

ORIGINAL ARTICLE**Seroprevalence of Human Immunodeficiency Virus, Hepatitis B Virus, Hepatitis C Virus, and Syphilis among Blood Donors at Jigjiga Blood Bank, Eastern Ethiopia****Melese Abate¹, Tesfaye Wolde¹****ABSTRACT**

BACKGROUND: *Transfusion-transmissible infectious agents such as human immunodeficiency virus (HIV), hepatitis B virus (HBV), hepatitis C virus (HCV), and Syphilis are among the greatest threats to blood safety for recipients. They are also the leading causes of death and chronic and life-threatening abnormalities.*

METHODS: *A retrospective analysis of consecutive blood donors' records covering the period between January 2010 and December 2014 was conducted to analyze for seroprevalence of HIV, HBV, HCV and syphilis among blood donors aged 17-65 years. The association of these infections with age group, blood group, their co-infection rate and year trends were analyzed. Linear regression analysis was used to determine trends of HIV, HBV, HCV and syphilis infections. Sterile venous anti-coagulated blood was collected from the donors and analyzed using highly sensitive and specific kits.*

RESULT: *From the total of 6827 consecutive blood donors, 963(14.1%) had serological evidence of infection with at least one pathogen and 73(1.07%) had multiple infections. The overall seroprevalence of HIV, HBV, HCV and syphilis was 3.16%, 9.48%, 0.73% and 0.73% respectively. Among those with multiple infections, the most common combinations were HIV-HBV 41/73(56.2%). Blood group "O positive" was the most common with 51.62% followed by "A positive". Moreover, significantly declining trends of HIV, HCV and syphilis seropositivity were observed over the study period.*

CONCLUSION: *A substantial percentage of the blood donors harbour HIV, HBV, HCV and syphilis infections. Strict selection of blood donors and comprehensive screening of donors' blood using standard methods are highly recommended to ensure the safety of blood for recipients.*

KEYWORDS: *HIV, HBsAg, HCV, Syphilis, Infectious pathogens, Blood donors, Jigjiga*

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INTRODUCTION

Human immunodeficiency virus (HIV), hepatitis B virus (HBV) and hepatitis C virus (HCV) are of more important concern because of their prolonged presence in the blood and carrier or latent state. They are the leading causes of death and chronic and life-threatening abnormality. Blood transfusion accounts for 5-10% of HIV infections in sub-Saharan Africa (1). The United Nations Program on HIV/AIDS (UNAIDS) estimates that 24.5 million people are currently infected with HIV in sub-Saharan Africa,

comprising more than 70% of the global HIV-infected population (2).

Based on a single point estimate, there are nearly 1.2 million people living with HIV/AIDS in Ethiopia. The prevalence rate in adults is estimated at 2.4% and the incidence rate is 0.29%. The prevalence and incidence rates significantly vary between geographical areas and with gender. The urban prevalence rate is estimated at 7.7%, while the rural prevalence rate is 0.9%. The prevalence rate is 1.7% for males and 2.6% for females. Among urban settings, the epidemic varies greatly from 2.4 in Somali region to 9.9% in Tigray,

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10.7% in Amhara and 10.8% in Afar regions. Rural HIV epidemic also varies significantly among regions with rural HIV prevalence ranging from 0.4% in Somali region to 1.5% in Amhara region (3).

HIV transmission occurs through sexual contact, exposure to contaminated blood or blood products and perennally. HIV recognizes host cells by binding to the CD4 cell membrane receptor and multiplies within the host cell. HIV is one of the members of the human retrovirus and is associated with three presentations: asymptomatic infection, acute infection with symptoms, and acquired immune deficiency syndrome (AIDS). The last one is characterized by progressive immune deficiency accompanied by a wide range of opportunistic infections. HIV infection is detected by demonstrating HIV-specific antibodies with different test kit, and polymerase chain reaction detects the HIV genome in infected cells. Infection is prevented by screening blood products for HIV and education people to prevent transmission by sexual contact and sharing of needles (4).

Hepatitis B virus (HBV) infection is a global health problem having 10 times great impact than AIDS. Worldwide, about 350 million people are chronic carriers of hepatitis B virus. Out of them, one-fourth is dying due to cancer or cirrhosis of liver (5, 6). In Indonesia (1981), 10% of the blood donors were positive for HBsAg (7). In Kinshasa and Democratic Republic of Congo, among 7,277 blood donors, the incidences of HIV and HBsAg were 6.5% and 9.2% respectively (8). In Addis Ababa, in 1966, the mean prevalence of HBsAg among 1,260 households was 6.1% (9). The reported prevalence of carriers varies greatly from 0.1% in the developed countries to 20% in some developing countries. There are no seasonal trend for HBV infection and high predilection for any age group. However, there are definite high-risk groups such as parenteral drug abusers, institutionalized persons, health care personnel, multiple transfused patients, organ transplant patients, hemodialysis patients and staff (10). The virus is highly infectious and relatively easy to be transmitted from one person to another by blood-to-blood contact, during birth, via unprotected sex and by sharing needles(11).

The WHO (1997) estimates that approximately 3% of the world's population is to be infected with HCV and viremia persists in over 80%. In developing countries, the prevalence of antibodies to HCV is much higher, with reported rates reaching 4% to 6% in some parts of Africa and the Middle East (12). It is estimated the overall prevalence of HCV in Sub-Saharan Africa is 3.0%. The central African region has the highest estimated prevalence of 6%, West Africa with an estimated prevalence of 2.4%, and southern and east Africa with the lowest estimated prevalence of 1.6% (13). The prevalence of HCV infection varies throughout the world, the highest number of infection ranging from 6% to 28% in Egypt (14). The prevalence of antibody to HCV (anti-HCV) in healthy adult Ethiopian blood donors was 1.4% (15). Hepatitis C virus prevalence was 0.9% for the total population and 1.3% for adults over 15 years of age in a study conducted on two blood banks in Addis Ababa. On the other hand, the prevalence of anti-HCV among Ethiopian patients with chronic hepatitis, cirrhosis of the liver and hepatocellular carcinoma (HCC) was found to be 21%, 36% and 46% in the study respectively (16).

Syphilis is also a systemic disease caused by *Treponema pallidum* which can be spread by sexual contact, blood transfusion and via vertical transmission (17). In sub-Saharan Africa, syphilis remains a serious public health problem. The prevalence of active syphilis infection among African countries was 12.8% in Tanzania (18), and 3.8% in Kenya (19). A study conducted to assess the prevalence of infection with HIV, syphilis and HBV among Ethiopian blood donors in 1995 showed that the seroprevalence of HIV-1, syphilis and HBV was 16.7%, 12.8% and 14.4%, respectively (20). Information is very scarce on the sero-prevalence of HIV, HBV, HCV and syphilis among blood donors in Jigjiga city, Somali Regional State of Ethiopia. It should be noted that testing for HIV, HBV, HCV and syphilis infections is useful for epidemiological monitoring and public health planning. As a result of this dearth of information, guidelines and other adequate information on the preventive and control measures are essentially lacking in many settings in Ethiopia. Despite this, the aim of this study was to determine the seroprevalence of HIV,

HBV, HCV and syphilis in blood donors for epidemiological purpose and to prevent possible transmission of these infectious diseases in blood to the recipients or the health workers.

SUBJECTS AND METHODS

Study Area: This study was carried out in Jigjiga Blood Bank, Somali Regional State of Ethiopia on consecutive blood donors' records covering the period between January 2010 and December 2014. This blood bank is the center where an effective blood banking system is catering for all the blood needs of patients in the hospitals of this region. It is located 628Km east from the capital city, Addis Ababa. Institutional ethical clearance was obtained from the Research and Publication Committee of Jigjiga University. However, due to the nature of the study (retrospective review of blood donors' records), informed consent was not obtained from the subjects of the study.

Study Population: Since the study was retrospective, health data for 6827 blood donors who attended the blood donor's bank of the region between January 2010 and December 2014 were collected. Verbal informed consent was obtained from the authorities of the blood bank and the protocol for this study was approved by the Ethical Committee of the Ethiopian Somali Regional Health Bureau.

Collection and Processing of Samples: Blood samples were collected aseptically by venipuncture from the donors. The samples were analyzed for blood group, HIV-1 & 2, HBV, HCV, and Syphilis following standard procedures.

Laboratory Diagnosis for HIV-1 and 2: Each donor's serum sample was screened for HIV-1 and HIV-2 using Vironostika® HIV Uni-Form II Ag/Ab. The detection of HIV-1 and HIV-2 in the blood was done following the manufacturer's

instructions (BioMerieux, Boxtel, The Netherlands).

Laboratory Diagnosis for HBsAg and HCV Antibodies: Sera were checked for the presence of hepatitis B surface antigen (HBsAg) using ELISA, Hepanostika HBsAg (Murex Biotech Ltd, Dartford, UK). This is a fairly reliable test having more than 99.9% sensitivity and specificity. Similarly, IgG antibodies to HCV were detected using an ELISA technique (Murex anti-HCV version 4.0) according to the manufacturer's instructions.

Laboratory Diagnosis for Syphilis: Serum for all donors was tested for the presence of treponemal antibodies using rapid plasma regain test (RPR). The diagnosis was done following the manufacturer's instructions (RPR, Wampole Laboratories, Princeton, N.J., USA).

ABO Blood Grouping and Rhesus (RH) Typing: ABO and Rh blood groups determinations were carried out on a slide using monoclonal blood grouping antisera. The antisera; anti-A, anti-B, anti-AB, and anti-D were used following the manufacturer's instructions (BIOTEC Laboratories Ltd, Great Britain).

RESULTS

Out of the 6827 (6648 males and 179 females) individuals tested for HIV, HBV, HCV and Syphilis, 216 (3.16%) were HIV positive, 647 (9.48%) were HBsAg positive, 50 (0.73%) were HCV positive, while 50 (0.73%) were syphilis positive (Table 1). The results showed that the majority of the subjects had blood group "O positive" with 51.62% followed by "A positive" (29.02%), "B positive" (14.25%) and "AB positive" (3.05%) respectively. Age group and blood group wise distributions of HIV, HBsAg, HCV and syphilis positive cases are shown in Tables 2 and 3.

Table 1: Gender related prevalence of HIV, HBV, HCV and Syphilis among blood donors at Jigjiga blood bank, Eastern Ethiopia 2010-2014.

Parameters	Total No of blood donors (%)	HIV positive N (%)	HBV positive N (%)	HCV Positive N (%)	Syphilis Positive N (%)
Male	6648(97.38)	211(3.09)	638(9.35)	49(0.72)	48(0.70)
Female	179(2.62)	5(0.07)	9(0.13)	1(0.02)	2(0.03)
	6827(100.00)	216(3.16)	647(9.48)	50(0.73)	50(0.73)

Table 2: Blood group wise distribution of HIV, HBV, HCV and Syphilis positive cases among blood donors at Jigjiga blood bank, Eastern Ethiopia 2010-2014.

Blood Group	HIV positive N (%)	HBV positive N (%)	HCV Positive N (%)	Syphilis Positive N (%)	Total Subjects (%)
O positive	162(4.59)	463(13.14)	36(1.02)	28(0.79)	3524(51.62)
A positive	30(1.51)	112(5.65)	7(0.35)	13(0.66)	1981(29.02)
B positive	18(1.85)	53(5.45)	7(0.72)	5(0.51)	973(14.25)
AB positive	2(0.96)	9(4.33)	0(0.00)	1(0.48)	208(3.05)
O negative	1(1.15)	7(8.05)	0(0.00)	2(2.29)	87(1.27)
A negative	2(5.88)	2(5.88)	0(0.00)	0(0.00)	34(0.49)
B negative	1(5.88)	1(5.88)	0(0.00)	1(5.88)	17(0.25)
AB negative	0(0.00)	0(0.00)	0(0.00)	0(0.00)	3(0.04)
	216(3.16)	647(9.48)	50(0.73)	50(0.73)	6827(100.00)

Table 3: Age group wise distribution of HIV, HBV, HCV and Syphilis positive cases among blood donors at Jigjiga blood bank, Eastern Ethiopia 2010-2014.

Age group(year)	HIV positive N (%)	HBV positive N (%)	HCV Positive N (%)	Syphilis Positive N (%)	Total Subjects (%)
17-25	35(1.36)	244(9.47)	15(0.58)	6(0.23)	2578(37.76)
26-35	101(3.42)	259(8.77)	22(0.75)	23(0.78)	2952(43.24)
36-45	60(5.57)	111(10.29)	11(1.02)	17(1.58)	1078(15.79)
46-55	20(9.22)	33(15.21)	2(0.92)	4(1.84)	217(3.18)
56-65	0(0.00)	0(0.00)	0(0.00)	0(0.00)	2(0.03)
	216(3.16)	647(9.48)	50(0.732)	50(0.732)	6827(100.00)

Of all donated blood during the study period, 963(14.1%) had serological evidence of infection with at least one pathogen and 73(1.07%) had multiple infections. Among those with multiple infections, the most common combinations were HIV-HBV 41/73(56.2%) and HIV-HCV 11/73(15.1%) (Table 4).

Table 4: prevalence of co-infections of HIV, HBV, HCV and syphilis among blood donors at Jigjiga blood bank, Eastern Ethiopia 2010-2014.

Co-infections	Number	Percent
HIV-Syphilis	7	9.6
HIV-HBV	41	56.2
HIV-HCV	11	15.1
HBV-Syphilis	10	13.7
HBV-HCV	2	2.7
HCV-Syphilis	2	2.7
Total	73	100.0

Significantly declining trends of HIV, HBV, HCV and syphilis ($p < 0.001$) seroprevalence were observed over the five years study period. The seroprevalence of HIV was 6.4% in 2010 and showed decreased prevalence for consecutive years afterwards, and a highly significant decrease was observed in the year 2014. The seroprevalence of HBV decreased from 18.2% in 2010 to 9.6% in 2011 and increased again to 11.1% in 2012 and 10.6% in 2013. HCV prevalence decreased significantly from 2.1% in 2010 to 0.0% in 2011, 0.9% in 2012, 0.3% in 2013 and 0.8% in 2014. Similarly, the prevalence of syphilis decreased progressively from 2.4% in 2010 to 0.4% in 2011 and 2012, 0.7% in 2013 and 0.6% in 2014 (Table 5).

Table 5: Trends of seroprevalence of HIV, HBV, HCV and syphilis among blood donors at Jigjiga blood bank, Eastern Ethiopia 2010-2014.

Year	Total screened N	HIV positive N (%)	HBV positive N (%)	HCV positive N (%)	Syphilis positive N (%)
2010	676	43(6.4)	123(18.2)	14(2.1)	16(2.4)
2011	736	36(4.9)	71(9.6)	0(0.0)	3(0.4)
2012	1167	40(3.4)	129(11.1)	10(0.9)	5(0.4)
2013	1496	58(3.9)	158(10.6)	4(0.3)	10(0.7)
2014	2752	39(1.4)	166(6.0)	22(0.8)	16(0.6)
Total	6827	216(3.2)	647(9.5)	50(0.7)	50(0.7)
p-value of LR for trend	-	0.000	0.000	0.000	0.000

N=Number, LR=Linear Regression

DISCUSSION

It is a well-known fact that HIV, HBV and HCV are global infectious pathogens contributing to mortality and morbidity in all ages (21). In this study, a total of 216(3.16%) out of the 6827 subjects screened were seropositive for HIV, 647(9.48%) were positive for HBV, while 50(0.732%) and 50(0.732%) were positive for HCV and syphilis respectively.

The diseases studied are fairly age-specific and behavior-dependent. People of ages 20-40 years have been found to be more sexually and economically the most active group and HIV is at high prevalence in those groups (21). In our study, HIV prevalence has been found highest in the age group of 46-55 compared to the the age group of 26-35 which contradicts earlier reports (21, 22). This variation in prevalence between two groups may be attributed to the variation in duration and opportunity for risk exposure, the continuous sharing of sharps and use of unsterilized materials such as barbing clippers. The fact that these subjects are proposing donors does not exclude them from being potential sources or carriers of transfusion transmissible infections (TTI's), especially HIV. Thus, this study has uncovered the fact that donors themselves are not an exemption to the general HIV pandemic ravaging sub-Saharan Africa in general and Ethiopia precisely. In this study, the prevalence of HIV was 3.16% which is in line with the earlier reports (22). However, it is less than the report, 47.54%, in Nigeria (23). This variation may be due to the small sample size they used.

The seroprevalence of HBV (9.48%) in our study is lower than the previous reports of 10.4% in Nigeria (12), 15.0% in Ghana (24) and 14.4 % in Ghana (20) and 6.2% in Ethiopia (25); but it is higher than the earlier report in Ethiopia with 4.7% (22). Our finding is in agreement with the report of 9.2% in Kinshasa (8). Most countries in Africa, including Ethiopia, have high endemicity for hepatitis B. This clearly explains the reason behind the high seroprevalence obtained in our study.

The prevalence of hepatitis C (0.7%) identified in this study is less than the reports by Jesse *et al.* (26) with the age group 20-29 more infected and the reports of 5.71% in Nigeria (23). However, it is slightly similar with the prevalence of antibody to HCV in healthy adult Ethiopian blood donors of 1.4% (15) and 1.7%(25). Nevertheless, the prevalence of HIV, HBV and HCV could be higher in commercial sex workers, their clients and intravenous drug users, since they are involved in high risk behaviors.

Prevalence of active syphilis infection among African countries was 12.8% in Tanzania (18), and 3.8% in Kenya (19). However, the prevalence of syphilis (0.7%) in this study is less than that of the above reports; but in agreement with the earlier reports in Ethiopia (22). A study conducted to assess the prevalence of infection with HIV, syphilis and HBV among Ethiopian blood donors in 1995 showed that the seroprevalences of HIV-1, syphilis and HBV were 16.7%, 12.8% and 14.4%, respectively (20). A major limitation of our study is the fact that our sample size was small. A study done on 6827 subjects alone cannot provide overall prevalence of HIV, HBsAg, HCV and

syphilis status in the country as a whole. Yet, it can reflect the disease status in the larger Ethiopian community.

In this study, significantly declining trends of HIV, HBV, HCV and syphilis seroprevalences were observed among blood donors over the study period. This finding is consistent with the observed declining trends of HIV, HCV and syphilis in the report at Gondar University Hospital, Ethiopia (22), and with the observed declining trends of HIV seroprevalence in the general population of Ethiopia (27), as well as the declining trends of HIV and syphilis infection among pregnant women in Addis Ababa (28). The subsequent declining in HIV seroprevalence may be due to the effect of the prevention programs that have been instituted in recent years (29).

The HIV-HBV co-infection rate of 41/73 (56.2%) and the 11/73 (15%) HIV-HCV co-infection observed in this study are higher than the report from Gondar University Hospital, Ethiopia (22), in Port Harcourt (30), in Cameroon (31), and higher than the 40% HIV/HBV co-infection rate reported by Lodenyo *et al.* (32). This high rate of co-infection and the statistically significant relationship between HIV and syphilis, HIV and HCV infections might be due to the fact that these pathogens share common modes of transmission and risk groups (33, 34).

Also, because this study was a retrospective analysis, we could not gather information about the socio-economic status and behavioral patterns which are major indices in measuring the prevalence of these infections. The seroprevalence data, behavioral patterns and socio-economic status of our community indicates that there is a high potential for the spread of HBsAg, and HIV in Jigjiga city of Ethiopian Somali Regional State. If adequate preventive measures are not put in place, these infections can lead to the death of the most productive ages of the general population thereby resulting in a vicious cycle of poverty and vulnerability.

In conclusion, the high prevalence of HBV, HIV, HCV and syphilis observed among the blood donors in the study area calls for extensive blood screening practice in the blood banks.

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