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Prevalence of Chagas Disease Among Blood Donors in Usmanu Danfodiyo University Teaching Hospital (UDUTH), Sokoto Nigeria

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Abstract

Transfusion-transmissible infections (TTIs) are the greatest threats to blood transfusion safety and pose a serious public health problem in Nigeria. Chagas disease caused by *Trypanosoma cruzi* is one of the TTIs and can be transmitted through blood transfusion. In this study, we investigated the prevalence of Chagas disease among 239 consecutively recruited blood donors aged 18 to 65 years and mean age 28.8 ± 4.4 years using rapid diagnostic kits from CTK Biotech Inc. USA. From this study, we observed a prevalence of 19.7% for Chagas disease among blood donors in UDUTH Sokoto. The prevalence of Chagas based on the type of blood donors was not statistically significant ($p > 0.05$). The prevalence of Chagas was significantly higher among the single subjects ($p < 0.05$). There was a statistically significant association between age and the prevalence of Chagas disease among blood donors ($p = 0.05$). This study demonstrates a substantial risk of Chagas disease as one of the transfusion-transmissible infections in Usmanu Danfodiyo University Teaching Hospital (UDUTH), Sokoto North-Western, Nigeria. We recommend that effort be made to recruit and retain low risk voluntary non-remunerated donors and the need to routinely screen blood donors for Chagas disease. There is the need for a larger study to determine the prevalence of Chagas disease among blood donors in Nigeria using both Rapid kit and ELISA. Non-endemic countries receiving immigrants from the endemic ones should develop policies to protect organ recipients in particular and transfusion recipients in general from *T. cruzi* infection.

Keywords: Chagas, Disease, Blood donors, Sokoto.

Introduction

Annually, millions of people worldwide receive blood transfusions or blood-derived products. Around the world, more than 92 million blood donations are collected every year (WHO, 2009). In Nigeria, about 500,000 units of blood are collected yearly out of the required 1.5 million units of blood (Pondei *et al.*, 2013). Blood transfusion is a therapeutic procedure, as there is no genuine substitution (Attaullah *et al.*, 2012). Morbidity and mortality resulting from the transfusion of infected blood have far-reaching consequences, not only for the recipients themselves, but also for their families, their communities and the wider society (WHO, 2007). And access to safe blood and blood products still remains a major challenge particularly in the developing world due to high incidences of Transfusion Transmissible Infections (TTIs) (Usman *et al.*, 2012). Since a person can transmit an infection during its asymptomatic phase, transfusions can contribute to an ever-widening pool of infection in the population like Chagas disease (WHO, 2002).

Chagas disease, also known as American trypanosomiasis, is caused by infection with the protozoan parasite *Trypanosoma cruzi* (Tarleton *et al.*, 2014). *T. cruzi* is found mostly in blood-sucking



triatomine insects (kissing bugs) and small mammals in a sylvatic cycle that is enzootic from the Southern and South-western United States to Central Argentina and Chile. *T. cruzi* infection in humans occurs in a spotty distribution throughout the range of the sylvatic cycle (Hotez *et al.*, 2013). About 7 million to 8 million people are estimated to be infected worldwide, mostly in Latin America. Vector-borne transmission occurs in America. It was estimated that more than 300,000 persons with *Trypanosoma cruzi* infection live in the United States. Most people with Chagas disease in the United States acquired their infections in endemic countries (CDC, 2013). The insect vector is a triatomine bug that carries the parasite *Trypanosoma cruzi* which causes the disease. Chagas disease was once entirely confined to the region of the Americans – principally Latin America – but it has now spread to other continents (WHO, 2014). However, in the past decades it has been increasingly detected in the United States of America, Canada, many European and some Western Pacific countries. This is due mainly to population mobility between Latin America and the rest of the world (Tanwitz *et al.*, 2011).

The incidence of infection in the 0-12 years age group was 0%, which confirms the interruption of vectorial and transfusion-associated transmission of Chagas disease in Uruguay since 1997 (WHO 1998a). In Texas, of 241 newly collected specimens, 50.74% were infected with *T. cruzi* (Sonia *et al.*, 2009). In Australia in 2005-2006, 1067 of the 65,255 Latin American immigrants (16 per 1000) may be infected with *T. cruzi*, and in Canada, in 2001, 1218 of the 131,135 immigrants (9 per 1000) whose country of origin was identified may have been also infected. In Spain, a magnet for Latin American immigrants since the 2000, 5125 of 241,866 legal immigrants in 2003 (25 per 1000), could be infected. In the United States, 56,028 to 357,205 of the 7.2 million, legal immigrants (8 to 50 per 1000), depending on the scenario, from the period 1981-2005 may be infected with *T. cruzi*. On the other hand, 33,193 to 336,097 of the estimated 5.6 million undocumented immigrants in 2000 (6 to 59 per 1000) could be infected (Gabriel, 2007).

Chagas disease presents itself in two phases. The initial, acute phase lasts for about 2 months after infection. During the acute phase, a high number of parasites circulate in the blood. In most cases, symptoms are absent or mild, but can include fever, headache, enlarged lymph glands, pallor, muscle pain, difficulty in breathing, swelling and abdominal or chest pain. In less than 50% of people bitten by a triatomine bug, characteristic first visible signs can be a skin lesion or a purplish swelling of the lids of one eye (Bern *et al.*, 2011).

During the chronic phase, the parasites are hidden mainly in the heart and digestive muscle. Up to 30% of patients suffer from cardiac disorders and up to 10% suffer from digestive (typically enlargement of the oesophagus or colon), neurological or mixed alterations. In later years the infection can lead to sudden death or heart failure caused by progressive destruction of the heart muscle (Cantey *et al.*, 2012).

T. cruzi can also be transmitted by Consumption of food contaminated with *T. cruzi* through for example the contact with infected triatomine bug faeces, blood transfusions (blood from infected donors), passage from an infected mother to her new-born during pregnancy or childbirth, organ transplants using organs from infected donors, accidental exposure of healthcare workers to infected source person's blood (WHO, 2014).

There is no vaccine for Chagas disease. Vector control is the most effective method of prevention in Latin America. Blood screening is necessary to prevent infection through transfusion and organ transplantation (Myles, 2009).

The large reservoir of *T. cruzi* parasites in wild animals of the Americas means that the parasite cannot be eradicated. Instead, the control targets are elimination of the transmission and healthcare access for the infected and ill population (Barett *et al.*, 2003).

This study was designed to determine the prevalence of Chagas Disease among blood donors in Usmanu Danfodiyo University Teaching Hospital (UDUTH), Sokoto. The study was geared towards generating local evidenced-based data and providing scientific

evidence required for the formulation of effective management policies to enhance the effective screening of donor blood ensuring that blood transfusion is safer and free from prevailing TTIs.

Materials and Methods

Study Area

This study was carried out at the Haematology and Blood Transfusion Department of Usmanu Danfodiyo University Teaching Hospital (UDUTH) Sokoto, Nigeria. The hospital is a 500-bed teaching hospital and a centre of excellence rendering specialist medical care to people in Sokoto metropolis and neighbouring states of Zamfara and Kebbi States. Sokoto is the capital city of Sokoto State, Nigeria. The state is located between longitude 11°30', 13°50' East and latitude 4° to 6°0' North. It is bordered to the North by Niger Republic, Zamfara State to the East while Kebbi state borders most of the South and Western parts. The state falls within the Savannah vegetation zone (Mamman, 2000).

It's made up of Hausa and Fulani majority and a minority of Zabarmawa and Tuareg and other non-indigenous settlers. The two major languages in the state is Hausa and Fulfulde (spoken among the Fulani). The main occupation of the people is grain production and animal husbandry. Majority of the indigenous people practice agriculture. Crops produced include commercial crops like millet, sorghum, beans, rice and maize. Other occupations commonly practiced are dying, blacksmithing, weaving, carving, trading, and cobbling. Sokoto ranks second in livestock production in Nigeria. Modern Sokoto city is a major commercial centre in leather crafts and agricultural products. Occupation of city inhabitants also include trading, commerce, with a reasonable proportion of the population working in private and public sectors.

The vast Fadama land of the Sokoto-Rima River system dissects the plain and provides rich alluvial soil and extensive grassland fit for a variety of crop cultivation, hence farming and livestock rearing are the principal activities in the State (Sokoto State Diary, 2003). Other commercial activities are cement and leather production (Molyneaux and

Gramiccia, 1980). Based on 2006 population census, Sokoto State had a population of 3,696,999 with a projected population of 4,695,188.8 in 2015 based on the population annual growth rate of 3% (NPC, 2006).

Study Subjects

The test subjects were blood donors attending Haematology and Blood Transfusion Department of Usmanu Danfodiyo University Teaching Hospital, Sokoto either as voluntary non-remunerated, family replacement or commercial donors. Blood donors were apparently healthy and aged 18-65 years.

Inclusion Criteria

Inclusion criteria included; age (≥ 18 years and ≤ 65), willingness to offer a written informed consent to participate in the study and meeting the basic blood donation requirements; haemoglobin ≥ 12 g/dl for females and ≥ 13 g/dl for males, or PCV $\geq 36\%$ for females and 38% for males and weight ≥ 50 kg). Other criteria included; non- menstruating and non-lactating women.

Exclusion Criteria

All donors who presented to Haematology and Blood Transfusion Department of UDUTH Sokoto within the study period who do not meet the eligibility criteria were excluded from participating as subjects in this study (age < 18 years and > 65 years, non-consenting, not meeting the basic blood donation criteria (haemoglobin < 12 g/dl and < 13 g/dl for females and males respectively, or PCV $< 36\%$ for females and $< 38\%$ for male and weight < 50 kg), menstruating and lactating women.

Study Design

This case study was geared at investigating 239 consecutively recruited blood donors for TTIs. Sample obtained from each donor was tested for the presence of Chagas Antibodies. This was carried out using Combo Rapid Test kit from CTK Biotech Inc. USA. All donors who were found to be reactive were referred to relevant department for proper medical attention.



Ethical Clearance

Ethical clearance was sought from the ethical committee in UDUTH Sokoto.

Informed Consent

Written informed consent was obtained from all participants in the study

Questionnaire

Questionnaires was distributed to all consenting participants to collect socio-demographic and other bio-data

Sample Collection

Two (2) millilitres of whole blood was collected using syringe and needle and transferred into EDTA anti-coagulated tube and used for the presence of Chagas Ab rapid test.

Method of Screening for Chagas

Chagas screening using Chagas Combo Ab Rapid Test (plasma) with Catalog Number R0171C manufactured by CTK Biotech, Inc. (USA).

Principle of the Test

The onsite Chagas Ab Combo Rapid Test is a lateral flow chromatographic immunoassay based on the principle of indirect immunoassay. The test cassette consists of a burgundy coloured conjugate pad containing protein A conjugated with colloid gold (Protein A conjugates) and a nitrocellulose membrane strip containing a test band (T band) and a control (C band). The T band is pre-coated with recombinant *T. cruzi* antigens, and the C band is pre-coated with anti-protein A antibodies. When an adequate volume of test specimen is dispensed into the well of the test cassette, the specimen will bind to the protein A conjugates. The immunocomplex is then captured on the membrane by the pre-coated *T. cruzi* antigens, forming a burgundy coloured T band, indicating a Chagas Ab positive test result. Absence of the T band suggests a negative result. The test contains an internal control (C band) which should exhibit a burgundy coloured band of

immunocomplex of anti-protein A antibody –Protein A gold conjugates regardless of colour development on the T band. Otherwise, the test result is invalid and the specimen must be retested with another devise.

Procedure

- The pouch was opened at the notch and the cassette removed.
- The Cassette was placed on a clean flat surface and labelled with the donors Identification number.
- Then, 20ul of plasma sample was dropped into sample well with dropper vertically.
- Two drops of sample diluent are added immediately.
- The timer was started and the result was read in 15minutes.

Interpretation of the Test

1. **Negative Result:** If only C band is developed, the test indicates that no detectable anti-*T. cruzi* antibody present in the specimen. The result is negative.
2. **Positive Results:** if both C and T bands are developed, the test indicates for the presence of anti-*T. cruzi* antibody in the specimen. The result is positive.
3. **Invalid Result:** If no C is developed, the assay is invalid regardless of any burgundy colour in the T band.

Data Collection and Analysis

Data were collected into excel spread sheet and transferred into the data editor of Statistical Package for Social Sciences (SPSS, Version 20) software. Data were expressed as percentages. Effect of association of some demographic factors with the prevalence of Chagas disease was compared using Chi-square test. A p-value of ≤ 0.05 was considered statistically significant.

Results

A total of 239 consecutively recruited blood donors aged 18 to 65 years with mean age 28.8 ± 4.4 years

were tested for Chagas disease Table 1: Shows Prevalence of Chagas among Blood Donors in UDUTH. The prevalence of Chagas disease among blood donors in UDUTH Sokoto was 47 (19.7%).

Table 2: Shows the Prevalence of Chagas based on the Socio- demographic Characteristics of Blood

Donors in UDUTH Sokoto. There was a statistically significant relationship between age of blood donors and prevalence of Chagas disease (p=0.05). And the prevalence was significantly higher among singles compared to married and divorced blood donors (p=0.03).

Table 1: Prevalence of Malaria Parasitaemia and Chagas among Blood Donors in UDUTH

Statistics	Chagas	
	Negative	Positive
Frequency	192	47
Percentage (%)	80.3	19.7

Table 1 above shows the prevalence of Chagas disease among blood donors in UDUTH Sokoto. It shows that 47 (19.7%) was positive for Chagas.

Table 2: The Prevalence of Malaria and Chagas based on the Socio- demographic Characteristics of Blood Donors in UDUTH Sokoto

Parameters		Positive Chagas n (%)	X ²	p-value
Age	18-27	25 (18.2)	0.42	0.05
	28-37	13 (21.3)		
	38-47	6 (17.6)		
	48-57	3 (42.9)		
Gender	Male	41 (19.4)	0.80	0.19
	Female	6 (21.4)		
Marital Status	Single	31(16.8)	0.88	0.03
	Married	16 (29.6)		
	Divorced	0 (0)		
Occupation	Students	15 (26.3)	0.27	0.06
	Civil Servants	7 (12.3)		
	Farmers	16 (19.3)		
	Business	9 (28.1)		
Level of Education	Primary	4 (12.5)	0.67	0.06
	Secondary	10 (23.3)		
	Post-Secondary	18 (21.4)		
	Not Educated	15 (18.6)		
Donor Type	Voluntary	6 (18.8)	0.56	0.36
	Family	40 (19.7)		
	Replacement			



Table 2 above shows the relationship between various socio-demographic factors and the prevalence of Chagas among blood donors in UDUTH, Sokoto. The prevalence of Chagas disease was significantly higher among singles compared to married and divorced blood donors ($p=0.03$).

Discussion

In this present study, we investigated the prevalence of TTI's among 239 consecutively recruited blood donors at UDUTH Sokoto.

The prevalence of Chagas disease observed among blood donors in this study was 19.7%. The observed prevalence of Chagas disease in this study is lower than the observation in Texas which indicated that 50.74% of 241 newly collected specimens were infected with *T. cruzi* (Sonia *et al.*, 2009). Similarly, a previous report in Canada, in 2001 indicated that 1,218 of the 131,135 immigrants (9 per 1000) whose country of origin was identified were infected with Chagas disease. In the United States, 56,028 to 357,205 of the 7.2 million legal immigrants (8 to 50 per 1000) depending on the scenario, from the period 1981-2005 may be infected with *T. cruzi*. On the other hand, 33,193 to 336,097 of the estimated 5.6 million undocumented immigrants in 2000 (6 to 59 per 1000) could be infected with *T. cruzi*. Non-endemic countries receiving immigrants from the endemic ones should develop policies to protect organ recipients from *T. cruzi* infection, prevent tainting of the blood supply with *T. cruzi*, and implement secondary prevention of congenital Chagas disease (Gabriel, 2007). The high prevalence observed in this study could be as a result of life style and the poor environment sanitation in the State which exposes inhabitants to this vector which carry the parasite. There is poor and unplanned housing, poor waste disposal and toilet facility which create an enabling environment for *T. cruzi* parasites to thrive. The parasites are mainly transmitted by contact with the faeces of infected blood-sucking triatomine bugs. These bugs, vectors that carry the parasites, typically live in the cracks of poorly-constructed homes in rural or suburban areas (Carod-Artal *et al.*, 2003).

Also, the prevalence of Chagas was significantly higher among the 18-27 years age group ($p=0.05$).

The high prevalence of Chagas among younger donors may also be due to prevalent high-risk behaviours among youths in the area such as maintenance of multiple sex partners, having unprotected sex intercourse, intravenous drug abuse, tattooing and other high risk socio-cultural life styles that put them at risk.

Although most of the donors were male, there is no association between Chagas disease and gender of the donors ($p=0.19$). This observation is in agreement with previous report by Erhabor and Colleagues (2013) that female gender participation in blood donation in North Western Nigeria is significantly lower compared to findings from developed countries. This low female gender participation could be as a result of religious and cultural factors that females are not allowed to come out and do some things in the locality.

There was a statistically significant association between marital status with prevalence of Chagas disease ($p=0.03$). Most of the donors were singles. This could be as a result of their life style of maintaining multiple sex partners, drug addiction and living irresponsible life style. Unlike the married who try to be faithful to their life partner. Though the study area is a place where men due to religious reasons are entitled to marry up to four wives.

The prevalence of Chagas disease showed no association with donor types ($p=0.36$). But most of the donors were family replacement donors as against the WHO recommendation of voluntary non-remunerated donors who are the safe donor type. And it is difficult for a country's need for blood to be met through family replacement donors (WHO, 2014). No wonder that WHO advocates and recommends that member states develop a national blood transfusion policy based on voluntary non-remunerated regular blood donation in accordance with World Health Assembly Resolution 28.72 (WHA, 1975).

Conclusion

This study observed high prevalence of Chagas disease among blood donors in UDUTH Sokoto. The study established a relationship between prevalence of Chagas and marital status of donors in UDUTH Sokoto. Also, there is association between age of donors and prevalence of Chagas disease.

Recommendation

We hereby recommend the following:

1. That blood donors should be routinely screened for Chagas, to ameliorate the risk of the disease among blood donors.
2. There should be public enlightenment campaign to create awareness on the mode of transmission and the need to screen donors for Chagas.
3. There is need to promote the recruitment and retention of voluntary non-remunerated donors.
4. Migrants coming into the country from the endemic areas of Chagas disease should be screened for Chagas to reduce the risk of transmission of these agents by blood transfusion.

Limitation of the Study

Rapid test kit was used for testing of the subjects. It may be necessary to carry out a larger study and include the use of more advanced and sensitive methods like ELISA and PCR

Conflict of Interest

The authors declare no conflict of interests.

References

- Attaullah, S., Khan, S., Jabbar, K. (2012). Trend of transfusion transmitted infections frequency in blood donors: provide a road map for its prevention and control. *Journal of Translational Medicine*; **10**: 20.
- Barrett, M. P., Bruchmore, R. J. S., Stich, A., Lazzari, J. O., Frash, A. C., Cazzulo, J. J., Krishna, S. (2003). The trypanosomiasis. *Lancet*; **362**:1469-1480.

- Bern, C., Kjos, S., Yabsley, M. J., Montgomery, S. P. (2011). *Trypanosoma cruzi* and Chagas' disease in the United States. *Clinical Microbiology Review Journal*; **24**: 655-681.
- Cantey, P. T., Stramer, S. L., Townsend, R. L., et al. (2012). Montgomery SP: The United States *Trypanosoma cruzi* infection study: evidence for vector-borne transmission of the parasite that causes Chagas disease among United States blood donors. *Transfusion*; **52**:1922-1930.
- Carod-Artal, F. J., Vargas, A. P., Melo, M., Horan, T. A. (2003). American trypanosomiasis (Chagas' disease): an unrecognised cause of stroke. *Journal of Neurology, Neurosurgery and Psychiatry*; **74**:516-518.
- Centre for Disease Control (CDC) (2013). Parasites - American Trypanosomiasis (also known as Chagas Disease) : 1.
- Erhabor, O., Hussain, A. U., Abdulrahman, Y., Isaac, I. Z. (2013). Pattern of Donation and Some Haematological Indices of Blood Donors in Sokoto, Nigeria. *British Journal of Medical and Health Sciences*; **1(5)**:63-71.
- Gabriel, A. S. (2007). Epidemiology of Chagas disease in non- endemic countries: the role of international migration. *Memórias do Instituto Oswaldo Cruz*; **102 (1)**:74-93.
- Hotez, P. J., Dumonteil, E., Betancourt, C. M., et al. (2013). An Unfolding Tragedy of Chagas Disease in North America. *Public Library of Science Neglected Tropical Disease*; **7(10)**: 2300.
- Mamman, A.B. (2000). Sokoto State. In: A People United, a Future Assured (Survey of States). Mamman, A.B., J.O. Oyebanji and S.W. Peters (Eds.). Vol. 2, Gabumo Publication Co. Ltd., Calabar, Nigeria: 123-134.
- Molyneaux, L., Gramiccia, G.G. (1980). Parasitology. In: Research on the Epidemiology and Control of Malaria in the Sudan Savannah of West Africa. WHO, Geneva: 311.
- Myles, M. A. (2009). American Trypanosomiasis (Chagas' disease). In Manson's Tropical Diseases. 22nd edition. Edited by Cook GC, Zumla AI. London: W.B. Elsevier: 1327-1340.



- National Population Commission (2006). National Census Figures, Abuja, Nigeria: 206-210.
- Pondei, K., Lawani, E., Pughikumo, C. (2013). Blood donor practices at two blood banks in Bayelsa State. *Nigeria Journal of Medicine and Medical Sciences*; **4(9)**:357-361.
- Sokoto State Diary, (2003). Ministry of Information. Sokoto, Sokoto State: 4-5.
- Sonia, A. K., Karen, F. S., Jimmy, K. O. (2009). Biogeography and *Trypanosoma cruzi*. Infection Prevalence of Chagas Disease Vectors in Texas, USA. *Vector-Borne and Zoonotic Diseases*; **9(1)**: 41-50.
- Tanwitz, H. B., Weiss, L. M., Montgomery, S. P. (2011). Chagas Disease Has Now Gone Global. *Public Library of Science Neglected Tropical Diseases* **5(4)**: 1136.
- Tarleton, R. L., Gürtler, R. E., Urbina, J. A., Ramsey, J., Viotti, R. (2014). Chagas Disease and the London Declaration on Neglected Tropical Diseases. *Public Library of Science*: doi.org/10.1371/journal.pntd.0003219.
- Usman, W., Haroon K., Humayoon, S. S., Muhammad, A. A., Muhammad, A. M., Hasan, A. Z. (2012). Prevalence of Transfusion-Transmitted Infections among Blood Donors of a Teaching Hospital in Islamabad. *Annals of Pakistan Institute of Medical Sciences*; **8(4)**: 236-239.
- World Health Assembly Resolution (WHA) 28.72. (1975). Utilisation and supply of human blood and blood products: 1.
- World Health Organization (1998a). Chagas disease: interruption of transmission in Uruguay. *Weekly Epidemiological Records*; **73**: 1-4.
- World Health Organization (2007). Status of blood safety in the WHO African Region: Report of the 2004 Survey WHO Regional Office for Africa, Brazzaville: 1-25.
- World Health Organization (2002). Blood Safety Strategy for the African Region. Brazzaville, World Health Organization, Regional Office (WHO AFR /RC51/9 Rev.1).
- World Health Organization. (2009) Global Blood Safety and Availability: Facts and Figures from the 2007 Blood Safety Survey. WHO Fact Sheet #279.
- World Health Organization. (2014). Chagas disease (American trypanosomiasis). *World Health Organization Fact Sheet*. 340.