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Seroprevalence of Syphilis and Hepatitis C Virus Coinfection among Blood Donors Attending Aminu Kano Teaching Hospital, Kano-Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. Authors KAS, YDJ and IY designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors ABA and DBM managed the analyses of the study. Authors UM and DFM managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Blood transfusion is an important component of patients management, as it saves millions of life each year, but it also serves as a vehicle for transmission of blood-pathogens such as hepatitis C virus and syphilis as a result World Health Organization has recommended that all blood samples should be screened for transfusion transmissible infections prior to transfusion. Therefore this was conducted to determine the seroprevalence and socio-demographic distribution of Hepatitis C virus and Syphilis among blood donors in Aminu Kano Teaching Hospital, Kano. This is a cross sectional study of blood donors presented at the donor clinic of Aminu Kano Teaching Hospital, Kano

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between July and September 2018. A total of 90 blood samples were collected from voluntary and family replacement donors, aged between 18-57 years, the collected samples were screened for anti-*Treponema pallidum* antibodies using a rapid diagnostic kits and were also screened for the presence of anti-HCV and anti-*Treponema pallidum* antibodies using an enzyme-linked immunosorbent assay (ELISA) kit. All of the total 90 (100%) donors screened were males. Family replacement and voluntary donors were of 76 (84.4%) and 14(15.6%) donors respectively. The overall seroprevalence of HCV and syphilis was 7.8% (5.6% and 2.2% for HCV and syphilis respectively using ELISA test). Prevalence of 1.3% was found for syphilis using a rapid diagnostic kit. Therefore critical screening of blood donors is of prime importance because they serve as an asymptomatic reservoir and a potential source of transmission of these infections.

Keywords: Hepatitis C virus; syphilis; blood transfusion; ELISA; blood donors.

1. INTRODUCTION

Blood is one of the integral components of body constituents [1]. Blood is composed of pale yellow fluid called plasma in which are suspended red cells (erythrocytes), white cells (leukocytes) and platelets (thrombocytes). Plasma forms about 55% of the blood volume and contains about 95% of water, many solutes are dissolved in it including proteins, antibodies, salts, organic molecules, hormones, enzymes, products of digestion and wastes products of excretion [2]. Blood flows through every organ of the body providing effective communication between tissues [1] there are almost 5-6 litres of blood in the circulatory system of an average adult and about 300 ml in the circulatory system of a new born infant [2]. Blood has important transport, distributions regulatory and protective functions in the body such as the transport of oxygen from the lung to the tissues, nutrients absorbed from the digestive tract. Example: Monosaccharide and amino acids are transported to the cells of the body for use or storage; waste products of metabolism are transported from the tissues to sites of excretion; hormones are also carried from endocrine glands to the organs where they are needed; blood also assists in regulating the temperature of the body by absorbing and distributing heat throughout the body and skin surface where heat which is not required is dissipated; leukocytes are involved in body's immune defenses, by producing antibodies in response to infection and protecting the body from damage by bacteria, viruses, parasites, toxins and tumour cells [2].

There are many medical conditions or problems that might require transfusion of blood or blood products some of these conditions include, severe anaemia, acute blood loss due to pregnancy, childbirth and accidents, types of cancer or cancer treatment that can affect blood cells and surgery, thus transfusion of blood and blood product has become a routine activity in clinical practices [3]. Transfusion of blood and blood products saves millions of lives each year it can help patients suffering from threatening conditions and supports complex medical and surgical procedures it also plays an important role in maternal and child care and during man – made and natural disasters [4].

However blood transfusion serves as a vehicle for transmission of blood-borne pathogens including Hepatitis C virus (HCV) and syphilis. Transfusion transmissible infections are among the major public health problem worldwide affecting the quality of life and causing serious morbidity and mortality [5].

Hepatitis C is a viral infection of the liver caused by hepatitis C virus, a member of family Flaviviridae which has an enveloped linear single-stranded positive sense RNA genome. Hepatitis C virus is spread primarily by direct contact with contaminated blood or blood, use of infected sharp objects, transfusion of blood that are not screened for HCV infection intravenous drug –use, sexual exposure as well as vertical transmission that is from mother to her foetus during prenatal period. Hepatitis C virus is one of a major public health problem worldwide, and is a frequent cause of acute hepatitis and chronic liver disease including cirrhosis and hepatocellular carcinoma [6]. Globally an estimated 200 million people representing 3% of the population are chronically infected with the virus and 3 to 4 million are newly infected each year [7].

Syphilis is a systemic bacterial infection caused by spirochete of genus *Treponema pallidum*, which can be transmitted primarily through sexual contact via transfusion of blood and blood products and vertically from mother to her foetus

[8]. The causative agent of syphilis, *Treponema pallidum*, is killed by storing blood for 48-72 hours at 4ºC. Thus, storing of blood for at least three days in a refrigerator before transfusion can prevent the transmission of syphilis [9]. World Health Organization (WHO) estimated that approximately 12 million new cases of syphilis are reported each year in the world with more than 90% from developing countries. Screening for transfusion transmissible infections is a critical part of the blood transfusion process as it ensures that transfusion is as safe as possible [10]. However, the World Health Organization recommended that all blood donations should be screened for evidence of infections prior to the release of blood for clinical or manufacturing use [11]. Proper monitoring and selection of voluntary blood donors and routine screening of blood for syphilis, HCV and other transfusion transmissible infections has greatly reduced the risk of transmitting those infectious agents [12].

The improved screening and testing of blood donors has also significantly reduced transfusion-transmitted diseases in most developed countries. This has not been so in developing nations. Poor health education and lack of awareness result in the reservoir of infections in the population.

Therefore estimating the prevalence of hepatitis C virus and syphilis among blood donors permits the assessment of occurrence in the blood donor population and consequently the safety of blood donations. It also provides data that is useful in formulating the strategies for improving the management of safe blood supply. In addition, it also gives an idea of the epidemiology of these diseases in a given time at a specific population or community [13]. This study aimed to determine the seroprevalence and socio-demographic distribution of Hepatitis C virus and syphilis coinfection among blood donors at the study site.

2. MATERIALS AND METHODS

2.1 Study Population

This study was carried out at the Department of Haematology, Aminu Kano Teaching Hospital, Kano State. A total of ninety (90) blood samples were collected from consented healthy family replacement and voluntary donors at the blood donor clinic of Aminu Kano Teaching Hospital, Kano from July to September 2018. Ethical clearance was obtained from the ethical committee of Ministry of Health Kano. Volunteered male blood donors of age >18 years who consented to participate in the study were recruited. While, those who refused to give their consents were excluded from the study.

2.2 Study Design

An observational cross-sectional study of blood donors over the period of two months from July to September 2018 was carried out using a structured questionnaire; volunteers of age range between 18 to 57 years were screened for the determination of antibodies (IgG and IgM) to HCV and syphilis.

2.3 Sample Collection and Processing

Five millilitres (5 ml) of blood sample was collected from each donor by standard venipuncture technique using a sterile syringe and a tube. The samples were distributed in such a way that one millilitre (1 ml) from each sample was transferred into plain tube for screening of syphilis using a rapid diagnostic kit (Micropoint Diagnostic®, Nantong, China). A volume of 2 ml out of the total of 5 ml collected from each patient was aspirated in a test tube and centrifuged at 1000 rpm for 10 minutes to obtain the serum, which was used to carry out the HCsAg screening [2]. A drop of the centrifuged blood serum was dispensed on the test side of the rapid test HCsAg immunochromatographic testing strip (Lab Tech® HCsAg D01, Australia Rapid Test Kit), which was placed on a flat, dry and non-absorbent surface on the disinfected working bench and allowed to react for two minutes. After which the results were read according to manufacturers' instructions. Two (2) red lines which often appear on the control line and on the determinant (test) line of the test strip indicated a positive result, while a single line on the control line indicated a negative result. While, in the case where there is no red lines that appear on both the control and the determinant lines, the result was termed as invalid [14-16]. The remaining 3 ml of each sample was transferred into an appropriate EDTA container after which the plasma was extracted by centrifuging the blood at 3000 r/min for 5 minutes. The plasma was stored at -20ºC until ready for assay. Screening of the plasma for Hepatitis C virus and syphilis antibodies was conducted using an enzyme-linked immunosorbent assay (ELISA) kit (DIA. PRO Diagnostic®, Bioprobes, Italy) according to manufacturer's standard operational procedure [17].

3. RESULTS AND DISCUSSION

A total of 90 healthy blood donors were screened for syphilis infection using a rapid diagnostic test out of which 14(15.6%) were voluntary donors and 78(84.4) were family replacement and only 1 donor was positive to the test, therefore the prevalence is 1.3% as shown in Table 1.

The prevalence of HCV and syphilis pathogens tested by ELISA were 5.6% and 2.2% respectively whereby the overall prevalence was 7.8% (Table 2).

Table 3 showed the distribution of HCV and Syphilis pathogens among healthy blood donors according to socio-demographic factors. All the 90 donors screened were males aged between 18-57years, among the age groups the donors within 48-57 years have the highest prevalence of 28.6% and 14.3% for HCV and syphilis respectively. Out of 90 donors, 50(55.4%) were married and 40(44.4%) were single. High prevalence of HCV 6.0% was found among married donors, while single donors had higher prevalence of syphilis. Majority of the donors were self-employed 57(63.3), followed by civil servants 20(22.2%), and the prevalence rate is high among the civil servants, family replacement donors constitutes the largest group of the donors screened 78(84.4%), HCV and syphilis infections were found only among the family replacement donors.

Table 4 shows the possible risk factors associated with HCV and syphilis seropositivity in blood donors, among which blood transfusion (33.3%), injection or skin cutting by a traditional healers (6.6%), family history of liver disease (25.0%) and local circumcision (5.5%) play a role in HCV seropositivity, while blood transfusion (6.7%), history of STD (50.0%) and local circumcision (2.7%) play a role in syphilis seropositivity.

Data in most of the reported studies revealed that the prevalence of syphilis and HCV has greatly reduced as a result of the introduction of more sensitive and specific diagnostic assays, and more improvement in public health, especially in the developed countries. In this study, the prevalence of syphilis was 1.3% using rapid diagnostic test and 2.2% using ELISA, which is in line with study of Abdallah et al. [18]; Olokoba et al. [19]; and Butsashvili et al. [20], who reported 1.2%, 1.2% and 2.3%. Also, a report of Tessema et al. [21] had a rate of 1.3% which is similar to this study.

In contrast to this study, higher prevalence of syphilis was reported from different African countries, prevalence of 3.7% in Congo [22], 7.5% in Ghana [23], 15% in Sudan, 12.8% in Ethiopia [4], 12.7% in Tanzania [24], and 9.1% in Cameroon [25,26]. These wide differences in the prevalence of syphilis infection among blood donors may be due to difference in sample size, high exposure to risk factors such as sexual behaviours and laboratory techniques used.

Lower rate of 0.5% and 0.7% syphilis prevalence were reported in some part of Nigeria by Fasola et al. [27] and Benson et al. [28]. In other parts of the world like India 0.3% was found among healthy blood donors [29] and 0.75% in Pakistan [30], 0.02% in Turkey [31] in Saudi Arabia 0.028% [32] and 0.2% in South Korea [33]. The low prevalence may be attributed to the development of effective treatment programmes, clinical selection of blood donor, and by selecting the low-risk donors.

On the other hand, the seroprevalence of syphilis HCV in this study was 5.6% which is almost similar to prevalence reported by Alao et al. [34] and Buseri et al. [35], who reported 5.4% and 5.1% respectively. The prevalence rate of 5.6% HCV in this study is higher than 2.0%, 0.5%, 3.4% and 3.9% recorded by Odenigbo et al. [36], Erhabor et al. [37], Bala et al. [38] and Amiwero et al. [39] respectively. The prevalence of HCV antibodies in blood donors in developed countries ranges from 0.4% to 2%; seroprevalence studies in Europe and United States documented a significant reduction in the risk of HCV [40]. Lower prevalence of HCV was also found among blood donors in Jordan [41] 0.2% in Saudi Arabia [42] 0.95% in Syria [43] and 0.07% in Turkey [44]. Low prevalence of HCV among blood donors in some regions may be attributed to low exposure to some risk factors.

In contrast to this study, higher prevalence 8.4% of HCV was recorded by Ayolabi et al. [3]. Also, Egypt is reported to have a high prevalence 24.8% among healthy blood donors [13].

The highest prevalence of 14.3% was found among donors aged between 48-57years. This is almost similar to the work of Alao et al. [34], who documented the highest age prevalence of HCV among blood donors in Makurdi, Nigeria, and Dapus et al. [45], who reported the highest prevalence among the age group of 46-55 years. This may be attributed to the lower immunity in

older people. However, this fail to agree with 3.2% highest prevalence among donors aged between 21-30 years in Eastern Nigeria [36].

The result of this study showed that family replacement donors constituted the largest group of the donors, in which 85.4% were family replacement donors, while the voluntary donors constituted of 15. 6%. The seroprevalence rate of 5.6% and 2.2% for HCV and syphilis respectively were found among the family replacement donors.

Table 1. Seroprevalence of syphilis among blood donors at Aminu Kano Teaching Hospital, Kano using rapid diagnostic kit

Donor type	Number tested (%)	Syphilis number tested positive (%)
Voluntary donor	14(15.6)	0(0.0)
Family replacement donor	76(84.4)	1(1.3)
Total	90(100.0)	1(1.3)

Table 2. Overall seroprevalence of HCV and syphilis among blood donors at Aminu Kano Teaching Hospital, Kano

Serological marker	Number tested positive by ELISA	Percentage (%)
HCV	5	5.6
Syphilis	2	2.2
Total	7	7.8

Table 3. Seroprevalence of HCV and syphilis with regards to demographic factors of the blood donors

Demographic factors	Number donors screened (%)	HCV No tested positive (%)	Syphilis No tested positive (%)
Age			
18-27	46(51.1)	2(4.4)	1(2.2)
28-37	21(23.3)	1(4.8)	0(0.0)
38-47	16(17.8)	0(0.0)	0(0.0)
48-57	7(7.8)	2(28.6)	1(14.3)
Sex			
Male	89(98.9)	5(5.6)	2(2.2)
Female	0(0.0)	0(0.0)	0(0.0)
Marital status			
Married	50(55.6)	3(6.0)	1(2.0)
Single	40(44.4)	2(3.0)	1(2.5)
Occupation			
Civil servant	20(22.2)	2(10.0)	1(5.0)
Student	13(14.4)	0(0.0)	0(0.0)
Self-employed	57(63.3)	3(5.3)	1(1.8)
Donor type			
Voluntary donor	14(15.6)	0(0.0)	0(0.0)
Family replacement donor	76(84.4)	5(6.6)	2(2.6)

Table 4. Seroprevalence of HCV and syphilis with regards to possible risk factors

Risk factors	Number of donors screened (%)	HCV number tested positive (%)	Syphilis number tested positive (%)
Received blood transfusion			
Yes	6(6.7)	2(33.3)	1(16.7)
No	84(93.3)	3(4.1)	1((1.2)
Received surgical procedure in health facility			
Yes	9(10.0)	1(11.1)	0(0.0)
No	81(70.0)	4(4.9)	2(2,5)
Ever given an injection or skin cutting by a traditional healer			
Yes	30(33.3)	2(6.6)	1(0.0)
No	60(66.7)	3(5.0)	2(3.3)
History of jaundice			
Yes	3(3.3)	1(33.3)	0(0.0)
No	87(96.6)	4(4.5	2(2.3)
Family history of liver disease			
Yes	8(8.9)	2(25.0)	0(0.0)
No	82(91.1)	3(3.7)	2(2.4)
History of STD			
Yes	2(2.2)	0(0.0)	1(50.0)
No	88(97.8)	5(5.7)	1(1.1)

4. CONCLUSION

The present study clearly documented the seroprevalence of Hepatitis C virus and syphilis pathogens among blood donors as 5.6% and 2.2% respectively. It can also be concluded that voluntary blood donors have been found to be safer than family replacement donors despite the low percentage of voluntary blood donors and there is no participation of female donors during this research; so there is need to increase awareness in the community and the female population to dispel wrong cultural perceptions and myths that discourage female from blood donation. It is of utmost important to adapt the use of highly specific and sensitive diagnostic assays so as to ensure the safety of blood for the patients.

CONSENT

As per international standard informed and written participant consent has been collected and preserved by the authors.

ETHICAL APPROVAL

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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