Journal of
Blood Disorders & Transfusion

OPEN ACCESS Freely available online

Research Article

Sociodemographic Characteristics, Hematological Parameters and Absolute CD4 Counts of Healthy Blood Donors at Two Teaching Hospitals in Nigeria

Ahaneku I Osuji[1]*, Nneka R Agbakoba[2], Martin O Ifeanyichukwu[2], Ejeatuluchukwu Obi[3] and Jean Njab[4]

[1]Department of Microbiology and Immunology, University of Abuja Teaching Hospital, Gwagwalada, Abuja, Nigeria; [2]Department of Medical Laboratory Science, Nnamdi Azikiwe University, Nnewi, Campus, Anambra State, Nigeria; [3]Department of Pharmacology and Therapeutics, Faculty of Medicine, Nnamdi Azikiwe University, Nnewi Campus, Nigeria; [4]Department of Operations Research, Tamlab Project for Africa, Abuja, Nigeria

ABSTRACT

Introduction: This observational study was undertaken to assess hematological parameters and the efficacy of screening methods in healthy subjects eligible for blood donation at the University of Abuja Teaching Hospital (UATH), Abuja Nigeria and Nnamdi Azikiwe University Teaching Hospital (NAUTH), Nnewi, Nigeria.

Methods: Two hundred and twelve (212) healthy subjects from the two hospitals (NAUTH-104, UATH-108) were tested for hematological parameters and absolute CD4 cell count using Sysmex auto-hematology analyzer and Partec Cyflow counter respectively. Sociodemographic data were collected using a questionnaire and ABO blood group testing was performed. Descriptive and inferential statistics were used to analyze the data obtained.

Results: The mean red blood cells, hematocrit, hemoglobin, white blood cells, CD4, and platelet count of the blood donor samples at UATH and NAUTH were within acceptable reference ranges except for hemoglobin values that showed a statistically significant decrease ($p<0.05$). Of 212 subjects tested, 40 (18.9%), 51 (24.1%), 24 (11.3%), 64 (30.2%), 16 (7.5%) and 22 (10.4%) had abnormally low values for red blood cells, white blood cells, hematocrit, hemoglobin, CD4 and platelets count respectively. Sociodemographic data showed that most blood donors were males, and belonged to O blood group, with a median age of 33 years old, and were students and traders.

Conclusion: We found that hematocrit (HCT) alone as a screening value has clear limits. Moreover, our study demonstrated other blood cells were low in this healthy population. Therefore, routine screening of prospective blood donors should be expanded to other hematological parameters.

Keywords: Hematological parameters; CD4 count; Blood donors

INTRODUCTION

Blood donors can be defined as apparently healthy persons who give their blood for medical treatment of individuals that require blood transfusion [1]. Blood donors are classified into voluntary non-remunerated donors, family replacement donors, and commercial (paid) donors. Also, they are grouped into first timer and old (repeat) blood donors [2]. Blood transfusion service is an integral and indispensable part of the healthcare system with the primary objective of ensuring safety, adequacy, accessibility, and efficiency of blood supply at all levels [3]. The objective of blood transfusion services is to provide adequate and safe blood to recipients at no risk to donors [1,3]. Transfusion of blood and blood products help save millions of lives every year. It can help patients suffering from life-threatening conditions live longer and with higher quality of life and supports complex medical and surgical procedures [4,5]. However, availability of adequate and well screened blood units has been a problem in many developing countries, Nigeria inclusive [4,6].

The National Blood Transfusion Service (NBTS) is the organization with statutory responsibility for the provision of blood for transfusion, and liaison with clinical services. The NBTS

***Correspondence to:** Osuji AI, Department of Microbiology and Immunology, University of Abuja Teaching Hospital, Gwagwalada, Abuja, Nigeria, Tel: +2348033507775; E-mail: ahanekuos@gmail.com

Received: October 14, 2019, **Accepted:** October 30, 2019, **Published:** November 06, 2019

Citation: Osuji AI, Agbakoba NR, Ifeanyichukwu MO, Obi E, Njab J (2019) Sociodemographic Characteristics, Hematological Parameters and Absolute CD4 Counts of Healthy Blood Donors at Two Teaching Hospitals in Nigeria. J Blood Disord Transfus 10:430. doi: 10.35248/2155-9864.19.10.430

coordinates all activities concerned with blood donor recruitment and the collection, testing, processing, storage and distribution of blood and blood products [7]. They are also involved in the clinical use of blood and surveillance of adverse transfusion events [7]. Presently in Nigeria, there are six NBTS centres, one in each geopolitical region of the country. This is not sufficient for a country with a population of over 180 million people and these centres are bedevilled with problems of lack of equipment, reagent and manpower required to deliver effective service to the nation [8]. In most blood transfusion centres in Nigeria, particularly our study sites, aphaeresis machine/ procedure that separates blood into various components is not available so that blood recipients shall be given the specific blood components needed. Even when available, it may not affordable to many patients in a resource constraint economy like Nigeria. In summary, blood transfusion services in Nigeria is currently facing interesting challenges among which are transfusion transmissible infections and inadequate screening of blood donors including hematological profile. This has resulted to not meeting with the best practices advocated by World Health Organization (WHO), and have resorted to diverse ways to meet the demand of blood supplies. This has led to proliferation of many unregulated blood transfusion services in various private and public hospitals/ laboratories. The proliferation of unregulated blood banking services and profiteering has its attendant implications on the spread of transfusion transmissible infections [9].

Many blood transfusion centres in Nigeria including our study centres screen blood donors only for Hematocrit (HCT) and bleed donors when it is within normal acceptable range. Other hematological parameters such as white blood cells (WBC), red blood cells (RBC), haemoglobin (HGB) and platelets count are not tested. Many blood donors with normal HCT and adjudged eligible for donation could have leucopenia/leucocytosis, low hemoglobin value or even thrombocytopenia. This may not be suitable to some blood recipients that require specific blood component. Moreover, there may be some underlying factors for low hemoglobin, leucopenia, leucocytosis etc. It is against this background that this study was conceived with main aim to assess hematological parameters of eligible healthy blood donors at these two tertiary hospitals in Nigeria as well as evaluate the efficacy of screening methods. Also, we measured the absolute CD4 cell count of the subjects, a value that is not mandatory for evaluating the eligibility for blood donation because subjects infected with HIV could have low CD4 count as it is the primary target of HIV replication [10].

MATERIALS AND METHODS

Study sites, design and subjects recruitment

The study areas include the blood banks of University of Abuja Teaching Hospital (UATH) and Nnamdi Azikiwe University Teaching Hospital (NAUTH), Nnewi from Northern and Southern Nigeria respectively. Both of these sites are in semi-urban city but NAUTH, Nnewi is more populated than UATH, Gwagwalada, Abuja as they attend to more patients. This is an observational, prospective study including 212 subjects (108 from UATH and 104 from NAUTH) who had been previously screened and found eligible by the respective blood banks for blood donation. These subjects were recruited over a period of five months using systematic random sampling until the required number of samples was collected.

Ethical considerations, inclusion and exclusion criteria

Ethical permission and approval was obtained from the health research ethics committee of both hospitals where the subjects were recruited and informed consent was obtained from the participants prior to sample collection and analysis. Subjects that were positive for transfusion transmissible infections (TTIs) were excluded and all subjects that signed the informed consent form were included in the study.

Sociodemographic analysis/Transfusion Transmissible Infections (TTIs) risk factors

With the aid of a structured questionnaire, relevant sociodemographic information and TTIs associated risk factors were obtained from the subjects that participated in the study. These included age, sex, marital status, academic attainment/social status, number of sexual partners, history of Sexually Transmitted Diseases (STDs), presence of tatoos/scarification marks, history of alcohol/drug abuse, sharing of sharps/occupational or domestic accident with sharp and hepatitis B vaccination status. Other information obtained from the questionnaire includes history of blood transfusion and surgery as well as previous infection with viral hepatitis and knowledge of HBV infection. The questionnaires were completed by the participants and any subject who needed help in filling the questionnaires were assisted by trained research assistants who were medical laboratory scientists and laboratory technicians that work in these blood banks.

Laboratory testing

Ten milliliters of venous blood was collected from each eligible blood donor, 5 mL volume were dispensed into potassium Ethylene Diamino Tetramino- Acid (EDTA) tube and plain bottle. All samples collected were analyzed immediately for complete blood count and absolute CD4 cell count. Those that cannot be processed immediately were preserved at 2-6°C until analyzed within 6 hours of blood collection following prescribed Standard Operating Procedures. ABO Blood group/ type of all blood donors recruited were determined using cell and serum grouping methods as indicated in the American Association of Blood Bank (AABB) technical manual [11]. Anti A, anti B and anti D reagents from Spectrum Biotech, USA was used and manufacturer's instruction was strictly followed. The principle of ABO blood group testing is based on antigen and antibody reaction resulting to agglutination. The procedure for cell grouping is as follow:

A drop of Anti A, Anti B and Anti D sera were placed on a clean white tile. Thereafter, a drop of donor's red blood cells were added on each of the anti-sera and mixed with a clean plastic stick. The tile containing the specimen and antiserum was shook using a rotary shaker for 2 minutes and results read. The test method for ABO grouping, tube method is as follow; five small test tubes were labeled as numbers 1 to 5. Each of these tube were added the following: Tube 1: One volume anti-A serum and one volume of 5% donor's red blood cells. Tube 2: One volume anti-B serum and one volume of 5% donor's red blood cells. Tube 3: One volume of donor's serum and one volume of 5% A cells. Tube 4: One volume of donor's serum and one volume of 5% B cells. Tube 5 (Auto-control): One volume of donor's serum and one volume of donor's 5% red cells. The contents of the tubes were mixed gently by tapping the base of the tubes with the finger. The tubes were incubated at room temperature for 5 minutes after which they were centrifuged at 150 g for 1 minute. The results were read by tapping

gently the base of each tube for agglutination or hemolysis. Results were recorded accordingly.

Hematological parameters of blood donors enrolled in this study were determined using Sysmex KN 21 auto hematology analyzer. The Sysmex KN 21 auto-hematology analyzer used was able to determine the hematological indices of the blood donors like Hemoglobin, Red Blood Cells (RBC), White Blood Cells (WBC) total and differential, Hematocrit and Platelets counts. The tests were done according to the instruction of the manufacturer of Sysmex auto hematology blood counter. Determination of CD4 cell count was performed on all blood samples following the method as described elsewhere [12]. This was achieved using Cyflow counter machine by Partec Germany. Flow cytometry is a method by which cell or micro particles in suspension is differentiated and counted according to the cell size, fluorescence emission and internal structure. The test methodology is as follow:

A 20 µl of CD4 antibody was added into respective labeled Rohren tubes after which 20 µl of well mixed EDTA whole blood of blood donors were added into their respective tubes. The contents of the tubes were mixed gently by tapping and incubated in the dark for 15 minutes at room temperature. A 800 µl of CD4 non-lyse buffer was added, mixed and read on the cyflow counter machine. The step by step procedure including the startup and shut down operational procedures were strictly followed.

Statistical analysis

Data obtained from this study were entered on Microsoft excel, validated on SPSS version 20 for windows and analyzed on Epi Info version 7 for windows. Descriptive statistics were calculated and reported for sociodemographic characteristics. Percentages were used to describe frequency analyses of categorical variables. Chi-square and Student t- test were used to compare categorical variables. A p value <0.05 was considered to indicate statistical significance.

RESULTS

Sociodemographic characteristics analysis

Of the 212 blood donors tested, 193 (91%) were males with median age of 33 years old, ranging from 18 to 60 years. This is shown in Table 1. There is no statistical significant difference in relation to gender between the two study sites. Categorization of blood donors according to marital status showed that the number of married participants was 90 (42.5%) out of 212 subjects. The study observed statistical significant difference between subjects at UATH, Abuja and NAUTH, Nnewi in relation to marital status. The academic status showed that more subjects with secondary education level donated blood at NAUTH whereas at UATH, subjects with tertiary education qualifications were more involved in blood donation and this is statistically significant. From Table 1 also, it was observed that applicants were more involved in donation at UATH while students' donors were more at NAUTH than at UATH and this is significant. There is no statistical significant difference between the two sites in relation to blood donation among business men and artisans.

Evaluation of TTIs risk factors

Transfusion Transmissible infections risk factors assessment among blood donors' participants revealed that lack of knowledge of HBV/HBV infection and no vaccination of the respondents with HBV vaccines were the major risk factors observed with statistical

Table 1: Demographic characteristics of blood donor participants at UATH and NAUTH

Blood Donors Demographics	UATH n=108	NAUTH n=104	Total (%) n=212	Chi-Square (p-value)
Gender				
Male	100	93	193 (91%)	0.64 (0.42)
Female	8	11	19 (9%)	0.64 (0.42)
Marital Status				
Married	62	28	90 (42.5%)	20.0 (0.00001)*
Single	45	76	121 (57.1%)	20.0 (0.00001)*
Separated	1	0	01 (0.5%)	0.96 (0.32)
Academic Status				
Primary	5	10	15 (7.1%)	1.99 (0.15)
Secondary	40	59	99 (46.7%)	8.21 (0.004)*
Tertiary	63	35	98 (46.2%)	12.92 (0.0003)*
Age Group (Years)				
18-25	22	56	78 (36.8%)	16.6 (0.001)*
26-40	67	38	105 (49.5%)	6.7 (0.008)*
41-60	19	10	29 (13.7%)	3.2 (0.007)*
Occupation/Profession				
Applicants	9	1	10 (4.7%)	6.3 (0.01)*
Students	27	43	70 (33%)	6.3 (0.01)*
Business/Trading	33	33	66 (31.1%)	0.0 (0.85)
Civil Servants	18	7	25 (11.8%)	5.0 (0.02)*
Artisans	21	20	41 (19.3%)	7.4 (0.06)

*Statistically Significant ($p<0.05$)

significant difference between the two hospitals under review. Also no statistical significant difference was observed among the risk factors assessed except for alcohol/drug abuse by subjects that was increased at NAUTH. The blood donors were declined donation because they pose a risk to blood recipients. This is presented in Table 2.

ABO blood group and donation pattern among blood donors

Table 3 shows the distribution of blood donors according to ABO blood groups. Blood group O is the most common donated blood units at both sites with 156 out of 212 blood donors tested representing 73.6% of the population while blood group AB was the least with 4 participants representing 1.9% of the population. There is no statistical significant difference between the two sites. Also presented in Table 3 is categorization of blood donor participants in relation to time of donation. Family replacement blood donors were the most common blood donors compared to voluntary and paid blood donors with statistical significant difference observed between the two sites. The study observed no statistical significant difference between the first timer blood donors and old blood donors across the two study sites. Also, voluntary non-remunerated blood donors were more at UATH than NAUTH and this is significant. There is no statistical significant different in relation to commercial (paid) blood donors across the two study sites.

Evaluation of some haematological parameters and absolute CD4 Cell count

Table 4 compared the count of red blood cells, hematocrit, hemoglobin, white blood cells, CD4 T-lymphocytes and platelets among blood donors at the two study sites. There was no statistically significant difference across all blood cells examined between the two study sites except the haemoglobin value of blood donors at UATH Abuja was significantly decreased in comparison of values at NAUTH Nnewi

Table 5 shows blood donors with abnormally low hematological parameters values at UATH and NAUTH. Among the blood donors screened and found eligible for donation, it was observed that fifty one (51) out of 212 blood donors have low WBC count representing 24.1%. Sixty four and 24 blood donors have low HGB and HCT values representing 30.2% and 11.3% of the population respectively while 40 (18.9%), 16 (7.5%) and 22 (10.4%) donors had low blood values of RBC, CD4 and Platelets counts respectively. There was statistical significance difference observed with haematocrit and haemoglobin levels between the two sites studied. None of the blood donors had abnormally high values of blood cells.

DISCUSSION

We conducted an observational, prospective study to describe the Sociodemographic characteristics, hematological parameters and absolute CD4 cell count in a cohort of persons evaluated as eligible for blood donation at two tertiary hospitals in Nigeria. The result obtained from this study has clearly shown that screening blood

Table 2: TTIs risk factors assessment of blood donors at UATH and NAUTH

HBV Risk Factors	UATH (n= 108)	NAUTH n= 104	Total (%) n= 212	Chi-square (p-value)
Lack of knowledge of HBV	57	72	129 (60.8%)	32.1 (0.00001)*
No HBV Vaccination	92	92	184 (86.8%)	0.490 (0.48)
Occupational/Domestic Accident	55	53	108 (50.9%)	0.00 (0.99)
Previous Blood Transfusion	6	2	8 (3.8%)	1.91 (0.16)
Multiple Sexual Partner	3	5	8 (3.8%)	0.59 (0.43)
History of STDs	6	1	7 (3.3%)	3.38 (0.06)
Alcohol/Drug Abuse	2	29	31 (14.6%)	28.0 (0.00001)*
Previous Surgeries/Dialysis	4	6	10 (4.7%)	0.5 (0.47)
Tribal Marks/Tatoo	7	13	20 (9.4%)	2.23 (0.13)
Visiting commercial Barber/Manicurer/Pedicurer	70	78	148 (69.8%)	2.59 (0.10)

*Statistically significant (p< 0.05); HBV: Hepatitis B Virus, STDs: Sexually transmitted diseases

Table 3: ABO blood group and blood donation pattern among blood donors at UATH and NAUTH

Blood Group and Donation Kind	UATH n=108	NAUTH n=104	Total (%) n=212	Chi-square (p-value)
ABO Blood Group				
A	13	19	32 (15.1%)	1.6 (0.2)
B	15	5	20 (9.4%)	5.0 (0.02)*
AB	2	2	04 (1.9%)	0.0 (0.96)
O	78	78	156 (73.6%)	0.2 (0.64)
Donation Type				
Family R. Donor	64	92	156 (73.6%)	23.1 (0.00001)*
Voluntary	37	6	43 (20.3%)	26.5 (0.00001)*
Commercial	7	6	13 (6.1%)	0.4 (0.82)
Donor Repeatability				
First Time Donor	50	54	104 (49.1)	0.6 (0.41)
Repeat (old) Donor	58	50	108 (50.9)	0.6 (0.41)

*Statistically Significant (p<0.05); Family R. Donor: Family Replacement Donor

Table 4: Comparison of some hematological parameters of blood donors at UATH and NAUTH

Blood Cells	UATH Blood Donors N=108 X ± SD	NAUTH Blood Donors N=104 X ± SD	p-value
RBC	4.74 ± 0.5	4.89 ± 0.6	0.459
HCT	40.5 ± 5.0	39.2 ± 3.5	0.204
HGB	11.7 ± 1.7	13.5 ± 1.3	0.004*
WBC	4.6 ± 1.1	5.0 ± 0.9	0.334
CD4	851.7 ± 279.5	893.8 ± 283.4	0.812
PLT	203.1 ± 50.6	225.7 ± 35.2	0.206

*Statistical significant (p<0.05); RBC: Red blood cells, HCT: Hematocrit, HGB: Hemoglobin, WBC: White blood cells, CD4: Cluster of differentiation type 4, PLT: Platelets

Table 5: Blood Donors with Abnormally Low Hematological Parameters Values at UATH and NAUTH

Haematological Parameters (Normal Value)	UATH Abuja n=108 No. (%) of samples with Low value	NAUTH Nnewi n=104 No. (%) of samples with Low value	Total (%) n= 212	p-value
RBC (4.3-6.0 $\times 10^{12}$/L)	17 (15.7%)	23 (21.2%)	40 (18.9%)	0.293
WBC (4.0-11 $\times 10^{9}$/L)	22 (20.4%)	29 (27.9%)	51 (24.1%)	0.26
HCT (36-52%)	5 (4.6%)	19 (18.3%)	24 (11.3%)	0.002*
HGB (12-18 g/dl)	45 (41.7%)	19 (18.3%)	64 (30.2%)	0.002*
CD4 (500-1500/µl)	10 (9.3%)	6 (5.8%)	16 (7.5%)	0.473
Platelets (150- 450 $\times 10^{9}$/L)	14 (13.0%)	8 (7.7%)	22 (10.4%)	0.261

*Statistical significant (p<0.05); RBC: Red Blood Cell; WBC: White Blood cell; HCT: Haematocrit; HGB: Hemoglobin; CD4: Cluster of Differentiation Type 4

donors for only HCT as hematological parameter is inadequate and has limits. The results showed that a significant number of eligible blood donors had abnormally low values of total white blood cells (WBC), red blood cells (RBC), platelets, hematocrit (HCT), hemoglobin and absolute CD4 count. Out of 212 blood donors recruited, 51 (24.1%) have low WBC count. Thirty one (31) and Twenty two (22) blood donors have low HGB and HCT values representing 14.6% and 10.4% of the population respectively. Our result is in agreement with the study of [1] that recorded low values of blood components among blood donors in Jos, Nigeria. They obtained 10.8%, 3.9% and 26.5% abnormal results with platelets, hematocrit and total WBC respectively while this study had 10.4%, 11.3% and 24.1% abnormally low values for platelets, HCT and total WBC count. The low values of this blood cell indicates that some blood units transfused to recipients are not rich enough in hematocrit, hemoglobin and RBC to solve the intended problem of anemia it was designed for. The study observed that some blood donors had leucopenia and low values of CD4 cell count. We were unable to investigate the possible causes of leucopenia and low CD4 cell counts among the subjects. This could be due to chronic infections [13]. Therefore further studies are needed to identify the possible reasons for low white blood cell count and low values of CD4 cell count among blood donor participants. It had been shown that low CD4 count could be due immunosuppression and HIV infection as the primary target for HIV infection is CD T-Lymphocytes [10]. Other studies by Fasola et al. and Ajugwo et al. [14,15] have reported that alterations and destructions of blood cells have been attributed to viral hepatitis particularly Hepatitis B and C.

Data obtained from this study further revealed that there were no significant differences in the mean values of hematological variables of blood donors recruited from UATH Abuja compared to those from the NAUTH Nnewi except a significant lower mean haemoglobin level reported among blood donors from UATH, Abuja. This could be possible although both sites are medium sized city. Also, different values of hematological parameters can be obtained from different cities and nations. In a similar study by Akinbo et al. [16] on hematological indices and CD4 count of apparently healthy population in Owo, Ondo State, Nigeria, they found the mean blood values of WBC, RBC, HGB, HCT and Platelets are higher in males than females. The reference range of males include 4.2-9.7, 4.0-5.3, 11.6-16.3, 35-48, 152-288 and 403-1900 for WBC, RBC, HB, HCT, Platelets and CD4 respectively. This finding correlates with our study that showed the average (mean) value blood donors at UATH and NAUTH for HCT for instance was 40.5 and 39.2 respectively. This is not statistically significant p>0.05.

The predictive transfusion transmissible infections risk factors observed among blood donors in the studied population included; lack of knowledge of HBV and HBV infection, no vaccination with HBV vaccines, occupational/domestic accident such as needle prick injuries and visiting commercial barbing salon, manicure/pedicure. These risk factors could expose blood donors to infections such as hepatitis viruses (B and C) and HIV. In a study by Lavanya et al. [17] in India, they reported that these risk factors were associated with HBV transmission among blood donors. Knowledge of HBV and Hepatitis B is not much known despite the study population is literate individuals. There is need for awareness of HBV infection and other transfusion transmissible infections in the population particularly on mode of transmission, prevention and risk factors. This can be achieved by mass mobilization campaign using media in various local languages of the country. The study had shown that most blood donors have not been vaccinated or protected from HBV. This might be a reflection of the general population. Therefore the populace should be vaccinated with recombinant HBV vaccines. This will go a long way in protecting people that

are susceptible as well as reducing the prevalence rate in the population.

Sociodemographic data obtained from this study showed that most blood donors recruited were males mostly of age group 18-40 years old (median age 33 years old). This collaborates with the study of Zheng et al. [18] in China that reported that most of the donors were males with mean age of 28 years. Also, most blood donors in the study population were mostly students, business men/traders and artisans. This collaborates with the study of [1] that showed that most blood donors were students, business men and artisans. This showed that blood donors' recruitment in Nigeria should be tailored towards going to schools and markets to recruit voluntary non remunerated blood donors as recommended by World Health Organization. In addition, most of the blood donors recruited belonged to blood group O as this is a universal blood donor and were mainly of family replacement blood donors.

CONCLUSION

The findings from this study showed that some blood donors considered eligible for donation had abnormally low values of blood cells such as hematocrit (HCT) WBC, hemoglobin, RBC, CD4 cells and platelets indicating that screening blood donor for HCT only for certification for blood donation is inadequate and has limits. It is hereby recommended that routine screening of prospective blood donors should be expanded to other hematological parameters particularly in some groups of blood donors with greater risk of anemia, like young women. Though it will add extra cost to the patients/blood recipients, it will be beneficial. Additional studies on healthy blood donors with anaemia, leucopenia, thrombocytopenia and low CD4 count is important to identify the cause of these abnormalities as alteration and destruction of blood cells can be as result of viral hepatitis, malaria and HIV.

ACKNOWLEDGEMENTS

The authors were grateful to all blood donors that participated in the study and all laboratory personnel at the two study areas that provided logistics support during the study.

FUNDING

The study was principally funded by the authors as there was no grant or sponsorship from any organization.

AUTHOR'S CONTRIBUTIONS

AIO conceived the paper. AIO, MOI and EO were involved in the samples collection and analysis. NRA, AIO and JN provided ideas during the preparation of the manuscript. AIO and JN analyzed the data generated. All authors proof read and approved the manuscript before going to the press.

CONFLICT OF INTEREST

The authors declared that they have no conflict of interest concerning the publication of this paper.

REFERENCES

1. Lugos MD, Okoh JB, Polit UY, Vwamdem NY, Ofojekwu MJ, Nnanna OU, et al. Some haematologic parameters of blood donors at the national blood transfusion service (NBTS), Jos, Nigeria. J Blood Disord Transfus. 2019;10:416.
2. Benedict N, Augustina AO, Nosakhare BG. Blood donation in Nigeria: Standard of the donated Blood. J Lab Physicians. 2012;4:94.
3. Islam MB. Blood transfusion services in Bangladesh. Asian J Transfus Sci. 2009;3:108.
4. Osaro E, Charles AT. The challenges of meeting the blood transfusion requirements in Sub-Saharan Africa: the need for the development of alternatives to allogenic blood. J Blood Med. 2011;2:7.
5. World Health Organization. Hepatitis B. Global Hepatitis Programme, Geneva. 2010; Fact sheet no 204.
6. Aneke JC, Okocha CE. Blood transfusion safety; current status and challenges in Nigeria. Asian Journal of Transfusion Science. 2017;11:1.
7. World Health Organization. Global database on blood safety: report 2001–2002, Geneva. 2010.
8. Federal Ministry of Health. The National Blood Policy. National Blood Transfusion Service, Abuja. 2006.
9. Jayaraman S, Chalabi Z, Perel P, Guerriero C, Roberts I. The risk of transfusion‐transmitted infections in sub‐Saharan Africa. Transfus. 2010;50:433-442.
10. Constantine NT, Saville RD, Dax EM. Retroviral testing and quality assurance: essentials for laboratory diagnosis. MedMira Laboratories. 2005; 133-151.
11. American Association of Blood Banks (AABB). Technical Manual, 19th Edn. 2018; 345- 375.
12. World Health Organization. Guideline for Enumeration of CD4 T Lymphocytes in the context of HIV/AIDS. South East Asia, New Delhi, India. 2007.
13. Acheson NH. Fundamentals of Molecular Virology. 2nd Edition. John Wiley and Sons Inc. USA. 2011; 365-375.
14. Fasola FA, Otegbayo JA, Abjah UM, Ola SO. Haematological parameters in Nigerians with acute viral hepatitis. Nig J Gastroenterol Hepatol. 2009;1:27-31.
15. Ajugwo AO, Ukaji DC, Erhabor TA, Adias TC. Some Haematological Parameters of Symptomatic and Asymptomatic Hepatitis B Positive Patients Attending a Nigerian Tertiary Hospital. Br J Med Med Res. 2015;7:219.
16. Akinbo BD, Atere AD, Fatunade HB, Iyabor NO. Haematological indices and absolute CD4 counts of apparently healthy population in Ondo State, Nigeria. Br J Med Med Res. 2015;8:717-723.
17. Lavanya V, Viswanathan T, Malar SA, Malarvizhi A, Moorthy K. Prevalence of hepatitis B virus infection among blood donors with antibodies to hepatitis B core antigen. Int J Med Med. 2012;4:128-137.
18. Zheng X, Ye X, Zhang L, Wang W, Shuai L, Wang A, et al. Characterization of occult hepatitis B virus infection from blood donors in China. J Clin Microbiol. 2011;49:1730-1737.