The Ethiopian Public Health Institute

Magnitude of blood borne pathogens: HIV, Hepatitis B, C and syphilis and associated factors among blood donors in Ethiopia; a retrospective study

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National Blood Bank Service

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Acronyms

BBL	Central Blood Bank Laboratory
CI	Confidence Interval
ELISA	Enzyme-Linked Immuno Sorbent Assay
HBV	Hepatitis B virus
HCV	Hepatitis C virus
HIV	Human Immunodeficiency Virus
IQR	Inter quartile range
RPR	Rapid plasma reagin test
SPSS	Statistical Package for Social Science
TTIs	Transfusion Transmission Infections

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Abstract

Background: Even though blood transfusion saves lives and improve health of individuals, in low income countries, it is been challenged by two crucial issues - blood shortage and safety. Unsafe blood transfusion is one of the sources of transmission for infectious agents; such as human immunodeficiency virus, hepatitis B virus, hepatitis C virus, and syphilis. Therefore, this study was aimed to determine the magnitude of sero-prevalence of HIV, HBV, HCV, syphilis, and associated factors among blood donors in Ethiopia.

Methods : A retrospective cross-sectional study design was used to collect data from 2014 to 2019 in fourteen blood banks facilities. Screening of HIV, HBV, HCV and syphilis was done by using the Enzyme-Linked Immunosorbent Assay uniformly throughout the blood bank facilities. Records of blood donors were collected and reviewed by using a checklist from the Blood Bank Laboratories and the electronic database was used to access sociodemographic information about the donors. Data was managed, cleaned and analyzed using Stata 14. Logistic regression was fitted to identify factors associated with cumulative transfusion transmittable infection positivity, and for each of the infection. P value < 0.05 was considered statistically significant.

Result: Total of 554,954 blood donors in fourteen blood bank facilities from 2014 -2019 was included in the study. The overall sero-prevalence of HBV, HIV, HCV, and syphilis was 2.4% 95CI [2.4, 2.5], 0.4% 95CI [0.4, 0.4], 0.4% 95CI [0.4, 0.4] and 0.9% 95CI [0.9, 1.0], respectively. The prevalence of TTIs was comparatively higher in 2014, 5.7% 95%CI [5.4, 6.0] and lowest in 2019, 3.40% 95%CI [3.20, 3.50]. Age, sex and mode of blood donations are a significant predictor for HBV, HCV, syphilis infections. The odds of having HBV among blood donors is 1.1 (AOR =1.1; 95% CI: 1.0, 1.2) times higher in age group 25-34 years, 1.2 (AOR =1.2; 95% CI: 1.1, 1.3) times higher age 35-44 years, 1.3 (AOR =1.3; 95% CI: 1.1, 1.5) times higher age from 45-54 years compared to age from 15-24 years. The odds of having an HBV among blood donors 1.4 (AOR =1.4; 95% CI: 1.4, 1.5) times higher for male. The odds of having HBV among mobile site blood donors is 1.4 (AOR =1.4; 95% CI: 1.3, 1.6) times higher than in a static site. The odds of having a syphilis among blood donors 1.2 (AOR =1.4; 95% CI: 1.1, 1.4) times higher for male.

Conclusions: Although the trend of blood born infection has gradually reduced since start of the study, TTIs can still be considered as highly prevalent in Ethiopia, particularly prevalence of

HBV followed by syphilis. Age, sex and mode of blood donations are found to be significant predictors for the TTIs. We recommend strict donor screening and testing. Voluntary donors blood donners shall be encouraged to donate blood. In additions strengthen strategies to increase and motivate enrolment of safe regular donors.

Keywords: Blood donor, blood bank facility, Blood transfusion, Transfusion transmitted infection

Background

Blood transfusions save lives and improve health but in low income countries, particularly in Africa, many patients requiring blood are facing two crucial blood transfusion-related issues - blood shortages and unsafe blood(Organization 2017, Weimer, Tagny et al. 2019). According to the World Health Organization (WHO) blood safety and availability status survey reports in 2015, around 117.4 million units of donated blood are collected globally every year, 42% of these blood donations are collected in high income countries home to less than 16% of world's population(Organization 2017). The blood donation rate in low income countries is 4.4% which is by far lower than in high income countries 32.6 % .(Hussein, Haj et al. 2017, Lokpo, Dakorah et al. 2017, Organization 2017).

Although blood transfusions saves millions of lives, if unsafe, it could be a most frequent source of transmission for infectious agents; such as human immunodeficiency virus (HIV), hepatitis B virus (HBV), hepatitis C virus (HCV), syphilis and others(Ozaras and Leblebicioglu 2019, Tigabu, Engda et al. 2019, Weimer, Tagny et al. 2019)

In Sub Sahran Africa, because there is no data on HIV prevalence in blood donors and recepients post transfusion, the incidence of HIV attributable to transfusion is uncertain. The findings suggested that only 1% of new HIV infections are attributable to transfusion(Morar, Pitman et al. 2016). In Ethiopia local studies done previously shows the seroprevalence of HIV ranges from 0.5% to 6.4%.

Twenty three percent of global burden of HBV is concentrated in SSA particularly in West African Countries where six of them reported donor HBV prevalence above 10%(Apata, Averhoff et al. 2014). For instance, the reported rates of donor HBV seroprevalence in Nigeria ranges between 10.6% to 17% and while study done in Eritrean, Eastern part of Africa revealed 2% (Apata, Averhoff et al. 2014, Siraj, Achila et al. 2018) Many African countries, reported an increase in donor HCV prevalence, for instance in Eritrea the HCV seroprevalence accounts 0.7% (Siraj, Achila et al. 2018, Ozaras and Leblebicioglu 2019). Sero prevalence of HBV in Ethiopia ranges from 4.1% to 9.5%(5,67,8). Regarding HCV local studies in Ethiopia shows lowest prevalence 1.6% in Gondor and highest 8.5% in Wolita sodo (Bisetegen, Bekele et al. 2016, Tigabu, Engda et al. 2019).

Study done in Eritrea shows the syphilis prevalence among blood donors is 0.3% . In Ethiopia, data shows the syphilis prevalence among blood doners ranges from 1.2% in Bahir dar to 7.5% in Wolita sodo. (Bisetegen, Bekele et al. 2016, Gebregziabher, Meshasha et al. 2017, Tigabu, Engda et al. 2019).

Studies conducted in Ethiopia related to seroprevalence of pathogens among blood donors are not consistent and representative. This study had used representative data to estimate the seroprevalence and associated factors. this study findings made clear that the magnitude of unsafe blood collected from blood donors. The study findings shall guide policy makers to improve screening and testing strategies at blood banks to ensure safety of blood recipients. (Bhattacharya, Chandra et al. 2007, Khedmat, Alavian et al. 2009). Therefore, this study was aimed to determine magnitude of the sero-prevalence of HIV, HBV, HCV, syphilis, and associated factors among blood donors in Ethiopia.

Methods and Materials

Study Setting and sample size: Ethiopia is the second most populous nation in Africa, with an estimated population of 103 million. There are 25 blood bank sites in the country. Donated blood is obtained either from volunteers, or from those who donate to replace for recipients. . The study was conducted in 14 national and regional blood banks in Ethiopia (Tigray, Amhara, Oromiya, Afar, Adiss Ababa Diredawa, Southern nations nationalities peoples).

Study Deign: A retrospective cross-sectional study was used to collect retrospective data of blood donors from 2014 to 2019. Variables from Central Blood Bank Laboratory (BBL) electronic database includes residence, age, sex, strategy of donation (replacement/volunteer), weight and type of pathogen tested positive (Hepatitis B&C, HIV and/or syphilis).

Study population: All blood donors registered and screened in the fourteen blood bank laboratories were included in the study. Only those blood donors in the age of 18-65 years, whose weight is ≥45 and had no illness history qualifies for blood donation in Ethiopia. According to NBB protocol, these are pre-set screening criteria for blood donor. **Laboratory screening methods**: Screening for HIV, HBV and HCV was done by using the Enzyme-Linked Immunosorbent Assay (ELISA) (HIV1/2: Vironostika HIV Uni-Form II Ag/Ab (BioMerieux,

Boxtel, The Netherlands); HBsAg: a third generation ELISA, Hepanostika HBsAg (Murex Biotech Ltd, Dartford, UK). HCV: ELISA technique (Murex anti-HCV version 4.0). Treponemal antibodies using rapid plasma reagin test (RPR) (RPR, Wampole Laboratories, Princeton, N.J., USA).Test protocol and result interpretation were done according to the manufacturer instruction.

Data management and analysis: The data were routinely collected in the blood bank facilities and entered a blood safety registration database designed for data repository. Health personnels working in the blood bank facilities recorded the data. Data in the database was exported into Microsoft Excel; and checked for consistencies and completeness as part of data cleaning. Data analysis was conducted using SPSS version 23 statistical package and Stata Statistical Software (Release 14. College Station, TX: StataCorp LP). The donor characteristics were described in terms of mean/median or percentage, as appropriate. Differences in prevalence of HIV, HBV, HCV and syphilis for socio-demographic variables tested for significance using logistic regression. Logistic regression was built for each of the transfusion transmittable disease and expressed as estimated odds ratios (HRs) with 95% confidence intervals (CIs). P value less than 0.05 was considered statistically significant.

Ethical clearance: Permission for the study was obtained to have access to the row data in the blood bank source document to analyze. Donor informed consent was not required in this case, as this is secondary data obtained from registers and/or an electronic database and is impossible to track back blood donors for consent. All data collected from the blood bank register and the central data base was anonymous; no names of persons were included.

Result

Socio-demographic characteristics of study participants

A total of 554,954 blood donor's data in fourteen blood bank facilities from seven regional states over 2014 -2019 were included in the study. of this, 354,707[63.9%] were males. The participants age [in years] ranged from 18 to 66; median age was 27 years with IQR [19,29]. Most of the donors were between the age of 15-24 years accounting 335,446 [60.45%] followed by ages between 25-34 years; 145,589[26.24%] the least were less than 55 years age group 3,618[0.65%].

Concerning the occupation of the donors, Student accounts 223,912 [50.75%] followed by Private Workers 140,425 [31.83%] and unemployed donors account 2607 [0.59 %]. Regarding donor's blood type 29.63% of the donors had type O blood group, 15.47% had type B, 29.08% had type A and 25.82% had type AB. The national blood bank service agency found in Addis Ababa contributed 270,431 (49%) of the donors over the study period. [*See table 1*].

Table 1: Socio demographic and clinical characteristics of blood donors in the 14 blood bank facilities in Ethiopia in 2014 -2019, N= 554,954

Variables	Frequency	Percent
Age [n= 554,908]		
Mean [SD]	25.168	8.04
Median [IQR]	27.0	19-29
15-24	335446	60.45
25-34	145589	26.24
35-44	53447	9.63
45-54	16808	3.03
>=55	3618	0.65
Sex [n= 554,954]		
Female	200247	36.08
Male	354707	63.92
Occupation		
Student	223912	50.75
Civil servant	61730	13.99
Teacher	2152	0.49
Driver	2655	0.60
Military	7735	1.75
Private worker	140425	31.83
Unemployed	2607	0.59
Blood type		
O	149046	29.63
A	146307	29.08
B	77843	15.47
AB	129890	25.82
place of Donation		
Static	15292	4.28
Mobile/outreach	342393	95.72
Donation type		

Replacement	25356	6.18
Volunteer	385159	93.82
Year of Donation		
2014	24087	4.34
2015	85377	15.39
2016	92816	16.73
2017	141684	25.53
2018	143189	25.80
2019	67741	12.21

The number of donors increased from 24087 to 143189 in five years. Trend of blood donation progressively improved in all regions from 2014 to 2018 by far, higher increment was observed in Addis Ababa, followed by Oromia Amhara and Tigray *(see fig 1). Throughout the study period, majority of donors were male, however, the increment was proportional between male and female (Fig 2)*

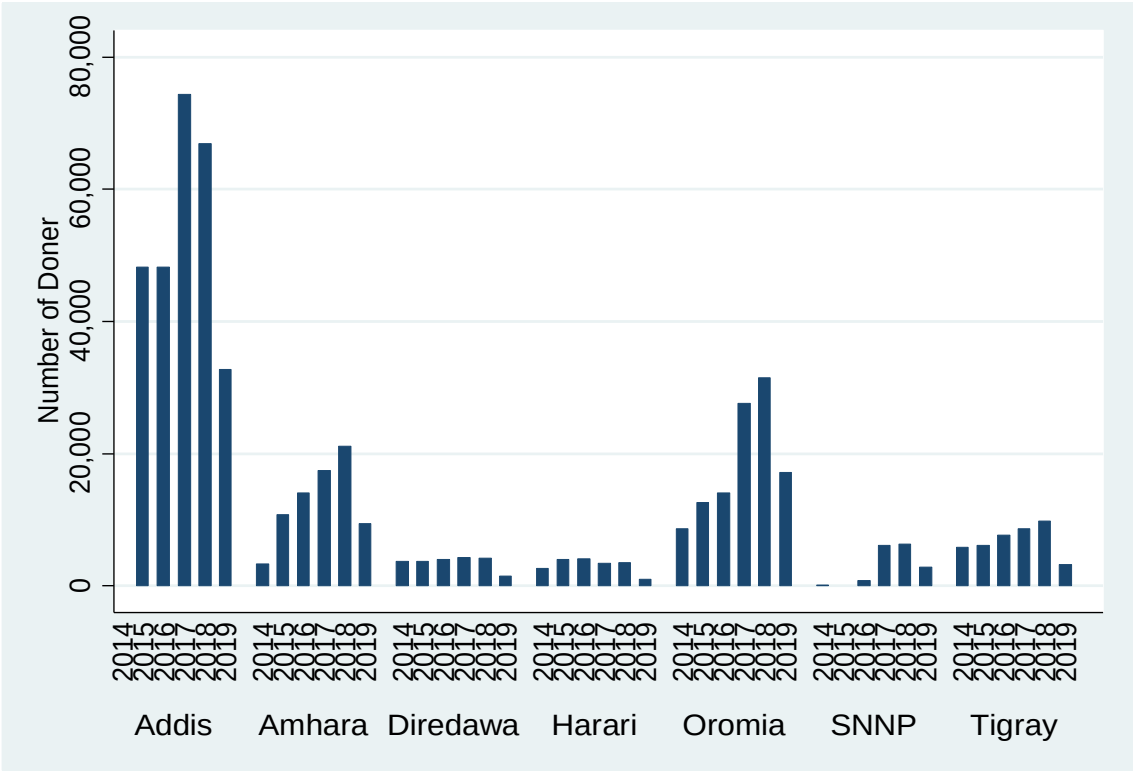


Figure 1: The number of blood donor by region over year in fourteen blood bank facilities in Ethiopia

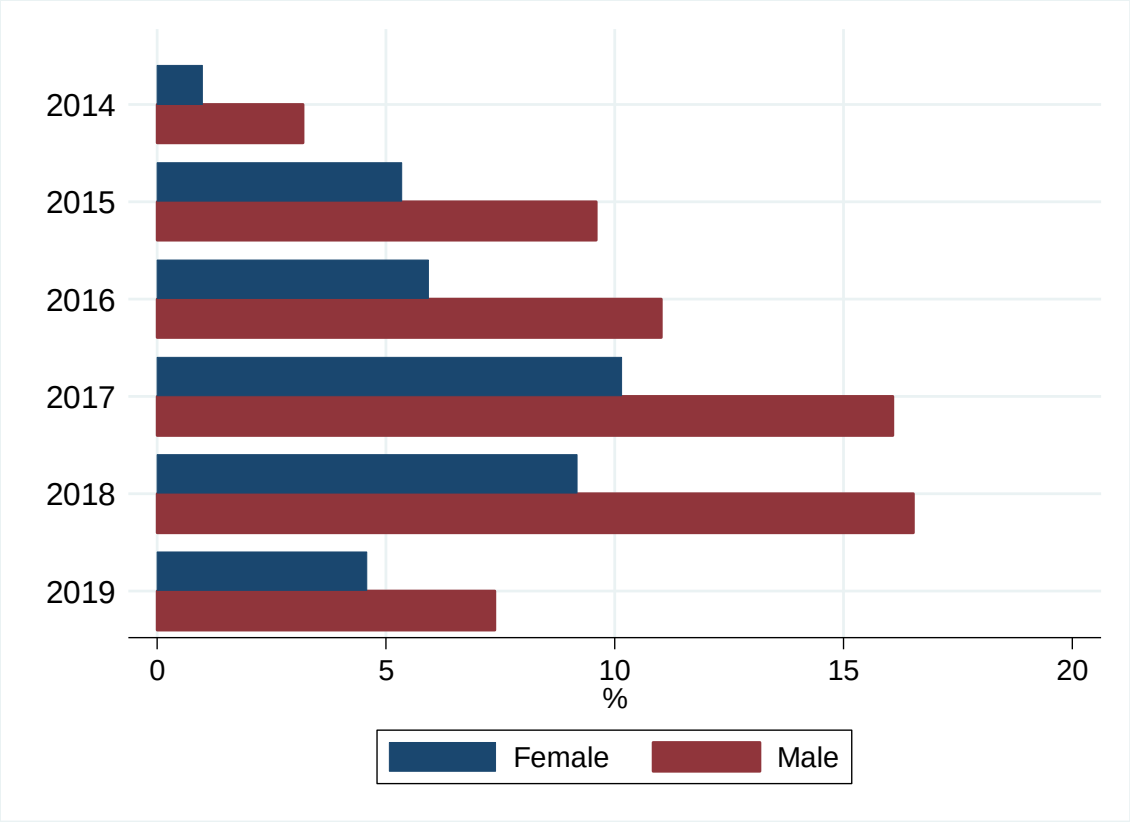


Figure 2: The number of blood donor by gender over six years in fourteen blood bank facilities in Ethiopia

Sero-prevalence of transfusion transmissible infections

From a total of 554,954 blood donors 4.1% 95CI [4.1, 4.2] had serological evidence for at least one of transfusion transmittable infections, of which 4.7% 95CI [4.6, 4.8] were in male donors. The overall sero-prevalence of HIV, HBV, HCV, and syphilis was 0.4% 95CI [0.4, 0.4], 2.4% 95CI [2.4, 2.5], 0.4% 95CI [0.4, 0.4], and 0.9% 95CI [0.9, 1.0], respectively.

Blood donors from Harari region had the highest rate of infection 6.5% 95%CI [6.2, 6.9] and donors from Adiss Ababa had the lowest TTI cases which accounts 3.40 % 95%CI [3.30, 3.40]. The Highest HIV rate were observed in Amhara & Diredawa regions with prevalence of 0.50% 95%CI [0.40, 0.50] and the lowest rate was found in Oromiya 0.30%95%CI [0.30, 0.30]. In addition, SNNPR had the highest rate of HBV infection, 4.40% 95%CI [4.10,4.80] and the prevalence of HBV infection was found to be in Adiss Ababa 1.70% 95%CI [1.70,1.80] .

HIV prevalence in driver blood donors was 0.90% 95%CI [0.60, 1.40] and the prevalence was lowest in students 0.30% 95%CI [0.30, 0.40]. HBV prevalence was highest in Military, 4.60 % 95%CI [4.20, 5.10] and lowest in student, 2.30% 95%CI [2.30, 2.40].

The most prevalent type of TTIs in the study period was HBV and list prevalent was HCV. The frequency of TTIs was comparatively higher in 2014 5.70% 95%CI [5.40, 6.00] and lowest in 2019 3.40% 95%CI [3.20, 3.50] [*See table 2*].

Table 2: The prevalence of transfusion transmission disease with sociodemographic variables in different regions: six years donor data from fourteen blood bank facilities in Ethiopia, N= 554,954

Variables	Frequency	HIV%[95CI]	HBV%[95CI]	HCV%[95CI]	RPR%[95CI]	One infection %[95CI]
Sex						
Male	354707	0.38 [0.36, 0.40]	2.88 [2.82, 2.93]	0.42 [0.40, 0.45]	1.11[1.07, 1.14]	4.68 [4.61, 4.75]
Female	200247	0.40 [0.38, 0.43]	1.65 [1.59, 1.70]	0.39 [0.37, 0.41]	0.63[0.60, 0.67]	3.11 [3.03, 3.18]
Region						
Addis Ababa	270431	0.40 [0.40, 0.40]	1.70[1.70,1.80]	0.40 [0.40, 0.50]	0.90 [0.90, 0.90]	3.40 [3.30, 3.40]
Amhara	75946	0.50 [0.40, 0.50]	3.10[3.00,3.20]	0.40 [0.40, 0.50]	0.80 [0.80, 0.90]	5.10 [4.90, 5.20]
Diredawa	21211	0.50 [0.50, 0.70]	2.90[2.70,3.20]	0.40 [0.30, 0.40]	1.40 [1.30, 1.60]	5.10 [4.80, 5.40]
Harari	18606	0.40 [0.30, 0.50]	3.80[3.50,4.10]	0.40 [0.30, 0.50]	2.20 [2.00, 2.40]	6.50 [6.20, 6.90]
Oromia	111576	0.30 [0.30, 0.30]	2.90[2.80,3.00]	0.30 [0.30, 0.40]	0.80 [0.70, 0.80]	4.30 [4.10, 4.40]
SNNP	16056	0.40 [0.30, 0.50]	4.40[4.10,4.80]	0.50 [0.40, 0.70]	0.80 [0.70, 1.00]	6.10 [5.70, 6.50]
Tigray	41200	0.30 [0.30, 0.40]	3.10[3.00,3.30]	0.40 [0.30, 0.40]	1.10 [1.00, 1.20]	4.80 [4.60, 5.00]
Blood bank facility						
Adama	42467	0.30 [0.30, 0.40]	3.20 [3.00,3.30]	0.30 [0.30, 0.40]	0.90 [0.80, 1.00]	4.60 [4.40, 4.80]
Arbaminch	16056	0.40 [0.30, 0.50]	4.40 [4.10, 4.80]	0.50 [0.40, 0.70]	0.80 [0.70, 1.00]	6.10 [5.70, 6.50]
DebireMarkos	18390	0.50 [0.50, 0.70]	5.60 [5.30, 6.00]	0.60 [0.50, 0.70]	1.40 [1.20, 1.50]	7.80 [7.40, 8.20]
DebireTabor	12443	0.40 [0.30, 0.50]	3.00 [2.70, 3.30]	0.50 [0.40, 0.70]	0.70 [0.60, 0.90]	3.00 [2.70, 3.30]
Debrebirhan	13583	0.40 [0.30, 0.50]	2.30 [2.10, 2.60]	0.40 [0.30, 0.50]	1.20 [1.10, 1.40]	4.20 [3.80, 4.50]
Diredawa	21211	0.50 [0.50, 0.70]	2.90 [2.70, 3.20]	0.40 [0.30, 0.40]	1.40 [1.30, 1.60]	5.10 [4.80, 5.40]

Gonder	30359	0.40 [0.40, 0.50]	1.90 [1.70, 2.00]	0.20 [0.20, 0.30]	0.20 [0.20, 0.30]	4.10 [3.80, 4.40]
Harar	18606	0.40 [0.30, 0.50]	3.80 [3.50, 4.10]	0.40 [0.30, 0.50]	2.20 [2.00, 2.40]	6.50 [6.20, 6.90]
Jimma	22913	0.30 [0.20, 0.40]	2.60 [2.40, 2.80]	0.30 [0.20, 0.30]	0.60 [0.60, 0.80]	3.80 [3.50, 4.00]
Mekelle	41200	0.30 [0.30, 0.40]	3.10 [3.00, 3.30]	0.40 [0.30, 0.40]	1.10 [1.00, 1.20]	4.80 [4.60, 5.00]
Metu	13763	0.40 [0.30, 0.50]	2.20 [2.00, 2.50]	0.40 [0.30, 0.50]	0.80 [0.70, 1.00]	3.70 [3.40, 4.00]
National BS	270431	0.40 [0.40, 0.40]	1.70 [1.70, 1.80]	0.40 [0.40, 0.50]	0.90 [0.90, 0.90]	3.40 [3.30, 3.40]
Nekemt	16937	0.30 [0.20, 0.40]	3.30 [3.10, 3.60]	0.50 [0.40, 0.60]	0.80 [0.70, 0.90]	4.90 [4.60, 5.20]
Woliso	13785	0.20 [0.10, 0.30]	2.90 [2.60, 3.20]	0.20 [0.10, 0.30]	0.50 [0.40, 0.60]	3.80 [3.50, 4.10]
Year of donation						
2014	24087	0.80 [0.70, 0.90]	4.10 [3.80, 4.30]	0.80 [0.70, 0.90]	0.40 [0.30, 0.50]	5.70 [5.40, 6.00]
2015	85377	0.50 [0.50, 0.60]	3.00 [2.90, 3.10]	0.60 [0.60, 0.70]	0.90 [0.80, 0.90]	5.00 [4.80, 5.10]
2016	92816	0.50 [0.50, 0.60]	2.60 [2.50, 2.70]	0.40 [0.40, 0.40]	1.40 [1.30, 1.40]	4.80 [4.70, 4.90]
2017	141684	0.30 [0.20, 0.30]	2.00 [1.90, 2.10]	0.50 [0.50, 0.50]	0.80 [0.80, 0.90]	3.50 [3.40, 3.60]
2018	143189	0.30 [0.30, 0.30]	2.40 [2.30, 2.50]	0.20 [0.20, 0.20]	1.00 [0.90, 1.00]	3.90 [3.80, 4.00]
2019	67741	0.30 [0.30, 0.30]	2.00 [1.90, 2.10]	0.20 [0.20, 0.30]	0.80 [0.80, 0.90]	3.40 [3.20, 3.50]
Occupation						
Student	223912	0.30 [0.30, 0.40]	2.30 [2.30, 2.40]	0.30 [0.30, 0.30]	0.40 [0.40, 0.40]	3.40 [3.40,3.50]
Civil servant	61730	0.50 [0.40, 0.50]	3.40 [3.30, 3.50]	0.50 [0.40, 0.60]	1.80 [1.70, 1.90]	5.90 [5.70,6.10]
Teacher	2152	0.30 [0.20, 0.70]	4.10 [3.30, 5.00]	0.50 [0.30, 1.00]	1.90 [1.40, 2.50]	6.90 [5.90,8.10]
Driver	2655	0.90 [0.60, 1.40]	3.70 [3.10, 4.50]	0.60 [0.40, 1.00]	1.40 [1.00, 2.00]	6.70 [5.80,7.70]
Military	7735	0.60 [0.40, 0.80]	4.60 [4.20, 5.10]	0.50 [0.40, 0.70]	2.60 [2.30, 3.00]	7.90 [7.40,8.60]
Private	140425	0.50 [0.40, 0.50]	2.30 [2.30, 2.40]	0.60 [0.50, 0.60]	1.20 [1.10, 1.20]	4.50 [4.40,4.60]

worker						
Unemployed	2607	0.60 [0.40, 1.00]	4.00 [3.30, 4.80]	0.40 [0.20, 0.70]	3.50 [2.80, 4.20]	8.30 [7.30,9.40]
Age						
15-24	335446	0.40 [0.30, 0.40]	2.20 [2.20, 2.30]	0.30 [0.30, 0.40]	0.40 [0.40, 0.50]	3.30 [3.30, 3.40]
25-34	145589	0.40 [0.30, 0.40]	2.70 [2.70, 2.80]	0.40 [0.40, 0.50]	0.90 [0.80, 0.90]	4.30 [4.20, 4.50]
35-44	53447	0.50 [0.50, 0.60]	2.80 [2.70, 3.00]	0.60 [0.50, 0.70]	2.20 [2.10, 2.30]	6.00 [5.80, 6.20]
45-54	16808	0.70 [0.60, 0.80]	2.90 [2.70, 3.20]	0.70 [0.60, 0.80]	5.60 [5.20, 5.90]	9.40 [9.00, 9.90]
>=55	3618	0.30 [0.20, 0.50]	2.40 [1.90, 2.90]	0.60 [0.40, 0.90]	10.50 [9.60,11.60]	13.60 [12.50, 14.70]
Blood type						
O	149046	0.40 [0.40, 0.40]	2.40 [2.30, 2.50]	0.40 [0.40, 0.40]	0.90 [0.90, 1.00]	4.00 [3.90, 4.10]
A	146307	0.40 [0.40, 0.40]	2.50 [2.40, 2.50]	0.40 [0.40, 0.40]	1.00 [0.90, 1.00]	4.30 [4.20, 4.40]
B	77843	0.40 [0.30, 0.40]	2.80 [2.70, 2.90]	0.40 [0.30, 0.40]	1.00 [0.90, 1.00]	4.40 [4.30, 4.60]
AB	129890	0.40 [0.30, 0.40]	1.90 [1.80, 2.00]	0.40 [0.40, 0.50]	0.90 [0.90, 1.00]	3.50 [3.40, 3.60]
Place of Donation						
Static	15292	0.50 [0.40, 0.60]	2.40 [2.20, 2.70]	0.40 [0.30, 0.50]	1.20 [1.00, 1.30]	4.50 [4.10, 4.80]
Mobile	342393	0.40 [0.40, 0.40]	2.00 [2.00, 2.10]	0.40 [0.40, 0.50]	0.90 [0.90, 0.90]	3.70 [3.60, 3.80]
Donation type						
Replacement	25356	0.50 [0.40, 0.60]	3.50 [3.20, 3.70]	0.40 [0.30, 0.50]	1.60 [1.40, 1.70]	5.90 [5.60, 6.20]
Volunteer	385159	0.40 [0.40, 0.40]	2.10 [2.10, 2.20]	0.40 [0.40, 0.40]	0.90 [0.90, 1.00]	3.80 [3.80, 3.90]

Figure 3: Trends in the prevalence of transfusion transmittable infections among blood donors in Ethiopia

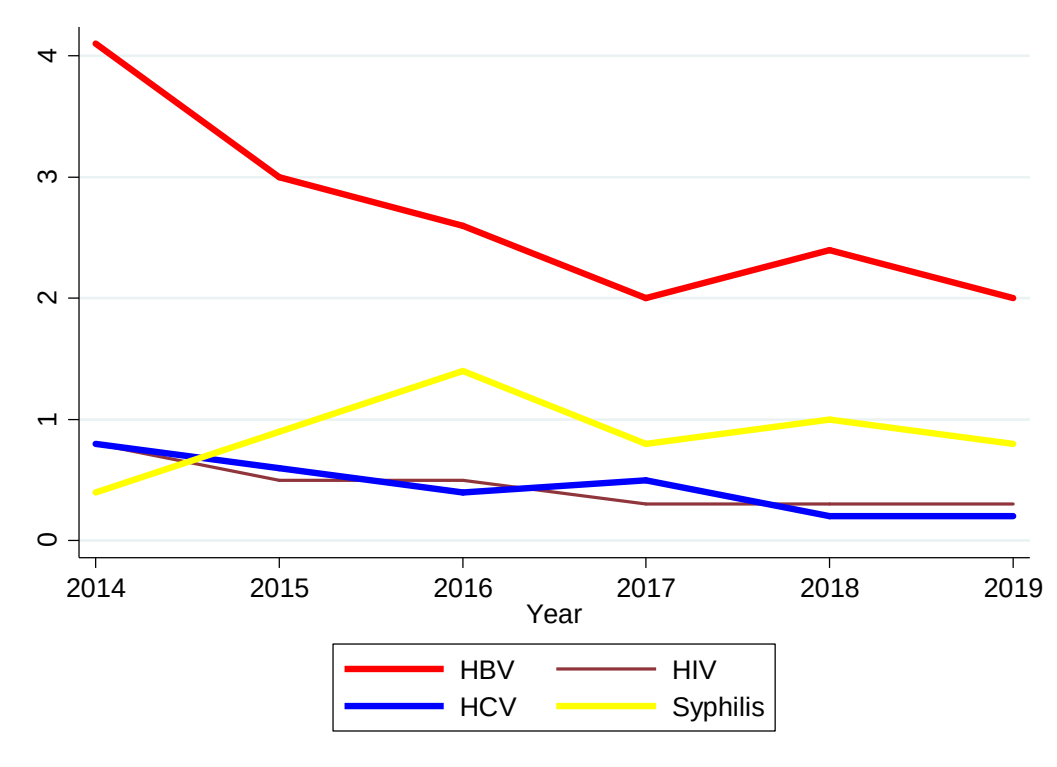
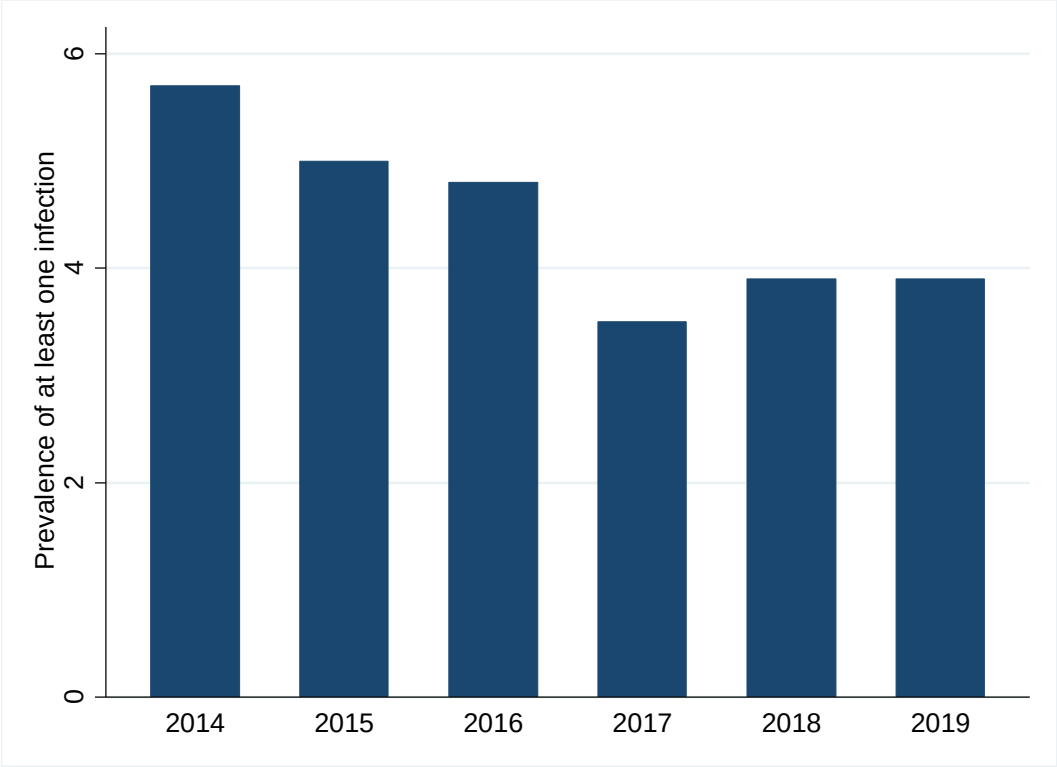


Figure 4: Trends in the magnitude of at least one transfusion transmittable infections among blood donors in Ethiopia



Factors associated with TTIs

As per the result of multivariate analysis the odds of having at least one infection among blood donors was 1.2 (AOR =1.2 ; 95% CI: 1.1 , 1.2) times higher in donors with age spanning from 25-34 years, 1.6 (AOR =1.6 ; 95% CI: 1.5 , 1.7) times higher for donors age spanning from 35-44 years, 2.7 (AOR =2.7 ; 95% CI: 2.5 , 3.0) times higher for donors age spanning from 45-54 years and 4.9 (AOR =4.9 ; 95% CI: 4.2 , 5.7) times higher for donors age above 55years compared to age spanning from 15-24 years

The odds of having at least one infection among blood donors was 1.2 (AOR =1.2 ; 95% CI: 1.1 , 1.3) times higher in male blood donors compared to female.

Regarding year of donation the odds of having at least one infection among blood donors in 2014 was 1.8 (AOR =1.8 ; 95% CI: 1.5 , 2.1) times higher compared to donors in 2015 1.4 (AOR =1.4 ; 95% CI: 1.3 , 1.6) times higher , among blood donors in 2016 1.2 (AOR =1.2 ; 95% CI: 1.1 , 1.4) times higher , among blood donors in 2017 0.8 (AOR =0.8 ; 95% CI: 0.7 ,0.9) times higher compared to blood donors in 2019

Regarding the occupations of donors, odds of having at least one infection among civil servant blood donors was 1.3 (AOR =1.3 ; 95% CI: 1.2 , 1.4) times higher, among Military blood donors 1.5 (AOR =1.5 ; 95% CI: 1.2 , 1.7) times higher , among Private worker blood donors 1.3 (AOR =1.3 ; 95% CI: 1.2 , 1.4) times higher and among Unemployed blood donors 2.4 (AOR =2.4 ; 95% CI: 2.0 ,2.8) times higher compared to blood donors who are students in occupations

Concerning mode of blood donations, the odds of having at least one infection among mobile site blood donors was 1.4 (AOR =1.4 ; 95% CI: 1.3, 1.6) times higher compared to static

Regarding the residence of donors the odds of having at least one infection among 2.residence2 blood donors 1.4 (AOR =1.4 ; 95% CI: 1.2 , 1.6) times higher, among 3.residence2 donors 1.9 (AOR =1.9 ; 95% CI: 1.8 , 2.0) times higher compared to blood donors who resides in 1b.residence2 (*see Table 3)*

Table 3: Multivariable logistic regression analysis for factors associated with transfusion transmission diseases: six years donor data from fourteen blood bank facilities in Ethiopia, n= 554,954

Category	One inf	HBV	HCV	Syphilis	HIV
	AOR [95%CI]	AOR [95%CI]	AOR [95%CI]	AOR [95%CI]	AOR [95%CI]
Age category					
15-24	1.00*	1.00*	1.00*.	1.00*.	1.00*.
25-34	1.2 [1.1 , 1.2] ***	1.1 [1.0, 1.2] ***	1.3 [1.1, 1.5] ***	1.3 [1.1, 1.5] ***	0.8 [0.7, 1.0] *
35-44	1.6 [1.5, 1.7] ***	1.2 [1.1, 1.3] ***	1.3 [1.1, 1.7] ***	3.0 [2.6, 3.5] ***	1.3 [1.0, 1.6] **
45-54	2.7 [2.5, 3.0] ***	1.3 [1.1, 1.5] ***	1.7 [1.2, 2.2] ***	8.6 [7.4, 10.0] ***	1.6 [1.2, 2.1] ***
>=55	4.9 [4.2, 5.7] ***	1.3 [0.9, 1.8]	0.8 [0.4, 1.8]	21.2 [17.5, 25.6] ***	0.6 [0.3, 1.6]
Sex					
Female	1.00*	1.00*.	1.00*.	1.00*.	1.00*.
Male	1.2 [1.1, 1.3] ***	1.4 [1.4, 1.5] ***	0.9 [0.8, 1.0] **	1.2 [1.1, 1.4] ***	0.9 [0.8, 1.0] *
Year of donation					
2014	1.8 [1.5, 2.1] ***	2.2 [1.8, 2.7] ***	14.7 [9.1, 23.8] ***	1.3 [0.9, 1.9]	4.2 [2.9, 6.3] ***
2015	1.4 [1.3, 1.6] ***	1.9 [1.7, 2.1] ***	3.6 [2.4, 5.3] ***	0.7 [0.5, 0.8] ***	1.4 [1.1, 1.8] **
2016	1.2 [1.1, 1.4] ***	1.4 [1.2, 1.6] ***	2.3 [1.6, 3.4] ***	1.3 [1.1, 1.6] **	1.4 [1.1, 1.8] ***

2017	0.8 [0.7, 0.9] ***	0.9 [0.8, 1.0]	2.3 [1.6, 3.4] ***	0.8 [0.7, 1.0] *	0.6 [0.4, 0.7] ***
2018	1.0 [0.9, 1.1]	1.2 [1.1, 1.3] ***	1.0 [0.7, 1.6]	1.0 [0.8, 1.2]	0.9 [0.7, 1.2]
2019	1.00*	1.00*	1.00*.	1.00*.	1.00*.
Occupation					
Student	1.00*.	1.00*.	1.00*.	1.00*.	1.00*.
Civil servant	1.3 [1.2, 1.4] ***	1.2 [1.1, 1.4] ***	1.4 [1.1, 1.7] **	2.4 [2.0, 2.9] ***	1.5 [1.2, 1.9] ***
Teacher	1.1 [0.8, 1.5]	1.0 [0.7, 1.5]	1.2 [0.5, 2.9]	2.2 [1.3, 3.7] ***	0.7 [0.2, 2.2]
Driver	0.9 [0.6, 1.4]	0.9 [0.5, 1.3]	1.3 [0.5, 3.6]	0.8 [0.3, 2.3]	1.9 [0.9, 4.2] *
Military	1.5 [1.2, 1.7] ***	1.6 [1.3, 1.9] ***	1.7 [1.0, 3.0] **	2.2 [1.6, 3.2] ***	1.7 [1.0, 2.8] *
Private worker	1.3 [1.2, 1.4] ***	1.1 [1.0, 1.2] **	1.2 [1.0, 1.4]	2.1 [1.8, 2.4] ***	1.1 [0.9, 1.3]
Unemployed	2.4 [2.0, 2.8] ***	1.6 [1.2, 2.0] ***	1.1 [0.4, 2.6]	8.1 [6.1, 10.7] ***	1.9 [1.1, 3.5] **
Blood type					
O	1.00*.	1.00*	1.00*.	1.00*.	1.00*.
A	1.1 [1.0, 1.1] **	0.9 [0.8, 1.0] ***	1.1 [1.0, 1.3]	1.1 [1.0, 1.2]	1.2 [1.0, 1.4] **
B	1.0 [0.9, 1.0]	1.0 [0.9, 1.1]	1.1 [0.9, 1.4]	1.1 [0.9, 1.3]	0.8 [0.7, 1.1]
AB	1.0 [0.9, 1.1]	1.0 [0.9, 1.1]	1.1 [0.9, 1.3]	1.0 [0.9, 1.2]	1.0 [0.8, 1.2]

Donation mode					
Static	1.00*.	1.00*	1.00*.	1.00*.	1.00*.
Mobile	1.4 [1.3, 1.6] ***	1.6 [1.4, 1.8] ***	1.6 [1.1, 2.2] ***	0.9 [0.8, 1.1]	1.4 [1.0, 1.8] **
Donation type					
Replacement	1.00*.	1.00*.	1.00*.	1.00*.	1.00*.
Volunteer	1.0.	1.0.	1.0.	1.0.	1.0.
Residence					
Urban/AA	1.00*.	1.00*.	1.00*.	1.00*.	1.00*.
Semi Urban	1.4 [1.2, 1.6] ***	1.6 [1.3, 1.9] ***	0.6 [0.4, 1.1]	1.6 [1.3, 2.1] ***	0.8 [0.5, 1.3]
Rural	1.9 [1.8, 2.0] ***	2.0 [1.9, 2.2] ***	1.1 [0.9, 1.3]	1.3 [1.1, 1.5] ***	0.9 [0.8, 1.1]

*** *p<0.01*, ** *p<0.05*, * *p<0.1*

Discussion

The result showed that the overall sero-prevalence of TTIs was 4.68% and 3.11% for male and female respectively. This finding is similar with the findings od a study done elsewhere in Rawalpindi, Pakistan which accounts 9.6%(Kamran, Mahmood et al. 2014).

In addition to these, previous studies done in Ethiopia at sub national level had similar findings with this survey. For instance, at Addis Ababa national blood bank of Ethiopia,the rate of TTIs was 9.5%(Gebregziabher, Meshasha et al. 2017), while at Hawassa and Yirgalem the rate was 7.29% and 7.0% respectively(Ajugwo, Erhabor et al. 2017, Bonja, Hussein et al. 2017, Hussein, Haj et al. 2017).

However, this study's finding was slightly higher compared to a studys done Pakistan, that had reported the rate up to 5.29%(Sadiq, Hashim et al. 2017). A study done in Yemen shows the rate of TTIs is 3.7%(Saghir, Al–Hassan et al. 2012). In addition, a study done in western Africa Uganda reported TTIs as 5.7%(Apecu, Mulogo et al. 2017) and in Eretria, 3.6% of donated blood was found to be positive for at least one of he TTI(Siraj, Achila et al. 2018). A study done in western Ethiopia Gondar had reportedTTIs prevalence as 6.55%(Bonja, Hussein et al. 2017) while in Harar regional state blood bank reported 6.6%(Teklemariam, Mitiku et al. 2018). In contrast, there are comparatively prevalence of TTIs in different African countries regarding are by far large that ranges fron29.82% in Burkina Faso to 12.0% in Kenya(Matee, Magesa et al. 2006, Nagalo, Sanou et al. 2011, Walana, Ahiaba et al. 2014, Abate and Wolde 2016, Bisetegen, Bekele et al. 2016, Wairimu, Herbert et al. 2016, Ajugwo, Erhabor et al. 2017, Okoroiwu, Okafor et al. 2018). In Ethiopia, the overall sero-prevalence of TTIs ranges from 8.2%-29.5%(Tigabu, Engda et al. 2019). The lowest record in was observed in North West Ethiopia , Gondor while highest prevalence were observed in Wolaita Sodo (Bisetegen, Bekele et al. 2016).

The discrepancies might be explained by variation in study population, total sample size, design, geographical differences, donor recruitment time period, strength of preliminary screening of donors and factors related to test algorithms used for screening, the test kits on the market, storage and validation of the test kits

In this study the prevalence of viral TTIs was 3.2%. Similarly study done in Democratic Republic of Congo had showen viral TTI prevalence of 3.9%,(Abate and Wolde 2016, Bisetegen, Bekele et al. 2016, Morar, Pitman et al. 2016). However, this study, TTI prevalence is higher than TTI prevalence seen by a a study done elsewhere in India showed 1.9% (Afrose, Arif et al. 2015), in addition a study done in Iraq showd that 0.98% of blood donors had sero positive for hepatitis B and C viruses,(Bonja, Hussein et al. 2017).

Sero-prevalence of HIV

Regarding specific viral TTIs in this study, the prevalence of HIV was 0.4% 95CI [0.4, 0.4] which is higher compared to a study done elsewhere in India. In Yemen and Eretria, sero prevalence of HIV among blood donors accounts for 0.09%,0.14% and 0.18% respectively(Fessehaye, Naik et al. 2011, Saghir, Al–Hassan et al. 2012, Afrose, Arif et al. 2015). Similarly the prevalence of viral TTIs in this study was fould to be higher than a prevalence in Jigjiga, 0.1%(Abate and Wolde 2016) the prevalence is lower compared in other African countries which ranged from 4.1% in Cameroon to 8.5% Mozambique,(Stokx, Gillet et al. 2011, Ajugwo, Erhabor et al. 2017)

In addition, the studies conducted in Hawasa blood bank and Yirgalem Hospital indicated viral sero prevalence of 1.6%(Sarah, El Halim et al. 2016, Bonja, Hussein et al. 2017). In addition, in eastern Ethiopia, the sero-prevalence of HIV was 1.4% among blood donors (eastern Ethiopia). The possible reason for this discrepancy could be difference in risky behaviors for HIV among donors. Besides the risky behavior inability to do proper through donor medical selection during donation will contribute for the variations.

Sero-prevalence of HBV

In this study, sero-prevalence of HBV was 2.4% 95CI [2.4, 2.5] which is more or less similar with a study done in Gondar and Dire Dawa with HBV prevalence of 3.6% & 3.7% respectively(Abate and Wolde 2016, Biadgo, Shiferaw et al. 2017).

The prevalence of HBV in this study is lower than the prevalence reported by other studies in most Africa countries. For instance, a study done in Nigeria, Mozambique and Equatorial Guinea had showed HBV (HBsAg) prevalence of 10.9%, 10.6% respectively in their respective blood

donors. (Stokx, Gillet et al. 2011, Xie, Li et al. 2015, Ajugwo, Erhabor et al. 2017). In addition, studies done at sub national level in Ethiopia shows higher figure compared to this study finding. For instance, a blood donor studyreveled that Jigjiga Eastern Ethiopia, Estern Ethiopia, Bahir Dar, Hawasa and Gondar had HBV seroprevalence of 10.9%, 6.6%, 4.11%, 4.8% & 4.7% respectively(Tessema, Yismaw et al. 2010, Assefa, Mathewos et al. 2013, Mohammed and Bekele 2016, Bonja, Hussein et al. 2017). The socio-cultural difference, differences in population risks, high endemicity for HBV in most African countries might be again the possible reasons for these differences.

Sero-prevalence of HCV

In this study, blood donors' sero-prevalence of HCV was 0.4% 95CI [0.4, 0.4] which is by far lower than studies done elsewhere in African countries. For instance in Equatorial Guinea, prevalence of HCV among blood donors was 3.7% (Xie, Li et al. 2015). In Kenya and Nigeria, the prevalence for HCV among donors were 3.2% and 2.8% respectively (Wairimu, Herbert et al. 2016, Ajugwo, Erhabor et al. 2017).

In this study the HCV prevalence in blood donors is lower than the HCV prevalence in Gondar, Jigjig and Hawasa which were 0.8%, 0.7% & 0.6% respectively(Abate and Wolde 2016, Biadgo, Shiferaw et al. 2017, Bonja, Hussein et al. 2017).

Sero-prevalence of syphilis

The overall sero-prevalence of syphilis among blood donors in this study was 0.9% 95CI [0.9, 1.0] It is lower than in the a study done elsewhere in Equatorial Guinea which accounts 21.5% (Xie, Li et al. 2015). In addition, studies done in Cameroon and Kenya reveled that sero-positive of syphilis among donors were 8.1% and 1.2% respectively(Moukoko, Sack et al. 2014, Wairimu, Herbert et al. 2016).

A study done in addis Ababa national blood bank showd sero positive of syphilis among blood donors was 1.3%(Gebregziabher, Meshasha et al. 2017). In contrast, the finding of this study is similar to some other studies done in Ethiopia. at Jigjiga and Hawasa blood bank, the syphilis prevalence was 0.7% &0.8% respectively(Abate and Wolde 2016, Bonja, Hussein et al. 2017).

The possible reason of discrepancy could be duration of the study, cultural differences and behavioral diferrences of the study participant.

Factors associated TTIs

In this study age is a significant predictor of HBV infections. the odds of having a HBV positive among blood donors 1.1 (AOR =1.1 ; 95% CI: 1.0 , 1.2) times higher for donors age spanning from 25-34 years, 1.2 (AOR =1.2 ; 95% CI: 1.1 , 1.3) times higher for donors age spanning from 35-44 years, 1.3 (AOR =1.3 ; 95% CI: 1.1 , 1.5) times higher for donors age spanning from 45-54 years compared to age spanning from 15-24 years. Similarly, study done in Eritrea, Bahir Dar blood bank age is a significant predictor of having a HBV and other TTIs among blood donors(Siraj, Achila et al. 2018, Shiferaw, Tadilo et al. 2019).

The odds of having HBV among blood donors is 1.4 (AOR =1.4 ; 95% CI: 1.4 , 1.5) times higher for male donors compared to female. At Bahir Dar blood bank sex is a significant predictor of having a TTIs among blood donors(Shiferaw, Tadilo et al. 2019). Concerning mode of blood donations, the odds of having HBV among mobile sites' blood donor is 1.4 (AOR =1.4 ; 95% CI: 1.3, 1.6) times higher compared to static sites. Similarly, in Bahirdar, mobile site blood donors had higher risk of HBV infection(Shiferaw, Tadilo et al. 2019).

In relations to occupations of blood donors, the odds of having HCV among civil servant blood donors is 1.4 (AOR =1.4 ; 95% CI: 1.1, 1.7) times higher, among Military blood donors 1.7 (AOR =1.7; 95% CI: 1.0, 3.0) times higher compared to students. Similarly in Bahir dar being government employed and unemployed were a significant predictors to have HCV infection(Shiferaw, Tadilo et al. 2019).

In this study age is a significant predictor for syphilis infections the odds of having a syphilis among blood donors 1.3 (AOR =1.3 ; 95% CI: 1.1 , 1.5) times higher for donors age spanning from 25-34 years, 3.0 (AOR =3.0 ; 95% CI: 2.6 , 3.5) times higher for donors age spanning from 35-44 years, 8.6 (AOR =8.6 ; 95% CI: 7.4 , 10.0) times higher for donors age spanning from 45-54 years and 21.2 (AOR =8.6 ; 95% CI: 7.4 , 10.0) compared to age spanning from 15-24 years. Similarly, study done in Bahir Dar blood bank age is a significant predictor of having a syphilis among blood donors(Shiferaw, Tadilo et al. 2019). The odds of having a syphilis among blood donors 1.2 (AOR =1.4; 95% CI: 1.1, 1.4) times higher for male donors compared to

female. Similarly, study done in Bahir Dar blood bank, sex is a significant predictor of having a syphilis among blood donors(Shiferaw, Tadilo et al. 2019)

Conclusions:

- There is high prevalence of transfusion transmissible infections (TTIs) in Ethiopia particularly HBV followed by syphilis. Comparatively the frequency of TTIs trend progressively reduced since start of study. TTIs was higher in 2014 5.7% and lowest in 2019 3.4%.
- Age, sex, occupation and mode of blood donations are significant predictors for HBV, HCV, HIV, syphilis infections.

Recommendation:

- In general, strict donor screening, testing and encouragement of blood donation from voluntary donors should be practiced for safe blood supply.
- Awareness creation on TTIs at community level should be strengthened at large
- In additions strengthen strategies to increase and motivate enrolment of safe regular donors.
- Scale up and strengthening post donation counselling, referral and linkage services.
- Moreover, further studies should be conducted meticulously using advanced prospective research methods

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Annexures

Logistic regression output

HCV infection	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
15-24	1.000	.	.	.	.	.	
25-34	1.378	0.071	6.20	0.000	1.245	1.526	***
35-44	1.838	0.123	9.13	0.000	1.613	2.095	***
45-54	2.156	0.213	7.77	0.000	1.776	2.618	***
>=55	1.834	0.407	2.73	0.006	1.187	2.832	***
Female	1.000	.	.	.	.	.	
Male	0.832	0.038	-4.01	0.000	0.760	0.910	***
2014.year	4.031	0.465	12.08	0.000	3.215	5.054	***
2015.year	2.584	0.241	10.16	0.000	2.152	3.103	***
2016.year	1.716	0.166	5.59	0.000	1.420	2.074	***
2017.year	2.061	0.185	8.06	0.000	1.729	2.457	***
2018.year	0.838	0.084	-1.75	0.080	0.688	1.021	*
2019b.year	1.000	.	.	.	.	.	
Addis	1.000	.	.	.	.	.	
Amhara	1.098	0.076	1.34	0.180	0.958	1.258	
DD	0.632	0.078	-3.74	0.000	0.497	0.804	***
Harar	0.699	0.088	-2.85	0.004	0.546	0.894	***
Oromia	0.796	0.051	-3.59	0.000	0.703	0.902	***
SNNp	1.632	0.188	4.26	0.000	1.302	2.045	***
Tigry	0.785	0.071	-2.69	0.007	0.658	0.937	***
Constant	0.002	0.000	-67.71	0.000	0.002	0.003	***

Mean dependent var	0.004	SD dependent var	0.063
Pseudo r-squared	0.020	Number of obs	541905.000
Chi-square	584.149	Prob > chi2	0.000
Akaike crit. (AIC)	27959.997	Bayesian crit. (BIC)	28150.446

**** p<0.01, ** p<0.05, * p<0.1*

Logistic regression output

Hbv infection	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
15-24	1.000	.	.	.	.	.	
25-34	1.255	0.026	10.98	0.000	1.205	1.307	***
35-44	1.347	0.040	10.10	0.000	1.271	1.427	***
45-54	1.403	0.067	7.09	0.000	1.277	1.540	***
>=55	1.120	0.124	1.03	0.303	0.903	1.391	
Female	1.000	.	.	.	.	.	
Male	1.594	0.033	22.37	0.000	1.531	1.661	***
2014.year	1.597	0.071	10.57	0.000	1.465	1.742	***
2015.year	1.630	0.057	14.07	0.000	1.523	1.745	***
2016.year	1.345	0.047	8.47	0.000	1.256	1.440	***
2017.year	1.040	0.035	1.15	0.248	0.973	1.111	
2018.year	1.198	0.039	5.49	0.000	1.123	1.277	***
2019b.year	1.000	.	.	.	.	.	
Addis	1.000	.	.	.	.	.	
Amhara	1.899	0.050	24.23	0.000	1.803	2.000	***
DD	1.515	0.067	9.40	0.000	1.389	1.651	***
Harar	1.937	0.081	15.73	0.000	1.783	2.103	***
Oromia	1.827	0.044	25.05	0.000	1.743	1.915	***
SNNp	3.175	0.135	27.16	0.000	2.921	3.451	***
Tigry	1.834	0.060	18.41	0.000	1.719	1.956	***
Constant	0.009	0.000	-136.26	0.000	0.008	0.010	***

Mean dependent var	0.024	SD dependent var	0.154
Pseudo r-squared	0.021	Number of obs	553653.000
Chi-square	2699.621	Prob > chi2	0.000
Akaike crit. (AIC)	124106.659	Bayesian crit. (BIC)	124297.472

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Logistic regression output

hiv	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
15-24	1.000	.	.	.	.	.	
25-34	0.994	0.054	-0.11	0.913	0.894	1.105	
35-44	1.378	0.096	4.63	0.000	1.203	1.579	***
45-54	1.859	0.183	6.30	0.000	1.533	2.255	***
>=55	0.811	0.246	-0.69	0.490	0.447	1.471	
Female	1.000	.	.	.	.	.	
Male	0.870	0.040	-3.00	0.003	0.795	0.953	***
2014.year	3.037	0.322	10.47	0.000	2.467	3.738	***
2015.year	1.754	0.148	6.64	0.000	1.486	2.070	***
2016.year	1.706	0.143	6.38	0.000	1.448	2.011	***
2017.year	0.848	0.074	-1.89	0.059	0.715	1.006	*
2018.year	0.992	0.084	-0.09	0.926	0.840	1.171	
2019b.year	1.000	.	.	.	.	.	
Addis	1.000	.	.	.	.	.	
Amhara	1.123	0.072	1.81	0.070	0.991	1.274	*
DD	1.061	0.108	0.58	0.563	0.869	1.295	
Harar	0.820	0.098	-1.65	0.098	0.648	1.037	*
Oromia	0.756	0.049	-4.31	0.000	0.665	0.859	***
SNNp	1.339	0.175	2.23	0.025	1.037	1.730	**
Tigry	0.631	0.062	-4.67	0.000	0.520	0.766	***
Constant	0.003	0.000	-72.05	0.000	0.003	0.004	***

Mean dependent var	0.004	SD dependent var	0.062
Pseudo r-squared	0.014	Number of obs	553655.000
Chi-square	395.383	Prob > chi2	0.000
Akaike crit. (AIC)	27788.780	Bayesian crit. (BIC)	27979.593

**** p<0.01, ** p<0.05, * p<0.1*

Logistic regression output

syphilis	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
15-24	1.000	.	.	.	.	.	
25-34	2.068	0.083	18.18	0.000	1.912	2.236	***
35-44	5.416	0.225	40.58	0.000	4.992	5.877	***
45-54	14.458	0.645	59.89	0.000	13.248	15.779	***
>=55	29.032	1.804	54.22	0.000	25.704	32.791	***
Female	1.000	.	.	.	.	.	
Male	1.218	0.041	5.85	0.000	1.140	1.301	***
2014.year	0.278	0.031	-11.35	0.000	0.222	0.346	***
2015.year	0.914	0.053	-1.56	0.119	0.817	1.023	
2016.year	1.487	0.077	7.62	0.000	1.343	1.646	***
2017.year	0.994	0.052	-0.12	0.906	0.897	1.101	
2018.year	1.040	0.053	0.76	0.447	0.940	1.149	
2019b.year	1.000	.	.	.	.	.	
Addis	1.000	.	.	.	.	.	
Amhara	1.579	0.074	9.80	0.000	1.441	1.730	***
DD	1.620	0.102	7.67	0.000	1.432	1.833	***
Harar	2.531	0.142	16.51	0.000	2.267	2.826	***
Oromia	1.378	0.057	7.74	0.000	1.270	1.494	***
SNNp	1.421	0.130	3.83	0.000	1.187	1.701	***
Tigry	1.776	0.094	10.84	0.000	1.601	1.970	***
Constant	0.003	0.000	-106.06	0.000	0.002	0.003	***

Mean dependent var	0.009	SD dependent var	0.096
Pseudo r-squared	0.095	Number of obs	553644.000
Chi-square	5559.127	Prob > chi2	0.000
Akaike crit. (AIC)	53250.505	Bayesian crit. (BIC)	53441.317

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Logistic regression output

one_infdum	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
15-24	1.000	.	.	.	.	.	
25-34	1.348	0.023	17.68	0.000	1.304	1.393	***
35-44	1.935	0.042	30.52	0.000	1.855	2.019	***
45-54	3.198	0.093	40.16	0.000	3.022	3.385	***
>=55	4.843	0.244	31.26	0.000	4.387	5.346	***
Female	1.000	.	.	.	.	.	
Male	1.306	0.021	16.82	0.000	1.266	1.348	***
2014.year	1.303	0.048	7.13	0.000	1.212	1.401	***
2015.year	1.514	0.042	15.09	0.000	1.434	1.597	***
2016.year	1.401	0.038	12.49	0.000	1.329	1.477	***
2017.year	1.039	0.027	1.45	0.146	0.987	1.094	
2018.year	1.087	0.028	3.21	0.001	1.033	1.144	***
2019b.year	1.000	.	.	.	.	.	
Addis	1.000	.	.	.	.	.	
Amhara	1.779	0.038	26.64	0.000	1.705	1.856	***
DD	1.380	0.047	9.54	0.000	1.292	1.474	***
Harar	1.783	0.058	17.90	0.000	1.674	1.900	***
Oromia	1.481	0.028	20.62	0.000	1.427	1.537	***
SNNp	2.364	0.085	23.88	0.000	2.202	2.536	***
Tigry	1.535	0.040	16.31	0.000	1.458	1.617	***
Constant	0.018	0.000	-150.81	0.000	0.017	0.019	***

Mean dependent var	0.041	SD dependent var	0.199
Pseudo r-squared	0.025	Number of obs	542172.000
Chi-square	4650.047	Prob > chi2	0.000
Akaike crit. (AIC)	181391.237	Bayesian crit. (BIC)	181581.693

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Logistic regression output

one_infdum	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
15-24	1.000	.	.	.	.	.	
25-34	1.348	0.023	17.68	0.000	1.304	1.393	***
35-44	1.935	0.042	30.52	0.000	1.855	2.019	***
45-54	3.198	0.093	40.16	0.000	3.022	3.385	***
>=55	4.843	0.244	31.26	0.000	4.387	5.346	***
Female	1.000	.	.	.	.	.	
Male	1.306	0.021	16.82	0.000	1.266	1.348	***
2014.year	1.303	0.048	7.13	0.000	1.212	1.401	***
2015.year	1.514	0.042	15.09	0.000	1.434	1.597	***
2016.year	1.401	0.038	12.49	0.000	1.329	1.477	***
2017.year	1.039	0.027	1.45	0.146	0.987	1.094	
2018.year	1.087	0.028	3.21	0.001	1.033	1.144	***
2019b.year	1.000	.	.	.	.	.	
Addis	0.423	0.015	-23.88	0.000	0.394	0.454	***
Amhara	0.753	0.029	-7.32	0.000	0.698	0.812	***
DD	0.584	0.028	-11.42	0.000	0.532	0.640	***
Harar	0.754	0.035	-6.11	0.000	0.689	0.826	***
Oromia	0.627	0.023	-12.52	0.000	0.582	0.674	***
SNNp	1.000	.	.	.	.	.	
Tigry	0.650	0.027	-10.33	0.000	0.599	0.705	***
Constant	0.043	0.002	-76.74	0.000	0.040	0.047	***

Mean dependent var	0.041	SD dependent var	0.199
Pseudo r-squared	0.025	Number of obs	542172.000
Chi-square	4650.047	Prob > chi2	0.000
Akaike crit. (AIC)	181391.237	Bayesian crit. (BIC)	181581.693

**** p<0.01, ** p<0.05, * p<0.1*