

Transfusion Transmissible Infections Among Voluntary Blood Donors at Dessie Blood Bank, Northeast Ethiopia: Cross-Sectional Study

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Background: The prevalence of transfusion transmitted infections (TTIs) among blood donors varies across different geographical populations. Establishing the sero-prevalence of the disease among blood donors is important to informing the direction of preventive and control strategies.

Objective: The aim of this study was to determine the sero-prevalence of transfusion transmitted infections among voluntarily blood donors at Dessie Blood Bank, North East Ethiopia.

Methods and Materials: A cross-sectional study was conducted from November 10 to December 12, 2018. A total of 384 blood donors were conveniently included in this study. Socio-demographic data and other factors were collected using a pre-tested structured questionnaire. Five milliliters of venous blood was collected using a sterile test tube from each blood donor and the blood was allowed to clot; then, serum was separated by centrifugation for laboratory investigation. Serum samples from blood donors were tested by enzyme-linked immunosorbent assays (ELISA) for the presence of hepatitis B surface antigen (HBsAg), and antibodies to human immunodeficiency virus (HIV-1/2), hepatitis C virus (HCV), and *Treponema pallidum*. Logistic regression was used to explore risk factors associated with each transfusion transmissible infection.

Results: From a total of 384 blood donors, 24 (6.25%) of them had serological evidence for at least one infection. The overall sero-prevalence rates of HBV, HCV, HIV, and syphilis among blood donors were 4.2%, 0%, 0.26%, and 1.82%, respectively. Educational status was significantly associated with HBV infection. Multiple sexual behaviors had statistically significant association with syphilis.

Conclusion: In conclusion, 6.25% of blood donors still harbor transfusion transmissible infections despite recent blood donation safety improvements with the greater majority (4.2%) of cases caused by HBV infection.

Keywords: transfusion transmitted infections, HBV infection, syphilis, HCV infection, HIV infection, Ethiopia

Introduction

Blood transfusion is an effective treatment for saving millions of lives worldwide each year. However, unsafe transfusion leads to many life-threatening complications and increases the possibility of transfusion-transmitted infections (TTIs).¹ The magnitude of this problem is directly related to the prevalence of TTIs among blood donors.²

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In a country like Ethiopia, where national blood transfusion services and policies, appropriate infrastructure, trained personnel, and financial resources are inadequate, blood safety remains an issue of major concern in transfusion medicine.³ An essential requirement in the procurement of safe blood is to have a national program for donor selection, recruitment, retention, and education; this could limit disease transmissions to the recipients. Common TTIs are human immunodeficiency virus (HIV), hepatitis B virus (HBV), hepatitis C virus (HCV), and syphilis, because of their prolonged viraemia and carrier or latent state.⁴

The study on TTIs among blood donors is of paramount importance to evaluate the burden and risk factors for TTIs in the general population.⁵ The prevalence of TTIs among blood donors varies across the world, as well as within countries. In sub-Saharan Africa, about 0–1.1% of HIV infections were related with blood transfusion.⁶ TTIs can be transmitted from one infected individual to another during delivery, by unprotected sex, and by sharing needles. HBV is highly infectious and relatively easy to be transmitted and has a relatively higher prevalence in the tropics.⁷ According to various studies conducted in different part of Ethiopia^{3,8–13} the overall sero-prevalence of TTIs was 2.4–29.5%.

The World Health Organization (WHO) recommended the quality-assured screening of all donated blood for TTIs, including HIV, HBV, HCV, and syphilis, and this was adopted by the Ethiopian government for the provision of safe and efficacious blood and blood components.¹⁴ Accordingly, continuous evaluation of the burden of TTIs in blood donors is significant for estimating the risk of transfusion and enhancing donor selection strategies to reduce infectious diseases transmission.³

Even though, there are few epidemiological studies conducted in Ethiopia on TTIs among blood donors^{3,8–12} most of them are retrospective. Also, due to the lack of understanding, un-availability of screening tests, limited access to health facilities, and the unavailability of surveillance systems, the accurate figures of TTIs in our population are still unknown, particularly in this study area. Therefore, the aim of this study was to determine the sero-prevalence of TTIs among voluntarily blood donors at Dessie Blood Bank, North East Ethiopia.

Methods and Materials

Study Area, Period, and Design

A facility-based cross-sectional study was conducted at Dessie Blood Bank from November 10 up to

December 12, 2018. Dessie Blood Bank is found in Dessie town, South Wollo Zone, Amhara National Regional State, North Eastern Ethiopia. The town is located at a distance of 401 Km from Addis Ababa, the capital city of Ethiopia. Its astronomical location is 11°8'N latitude and 39°38'E longitude.

Study Population and Sampling Technique

The study population was blood donors who were prospectively recruited in the study during the study period. To include blood donors who were eligible for donation, consented, interviewed, and gave blood for screening of TTIs, the convenient sampling technique was used. All participants who fulfilled the national and regional blood bank criteria were included and those who did not meet the inclusion criteria (<50 Kg, <18 years, >65 years, and unwillingness to give informed consent) were excluded from the study.

Sample Size Determination

The sample size was determined using sample size determination for estimation of a single population proportion formula and the following assumption was considered: 95% confidence interval ($Z_{\alpha/2}=1.96$), 50% proportion, and 5% margin of error.

$$n = \frac{(z_{\alpha/2})^2 * P(1 - P)}{d^2} = 384$$

Sample Collection and Laboratory Processing

Socio-demographic data, and other factors were collected using interview by a pre-tested structured questionnaire. From each blood donor, 5 mL of venous blood was collected using a sterile test tube and it was allowed to clot, then serum was separated by centrifugation at a speed of 3, 500 revolutions per minute for 5 minutes. The samples were screened for HIV-1 and -2 using a Vironostika HIV Uni-Form II Ag/Ab fourth generation ELISA (Bio-Merieux, Boxtel, Netherlands), HBsAg: a third generation ELISA, Hepanostika HBsAg UNi-Form II (Bio-Merieux), HCV: Human anti-HCV third generation ELISA (Human Gasellschaft for Bio-chemical and diagnostic MbH, Germany), and syphilis by using WANTAI anti-TP ELISA (Bejieng wantai biological pharmacy). All tests were performed according to the manufacturer's instructions.

Data Analysis

Epi-info version 3.5.1 was used to enter the data and it was transferred to SPSS version 20 software for analysis. Summary statistics such as frequencies and percentages were computed. The results were presented using words and tables. The binary logistic regression was used to assess the association between independent and dependent variables. The odds ratio and its 95% confidence interval (CI) were used to determine the strength of the association. A $P < 0.05$ was taken as statistically significant.

Data Quality Management

Laboratory investigations were done by an experienced laboratory technologist with at least 2 years work experience. Standard operational procedures were strictly followed and quality control materials were used for all serological tests. Careful cleaning, coding, and entering of data were done.

Ethical Considerations

The study was conducted after ethical clearance was obtained from the Department of Medical Laboratory Sciences, College of Medicine and Health Sciences, Wollo University, and permission was also obtained from Dessie Blood Bank. Written informed consent was obtained from all study participants before data collection. Confidentiality of the study participants was also strictly maintained by using data without any personal identifier. Positive donors for any infection were informed and requested to visit health institutions. This study was fully conducted in accordance with the ethical consideration of the Declaration of Helsinki.

Results

Socio-Demographic Characteristics of the Blood Donors

A total of 384 blood donors participated in this study, and more than half of them (213, 55.5%, and 217, 56.5%) were male and aged 18–24, respectively. The median age of the donors was 23 years, with the range between 18–50 years. The majority (274, 71.4%) of the study participants were unmarried (Table 1).

Sero-Prevalence of Transfusion Transmissible Infections

From a total of 384 blood donors, 24 (6.25%) had serological evidence for at least one infection. Hepatitis B virus was the most prevalent of the TTIs (16/384, 4.2%) among

Table 1 Socio-Demographic Characteristics of Blood Donors at Dessie Blood Bank, North East Ethiopia, 2018

Characteristics	N (%)
Sex	
Male	213 (55.5)
Female	171 (45.5)
Address	
Rural	40 (10.4)
Urban	344 (89.6)
Age group	
18–24	217 (56.5)
25–34	137 (35.7)
≥35	30 (7.8)
Educational status	
Illiterate	25 (6.5)
Literate	359 (93.5)
Occupation	
Employed	180 (46.9)
Unemployed	204 (53.1)
Marital status	
Unmarried	274 (71.4)
Married	110 (28.6)

blood donors. The overall sero-prevalence rates of HBV, HCV, HIV, and syphilis among blood donors were 4.2%, 0%, 0.26%, and 1.82%, respectively. Among those who have the TTIs, 15/24 (62.5%) were male, 15/24 (62.5%) were unemployed, 20/24 (83.3%) were unmarried, 19/24 (79.1%) were urban area dwellers, and 18/24 (75%) were within the age group of 18–24 years.

Prevalence and Associated Factors of HBV

The overall sero-prevalence of HBV among blood donors was 16 (4.2%). Its prevalence was 5.2% among males and 2.9% among females (Table 2). The age-specific distribution of HBV infection revealed that a high prevalence among blood donors within the age group of 18–24 years shows 13 (6%) and low prevalence 2 (1.5%) among blood donors within the age group of 25–34 years. Regarding the educational status of the blood donors, 3/25 (12%) of the illiterate and 13/359 (3.6%) of the literate had evidence of HBsAg sero-positivity (Table 2).

In binary logistic regression analysis only educational status was significantly associated with HBV infection. Those illiterate blood donors (AOR=16.95, 95%

Table 2 Sero-Prevalence of HBV Infection Regarding Socio-Demographic Characteristics and Personal Behavior of Blood Donors at Dessie Blood Bank, North East Ethiopia, 2018

Variable	HBV+	COR (95% CI)	P-value	AOR (95% CI)	P-value
	n (%)				
Sex					
Male	11/213 (5.2)	1.81 (0.62–5.31)	0.281	0.728 (0.178–2.98)	0.659
Female	5/171 (2.9)	1	-	1	
Address					
Rural	3/40 (7.5)	2.06 (0.56–7.58)	0.275	0.934 (0.148–5.9)	0.942
Urban	13/344 (3.8)	1	-	1	
Age group					
18–24	13/217 (6)	1.85 (0.23–14.7)	0.561	2.98 (0.23–38.7)	0.404
25–34	2/137 (1.5)	0.43 (0.038–4.9)	0.496	0.40 (0.03–6.1)	0.512
≥35	1/30 (3.3)	1	-	1	
Educational status					
Illiterate	3/25 (12)	3.63 (0.96–13.7)	0.057	16.95 (1.66–172.9)	0.017*
Literate	13/359 (3.6)	1	-	1	
Occupation					
Employed	4/180 (2.2)	0.36 (0.12–1.2)	0.085	0.59 (0.12–3.03)	0.526
Unemployed	12/204 (5.9)	1	-	1	
Marital status					
Unmarried	14/274 (5.1)	2.91 (0.65–13.01)	0.163	1.94 (0.26–14.5)	0.517
Married	2/110 (1.8)	1	-	1	
Multiple sexual behavior					
Yes	5/78 (5.1)	1.84 (0.62–5.45)	0.273	2.43 (0.74–8.01)	0.144
No	11/306 (3.6)	1	-	1	
Nose piercing					
Yes	1/24 (4.2)	1 (0.13–7.9)	0.999	7.65 (0.39–151.9)	0.182
No	15/360 (4.2)	1	-	1	
Ear piercing					
Yes	2/155 (1.3)	4.98 (1.12–22.24)	0.035	0.093 (0.009–0.93)	0.043
No	14/229 (6.1)	1	-	1	

Note: *Significant values.

Abbreviations: HBV, hepatitis B virus; COR, crude odds ratio; AOR, adjusted odds ratio; CI, confidence interval

CI=1.66– 172.9, $P=0.017$) were at higher risk of HBV infection compared to the literate blood donors (Table 2).

Prevalence and Associated Factors of Syphilis

The sero-prevalence of syphilis among blood donors was 7/384 (1.82%). The prevalence of syphilis was higher among male (4, 1.9%) blood donors compared with female (3, 1.75%) donors. Regarding the age group, a high prevalence was observed among blood donors within the age group of 25–34 years, which showed 3 (2.2%) (Table 3). In both bivariable and multivariable binary logistic

regression analysis, having multiple sexual behavior was the only variable which showed a statistically significant association with syphilis. The odds of syphilis among those who had multiple sexual behavior were about 7-times higher than among those who had no multiple sex behavior (AOR=7.13; CI=1.4–36.3) (Table 3).

Discussion

Blood transfusion is considered to be a potential risk factor for the transmission of blood-borne infections such as HBV, HCV, HIV, and syphilis, which are the greatest threats to blood safety for the recipient. The

Table 3 Sero-Prevalence of Syphilis Infection Regarding Socio-Demographic Characteristics and Personal Behavior of Blood Donors at Dessie Blood Bank, North East Ethiopia 2018

Variable	Syphilis+	COR (95% CI)	P-value	AOR (95% CI)	P-value
	n (%)				
Sex					
Male	4/213 (1.9)	1.07 (0.24–4.9)	0.928	0.94 (0.187–4.8)	0.944
Female	3/171 (1.75)	1		1	
Address					
Rural	1/40 (2.5)	1.44 (0.17–12.3)	0.737	1.04 (0.099–10.9)	0.974
Urban	6/344 (1.74)	1		1	
Age group					
18–24	4/217 (1.84)	1		1	
25–34	3/137 (2.2)	1.19 (0.26–5.41)	0.820	0.27 (0.035–2.08)	0.210
≥35	0		0.998		0.998
Educational status					
Illiterate	1/25 (4)	2.45 (0.28–21.2)	0.415	2.69 (0.21–35.5)	0.451
Literate	6/359 (1.67)	1		1	
Occupation					
Employed	5/180 (2.8)	2.89 (0.55–15.06)	0.209	5.22 (0.74–36.8)	0.097
Unemployed	2/204 (0.98)	1		1	
Marital status					
Unmarried	5/274 (1.8)	1.004 (0.19–5.3)	0.996	0.973 (0.13–7.4)	0.979
Married	2/110 (1.8)	1		1	
Multiple sexual behavior					
Yes	4/78 (5.1)	5.46 (1.2–24.9)	0.028*	7.13 (1.4–36.3)	0.018*
No	3/306 (0.98)	1		1	

Note: *Significant values.

Abbreviations: COR, crude odds ratio; AOR, adjusted odds ratio; CI, confidence interval.

current study tried to show the sero-prevalence of TTI among blood donors at Dessie blood bank, Ethiopia. In the current study, the overall sero-prevalence of TTIs was 24 (6.25%). The finding is consistent with previous reports from different parts of Ethiopia, such as Bahir Dar (6%),⁹ Gondar (6.55%),¹⁰ Hawassa (7%),¹¹ and Dire Dawa (7.06%).¹² However, this finding is lower compared to other studies conducted in different parts of the country, such as Eastern Ethiopia (12.4%),¹⁵ Jijiga (11.5%),¹⁶ Gondar (9.5%),³ and Wolaita Sodo (29.5%).¹³ Similarly, it is also lower than reports from different areas of Africa such as Eritrea (12.9%),¹⁷ Kenya (14.1%),¹⁸ Burkina Faso (24.0%),¹⁹ and Cameroon (13.7%).²⁰ In another way, the sero-prevalence finding in the current study is slight higher as compared to previous reports from different parts of Ethiopia, such as Debre Tabor (4.6%),²¹ and North Shoa, central Ethiopia (2.4%).⁸ Likewise, the rate of TTIs in the current study is somehow

higher than different research reports from other countries, like Eritrea (3.6%),²² Ghana (4.06%),²³ India (4.36%),²⁴ and Pakistan (5.8%).¹ The possible reasons for the discrepancy in the total sero-prevalence of TTIs between various studies could be variation in the total sample size, in the nature of the study population, research method used, time period, the test kits on the market, storage, and validation of the test kits.

Donors with a sero-positive result for HBV in the current study totalled 16 (4.2%), which is comparable with reports in Hawassa, Ethiopia (4.8%),¹¹ Gondar (4.7% and 3.6%),^{3,10} Bahir Dar (3.9%),⁹ and Dire Dawa (3.73%).²⁵ But it is higher than reports from Pakistan (1.84%),¹ Debre Tabor (2.76%),²¹ and India (1.61%).²⁴ On the other hand, as compared to reports from other studies in Wolaita Sodo (9.5%)¹³ and in Ghana (9.6%),²⁶ the sero-prevalence in the current study is low. The variation in the sero-prevalence across studies might be due to

differences in socio-demographic, cultural and societal behavior, socio-economic status, and awareness of the population. In addition, methods of laboratory diagnosis used for screening can also be possible reasons.

According to the current study, illiterate blood donors (AOR=16.95, 95% CI=1.66–172.9, $P=0.017$) were more likely to have HBV infection compared to literate donors. The relatively higher HBV sero-positivity among the illiterate might be attributed to poor awareness regarding mode of transmission due to their low educational status in which these individuals might have sexual contact and share sharp materials with a person infected with these type of TTI.

In our study, the sero-prevalence of HIV among blood donors was 0.26%, which is lower compared to previous studies conducted in Ethiopia (3.8%³ and 2.24%)¹⁰ and elsewhere in the world, like 1.4% in Nigeria²⁷ and 1% reported in Cameroon.²⁸ However the finding is comparable with previous studies from other countries such as India (0.32%,²⁴ 0.6%,²⁹ 0.2%,³⁰ and 0.34%),³¹ Pakistan (0.04%),¹ China (0.31%),⁴ and other parts of Ethiopia, specifically North Shoa (0.25%),⁸ and Harar (0.6%).³² These variations could also be due to actual changes in population risks or effectiveness of donor screening measures.

The prevalence of HCV infection among blood donors in this study was 0.00%, which is slightly comparable with previous studies (0.2%) in south west Ethiopia³³ and elsewhere in the world; 0.06% in Pakistan,³⁴ and 0.03% in Bangladesh.³⁵ On the other hand, this finding is much lower than previous studies done in Nigeria (2.5%)²⁷ and Kenya (3.21%).³⁶ The wide variations of HCV sero-prevalence in different studies might be due to differences in risk behaviors such as injecting drug use and sharing objects for skin piercing between different geographical areas, use of different methods for testing, and use of different generation of ELISA test kits, having different sensitivities and specificities and use of different sample size.

The overall (1.82%) sero-prevalence of syphilis in this study is consistent to previous reports like 1.3% in Gondar,³ 1.2% in Bahir Dar,⁹ 1.45% in India,³⁰ and 1.56% in Kenya.³⁶ However, it is lower than the 7.9% in Wolaita Sodo¹³ and 8.1% in Cameroon,²⁰ but is higher than the 0.74% in Debre Tabor,²¹ the 0.5% in Hawassa,¹¹ the 0.71% in North Shoa,⁸ the 0.6% in Eritrea,²² and the 0.05% in India.²⁹ Variation observed in sero-prevalence may be attributed to differences in geographical setting,

sample size, and use of different methods for testing. In this study multiple sexual behavior was significantly associated with higher risk of syphilis (AOR=7.13, 95% CI=1.4–36.3, $P=0.018$). This could be due to poor awareness about sexually transmitted diseases.

Limitation of the Study

These findings may, however, not precisely reflect the prevalence of the blood donor population due to the donor selection processes involved. Another weakness may be associated with intrinsic weakness of the diagnostic test used in this study use of serological and it would be better if nucleic acid based techniques had been used. Therefore, the results reported in this study may underestimate (presence of a window period) the frequency of TTIs among donors in this population. Another concern is the question on sex life style is associated with stigma, with a possibility of influence on overall risk estimate.

Conclusion and Recommendations

In conclusion, 6.25% of blood donors still harbor transfusion transmissible infections despite recent blood donation safety improvements with the greater majority (4.2%) cases caused by HBV infection. Promoting awareness creation regarding transmission of TTIs and early uptake of HBV screening test with subsequent vaccination would help reduce TTIs burden observed among blood donors. Further prospective studies should be conducted rigorously with advanced methods and a large sample size.

Abbreviations

HBV, hepatitis B virus; HCV, hepatitis C virus; HIV, human immunodeficiency virus; TTIs, transfusion-transmissible infections; WHO, World Health Organization.

Data Sharing Statement

The data that support the findings of this study are available upon reasonable request from the corresponding author.

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Author Contributions

All authors made substantial contributions to the conception and design, involved in data collection and laboratory work, data analysis, drafting, or revising the article, have agreed on the journal to which the article will be submitted, gave final approval of the version to be published, and agree to be accountable for all aspects of the work.

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Disclosure

The authors declare that they have no conflicts of interest.

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