

TRANSFUSION-TRANSMISSIBLE VIRAL PATHOGENS AMONG BLOOD DONORS IN IBADAN, NIGERIA

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ABSTRACT

Transfusion-transmissible infections (TTIs), principally hepatitis B virus (HBV), hepatitis C virus (HCV) and human immunodeficiency virus (HIV) among blood donors remain a major threat to blood safety. The rate of viral infections in donated bloods plays a key role as the main indicator of blood safety, and this has to be monitored regularly. This study was designed to determine the prevalence of three viral pathogens among blood donors in Ibadan, South-western Nigeria. A total of 273 consenting blood donors, comprising of 246 males and 27 females, aged 18 to 60 years (mean age = 32.7 years) were tested for the presence of HIV, HBV and HCV using commercially available Enzyme Immune Assay kits (EIA kits). Prevalence of 1.1% (3/273), 5.1% (14/273) and 0.4% (1/273) were recorded for HIV, HBV and HCV, respectively. Higher but not statistically significant ($P > 0.005$) prevalence rates of the pathogens were recorded in the males. Also, all recorded infections occur among blood donors age 18 to 40 years. In summary, this study reports the presence of HIV, HBV and HCV among the blood donors and consequently confirm the need for improved screening procedures to reduce post-transfusion transmission of infection.

Keywords: HIV, Hepatitis B Virus, Hepatitis C virus, Blood transfusion, Co-infection, Transfusion-transmissible infections.

INTRODUCTION

Despite the necessity of blood products in certain medical circumstances, transfusion of unhealthy blood products can cause serious risks for the patients or even endanger their lives (Mohammadali and Pourfathollah, 2014). Human immunodeficiency virus (HIV), hepatitis B virus (HBV) and hepatitis C virus (HCV) are the greatest viral threats to blood safety especially in Africa (Spearman *et al.*, 2017; Jary *et al.*, 2019; Tigabu *et al.*, 2019) because of their prolonged presence in the blood at a latent state (Tigabu *et al.*, 2019). The three viruses share routes of transmission and many people with HIV are co-infected with HBV and HCV (Zhang *et al.*, 2014).

Human immunodeficiency virus (HIV), hepatitis B and C virus infections contribute substantially to the global burden of viral diseases. Globally, 37.9 million [32.7–44.0 million] people were living with HIV at the end of 2018 with about 770,000 deaths, and African region remains the most severely affected, accounting for more than two-thirds of the people living with HIV worldwide and 470,000 of the 770,000 HIV-related deaths in 2018 (WHO, 2020). Hepatitis B is a global health

problem, with an estimated 257 million people chronically hepatitis B-surface antigen (HBsAg) positive (WHO 2017). Globally, hepatitis B mortality is increasing, with 500 000 to 1.2 million deaths occurring annually (Stanaway *et al.*, 2016). Hepatitis C virus infection is highly recognized as a major healthcare problem throughout the world and around 130 to 170 million people are chronic carriers of this virus globally (Tigabu *et al.*, 2019).

In sub-Saharan Africa, percentage of collected blood units reactive for HIV in 2016 accounts for 0.10%–1.26% of HIV infections (Kanagasabai *et al.*, 2018). The residual risk of transfusion-transmission of HBV varies worldwide, being greater in low and intermediate income countries, where the prevalence of the virus is higher (Prati and Valenti 2019). Transfusion-associated HCV has been reported as a major risk of HCV transmission (Biswas *et al.*, 2018).

The rate of viral infections in donated bloods plays a key role as the main indicator of blood safety, which has to be monitored regularly. This study was therefore designed to determine the prevalence of HIV, HBV and HCV among blood donors in Ibadan, Southwest Nigeria.

MATERIALS AND METHODS

Study Population

The study was carried out among 273 apparently healthy blood donors in Ibadan, Oyo state between October and December 2012. Ibadan is the capital and most populous city of Oyo State, Nigeria. It is the third most populous city in Nigeria after Lagos and Kano. Ibadan is located in the South-western part of Nigeria, 128 km inland northeast of Lagos and 530 km southwest of Abuja, the Federal Capital of Nigeria. The city ranges in elevation from 150 m in the valley area, to 275 m above sea level on the major north-south ridge which crosses the central part of the city. The city covers a total area of 3,080 square kilometres (1,190 sq mi), the largest in Nigeria.

Sample Collection and Processing

Blood sample (5 ml) was collected by venepuncture from each blood donor into labelled sterile sample bottle, free of anticoagulants or preservative. Each blood specimen was separated by centrifugation at 3000 rpm for 10 minutes to obtain serum. The serum was transferred aseptically into appropriately labelled cryovial and the sera kept at -20 °C until analysed.

Laboratory Analysis

The sera were screened for HIV antigen and

antibody, hepatitis B surface antigen (HBsAg) and HCV antibodies (anti-HCV) using commercial Enzyme Immune Assay kits. For HIV, GENSCREEN ULTRA HIV Ag-Ab, (BIO-RAD, France), which detects HIV p24 antigen and HIV antibodies was used. Monolisa™ HBsAg ULTRA, (BIO-RAD, France), was used for HBV detection while detection of HCV antibodies was carried out using DIA-PRO HCV Ab EIA test kit, (Diapro Diagnostic Bioprobes Milano- Italy). Each assay was carried out according to manufacturer's instructions. The plates were read using a 450 nm filter microplate reader and results interpreted as directed by the test kit manufacturer.

RESULTS

Socio-Demographic Characteristics of Blood Donors

Of the 273 blood donors involved in the study, 246 (90.1%) were males and 27 (9.9%) were females. The age range of the blood donor was 18-70 years with a mean age of 32.7 years. The blood donors were grouped into six categories based on their ages: 18-20 (10 donors), 21-30 (111 donors), 31-40 (103 donors), 41-50 (39 donors), 51-60 (9 donors) and 61-70 (1 donor). The age and gender distribution of the blood donor is presented in table 1.

Table 1: Socio-demographic Characteristics of the Blood Donors

| Age | Male Frequency (%) | Female Frequency (%) |
|--------------|--------------------|----------------------|
| < 20 (18-20) | 8 (3.2%) | 2 (7.4%) |
| 21-30 | 98 (39.8%) | 13 (48.1%) |
| 31-40 | 96 (39.0%) | 7 (25.9%) |
| 41-50 | 35 (14.2%) | 4 (14.8%) |
| 51-60 | 8 (3.3%) | 1 (3.7%) |
| 61-70 | 1 (0.4%) | 0 (0%) |
| Total | 246 (90.1%) | 27 (9.9%) |

Seroprevalence of HIV, HBV and HCV among Blood Donors

Of the 273 blood donors, 17 (6.2%) had serological evidence of exposure to at least one of the viral pathogens tested. The overall prevalence

rate of HIV, HBV, and HCV were 1.1% (3/273), 5.1% (14/273) and 0.4% (1/273), respectively. There was no HIV/HCV, HBV/HCV co-infection but a single HIV/HBV co-infection was observed (Figure 1).

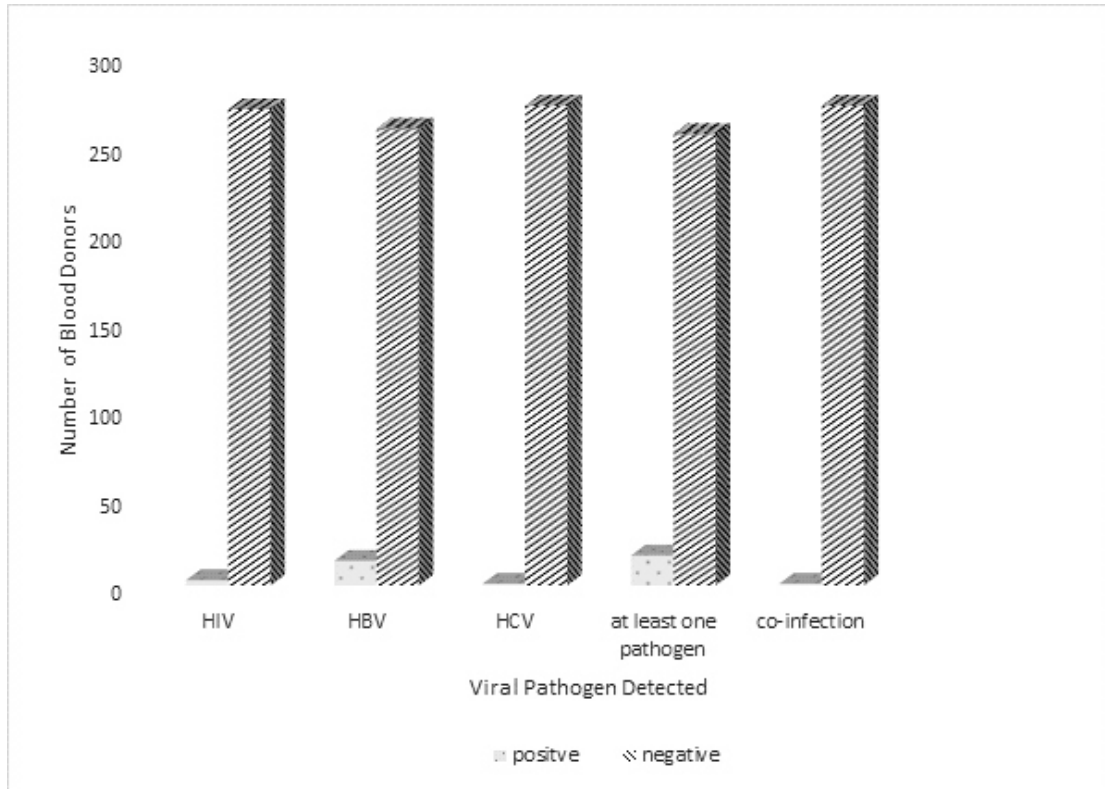


Figure 1: Seroprevalence of HIV, HBV, and HCV among the Blood Donors

Gender and Age Distribution of HIV HBV and HCV among Blood Donors

In this study, HIV, HBV and HCV prevalence were found to be higher in males than females but there was no statistical significance ($P > 0.005$). All the HIV positive blood donors were males (0.4%). For HBsAg, 13 males (4.5%) and 1 (0.4%) female tested positive while the only HCV positive donor was a male (0.4%). The HIV/HBV co-

infection was found in a male (0.4%). All the HIV, HBV and HCV infection was found to occur among blood donors age 18 to 40 years, with highest HIV and HBV prevalence among blood donor in age range 21-30 years and 31-40 years, respectively while the HCV positive donor was a 40-year old male. None of the blood donors above aged 40 tested positive for any of the viruses (Table 2).

Table 2: Gender and Age Distribution of HIV, HBV and HCV among the Blood Donors

| Variable | NUMBER OF DONORS | HIV POSITIVE | HBV POSITIVE | HCV POSITIVE |
|--------------|------------------|-----------------|------------------|-----------------|
| Male | 246 (90.1%) | 3 (100%) | 13 | 1 |
| Female | 27 (9.9%) | 0 (0%) | 1 | 0 |
| Total | 273 | 3(1.1%) | 14 (5.1%) | 1 (0.4%) |
| <21 (18-20) | 10 (3.7%) | 2 (66.7%) | 1 (7.1%) | 0 (0%) |
| 21-30 | 111 (40.7%) | 1 (33.3%) | 2 (14.3%) | 0 (0%) |
| 31-40 | 103 (37.7%) | 0 (0%) | 11 (78.6%) | 1 (100%) |
| 41-50 | 39 (14.3%) | 0 (0%) | 0 (0%) | 0 (0%) |
| 51-60 | 9 (3.3%) | 0 (0%) | 0 (0%) | 0 (0%) |
| 61-70 | 1 (0.4%) | 0 (0%) | 0 (0%) | 0 (0%) |
| Total | 273(100%) | 3 (1.1%) | 14 (5.1%) | 1 (0.4%) |

DISCUSSION

This study reports the prevalence of HIV, HBV, HCV and HIV/HBV co-infection among blood donors in Ibadan, a South-western city in Nigeria. It also reports high prevalence of blood borne viral infection among males compare to females as well as donors below 40 years of age. The prevalence of HIV, HBV and HCV was 1.1% (3/273), 5.1% (14/273) and 0.4% (1/273) respectively.

About 90% of the recruited blood donors for this study were males. The reason for this may be because females are not encouraged to donate blood or may be exempted from blood donation due to anaemia, pregnancy, breastfeeding or childbirth. Nonetheless, most published studies among blood donors (Jeremiah *et al.*, 2011; Motayo *et al.*, 2015; Ogbolu *et al.*, 2016; Okoroiwu *et al.*, 2018; Jary *et al.*, 2019; Tigabu *et al.*, 2019) usually have a higher male to female ratio in the study population as found in this study.

Among the blood donors, the rate of serological evidence for at least one pathogen was 6.2%, but higher prevalence rates of 19.3% has been documented in Nigeria (Okoroiwu *et al.*, 2018), while Tigabu *et al.*, 2019 recorded a closer prevalence rate of 8.2% among blood donors in Egypt. The decrease observed in this study may be as a result of the global trend resulting from improved control of sexually-transmitted infections and introduction of mandatory screening for Transfusion-transmissible Infections (TTI). In agreement with previous reports (Jeremiah *et al.*, 2011; Motayo *et al.*, 2015; Ogbolu *et al.*, 2016; Tigabu *et al.*, 2019) on the distribution of viruses causing greatest threat to blood safety, this study showed that HBV was most predominant (5.1%), followed by HIV (1.1%) and HCV (0.4%).

The published prevalence rates of HIV varies worldwide, depending on the country, study population, year of study and method used. In Nigeria, HIV prevalent rates reported from studies in Nigeria among different study population ranged from 2.6% to 6.5% (Jeremiah *et al.*, 2011; Motayo *et al.*, 2015; Ogbolu *et al.*, 2016; Okoroiwu *et al.*, 2018) but this study shows a lower rate. Corroborating this lower prevalence is the

11-year HIV evaluation study among blood donors by Okoroiwu *et al.* (2018), who reported a sharp decline in HIV prevalence across the years from a score of 5.7% in the starting year (2005) to 1.7% in the ending year (2016), the earlier rise in HIV seroprevalence corresponding to the peak of HIV epidemic at the era when HIV was not recognized as public health concern. In addition, a prevalence as low as 0.1% has been recorded in the Eastern part of Africa among blood donors (Yusuf and Alemayehu, 2016).

Nigeria is considered a high HBV endemic regions since HBV chronic infection can be present in more than 8% of the population. A lower than 8% HBV prevalence reported in this study has been observed in other HBV studies in the country (Nwogoh *et al.*, 2011; Onyekwere and Hameed 2015; Okoroiwu *et al.*, 2018; Meka *et al.*, 2019), possibly showing a decline in HBV prevalence in the country as a result of improved blood screening and banking system since introduction of mandatory screening for TTI and launching of intervention programmes has been shown to reduce TTI (Mohammadali and Pourfathollah, 2014; Okoroiwu *et al.*, 2018). The prevalence of HCV in this study is not far from 0.5% and 0.86% reported in Port Harcourt and Ile-Ife respectively in Nigeria (Erhabor, 2006; Salawu *et al.*, 2010), although higher HCV prevalence rates among blood donors in the country have been reported before and after this study, ranging between 1.5% to 3.6% (Jeremiah *et al.*, 2011; Motayo *et al.*, 2015; Ogbolu *et al.*, 2016; Okoroiwu *et al.*, 2018). The reason for the irregular pattern of HCV prevalence in the country is unclear but may be due to differences in diagnostic techniques used in the studies; however the global seroprevalence of HCV among blood donors has been shown to vary from 0.4% to 19.2% (Mohammadali and Pourfathollah, 2014; Tigabu *et al.*, 2019)

In relation to gender, males had higher prevalence of HIV, HBV and HCV compared to females, although there was no statistical correlation ($P > 0.005$). This may be due to the higher male to female ratio (10:1) of the study population, although several studies with closer male to female ratio have also reported high HIV, HBV and HCV prevalence among males compared to females in Nigeria (Ogbolu *et al.*, 2016; Okoroiwu *et al.*, 2018)

and other African countries (Jary *et al.*, 2019; Tigabu *et al.*, 2019). Age distribution of HIV, HBV and HCV in the study shows that all the viral infections were found to occur among blood donors in age group 18 to 40 years. This finding is similar with published reports prior to and after this study in which higher prevalence of TTI was observed among the youths in the age groups of 18-45 years (Tessema *et al.*, 2010; Bartonjo *et al.*, 2019).

CONCLUSION

This study shows the presence of HIV, HBV and HCV as Transfusion- Transmissible Infection (TTI) among blood donors in the study population, dominated by male youths, between age group 18-40 years. Although a decline in the prevalence rate of these infections was observed in the study, there is the need for regular and proper screening of blood donors for these important pathogens as well as appropriate selection of blood donors using WHO donor selection guide, to achieve zero transfusion of infected blood since one infected blood could pose a major risk.

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