex HTLV I/II ELISA infectious disease. The kit had a sensitivity of 100% and a specificity of 99.88%. Antibodies for Chagas were screened using the GrupoBios S.A. test ELISA Chagas III. The kit had a sensitivity of 100% and a specificity of 100%.

Ethical approval

The study was approved by the Institutional Review Board (IRB) of the Ministry of Public Health, Guyana. Permission was also obtained from the Director of the National Blood Transfusion Service.

Statistical analysis

All data were retrieved from the anonymized blood donor register, donor cards, and logbooks. Delphyn blood bank software was used by the principal researchers with the help of the blood bank staff. Donors' records containing specific sociodemographic information (age, sex, ethnicity, donor type, seropositivity for TTIs, blood type, and blood donor code), the number of donations and the serostatus of TTIs were transferred to an Excel Spreadsheet (Microsoft Inc.) and analyzed using SPSS (Statistical Package for the Social Sciences) software version 22.0.

Table 1: Demographic characteristics of blood donors (2015–2018), NBTS Guyana

CHARACTERISTIC		n (%)
SEX	Male	23766 (60.6)
	Female	15458 (39.4)
AGE (YEARS)	15–20	3652 (9.3)
	21–30	12776 (32.5)
	31–40	10191 (25.9)
	41–50	7728 (19.7)
	> 51	4958 (12.6)
DONOR TYPE	Voluntary – 1st time	12211 (31.1)
	Voluntary – Regular	26537 (67.5)
	Family Replacement –1st time	363 (0.9)
	Family Replacement – Regular	163 (0.4)
ETHNICITY	Afro-Guyanese	11346 (28.9)
	Indo-Guyanese	18407 (46.8)
	Mixed	8482 (21.6)
	Amerindian	615 (1.6)
	Caucasian	187 (0.5)
	Chinese	28 (0.1)
	Others	232 (0.6)
BLOOD GROUP (ABO + RHESUS)	A+	7943 (20.2)
	B+	9041 (23.0)
	O+	18133 (46.2)
	AB+	2106 (5.4)
	A-	387 (1.0)
	B-	424 (1.1)
	O-	1086 (2.8)
	AB-	119 (0.3)
LOCATION	Inhouse	16909 (43.0)
	G/Town Mobile Drive	14739 (37.5)
	Region 2	640 (1.6)
	Region 3	948 (2.4)
	Region 6	5047 (12.8)
	Region 9	16 (0.0)
	Region 10	1005 (2.6)

The seroprevalence of HIV, HTLV, HCV, HBsAg, Chagas, syphilis, malaria, and microfilaria was expressed in percentages for the entire study group and based on different sociodemographic characteristics (age, sex, ethnicity, region, donor blood type, and donor category) and frequency of donation. Descriptive statistics were performed, and the results were presented as percentages in tables and graphs. The chi-squared test for trend was applied to examine the variation in trends. Logistic regression was used to explore the association between dependent and independent variables. The associations are presented as odds ratios (OR), together with 95% confidence intervals (CI). P-values of less than 0.05 were considered statistically significant.

Results

Sociodemographic characteristics of blood donors

A total of 39,308 blood donors were screened at the National Blood Transfusion Service (NBTS) from January 2015 to December 2018, with 98.6% of those donors being volunteers (Table 1 and Table 2). Of the total, 43% of blood donors donated blood at the central blood bank location. Overall, a larger percentage (60.6%) of blood donors were male, while most (32.5%) of the study subjects were in the 21–30 age group. Of all donors, 46.2% of them had the O-positive blood type. Most of the donor population were Indo-Guyanese (46.8%) followed by Afro-Guyanese (28.9%) (Table 1).

Table 2. Total blood donors, volunteer vs replacement, in the years 2015–2018 at the National Blood Transfusion Service (NBTS), Guyana.

Type of donor	2015	2016	2017	2018	p-value
VF	3270 (31.6)	6401 (32.6)	2903 (29.7)	2839 (30.3)	0.00
VR	6910 (66.8)	12934 (65.9)	6751 (69.2)	6407 (68.3)	0.00
RF	101 (1.0)	224 (1.1)	69 (0.7)	81 (0.9)	0.003
RR	56 (0.5)	58 (0.3)	29 (0.3)	49 (0.5)	0.001
Total	10337	19617	9752	9376	

Voluntary first time – VF; Voluntary repeat – VR; Replacement first time – RF; Replacement repeat – RR

Seroprevalence of transfusion-transmissible infections (TTIs)

A total of 2,418 (6.2%) blood donors tested positive for at least one TTI agent. The positivity rates of HIV, HTLV, syphilis, HBV, HCV, Chagas, microfilaria, and malaria were 0.8%, 0.8%, 0.6%, 1.5%, 1.3%, 1.2%, 0.0%, and 0.0%, respectively. Overall, HBV was the most prevalent TTI (Figure 1). Among the 2,418 blood donors, 107 (4.4%) donors were coinfected. Sixteen dual infection combinations were observed, with Chagas and HCV being the most common (0.7%), followed by HBV–Chagas (0.5%), HTLV–HBV (0.5%), and HIV–HTLV (0.4%) (Figure 2).

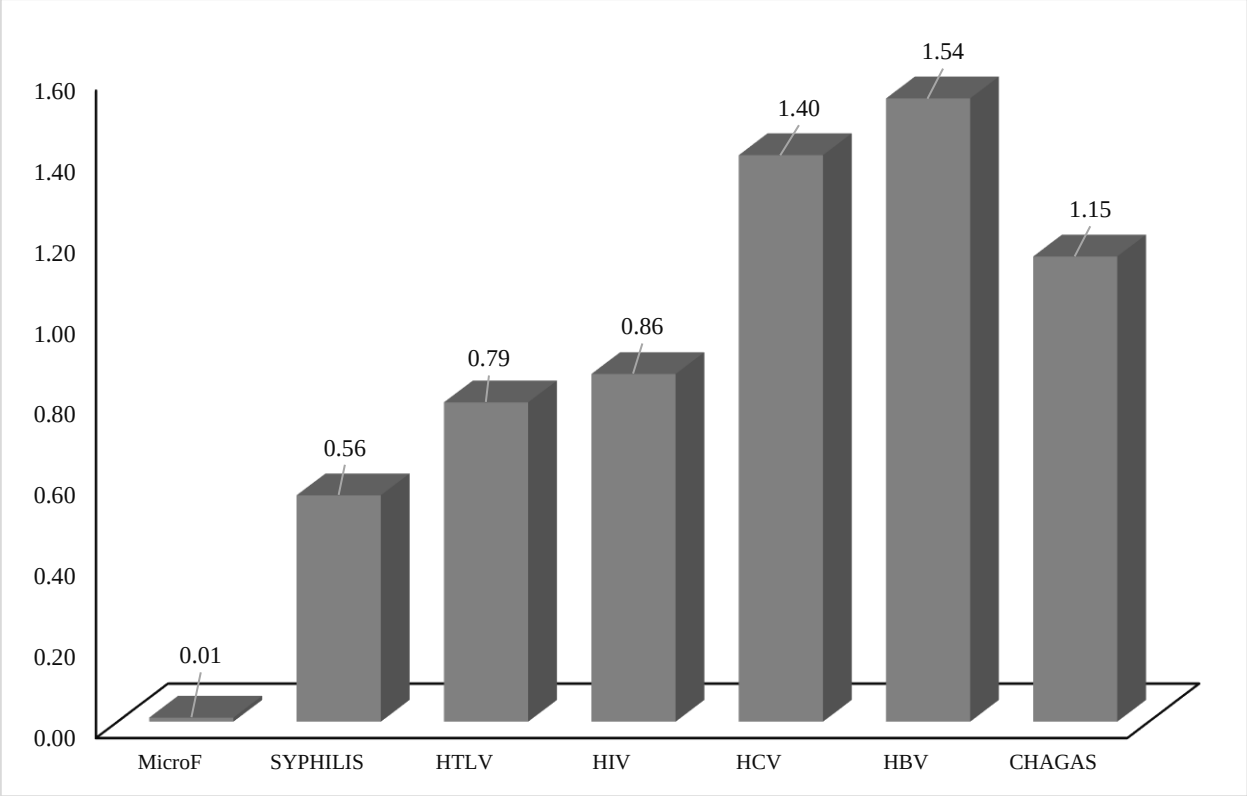

Figure 1. Prevalence of transfusion-transmissible infections in 2015–2018 at the National Blood Transfusion Service (NBTS), Guyana.
(MicroF: microfilaria; HTLV: human T-lymphotropic virus type 1; HIV: human immunodeficiency virus; HCV: hepatitis C virus; HBV: hepatitis B virus)

Trends and associated sociodemographic factors of blood donors regarding TTIs (2015–2018)

The overall trend of TTIs showed an increase from the lowest prevalence, 5.1%, in 2015 to 7% in 2016, followed by decreases in 2017 (6.8%) and 2018 (5.8%). HBV was the most prevalent TTI (1.5%), with a significant ($p \leq 0.05$) progressive increase from 2015 (1.3%) to 2017 (1.8%), followed by a subsequent decrease in 2018 (1.3%) (Table 3).

Overall, in regard to donor types, no TTI was significantly prevalent in both first-time and regular family replacement blood donors ($p \geq 0.05$). HTLV, syphilis, HBV, and microfilaria were significantly ($p \leq 0.05$) prevalent in both first-time and regular voluntary donors, while HIV was significantly ($p \leq 0.05$) prevalent in just first-time voluntary donors. Chagas was not significantly present in any of the blood donor types. HTLV (43.9%) and HBV (45.8%) were the significantly prevalent TTIs in Afro-Guyanese donors ($p \leq 0.05$), while Chagas (37.6%, $p \geq 0.05$) was statistically prevalent in Indo-Guyanese donors. TTI positive blood donors with O positive (O+) blood type had a statistically significant prevalence of syphilis (40.9%, $p \leq 0.05$). All TTIs except HIV, syphilis, and microfilaria showed significant prevalence in blood donors who donated mostly at the blood bank or via mobile blood drives (Table 3).

Table 3. Reactive Serological Marker, Type of Donor, Sex, Age Group at NBTS (2015–2018)

Characteristic n (%) Reactive Serological Marker	Total	2015	2016	2017	2018	*p* Value
HIV	307 (0.8)	75 (0.7)	116 (1.2)	66 (0.7)	50 (0.5)	0.00
HTLV	312 (0.8)	68 (0.7)	76 (0.8)	86 (0.9)	82 (0.9)	0.2
Syphilis	227 (0.6)	30 (0.3)	51 (0.5)	66 (0.7)	80 (0.9)	0.00
HBV	600 (1.5)	139 (1.3)	158 (1.6)	179 (1.8)	124 (1.3)	0.01
HCV	510 (1.3)	122 (1.2)	180 (1.8)	106 (1.1)	102 (1.1)	0.00
Chagas	458 (1.2)	89 (0.9)	108 (1.1)	159 (1.6)	102 (1.1)	0.00
Microfilaria	4 (0.0)	1 (0.0)	3 (0.0)	0	0	0.1
Malaria	0	0	0	0	0	
Sex						
Male	23766 (60.6)	6213 (60.1)	5749 (58.8)	5901 (60.6)	5903 (63.0)	
Female	15458 (39.4)	4121 (39.9)	4027 (41.2)	3842 (39.4)	3468 (37.0)	0.00
Age group						
15–20	3652 (9.3)	1098 (10.6)	982 (10.0)	839 (8.6)	733 (7.8)	
21–30	12776 (32.5)	3263 (31.5)	3407 (34.7)	3080 (31.6)	3026 (32.3)	
31–40	10191 (25.9)	2632 (25.4)	2384 (24.3)	2614 (26.8)	2561 (27.3)	
41–50	7728 (19.7)	2075 (20.0)	1879 (19.1)	1936 (19.8)	1838 (19.6)	
> 51	4958 (12.6)	1283 (12.4)	1164 (11.9)	1292 (13.2)	1219 (13.0)	0.00
Type of donor						
Voluntary – 1st time	12211 (31.1)	3270 (31.6)	3199 (32.6)	2903 (29.7)	2839 (30.3)	0.00
Voluntary – Regular	26537 (67.5)	6910 (66.8)	6468 (65.9)	6752 (69.2)	6407 (68.3)	0.00
Family Replacement – 1st time	363 (0.9)	101 (1.0)	112 (1.1)	69 (0.7)	81 (0.9)	0.01
Family Replacement – Regular	163 (0.4)	56 (0.5)	29 (0.3)	29 (0.3)	49 (0.5)	0.004

HTLV was significantly ($p \leq 0.05$) more prevalent among female donors (58%) compared to HBV, which was significantly ($p \leq 0.05$) more prevalent in males (65.7%). A significant prevalence of TTIs – HBV (35.7%), HCV (31.2%), and Chagas (37.8%) – was seen especially in the 21–30 age group, while HTLV (26.9%) was significantly observed in the > 51 age group ($p \leq 0.05$) compared to other age groups (Table 4). Overall, in regard to donor types, no TTI was significantly prevalent in both first-time and regular family replacement blood donors ($p \geq 0.05$). HTLV, syphilis, HBV, and microfilaria were significantly ($p \leq 0.05$) prevalent in both first-time and regular voluntary donors, while HIV was significantly ($p \leq 0.05$) prevalent in just first-time voluntary donors.

Chagas was not significantly present in any of the blood donor types. HTLV (43.9%) and HBV (45.8%) were the significantly prevalent TTIs in Afro-Guyanese donors ($p \leq 0.05$), while Chagas (37.6%, $p \geq 0.05$) was statistically prevalent in Indo-Guyanese donors. TTI positive blood donors with O positive (O+) blood type had a statistically significant prevalence of syphilis

(40.9%, p ≤ 0.05). All TTIs except HIV, syphilis, and microfilaria showed significant prevalence in blood donors who donated mostly at the blood bank or via mobile blood drives (Table 4).

Table 4. Blood donor characteristics and chi-square for transfusion-transmissible infections (TTIs), 2015–2018, NBTS, Guyana.

Characteristic	HIV (307)	HTLV (312)	Syphilis (227)	HBV (600)	HCV (510)	Chagas (458)	Microfilaria (4)
Sex							
Male	185 (60.3)	131 (42.0)	145 (64.2)	394 (65.7)	317 (62.2)	274 (60.0)	1 (25.0)
Female	122 (39.7)	181 (58.0)	81 (35.8)	206 (34.3)	193 (37.8)	183 (40.0)	3 (75.0)
χ^2	0.1	45.6	1.2	6.6	0.5	0.08	2.1
***p* Value**	0.9	0.00	0.3	0.01	0.5	0.80	0.1
Age (years)							
15–20	28 (9.1)	17 (5.4)	17 (7.5)	58 (9.7)	36 (7.1)	66 (14.4)	0
21–30	104 (33.9)	78 (25.0)	80 (35.4)	214 (35.7)	159 (31.2)	173 (37.8)	3 (75.0)
31–40	63 (20.5)	73 (23.4)	54 (23.9)	185 (30.8)	103 (20.2)	96 (21.0)	0
41–50	76 (24.8)	60 (19.2)	41 (18.1)	95 (15.8)	122 (23.9)	87 (19.0)	1 (25.0)
> 51	36 (11.7)	84 (26.9)	34 (15.0)	48 (8.0)	90 (17.6)	36 (7.9)	0
χ^2	7.9	62.3	3	22.4	24.7	29.8	4.2
***p* Value**	0.1	0.00	0.6	0.00	0.00	0.00	0.4
Donor Type							
Voluntary – 1st time	113 (36.8)	121 (38.8)	92 (40.5)	244 (40.7)	172 (33.7)	159 (34.7)	4 (100.0)
χ^2	4.6	8.7	9.5	26.2	1.7	2.9	8.9
***p* Value**	0.03	0.003	0.002	0.00	0.2	0.09	0.00
Voluntary – Regular	192 (62.5)	185 (59.3)	132 (58.1)	346 (57.7)	335 (65.7)	294 (64.2)	0
χ^2	3.5	9.7	9.1	26.9	0.8	2.3	8
***p* Value**	0.06	0.002	0.003	0.00	0.4	0.1	0.00
Family Replacement – 1st time	0	4 (1.3)	3 (1.3)	8 (1.3)	2 (0.4)	3 (0.7)	0
χ^2	4.1	0.4	0.4	1.1	1.6	0.4	0.04
***p* Value**	0.04	0.5	0.5	0.3	0.2	0.5	0.8
Family Replacement – Regular	0	2 (0.6)	0	1 (0.2)	2 (0.4)	1 (0.2)	0
χ^2	1.2	0.4	0.9	0.9	0.006	0.4	0.03
***p* Value**	0.3	0.5	0.3	0.3	0.9	0.5	0.8
Ethnicity							
Afro-Guyanese	89 (29.0)	137 (43.9)	81 (35.7)	275 (45.8)	142 (27.8)	153 (33.4)	2 (50.0)
Indo-Guyanese	142 (46.3)	77 (24.7)	105 (46.3)	196 (32.7)	253 (49.6)	172 (37.6)	1 (25.0)
Mixed	74 (24.1)	84 (26.9)	36 (15.9)	122 (20.3)	102 (20.0)	118 (25.8)	1 (25.0)
Amerindians	1 (0.3)	12 (3.8)	3 (1.3)	6 (1.0)	10 (2.0)	10 (2.2)	0
Caucasians	0	1 (0.3)	0	0	2 (0.4)	3 (0.7)	0

Others	1 (0.3)	1 (0.3)	2 (0.9)	0	1 (0.2)	2 (0.4)	0
χ^2	6.0	72.9	8.8	93.7	3.9	17.5	1.2
***p* Value**	0.40	0.00	0.2	0.00	0.7	0.01	0.9
Blood group							
A+	59 (19.2)	79 (25.4)	55 (24.4)	117 (19.6)	114 (22.4)	88 (19.2)	1 (25.0)
A-	2 (0.7)	1 (0.3)	3 (1.3)	3 (0.5)	5 (1.0)	4 (0.9)	0
B+	72 (23.5)	72 (23.2)	51 (22.7)	135 (22.6)	100 (19.6)	112 (24.5)	1 (25.0)
B-	7 (2.3)	1 (0.3)	0	4 (0.7)	6 (1.2)	3 (0.7)	0
O+	136 (44.3)	131 (42.1)	92 (40.9)	297 (49.7)	243 (47.6)	218 (47.6)	2 (50.0)
O-	15 (4.9)	9 (2.9)	7 (3.1)	15 (2.5)	8 (1.6)	12 (2.6)	0
AB+	15 (4.9)	15 (4.8)	12 (5.3)	26 (4.4)	32 (6.3)	19 (4.1)	0
AB-	1 (0.3)	3 (1.0)	5 (2.2)	0	2 (0.4)	2 (0.4)	0
χ^2	10.1	13.0	33.7	7.3	7.6	3.3	0.5
***p* Value**	0.2	0.07	0.00	0.40	0.40	0.90	1
Location							
Inhouse	118 (38.4)	96 (30.8)	100 (44.1)	198 (33.0)	207 (40.6)	142 (31.0)	1 (25.0)
G/Town	136 (44.3)	145 (46.5)	82 (36.1)	282 (47.0)	185 (36.3)	241 (52.6)	3 (75.0)
Mobile Drive							
Region 2	4 (1.3)	11 (3.5)	4 (1.8)	13 (2.2)	18 (3.5)	7 (1.5)	
Region 3	10 (3.3)	13 (4.2)	13 (5.7)	20 (3.3)	8 (1.6)	9 (2.0)	
Region 6	36 (11.7)	35 (11.2)	26 (11.5)	73 (12.2)	83 (16.3)	48 (10.5)	
Region 9	0	0	0	0	0	0	
Region 10	3 (1.0)	12 (3.8)	2 (0.9)	14 (2.3)	9 (1.8)	11 (2.4)	
χ^2	9.9	31.5	13.6	32.7	20.2	46.5	2.6
***p* Value**	0.2	0.00	0.06	0.00	0.005	0.00	0.9

Logistic regression analysis shows that male donors have a significant (OR = 0.57, CI: 0.45–0.71) chance of presenting with HTLV and HBV, with odds of 0.51 and 1.51, respectively, when compared to female donors. Additionally, blood donors in the 41–50 age group compared to those in the > 51 age group, with blood types O+, A-, and B-, compared to AB-, had significant ($p \leq 0.05$) risk of presenting with HTLV. Blood donors who donated in Region 2 were at a significantly higher risk of HTLV and HCV infection compared to those in Region 10. Furthermore, logistic regression analysis showed that the odds of blood donors presenting with syphilis significantly ($p \leq 0.05$) increased with age, while all age groups except 31–40 ($p \geq 0.05$) had a significant chance of presenting with Chagas.

Discussion

Over the observed four years, this study showed that 2,418 donors tested positive for at least one of the eight TTI markers that were screened. The study had similar findings as observed in the studies conducted in eastern Ethiopia by Teklemeriam et al (18) and by Birhaneselassi et al (19). Our findings included a higher percentage compared to similar studies conducted in the neighboring Brazil (20), in South India (21), in Andaman and Nicobar Islands (22), in South Gujarat, India (23), in Kano, Nigeria (8) and in South-South Nigeria (24).

The differences in prevalence among these studies may be due to the existence of different magnitudes of risk factors for contracting transfusion-transmissible infections,

discrepancies in the overall sample size, donor enrolment, the observed period, as well as factors associated with testing procedures used for screening, storage, and validation of test kits.

Of the eight TTIs that were studied, the most common was HBV, followed by HCV, Chagas, HIV, HTLV, syphilis, and malaria. The rate of TTI variation depends on improvement in analytical technology, which could improve the current screening reagents, not only to make them more specific, but also more reliable (25). Likewise, our study revealed that HBV was significantly more prevalent among males when compared to female donors; this might be due to the fact that sex is a genetic factor of disease consequence. Concerning HBV infection, when this virus infects an adult, most subjects will produce protective antibodies and fully fight off the infection. But in a few subjects (5%–10%), the virus will establish a chronic infection. Moreover, because of the slow plasma disappearance rate for HBsAg in males compared to females, males are more likely to develop chronic HBV infection. In addition to the above-mentioned reasons, behavioral risk factors such as having multiple sex partners could be the cause of the increase in prevalence of HBV among male donors (26).

HIV's seroprevalence in this study is lower compared to a previous study performed at the same blood bank during 2010–2011 (1.42%) (27) and the 2016 national estimated HIV prevalence (1.6%) (28). Many factors could be the cause of the differences in seroprevalence recorded in some developing nations, such as cultural and religious differences, differences in education level, and different socioeconomic structure (8, 24). Having multiple or concurrent sex partners, dependence on unskilled persons for childbirth, instruments used for female genital mutilation, cultural tattooing or markings on the body are some of the sociocultural and religious practices involved in the risk of transmission (29). A lot of effort needs to be put in to reduce such practices and to prevent the spread of infections. Introducing aggressive campaigns and counseling before and after blood transfusions might in some way help reduce transmission (2).

This study shows an increasing trend in blood donations testing positive for TTIs in the last four years. One of the reasons associated with the increasing trend of TTIs in donated blood during 2016 could be the increased number of first-time blood donors in that particular year, since studies have identified that first-time blood donors always tend to pose a greater risk of infectious donation than repeat donors. One assumption is that repeat donors are well-informed of the risky behaviors that might cause blood infections and as such reduce the probability of blood infections in the window period. Furthermore, if a donor tests negative prior to a donation, it is likely that most repeat donors will not suddenly engage in high-risk behaviors. Therefore, it is very important to ensure the safety of blood supply through careful recruitment of new donors and maintaining the donation pool (2).

This study had a few limitations. Many epidemiological data were not collected since this was a retrospective study. There could be much more information if it is collected with the aim of better establishing the risks of TTI infection. This study did not do any confirmatory tests nor were any molecular data evaluations done. Repeated positive tests were considered positive for the purposes of this study. As such, false positive cases cannot be completely excluded. Despite the limitations, this study highlighted the trends and associated sociodemographic factors of major TTIs.

Acknowledgement. We extend our gratitude to the technologists, technicians, and staff of the National Blood Transfusion Service (NBTS) for their assistance during this research work.

Disclosure

Funding. No specific funding was received for this study

Competing interests. None to declare.

References

1. WHO. Screening Donated Blood for Transfusion-Transmissible Infections: Recommendations. Geneva: Geneva: World Health Organization; 2009. WHO Guidelines Approved by the Guidelines Review Committee.; 2009. https://apps.who.int/iris/handle/10665/44202 [Accessed 16th August 2019]

2. Song Y, Bian Y, Petzold M, Ung COL. Prevalence and trend of major transfusion-transmissible infections among blood donors in Western China, 2005 through 2010. PLoS One. 2014; 9(4):e94528. doi: 10.1371/journal.pone.0094528.

3. Chiavetta JA, Escobar M, Newman A, He Y, Driezen P, Deeks S, Hone DE, O'Brien SF, Sher G. Incidence and estimated rates of residual risk for HIV, hepatitis C, hepatitis B and human T-cell lymphotropic viruses in blood donors in Canada, 1990-2000. CMAJ. 2003; 169(8):767-73.

4. Christensen PB, Groenbaek K, Krarup HB. Transfusion-acquired hepatitis C: the Danish lookback experience. The Danish HCV [hepatitis C virus] Lookback Group. Transfusion. 1999; 39(2):188–93. doi: 10.1046/j.1537-2995.1999.39299154734.x.

5. Bhaumik P, Debnath K. Prevalence of Blood-Borne Viral Infections among Blood Donors of Tripura. Euroasian J Hepatogastroenterology. 2014; 4(2):79–82. doi: 10.5005/jp-journals-10018-1106.

6. Buseri FI, Muhibi MA, Jeremiah ZA. Sero-epidemiology of transfusion-transmissible infectious diseases among blood donors in Osogbo, south-west Nigeria. Blood Transfus. 2009; 7(4):293–9. doi: 10.2450/2009.0071-08.

7. Al-Gani FA. Prevalence of HBV , HCV and HIV-1, 2 infections among blood donors in Prince Rashed Ben Al-Hassan Hospital in North Region of Jordan Fathi Abed Al-Gani. Int J Biol Med Res. 2011; 2(4): 912 - 916.

8. Nwankwo E, Momodu I, Umar I, Musa B, Adeleke S. Seroprevalence of major blood-borne infections among blood donors in Kano, Nigeria. Turkish J Med Sci. 2012; 42:337–41.

9. Nwokeukwu HI, Nwabuko CO, Chuku A, Ajuogu E, Dorathy OA. Prevalence of human immunodeficiency virus, hepatitis B virus, hepatitis C virus, and syphilis in blood donors in a tertiary health facility in south eastern Nigeria. Hematol Leuk. 2014;2(4). doi: 10.7243/2052-434X-2-4.

10. Kafi-abad SA, Rezvan H, Abolghasemi H, Talebian A. Prevalence and trends of human immunodeficiency virus, hepatitis B virus, and hepatitis C virus among blood donors in Iran, 2004 through 2007. Transfusion. 2009; 49(10):2214–20. doi: 10.1111/j.1537-2995.2009.02245.x

11. Bihl F, Castelli D, Marincola F, Dodd RY, Brander C. Transfusion-transmitted infections. J Transl Med. 2007; 5:25. doi: 10.1186/1479-5876-5-25.

12. Nagalo MB, Sanou M, Bisseye C, Kaboré MI, Nebie YK, Kienou K, et al. Seroprevalence of human immunodeficiency virus, hepatitis B and C viruses and syphilis among blood donors in Koudougou (Burkina Faso) in 2009. Blood Transfus. 2011; 9(4):419–24. doi: 10.2450/2011.0112-10.

13. Maresch C, Schluter PJ, Wilson AD, Sleigh A. Residual infectious disease risk in screened blood transfusion from a high-prevalence population: Santa Catarina, Brazil. Transfusion. 2008; 48(2):273–81. doi: 10.1111/j.1537-2995.2007.01521.x.

14. Fernandes H, D'souza PF, D'souza PM. Prevalence of transfusion transmitted infections in voluntary and replacement donors. Indian J Hematol Blood Transfus. 2010 Sep;26(3):89–91. doi: 10.1007/s12288-010-0044-0.

15. Jayaraman S, Chalabi Z, Perel P, Guerriero C, Roberts I. The risk of transfusion-transmitted infections in sub-Saharan Africa.

Transfusion. 2010; 50(2):433–42. doi: 10.1111/j.1537-2995.2009.002402.x.

16. Farshadpour F, Taherkhani R, Tajbakhsh S, Gholizadeh Tangestani M, Hajiani G, Sharifi N, Taherkhani S, Nejadbolkheyr A. Prevalence and Trends of Transfusion-Transmissible Viral Infections among Blood Donors in South of Iran: An Eleven-Year Retrospective Study. PLoS One. 2016;11(6):e0157615. doi: 10.1371/journal.pone.0157615.

17. WHO. Universal access to safe blood transfusion. World Health Organization; 2008. https://apps.who.int/iris/handle/10665/69747 (accessed 23.04.2022)

18. Teklemariam Z, Mitiku H, Weldegebreal F. Seroprevalence and trends of transfusion transmitted infections at Harar blood bank in Harari regional state, Eastern Ethiopia: eight years retrospective study. BMC Hematol. 2018; 18:24. doi: 10.1186/s12878-018-0115-2 19.

19. Birhaneselassie M. Prevalence of Transfusion-Transmissible Infections in Donors to an Ethiopian Blood Bank Between 2009 and 2013 and Donation Factors That Would Improve the Safety of the Blood Supply in Underdeveloped Countries. Lab Med. 2016; 47(2):134–9. doi: 10.1093/labmed/lmw003.

20. Pessoni LL, Aquino ÉC de, Alcântara KC de. Prevalence and trends in transfusion-transmissible infections among blood donors in Brazil from 2010 to 2016. Hematol Transfus Cell Ther. 2019;41(4):310–5. doi: 10.1016/j.htct.2019.03.009.

21. Suresh B, Sreedhar B. KV, Chandara M. Seroprevalence and Trends of Transfusion Transmissible Infections among Blood Donors at A Tertiary Care Referral Teaching Hospital in Southern India. National J Lab Med. 2015; 4(4):72-76. doi: NJLM/2015/15610:2082

22. Sehgal S, Shaiji PS, Brar RK. Seroprevalence and Trends of Transfusion Transmissible Infections in Blood Donors in Andaman and Nicobar Islands- An Institutional Retrospective Study. J Clin Diagn Res. 2017; 11(4):EC21–4. doi: 10.7860/JCDR/2017/25137.9649.

23. Dobariya GH, Raja KA, Unagar CA, Pandya AN, Patel JN, Jarag M, Wadhwani SJ. Prevalence and trends of transfusion transmitted infections among blood donors of blood bank attached to government hospital of South Gujarat, India. Int J Res Med Sci. 2016;4:4123–7. DOI: http://dx.doi.org/10.18203/2320-6012.ijrms20162946

24. Akpan IS, Onukak AE, Edet IV, Oyewumi AO. The burden of human immunodeficiency virus, hepatitis B and C virus infections in patients with sickle cell anemia in Uyo, Nigeria: A hospital based cross-sectional study. Int J Blood Transfus Immunohematol. 2021;11:100066Z02IA2021. doi:10.5348/100066Z02IA2021RA

25. Tigabu A, Engda T, Mekonnen F. Seroprevalence of transfusion transmissible viral infections (HIV, HBV and HCV) among voluntary blood donors at University of Gondar Comprehensive Specialized Hospital, Gondar; Northwest Ethiopia. BMC Infect Dis. 2019; 19(1):393. doi: 10.1186/s12879-019-3950-2.

26. Shiferaw E, Tadilo W, Melkie I, Shiferaw M. Sero-prevalence and trends of transfusion-transmissible infections among blood donors at Bahir Dar district blood bank, northwest Ethiopia: A four year retrospective study. PLoS One. 2019; 14(4):e0214755. doi: 10.1371/journal.pone.0214755.

27. Kurup R, Barclay C. A study on the prevalence of HIV among blood donors in Guyana. J Dis Glob Heal 2015; 3(1):39–43. Retrieved from https://www.ikprress.org/index.php/JODAGH/article/view/503

28. Center for Disease Control and Prevention (CDC). Global HIV and TB. 2016. Available from: https://www.cdc.gov/globalhivtb/where-we-work/guyana/guyana.html

29. Bharti KS, Lodha ND. Changing Trends of transfusion transmissible infections in blood donors in vidharbha region: a retrospective study of thirteen years. International Journal of Contemporary Medical Research 2018;5(9):I5-I9..

DOI:
http://dx.doi.org/10.21276/ijcmr.2018.5.9.23

Author contribution. Acquisition of data: FL, LP, RK, PL, CB
Administrative, technical or logistic support: FL, LP, RK, PL, CB
Analysis and interpretation of data: FL, LP, RK, PL, CB
Conception and design: FL, LP, RK, PL, CB
Critical revision of the article for important intellectual content: FL, LP, RK, PL, CB
Drafting of the article: FL, LP, RK, PL, CB
Final approval of the article: FL, LP, RK, PL, CB
Provision of study materials or patients: FL, LP, RK, PL, CBStatistical expertise: FL, LP, RK, PL, CB