Original Article

Risk Factors of Transfusion Transmissible Infections among Blood Donors at Karongi Regional Centre for Blood Transfusion in Rwanda

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Abstract

Background
Blood transfusion saves human lives, but also it can be a route for Transfusion-Transmissible Infections (TTIs) including Human Immuno-Deficiency Virus (HIV), Hepatitis B virus (HBV), Hepatitis C virus (HCV), and syphilis.

Objective
This study aimed to explore the risk factors associated with TTIs among blood donors at Regional Centre for Blood Transfusion (RCBT) of Karongi, Rwanda.

Methods
This was a retrospective cross-sectional study design conducted among 36,708 blood donors from 2015 to 2019. Data were extracted from the system known as eProgesaused and the outcome variable were TTIs including HBV, HCV and HIV (measured using Enzyme Immuno-Assay/Chemiluminescence Immunoassay) and syphilis (determined by Rapid Reagin Plasma). Descriptive statistics was computed to describe the characteristics of the blood donors. Bivariate and multivariable logistic regression were performed to assess the risk factors associated with TTIs. P value less than 0.05 was considered statistically significant.

Results
The study found that the overall prevalence of TTIs was 2.1%, while the prevalences of HBV, HCV, HIV, and syphilis were 1.3%, 0.4%, 0.06%, and 0.34%, respectively. Multivariable analysis showed that the factors associated with HBV, HCV, HIV and syphilis were being male, age more than 25 years, being married, living in urban areas, first time blood donors and blood donors living in Rusizi, Rusizi, Nyamasheke and Karongi districts.

Conclusion
This study revealed that the most frequent TTI was HBV among blood donors and the main risk groups were males, age group of 26-35 years, married and first time donors. Hence, while developing health policies to reduce the effects of HBV infection on safe blood transfusion, these study findings should be taken into account.

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Keywords: Blood transfusion, Transfusion-Transmissible Infections, Hepatitis, HIV, Syphilis. Risk factors, Rwanda

Introduction

Blood transfusion is one of the modern medical interventions used to save patients' life.[1] But, it is not risk-free because some blood-borne pathogens might be transmitted through blood to patients. [1] Human immunodeficiency virus (HIV), hepatitis B virus (HBV), hepatitis C virus (HCV), and syphilis are the common types of Transfusion-transmissible infections (TTIs),[2] which can threaten the life of patients and reduced the quality of blood.

The World Health Organization (WHO) suggested compulsory screening of all blood donors for HIV1, HIV2, HCV, HBV, and syphilis infections to prevent the risk associated with exposure to TTIs.[3] The combination of TTIs screening and the development of sensitive screening tests have contributed to the reduction of the occurrence of TTIs in in high income countries.[1] However, TTIs risk is still higher in the developing countries than in developed countries.[4] According to WHO report, the magnitude of HBV and HCV varies among blood donors from 0.004% in high income countries to 6.08% low income countries.[5] In Africa, 5 to 10% of HIV transmission is as a result of transfusing contaminated blood. [6] In sub-Saharan Africa, it was indicated in 2017 that 12.5% of blood recipients are more likely to acquire post-transfusion hepatitis.[7] Moreover, seroprevalence rates for HBV and HCV in African countries was the highest ranging from 10.0% to 14.96% and 1.5% to 8.69%, respectively.[8] The prevalence of HBV, HCV, HIV, and syphilis among blood donors in Cameroon was found to be 10.1%, 4.8%, 4.1%, and 5.7%,[9] while in Angola it was reported 8.5%, 3%, 2.1%, and 4.4%, respectively.[10]

Different studies indicated that TTIs is significantly associated with age, sex, occupation, number, and place of donation, and marital status.[11–15] A study carry out in Northwest Ethiopia indicated that some socio-demographic factors including gender, age, residence and occupation were significantly associated with HBV infection while donors employed by the government and unemployed were found to be associated with HCV infection.[4] However, HIV and syphilis infections among blood donors were found to be highly associated with the regularity of donations (donating blood on a regular basis) and informal occupations. [12–14] Besides, another study done in Eritrea showed that male donors were less likely to be seropositive to TTIs compared to female donors [15] and a study conducted in Kenya also showed that being married and a male were high-risk factors associated with TTIs.[10]

In Rwanda, efforts have been put in place to lower the risk of TTIs, through improved TTIs detection methods.[15] In addition, continuous monitoring and evaluation of trends in the prevalence of TTIs are crucial elements for the assessment of blood safety and the effectiveness of the blood safety strategies. Despite the known importance of monitoring and evaluation of TTIs, published information on TTIs magnitude and associated factors in Rwanda among blood donors is limited. In East African countries the overall prevalences of TTIs among blood donors were as follows: Tanzanian 10.1%,[16] Kenya 14.1%,[17] Ethiopia 11.5%,[18] and Eritrea 12.9%.[1]

However, in Rwanda including the Western province, studies on TTIs were only done among the general population which varied from 3% to 8%.[19–21] Given that infected blood poses a risk to life, this study examined the risk factors associated with TTIs in Karongi Regional Centre for Blood Transfusion that serves the Western province.

Methods

Study design and setting

The study was conducted in Karongi District of Rwanda. It analyzed secondary data which was cross-sectionally collected by the Regional Center for Blood Transfusion (RCBT) of Karongi among blood donors from 2015 to 2019.

RCBT of Karongi is one of the five Regional Centers composing the Blood Transfusion Division (BTD) in Rwanda. It is based in Karongi district, Western province of Rwanda but serves 5 districts in the Western province namely, Karongi, Nyamasheke, Rusizi, Rutsiro, and Ngororero districts.

Study population

The study population consisted of records of 36,708 people who donated blood at RCBT Karongi from January 2015 to December 2019. Blood donors with valid positive or negative results for HBV, HCV, HIV, and syphilis were included. Blood donors with results that are inconclusive for being either positive or negative (indeterminate results), for any of the four Transfusion Transmissible Infections (TTIs) were excluded from the study.

Data extraction and measurement

Each blood donor received in RCBT Karongi is registered using a donor file and then later entered in the online system known as eProgesa used to manage blood donor's database. Socio-demographic characteristics including age group, gender, district, residence, marital status, occupation, blood group and donor's regularity status (one-time donor and repeat donor) were extracted from the system. Results of TTIs as dependent variable including HBV, HCV, HIV, and syphilis were also collected from the eProgesa system. The dependent variable was the presence of either HBV, HCV, HIV, or syphilis. A person was considered as having TTI if she/he was tested positive to one of these four diseases. During blood donation the RCBT of Karongi measured HBV, HIV, HCV using Enzyme Immuno-Assay (EIA)/ Chemiluminescence Immunoassay which has a sensitivity of 100% and specificity of 99.7%, and for syphilis with Rapid Reagin Plasma (RPR) which has a 100% sensitivity. Confirmation of HIV was done by using the Western blot technique while HBV and syphilis were confirmed through HBsAg Neutralization Test and Treponema Pallidum Hemagglutination method (TPHA) respectively.[22]

Data analysis

Data were analysed using Stata 15.0 software (StataCorp. 2015. Stata Statistical Software: Release 15. College Station, TX, US: StataCorp LP). Descriptive statistics using frequencies and proportions were computed to describe the socio-demographic characteristics of study participants. The prevalence and trends of TTIs (HBV, HCV, HIV, or syphilis) were assessed in each year from 2015 to 2019. Bivariate analysis using crude odds ratio (COR) corresponding 95% confidence interval (CI) was computed to determine association between TTIs and socio-demographic characteristics. To establish the independent variables associated with TTIs, multivariable logistic regression analysis using adjusted odds ratio (AOR) and corresponding 95%CI was performed. All the significant variables during bivariate analysis were considered together in the multiple logistic regression. The significance level was set at p value less than 0.05.

Ethical considerations

The approval to conduct this study was obtained from RCBT Karongi with a reference letter (Ref: No. 025/RBC/BIOS/BTD/RCBT Karongi/20). Confidentiality was ensured by not using participants' identifiers such as names, and data were protected into password-coded computers.

Results

Socio-demographic characteristics of participants

Table 1 shows that 57.5% (n=21,091) were males and 56.9% (n=20,883) were aged between 18 and 25 years. Half (50.5%, n=18,521) of the blood donors had the "O" blood group and first time donors were 64.8% (n=23,794). Slightly more than a half (53.9%, n=19,778) of the donors came from schools while singles represented (86.8%, n=31,849). The highest number of donors came from the district of Nyamasheke (28.6%, n=10,515), while the least number of donors came from the District of Ngororero (1.9%, n=692). Of all the occupation categories, students were the most that donated blood at 75.2% (n=27,606).

Table 1. Socio-demographic characteristics of blood donors

Characteristics	n (%)
Gender	
Male	21,091 (57.5)
Female	15,617 (42.5)
Age group (Years)	
18-25	20,883 (56.9)
26-35	9,205 (25.1)
36-45	4,598 (12.5)
46-55	1,637 (4.5)
56-65	385 (1.0)
Blood Group	
O Type	18,521 (50.5)
A Type	9,512 (25.9)
B Type	7,172 (19.5)
AB Type	1,503 (4.1)
Donor Regularity	
First time blood donors	23,794 (64.8)
Repeat donor	12,914 (35.2)
Residence type	
School	19,778 (53.9)
Rural	10,769 (29.3)
Urban	4,892 (13.3)
Military & Police camp	1,269 (3.5)
District	
Karongi	9,653 (26.3)
Nyamasheke	10,515 (28.6)
Rusizi	7,232 (19.7)
Rutsiro	8,616 (23.5)
Ngororero	692 (1.9)
Marital Status	
Single	31,849 (86.8)
Married	4,794 (13.1)
Religious	28 (0.1)
Divorced	5 (0.01)
Widowed	32 (0.1)
Occupation	
Student	27,606 (75.2)
Informal employment	4,749 (12.9)
Government employed civilian	1,890 (5.2)
Government employed uniformed	1,250 (3.4)
Self employed	529 (1.4)
Private institution staff	320 (0.9)
Unemployed	261 (0.7)
NGOs Staff	59 (0.2)
Religion	43 (0.1)

Prevalence of HIV, HBV, HCV, and Syphilis among blood donors

From 2015 to 2019 in RCBT, Karongi, the overall prevalence of all TTIs was 2.1% (n=781). However, the prevalences of HBV, HCV, HIV and syphilis were 1.3% (n=474), 0.4% (n=160), 0.06% (n=24) and 0.34% (n=123) respectively (Table 2).

A significant decreasing trend of HBV (p value = 0.018) was observed from 2015 to 2019. However, the trend of HIV and syphilis from 2015 to 2019 was somewhat constant. HCV trend declined in 2016 and increased in 2017 while from 2018 to 2019 remained fairly constant.

Table 2. Prevalence of HIV, HBV, HCV, and Syphilis among blood donors in RCBT Karongi from 2015 to 2019

Year	Total Tested Blood donors	HBV, n (%)	HCV, n (%)	HIV, n (%)	Syphilis ,n (%)	Overall TTIs , n(%)
2015	5,352	87 (1.6)	7 (1.3)	2 (0.04)	14 (0.26)	110 (2.1)
2016	7,251	122 (1.7)	24 (0.3)	6 (0.08)	38 (0.52)	190 (2.5)
2017	9,071	123 (1.4)	78 (0.9)	8 (0.09)	29 (0.32)	238 (2.6)
2018	7,720	82 (1.1)	26 (0.3)	3 (0.04)	21 (0.27)	132 (1.7)
2019	*7,314*	*60* (0.8)	*25* (0.3)	*5* (0.07)	*21* (0.29)	*111* (1.5)
Total	36, 708	474 (1.3)	160 (0.44)	24 (0.065)	123 (0.34)	781 (2.1)

Bivariate analysis for risk factors of TTIs infections

The bivariate analysis showed that HBV among blood donors was significantly associated with gender, age, donor regularity, residence setting, district of residence, marital status, and occupation. Males were more exposed than females (OR: 1.87, 95% CI: 1.53 – 2.29). The age groups of 26-35 years (OR: 1.89, 95% CI: 1.54 – 2.32) and 36-45 years (OR: 1.78, 95% CI: 1.36 – 2.31) were also associated with HBV compared to the age group of 18-25 years. First time blood donors (OR: 11.92, 95% CI: 7.69 – 18.46) were more likely to have HBV compared to repeat donors and blood donors living in Rusizi District (OR: 2.94, 95% CI: 2.25 – 3.83) were more exposed to have HBV compared to those leaving in other districts. Blood donors living in rural (OR: 1.31, 95% CI: 1.06 – 1.62), urban (OR: 2.06, 95% CI: 1.62 – 2.62), and military & police camps (OR: 1.69, 95% CI: 1.09 – 2.64) showed a higher risk of HBV infections compared to those coming from schools. Furthermore, married blood donors (OR: 1.42, 95% CI: 1.12 – 1.81) informal employed (OR: 1.44, 95% CI: 1.12 – 1.84), and self-employed (OR: 2.14, 95% CI: 1.22 – 3.75) were more exposed to HBV (Table 3).

Concerning HCV, there was an association with gender, age, donor regularity, and residence type, district of residence, and marital status. Males (OR: 1.73, 95% CI: 1.23 – 2.43) age group of 26-35 years (OR: 1.72, 95% CI: 1.18 – 2.52), 36-45 years (OR: 2.28, 95% CI: 1.48 – 3.51), 46-55 years (OR: 2.69, 95% CI: 1.48 – 4.898) and 56-65 years (OR: 6.22, 95% CI: 2.83 – 13.68). First time blood donors (OR: 4.30, 95% CI: 2.63 – 7.03) and living in the districts of Rusizi (OR: 3.52, 95% CI: 1.99 – 6.21), Nyamasheke (OR: 3.08, 95% CI: 1.78 – 5.36) and Karongi (OR: 2.07, 95% CI: 1.15 – 3.72) were associated with a high risk of HCV infections. Compared to blood donors coming from schools, blood donors living in urban (OR: 2.59, 95% CI: 1.75 – 3.81) were more exposed to have HCV. Furthermore, married blood donors (OR: 1.60, 95% CI: 1.08 – 2.37) were also found to be more exposed to have HCV compared to single blood donors (Table 3).

The bivariate analysis showed that HIV among blood donors was associated with certain age-group, donor regularity, and residence type. The age group of 36-45 years (OR: 3.03, 95% CI: 1.08 – 8.52), being first time blood donors (OR: 12.49, 95% CI: 1.69 – 92.52), donors living in the urban area (OR: 6.07, 95% CI: 2.16 – 17.07) had a high risk for HIV infections (Table 3).

Regarding syphilis, the bivariate analysis showed that syphilis among blood donors was associated with gender, age, donor regularity, and residence type, district of residence, marital status, and occupation. Males (OR: 1.93, 95% CI: 1.26 – 2.96), age group of 26-35 years (OR: 2.33, 95% CI: 1.51 – 3.59), 36-45 years (OR: 3.56, 95% CI: 2.24 – 5.66). First time blood donors (OR: 1.93, 95% CI: 1.26 – 2.96), living in the districts of Rusizi (OR: 2.00, 95% CI: 1.18 – 3.39) and Rutsiro (OR: 1.73, 95% CI: 1.03 – 2.92) were more exposed to have syphilis. Moreover, the risk of syphilis was higher in donors living in rural (OR: 3.27, 95% CI: 1.93 – 5.55), in urban (OR: 3.27, 95% CI: 1.93 – 5.55), and in military& police camps (OR: 7.62, 95% CI: 4.10 – 14.15) and married donors (OR: 2.55, 95% CI: 1.71 – 3.79). Having informal employment (OR: 2.830, 95% CI: 1.85 – 4.32), being police or army (OR: 5.07, 95% CI: 2.88 – 8.90) and self-employed (OR: 3.98, 95% CI: 1.60 – 9.92) were the risk factors of syphilis (Table 3).

Table 3. Bivariate analysis for risk factors associated with TTIs among blood donors

Character-istics	HBV			HCV			HIV			Syphilis		
	n (%)	OR (95% CI)	P values	n (%)	OR (95% CI)	P Values	n (%)	OR (95% CI)	P Values	n (%)	OR (95% CI)	P Values
Gender												
Female	135 (0.9)	1.00		48 (0.3)	1.00		11 (0.1)	1.00		27 (0.2)	1.00	
Male	339 (1.6)	1.87 (1.53-2.29)	<0.001	112 (0.5)	1.73 (1.23-2.43)	0.001	13 (0.06)	0.88 (0.39-1.95)	0.745	96 (0.5)	2.64 (1.721-4.048)	<0.001
Age group (Years)												
18-25	201 (0.9)	1.00		62 (0.3)	1.00		9 (0.04)	1.00		41 (0.2)	1.00	
26-35	166 (1.8)	1.89 (1.54-2.32)	<0.001	47 (0.5)	1.72 (1.18-2.52)	0.005	6 (0.1)	1.51 (0.54-4.25)	0.432	42 (0.5)	2.33 (1.5-3.59)	<0.001
36-45	78 (1.7)	1.78 (1.36-2.31)	<0.001	31 (0.7)	2.28 (1.48-3.51)	<0.001	6 (0.1)	3.03 (1.08-8.52)	0.035	32 (0.7)	3.56 (2.24-5.66)	<0.001
46-55	23 (1.4)	1.47 (0.95-2.26)	0.084	13 (0.8)	2.69 (1.48-4.90)	0.001	2 (0.1)	2.84(0.61-13.14)	0.182	6 (0.4)	1.87 (0.79-4.41)	0.153
56-65	6 (1.6)	1.63 (0.72-3.69)	0.243	7 (1.8)	6.22 (2.83-13.68)	<0.001	1 (0.3)	6.04 (0.76-47.79)	0.088	2 (0.5)	2.65 (0.64-11.01)	0.179
Donor Regularity												
Repeat blood donor	21 (0.2)	1.00		18 (0.1)	1.00		1 (0.0)	1.00		27 (0.2)	1.00	
First time blood donor	453 (1.9)	11.92 (7.69-18.46)	<0.001	142 (0.6)	4.30 (2.63-7.03)	<0.001	23 (0.1)	12.49(1.69-92.52)	0.013	96 (0.4)	1.93 (1.26-2.96)	0.003
Residence type												
School	204 (1.0)	1.00		66 (0.3)	1.00		6 (0.03)	1.00		31 (0.2)	1.00	
Rural	145 (1.3)	1.31 (1.06-1.62)	0.014	47 (0.4)	1.31 (0.90-1.90)	0.159	8 (0.1)	2.45 (0.85-7.06)	0.097	52 (0.5)	3.09 (1.98-4.82)	<0.001
Urban	103 (2.1)	2.06 (1.62-2.62)	<0.001	42 (0.9)	2.59 (1.75-3.81)	<0.001	9 (0.2)	6.07 (2.16-17.07)	0.001	25 (0.5)	3.27 (1.93-5.55)	<0.001
Military & Police camp	22 (1.7)	1.69 (1.09-2.64)	0.020	5 (0.4)	1.18 (0.48-2.94)	0.720	1 (0.1)	2.45(0.85-7.06)	0.377	15 (1.2)	7.62 (4.10-14.15)	<0.001
District												
Rutsiro	78 (0.9)	1.00		16 (0.2)	1.00		4 (0.04)	1.00		24 (0.2)	1.00	
Karongi	90 (0.9)	1.03 (0.76-1.40)	0.848	37 (3.8)	2.07 (1.15-3.72)	0.015	7 (0.1)	1.91 (0.56-6.52)	0.303	30 (0.3)	1.36 (0.80-2.33)	0.259
Nyamasheke	110 (1.0)	1.16 (0.86-1.55)	0.326	60 (0.6)	3.08 (1.78-5.36)	<0.001	5 (0.1)	1.82 (0.49-6.77)	0.373	33 (0.5)	2.00 (1.18-3.39)	0.010
Rusizi	189 (2.6)	2.94 (2.25-3.83)	0.000	47 (0.6)	3.52 (1.99-6.21)	<0.001	7 (0.1)	2.1 (0.63-7.30)	0.226	34 (0.4)	1.73 (1.03-2.92)	0.040
Ngororero	7 (1.0)	1.12 (0.51-2.43)	0.777	0(0.0)	Undefined		1 (0.1)	3.8 (0.42-34.06)	0.232	2 (0.3)	1.27 (0.30-5.37)	0.748
Marital Status												
Single	389 (1.2)	1.00		129 (0.4)	1.00		18 (0.1)	1.00		89 (0.3)	1.00	
Married	83 (1.7)	1.42 (1.12-1.81)	0.004	31 (0.6)	1.60 (1.08-2.37)	0.019	6 (0.1)	2.22 (0.88-5.59)	0.092	34 (0.7)	2.55 (1.71-3.79)	<0.001
Religious	1 (.35.7)	2.99 (0.41-22.09)	0.282	0(0.0)	Undefined		0(0.0)	Undefined		0(0.0)	Undefined	
Divorced	0(0.0)	1.00		0(0.0)	Undefined		0(0.0)	Undefined		0(0.0)	Undefined	
Widowed	1 (3.1)	2.61 (0.35-19.15)	0.346	0(0.0)	Undefined		0(0.0)	Undefined		0(0.0)	Undefined	
Occupation												
Student	321 (1.1)	1.00		121 (0.4)	1.00		17 (0.1)	1.00		66 (0.2)	1.00	
Informal employment	79 (1.7)	1.44 (1.12-1.84)	0.004	24 (0.5)	1.15 (0.74-1.79)	0.523	1 (0.05)	0.86 (0.11-6.46)	0.883	32 (0.7)	2.830 (1.85-4.32)	0.000
Government employed civilian	25 (1.3)	1.14 (0.76-1.72)	0.532	6 (0.3)	0.72 (0.32-1.64)	0.440	5 (0.1)	1.71 (0.63-4.64)	0.292	5 (0.3)	1.106 (0.45-2.75)	0.827
Government employed uniformed	21 (16.8)	1.45 (0.93-2.27)	0.100	5 (0.4)	0.91 (0.37-2.24)	0.841				15 (1.2)	5.068 (2.88-8.90)	<0.001
Self employed	13 (2.4)	2.14 (1.22-3.75)	0.008	1 (0.2)	0.43 (0.06-3.08)	0.401	1 (0.1)	1.30 (0.17-9.77)	0.799	5 (0.3)	3.981 (1.60-9.92)	0.003
Private institu-tion staff	7 (2.2)	1.90 (0.89-4.05)	0.096	0(0.0)	Undefined		0(0.0)	Undefined		0(0.0)	Undefined	
Unemployed	6 (2.3)	2.00 (0.88-4.53)	0.096	3 (1.2)	2.64 (0.83-8.36)	0.098	0(0.0)	Undefined		0(0.0)	Undefined	
NGOs Staff	1 (1.7)	1.47 (0.20-10.61)	0.705	0(0.0)	Undefined		0(0.0)	Undefined		0(0.0)	Undefined	
Religion	1 (2.3)	2.02 (0.28-14.74)	0.487	0(0.0)	Undefined		0(0.0)	Undefined		27 (0.2)	Undefined	

Multivariable logistic analysis for risk factors of TTIs

Multivariable analysis (Table 4) shows that HBV was significantly associated with male gender (AOR: 1.70, 95% CI: 1.38 – 2.10), age group of 26-35 years (AOR: 1.26, 95% CI: 1.20 – 1.93), first time blood donors (AOR: 13.21, 95% CI: 8.46 – 20.64), blood donors living in Rusizi District (AOR: 2.52, 95% CI: 1.91 – 3.33) and being married blood donors (OR: 1.74, 95% CI: 1.24 – 2.44).

HCV was associated with male gender (AOR: 1.55, 95% CI: 1.09 – 2.20), age groups of 26-35 years (AOR: 1.63, 95% CI: 1.06 – 2.49), 36-45 years (AOR: 2.04, 95% CI: 1.18 – 3.53), 46-55 years (AOR: 2.43, 95% CI: 1.21 – 4.86), 56-65 years (AOR: 5.82, 95% CI: 2.42 – 14.01). Furthermore, HCV was also significantly associated with first time blood donors (AOR: 4.71, 95% CI: 2.84 – 7.83), and living in the districts of Rusizi (AOR: 2.96, 95% CI: 1.65 – 5.30), Nyamasheke (AOR: 3.92, 95% CI: 2.19 – 7.01) and Karongi (AOR: 2.64, 95% CI: 1.44 – 4.84).

Being first time blood donors (AOR: 12.19, 95% CI: 1.63 – 91.05) and blood donors living in urban (AOR: 4.11, 95% CI: 1.25 – 13.57) were significant correlates of HIV infection.

Male gender (AOR: 1.91, 95% CI: 1.22 – 2.98) and first time blood donors (AOR: 2.32, 95% CI: 1.46 – 3.67) and living in rural (AOR: 2.21, 95% CI: 1.25 – 3.90) and urban (AOR: 2.25, 95% CI: 1.20 – 4.22) were determinants of syphilis.

Table 4. Multivariable logistic analysis for risk factors of TTIs

Variables	HBV		HCV		HIV		Syphilis	
	AOR (95% CI)	P-values	AOR (95% CI)	P-values	AOR (95% CI)	P-values	AOR (95% CI)	P-values
Gender								
Female	1.00		1.00				1.00	
Male	1.70 (1.38-2.10)	<0.001	1.55 (1.09-2.20)	0.015			1.91 (1.22-2.98)	0.005
Age (Years)								
18-25	1.00		1.00		1.00		1.00	
26-35	1.52 (1.20-1.93)	0.001	1.63 (1.06-2.49)	0.025	0.96 (0.31-2.94)	0.945	1.24 (0.75-2.04)	0.406
36-45	1.26 (0.90-1.76)	0.180	2.04 (1.18-3.53)	0.011	1.81 (0.56-5.91)	0.324	1.37 (0.74-2.53)	0.311
46-55	0.96 (0.59-1.56)	0.868	2.43 (1.21-4.86)	0.012	1.64 (0.32-8.42)	0.553	0.69 (0.27-1.78)	0.442
56-65	1.08 (0.46-2.55)	0.858	5.82 (2.42-14.01)	<0.001	3.76 (0.44-32.19)	0.226	0.94 (0.21-4.18)	0.939
Donor Regularity								
Repeat blood donor	1.00		1.00		1.00		1.00	
First time blood donor	13.21 (8.46-20.64)	<0.001	4.71 (2.837-7.832)	<0.001	12.19 (1.63-91.05)	0.015	2.32 (1.46-3.67)	<0.001
Residence type								
School	1.00		1.00		1.00		1.00	
Rural	0.87 (0.64-1.18)	0.366	1.06 (0.67-1.70)	0.796	2.17 (0.66-7.09)	0.2	2.21 (1.25-3.90)	0.006
Urban	0.96 (0.59-1.56)	0.868	1.26 (0.78-2.04)	0.336	4.11 (1.25-13.57)	0.02	2.25 (1.20-4.22)	0.011
Military & Police camp	1.93 (0.25-15.18)	0.532	0.43 (0.16-1.16)	0.096	1.64 (0.17-15.64)	0.668	0.0001 (0.0-14.0)	0.981
District								
Rutsiro	1.00		1.00					
Karongi	1.20 (0.88-1.65)	0.252	2.635 (1.436-4.836)	0.002				
Nyamasheke	1.30 (0.95-1.77)	0.097	3.923 (2.194-7.013)	<0.001				
Rusizi	2.52 (1.91-3.33)	<0.001	2.956 (1.649-5.300)	<0.001				
Ngororero	1.07 (0.49-2.35)	0.867	1.00					
Marital Status								
Single	1.00		1.00					
Married	1.74 (1.24-2.44)	0.001	1.53 (0.94-2.48)	0.088				
Religious	1.92 (0.15-2.17)	0.986	1.00					
Divorced	1.00		1.00					
Widowed	5.43 (0.67-43.99)	0.113	1.00					

Discussion

Blood transfusion services in Rwanda have strived to improve the quality of blood since 2011. However, the Western province has been reporting a high incidence of the major TTIs in the overall population. Therefore, identification and trends evaluation of the prevalence and the risk factors associated with TTIs in the Western province was a valuable step towards assessing the existing and devising new intervention strategies for fighting TTIs among blood donors. Hence, this study aimed to determine the risk factors of TTIs among blood donors in the RCBT Karongi catchment area.

Findings showed a significantly decreasing trend of HBV proportion and a slightly decrease in HCV proportion whereas the proportion of HIV and syphilis among blood donors remained slightly constant from 2015 to 2019. This may be explained by vaccination campaigns among people at risk for HBV and HCV testing campaigns that targeted suspected individuals in Rwanda. These campaigns might have played a role in the decline HBV and HCV infection rates. [19,20] However, low prevalence of syphilis might be linked with the reduced prevalence of HIV proving success of the national HIV control program and surveillance systems. [21,23] In addition, since 2014 blood service in Rwanda started the accreditation process which may have resulted in the strengthening of blood donors selection and qualification process, leading to the decline of TTIs prevalence among blood donors.[24]

In this study, the HBV, HCV, and syphilis infections were significantly associated with male blood donors. This finding was consistent with a study conducted in Jijiga Blood Bank, Eastern Ethiopia.[18] The higher risk for males to counteract TTIs can be related to being more involved in sexual intercourse, fights, and conflicts that might lead to blood contact.[15,19]
The current analysis revealed that the risk of HBV and HCV increases with age. This association is consistent with what was found in studies conducted in the National Blood Transfusion Service of Eritrea and Western China.[15,25] HBV and HCV infections were increasing by age among blood donors and this might be due to duration of exposure to the virus and also to the fact that people in these age groups are more sexually active than young people. [26] According to blood donor's regularity, in RCBT Karongi, first time blood donors were found to be significantly related with all TTIs (HBV, HCV, HIV, and syphilis). This association was similarly found in the studies conducted in Shiyan-Central China,[27] Eritrea,[15] Bahir Dar district blood bank, northwest Ethiopia[28]. This finding from the current study confirms the theory that that first-time blood donors constitute a high-risk group to TTIs.[29]

HIV and syphilis were found to be significantly associated with urban areas among blood donors. This reflects the situation existing in Rwanda where urban areas present a high prevalence of HIV.[23] However, in a study conducted in Rwanda in 2016 in the general population, there was no association between syphilis and urban residence.[21] But, according to different studies and surveys conducted it was hypothesized that people living in urban settings are more likely to acquire syphilis compared to those residing in rural areas. [30,31]

The districts bordering neighbouring countries to Rwanda constituted a high risk for HBV and HCV. In line with this, Rusizi, Karongi, and Nyamasheke Districts are bordered by Democratic Republic of Congo (DRC). Moreover, Rusizi district is bordered by Burundi. These border districts are characterized by significant cross-border trade and mobility, which could increase the number of roving sexual encounters. Married individuals were found to be a significant risk factor for HBV among blood donors in RCBT Karongi. This was in agreement with another study carried out in five Chinese blood centres.[32]

Though, this might be linked to sexual behaviour, possibly behaviour like traditional scarification or low vaccination rate among the married population could be contributing to the situation.[19]

One drawback for this study is that it was of retrospective design, which makes it impossible to establish a cause-and-effect connection between the various factors and TTIs. The self-report, which could be connected to social desirability bias, is another limitation that should be taken into account while interpreting these results. However, the main strength of the study is using large sample size which could enhance precision of results.

Conclusion

This study found that HBV was the most common TTI, even though its total prevalence was lower than in other Sub-Saharan African countries. Furthermore, the current study revealed that being male, age more than 25 years, being married, living in urban areas, first time blood donors and blood donors living in Rusizi, Nyamasheke and Karongi districts were associated with each TTI. Therefore, those groups should be targeted for more health education and awareness regarding the risk of HBV, HCV, HIV and syphilis infection prevention and control. Additionally, considering the limitations of this study, a longitudinal study need to be carried out to establish the causation and its direction in relation to the variables influencing TTIs.

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Conflict of Interest

The authors declare that there is no any conflict of interest.

Author Contributions

ON analysed the data, drafted, and finalised the manuscript. HDU advised on data analysis and structure of the manuscript and reviewed the manuscript. CMCS, MH, and JN contributed to drafting the manuscript, JN additionally supervised the study and guided the analysis and interpretation of data. All authors have read and agreed to the final version of the manuscript.

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