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ORIGINAL RESEARCH

Socio-demographic and Haematological Profile of Voluntary Blood Donors in Abakaliki, Southeast Nigeria

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Abstract

Background: Donor characteristics could significantly impact the availability and quality of blood products.
Objective: To examine the socio-demographic and haematological profile of voluntary blood donors in Abakaliki and their suitability for whole blood and component donation.
Methods: This was a cross-sectional study of 103 prospective voluntary donors. Socio-demographic characteristics were obtained using a questionnaire. A blood count was performed with a haematology autoanalyser, while the Haemoglobin phenotype was done by Haemoglobin electrophoresis.
Results: Males were in a slight majority of the voluntary blood donors (56; 54.4%), while females were 47 (45.6%). Most were undergraduates (89; 86.4%) within the age range of 18-25 years. Thirty-two per cent were repeat donors. The blood donors' mean haematocrit level and Mean Corpuscular Volume (MCV) were 36.3±5.3% and 78.9±5.7fl, respectively, which may suggest latent iron deficiency anaemia. Platelet count was 162.1±62.8 x 10^9/L, which is not optimal for high-yield platelet donation, while 65% and 35% of the 103 blood donors had HbAA and HbAS haemoglobin phenotype, respectively.
Conclusion: Most blood donors were males and students with minimal representation of other occupation groups. Their mean haematocrit and MCV were low, while platelet count was compatible with the WHO threshold for apheresis platelet donation, albeit undesirably low for optimal platelet yield. A significant proportion of donors is the haemoglobin AS phenotype. Strategic blood donor recruitment, nutritional counselling and supplementation may be employed to improve the availability and quality of blood and its components.

Keywords: Anaemia, Blood count, Blood donation, Haematocrit, Mean Corpuscular Volume, Platelet count.

Introduction

Blood transfusion is an essential component of the health care system of any country. [1] It plays a vital role in patient management. It can be defined as the safe vein-to-vein transfer of blood. Blood transfusion should prioritise providing safe and quality blood from a healthy donor to the recipient. [2] Blood donors are healthy individuals who willingly donate their blood for the medical management of other individuals. [3] Voluntary donors donate blood for altruistic reasons and are adjudged the safest category of donors.

World Health Organization's (WHO) policy is to achieve 100% non-remunerated blood donation. [4] Although the number of voluntary blood donations has increased in the last

decade, gaps still exist in donor recruitment and donor retention. [4] Demographic profiles like age, sex, educational level, ethnicity and marital status are essential for drafting strategies for voluntary donor recruitment.[5] Recruitment and retention of voluntary donors are critical for sustaining hospital blood banks' blood supply.[2] Likewise, the effectiveness of a transfusion blood service depends on the quality of the blood transfused and the safety of the donor thereafter.[4] The quality of blood is determined by assessing the donor's fitness with parameters like the haematocrit level, platelet count, genotype and transfusion transmissible infections screening status. On the other hand, the donor's safety is determined by age, weight and the absence of co-morbidities. Some tertiary health centres in Nigeria have recently improved their infrastructure and are involved in component blood banking. Most hospital-based blood banking systems rely on haematocrit estimation alone in assessing the haematological status of a blood donor.[1] This is inadequate for choosing suitable donors for other blood components like platelets and identifying those with latent anaemia or other haematological conditions.

Donor supply of whole blood and components is an important and indispensable part of patient management. Efforts should be made to optimise donor recruitment and blood quality while prioritising donors' safety.[5] The aim of this study was to document the socio-demographic characteristics and comprehensive haematological profile of voluntary blood donors in Abakaliki and determine their suitability for whole blood and blood component donation. The outcome of this study may proffer strategies to improve the provision of blood and blood components for blood transfusion therapy.

Methods

Study design

This was a descriptive, cross-sectional study.

Study location

The study was carried out at the Blood Bank unit of a 600-bed tertiary health institution in Abakaliki, Ebonyi State from June to October 2022. The hospital is a referral centre for parents from the surrounding Enugu, Cross River, Abia, Imo, and Benue states in Nigeria.

Study population

A total of 103 consecutive voluntary blood donors who consented and presented themselves at the blood bank unit were purposively recruited for the study. Donors who withheld consent forms were not enrolled.

Sample collection and analysis

Demographical data were collected by filling out the blood donor questionnaire form. Five millilitres of venous blood were collected from the antecubital fossa to determine haematological parameters using EDTA-anticoagulated sample bottles. The haematological parameters were analysed within one hour of blood sample collection using the MINDRAY B3000 haematology analyser (Mindray, Shenzhen, China). The haematological indices of the blood donors determined included haemoglobin (Hb), Red Blood Cell (RBC) indices, White Blood Cells (WBC) total and differential, haematocrit and Platelet count. The ABO Blood group type (cell grouping) of all blood donors recruited was determined using the slide agglutination technique. A drop of blood was placed on a clean tile in three separate spots. Each drop was mixed with commercially prepared antisera, Anti-A, Anti-B and Anti-D reagents from SKYTEC DIAGNOSTICS USA and observed for agglutination macroscopically. The principle of ABO blood group testing is based on antigen and antibody reactions resulting in agglutination. Thereafter, samples were separated in a centrifuge, and sera obtained were tested for hepatitis B surface antigen (HBsAg), antibodies to hepatitis C virus (HCV), human immunodeficiency virus (HIV) 1/2, and Treponema pallidum using commercially

available immunochromatic based rapid kits (SKYTEC DIAGNOSTICS USA). A test is positive if two transverse bands (T-test T and Control, C) are seen and negative when only one band at control (C) is seen. The sera were further tested for the listed TTIs using an enzyme-linked immunosorbent assay kit (HIGHTOP HIV AB/AG, HIGHTOP HBSAG, RECOMBI HCV and SYPHILIS ELISA KITS CHINA). The haemoglobin phenotype of the donors was done using haemoglobin electrophoresis acetate at pH 8.6. Haemoglobin extract (Haemolysate) of the EDTA whole blood samples of the blood donors were prepared using distilled water. Each compartment of the electrophoretic tank was filled with 100ml Tris EDTA-boric acid buffer at PH 8.6, and a filter paper was soaked into each compartment to drape over the bridge. The haemoglobin extract of the donors and known controls were applied on the electrophoretic cellulose acetate strip and placed across the bridge in the chamber. This is subjected to an electric field at 350 volts for 25 minutes to separate the different haemoglobin variants, which are read using controls as a guide.

Ethical considerations

The study was approved by the Health Research Ethics Committee of the AEFUTHA. The subjects gave informed consent prior to enrolment and sample collection.

Statistical analysis

The data were analysed using IBM SPSS version 19.0. Amork, NY: IBM Corp (2010). Continuous variables, including age, blood pressure measurements and haematological parameters, were summarised as mean, standard deviation and ranges, while categorical variables, including age group, gender, type of donor, blood group status, and Hb phenotype, were summarised as frequencies and percentages. The Kolmogorov-Smirnov test checked the distribution of data. The difference in mean of continuous variables between groups was tested using the student's t-test while Chi-Square or Fisher's test was used as appropriate to compare the difference in proportion between categorical variables. *P* value ≤ 0.05 was considered statistically significant.

Results

Table I shows that out of the 103 voluntary blood donors who participated in the study, 47 (45.6%) were females and 56 (54.4%) were males. Most 89 (86.4%) were undergraduate students. The majority were between the ages of 18 and 25 while 70 (68%) were first-time donors.

Among the voluntary blood donors, 67 (65%) had a Haemoglobin AA phenotype, while 36 (35%) had AS. The predominant blood group was group O (55; 53.4%), while blood groups A, B and AB were found in 24 (23.3%), 21 (20.4%) and 8 (7.8%), respectively. Ninety-five (92.2%) had Rhesus-positive blood group while 8 (7.8) were Rhesus-negative (Table II).

In Table III, the mean weight of the voluntary blood donors was 63.3±14.4kg, while the mean systolic and diastolic blood pressure were 113.9±12.9mmHg and 76.5±11.2mmHg, respectively. The mean haematocrit value was 36.3±5.3%, MCV was 78.9±5.7 fl and platelet count was 162.1±62.8 (x 10^9/L).

All the donors tested negative for Hepatitis B, C, Syphilis and HIV infections using the rapid screening test kits. On further screening with enzyme-linked immunosorbent assay, one donor (1%) tested positive for Hepatitis B. Table IV reveals that there was a statistically significant lower mean age, weight and systolic blood pressure values in the females' blood donors when compared to the males respectively (26.0±7.4 vs 21.4±3.9; 71.8±13.7 vs 56.0±10.7; 119.3±12.6 vs 109.3±11.5; $p<0.001$ in each case). Haematocrit values were also significantly lower in females compared to males (34.6±5.7 vs 38.3±4.0), while the platelet counts were higher in females, though without statistical significance.

Table I: Socio-demographic characteristics of voluntary blood donors

Characteristic	*Frequency (%)*
Age group (Years)	
18-24	77 (74.8)
25 – 34	16 (15.5)
35 – 44	8 (7.8)
≥45	2 (1.9)
Sex	
Female	47 (45.6)
Male	56 (54.4)
Occupation	
Undergraduate Students	89 (86.4)
Physicians	4 (3.9)
Civil Servant	4 (3.9)
Health worker	3 (2.9)
Lawyer	1 (1.0)
Unemployed	2 (1.9)
Highest Level of Education	
Undergraduates	89(86.4)
Postgraduate	14 (13.6)
Type of Donor	
First time	70 (68.0)
Repeat	33 (32.0)

Table II: Haemoglobin phenotype and blood group distribution of donors

Blood characteristics	*Frequency (%)*
Haemoglobin Phenotype	
AA	67 (65.0)
AS	36 (35.0)
Blood Group (ABO)	
O	55 (53.4)
A	24 (23.3)
B	21 (20.4)
AB	3 (2.9)
Rhesus Status	
Positive	95 (92.2)
Negative	8 (7.8)

Table V depicts that 34 (72.3%) of the male blood donors had Hb A phenotype while 13 (27.7%) were HbAS. For the female donors, 33 (58.9%) had the Hb A phenotype, while 23 (41.1%) had the Hb AS phenotype. There were no sex predilections for the ABO and Rhesus-positive blood group distribution. However, Rhesus-negative and AB blood groups were seen only among female donors. Only 13 (27.7%) females and 20 (35.5%) males are repeat donors.

Discussion

The socio-demographic data obtained in the current study showed the impact of gender on blood donation and opines that slightly more

males donated blood than females. This agrees with previous studies done in Nigeria that showed male dominance in donor pools but is at variance with reports from some developed countries where female donors constitute as high as 55% of donors. [1,3,5,6]

Table III: Mean weight, blood pressure and blood count distribution of blood donors

Parameters	*Mean (SD)*	*Range*
Weight (Kg)	63.3±14.4	60.4 – 66.1
SBP (mmHg)	113.9±12.9	111.0 – 116.7
DBP (mmHg)	76.5±11.2	74.1 – 79.0
Blood counts		
WBC (×10 ^{9}/L)	5.6±2.3	5.1 – 6.0
Lymphocyte (×10 ^{9}/L)	2.9±0.3	2.7 – 3.9
Monocyte (×10 ^{9}/L)	0.5±0.4	0.4 – 0.6
Granulocyte (×10 ^{9}/L)	2.3±1.0	2.1 – 2.5
HCT %	36.3±5.3%	35.2 – 37.3
RBC (×10 ^{12}/L)	4.9±3.3	4.2 – 5.6
MCV fL	78.9±5.7	77.7 – 80.0
MCHC g/dL	30.8±3.6	30.1 – 31.5
RDW_c g/dL	16.9±5.3	15.8 – 17.9
RDW_s fL	44.7±5.3	43.7 – 45.8
Platelet (×10 ^{9}/L)	162.1±62.8	149.9 – 174.4
MPV fL	9.5±1.2	9.3 – 9.7
PCT mL/L	0.15±0.06	0.14 – 0.16
PDW%	14.4±2.4	14.0 – 14.9
PLCR%	21.5±5.2	20.5 – 22.5

Table IV: Distribution of age, weight, blood pressure and blood counts between males and females

	Males	*95% CI*	*Females*	*95% CI*	*p-value*
Age (years)	26.0±7.4	23.8 – 28.2	21.4±3.9	20.3 – 22.4	<0.001
Anthropometry					
Weight Kg	71.8±13.7	67.8 – 75.9	56.0±10.7	53.2 – 58.9	<0.001
Blood pressure					
SBP mmHg	119.3±12.6	115.2 – 123.4	109.3±11.5	105.8 – 112.7	<0.001
DBP mmHg	79.1±12.7	74.9 – 83.2	74.4±9.3	71.6 – 77.2	0.059
Blood count					
WBC (x10 ^{9}/L)	5.5±2.5	4.8 – 6.2	5.6±2.1	5.0 – 6.2	0.752
Lymphocyte (x10 ^{9}/L)	2.9±1.7	2.4 – 3.4	3.0±1.3	2.6 – 3.3	0.203
Monocyte (x10 ^{9}/L)	0.5±0.4	0.3 – 0.6	0.5±0.4	0.4 – 0.7	0.407
Granulocyte (x10 ^{9}/L)	2.3±1.1	2.0 – 2.6	2.2±0.7	2.1 ± 2.4	0.458
RBC x10 ^{12}/L	4.9±0.7	4.7 – 5.1	4.3±0.5	4.2 – 4.5	0.966
HCT %	38.3±4.	37.1 – 39.5	34.6±5.7	33.1 – 36.2	<0.001
MCV fL	78.5±5.5	76.9 – 80.2	79.2±5.9	77.6 – 80.7	0.583
MCHC pg	30.7±3.7	29.6 – 31.8	30.8±3.6	29.8 – 31.7	0.905
RDW_c g/dL	17.0±6.3	15.2 – 18.9	16.7±4.5	15.5 – 17.9	0.747
RDW_s fL	44.0±5.0	42.4 – 45.6	45.3±5.3	43.9 – 46.7	0.211
Platelet (x10 ^{9}/L)	158.7±59.4	141.2 – 176.2	165.0±65.8	147.4 – 182.6	0.615
MPV fL	9.5±1.3	9.1 – 9.8	9.5±1.1	9.2 – 9.8	0.852
PCT mL/L	0.15±0.06	0.14 – 0.17	0.15±0.06	0.13 – 0.17	0.809
PDW%	14.5±1.9	13.9 – 15.0	14.4±2.8	13.6 – 15.1	0.828
PLCR %	21.0±5.8	19.3 – 22.7	21.9±4.8	20.6 – 23.2	0.401

Table V: Distribution of Haemoglobin phenotype, blood group and donor type between males and females

Parameter	*Females*	*Males*	*Statistics*	*p-value*
Haemoglobin Phenotype				
AA	34 (72.3)	33 (58.9)	χ^2 =2.022	0.155
AS	13 (27.7)	23 (41.1)		
ABO Blood group				
O	26 (55.3)	29 (51.8)		
A	11 (23.4)	13 (23.2)	χ^2 = 2.611	0.455
B	10 (21.3)	11 (19.6)		
AB	0 (0.0)	3 (5.4)		
Rhesus status				
Positive	47 (100.0)	48 (85.7)	Fisher's Exact Test	0.007
Negative	0 (0.0)	8 (14.3)		
Donor type				
First time	34 (72.3)	36 (64.3)	χ^2 = 0.761	0.383
Repeat	13 (27.7)	20 (35.7)		

The donorship rate of 46.6% among females exhibited in this study is relatively high compared to similar studies in developing countries.[5,7] Demotivating factors to blood donation among females include socio-cultural factors, superstitions, malnutrition, malaria and physiological processes (lactation and menstruation), which may predispose women to anaemia. The finding in the present study could be attributable to the fact that this study was carried out immediately after the World Blood Donor Day celebration, which provided the needed public awareness, reminders, and information on the safety processes of blood donation. This could have blended with the strong altruistic tendency of women to improve their donorship rate. Olawumi *et al.* noted that providing reminders to donate is one of the motivators for donating blood among women. At the same time, Steel *et al.* observed that women were more motivated to give blood for altruistic reasons than men. [7, 8] Sustenance of awareness programs about blood donation safety will help provide knowledge and information that would encourage blood donation, especially among healthy women, thereby increasing blood supply.

Most of the blood donors were students between 18 and 24 years old. The middle-aged, the elderly, and those belonging to other occupations represented only a minority. Our finding agrees with previous studies in southeast and southwest Nigeria and WHO 2022 Fact Sheets on blood donors' demographics, which show that the major donor population in developing countries were young adults in their early twenties and thirties. [5,9-10] This age group comprises mainly students who may be better equipped with information on blood donation due to stakeholders' focus on blood donor campaigns and public education in schools. [11] Developing strategies to carry along the neglected population groups in blood drive campaigns and education will increase blood donation rates. [12]

Sixty-eight per cent of the blood donors were first-time donors, while 32% were repeat donors. This shows a low return rate of 32%,

similar to the findings by Fasola *et al.* [9] Transfusion-transmissible infections are more common among first-time blood donors than among repeat and regular donors. [13] This poses a greater risk in a resource-limited country, where many blood samples are still screened with rapid screening kits rather than WHO-recommended enzyme-linked immunosorbent assays. Strategies to encourage return rates, like a schedule of re-donation appointments, a thank-you phone call to the donor, a post-donation message to inform the donor that the blood was used to save lives, and regular follow-up with donors, should be encouraged. Healthy older people are more likely to become regular donors, and awareness campaigns about donations should target that population. [12]

In the present study, blood group O donors were the highest at 53.4%, followed by blood group A (23.3%), blood group B (20.4%), and blood group AB (2.9%). Studies done by Osuji *et al.* and Aworanti *et al.* on blood donors showed similar findings. [3, 14] Ninety-two per cent of the blood donors were Rhesus-positive, which agrees with the blood group prevalence study in the locality. [15] Though most donors had an AA haemoglobin phenotype, 35% had an AS phenotype. This aligns with the report of Omisakin *et al.*, which is explainable by the high prevalence of sickle cell trait in our environment. [16] The World Health Organization (WHO) does not consider the sickle cell trait a contraindication for blood donation, provided the blood will not be transfused to hypoxia-susceptible and sickle cell-prone patients such as foetuses, neonates, and sickle cell disease patients. However, in our environment, where haemoglobin electrophoresis is not routinely done before transfusion, sickle cell disease patients may be inadvertently transfused with sickle cell trait blood. This will aggravate the inherent haemo-rheological abnormalities, increase hypercoagulability, and increase the burden of HbS. Considering the significant number of AS phenotypes among blood donors, it is, therefore, reasonable to consider the possibility of implementing a practice of routine screening for sickle cell trait in blood donors prior to donating blood or donated blood units since most donors may not be aware of their status.

The current study assessed the haematological profile of the blood donors, including the haematocrit level and the red cell indices (MCV and MCH) to access latent anaemia and iron deficiency, white blood count and platelet count to reveal other haematological conditions. It was observed that the mean haematocrit level of the blood donors was 36.3±5.3%, and females had significantly lower haematocrit compared to males, which aligns with the findings of Balogun *et al.* among blood donors. [17] The observed mean haematocrit percentage of the donors is lower than the recommendation of greater than or equal to 38% for males by the National Blood Service Commission (NBSC). [18] Also, the donors' mean cell volume (MCV) and mean cell haemoglobin concentration (MCHC) were low; most were first-time donors. This may suggest a high prevalence of iron deficiency anaemia in our environment due to undernutrition, and careful donor selection is needed for the safety of the donor. [19] Return donors may also benefit from iron replacement therapy. [20] Optimal haematocrit of donated blood is needed to raise recipients' haematocrit levels and improve oxygen supply when prescribed for the anaemic patient. Blood banks may need to incorporate periodic assessments of the iron levels of regular blood donors and the provision of iron therapy to enable their retainment in the donor pool.

We observed that the participants' mean total white cell count was in the normal reference range and comparable to the previous report by Balogun *et al.* but at variance with Osuji *et al.*, who reported subclinical leucopaenia among blood donors. [3,17] There was no significant difference in the white cell count or differentials between the male and female donors in this study.

The mean platelet count of the subjects was 162,000/mm ^{3} with a range of 149,900–174,400/mm^3, which agrees with previous reports. [17,21] The participants' platelet count met the recommended criteria of 150,000/mm^3 for platelet apheresis donation but did not meet the requirements of 300,000/mm^3 according to the Association for the Advancement of Blood and Biotherapies (AABB) for high yield/double unit platelet apheresis. Some studies have opined that genetic/ethnic variables are responsible for lower mean platelet counts observed in Africans than in Caucasians. [22] Undernutrition could also be accountable for our environment. [19] Identifying healthy donors with high platelet counts, deploying registers, and maintaining contacts to encourage them to become regular blood donors will be valuable to health centres that provide blood and blood components.

All the voluntary donor participants tested negative for hepatitis B, hepatitis C, HIV, and Syphilis using rapid screening kits. However, one participant tested positive for hepatitis B with an enzyme-linked Immunosorbent Assay (ELISA). This shows the superiority of third—and fourth-generation ELISAs for detecting transfusion-transmitted infections among blood donors.

We conclude that students are the major participants in the voluntary donor pool, with little participation from other occupation groups. Also, healthy blood donors may have sub-optimal haematological parameters that routine haematocrit screening will not detect.

Limitations of the study: we could not interrogate the cause of low MCV in the participants, knowing that iron deficiency anaemia may not be the only cause.

Conclusion

This study provides information that is anticipated to improve blood donor recruitment strategies for the health care system. Blood banks are responsible for providing safe blood and blood component transfusion therapy that meets patients' physiological needs. This is dependent on the constant availability of voluntary blood donors. Blood drive campaigns should also be directed to workplaces, and reminder systems should be incorporated into the blood banking system. Complete blood count should be incorporated in donor screening to ensure the safety of those with borderline anaemia and prompt referral for those with sub-optimal parameters. It is also needed for the selection of suitable donors for platelet products. Haemoglobin electrophoresis should be performed for donated blood and donors for patients with haemoglobinopathies and hypoxic conditions because of the high prevalence of sickle cell trait in our environment.

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References

1. Ogar CO, Okpokam DC, Okoroiwu HU, Okafor IM. Comparative analysis of hematological parameters of first-time and repeat donors: Experience of a blood bank in Southern Nigeria. (Hematol Transfus Cell Ther 2022;44:512-518. https://doi.org/10.1016/j.htct.2021.06.013

2. Burgdorf KS, Simonsen J, Sunby A, Rostgaard K, Pedersen OB, Serensen E, *et al.* Socio-demographic characteristics of Danish blood donors. PLoS One 2017;12:1-

11. https://doi.org/10.1371/journal.pone.0169112

3. Osuji AI, Agbakoba NR, Ifeanyichukwu MO, Obi E, Njab J. Socio-demographic characteristics, hematological parameters and absolute CD4 count of healthy blood donors at two teaching hospitals in Nigeria. J Blood Disord Transfus 2019;10:430-436. https://doi.org/10.35248/2155-9864.19.10.430

4. Jaffry TN, Khalid S, Tariq N, Fiaz A, Zafar S, Yasir S. Socio-demographic factors influencing voluntary blood donation in the general population of Islamabad, Pakistan. J Community Med Public Health Care. 2019;6:1-5. https://doi.org/10.24966/CMPH-1978/100055

5. Ugwu AO, Madu AJ, Efobi CC, Ibegbulam OG. Pattern of blood donation in Enugu, Southeastern Nigeria. Niger J Clin Pract. 2018;21:1438-1443. https://doi.org/10.4103/njcp.njcp_346_17

6. Lattimore S, Wickenden C, Brailsford SR. Blood donors in England and North Wales: demography and patterns of donation. Transfusion 2015;55:91-99. https://doi.org/10.1111/trf.12835

7. Olawunmi HO, Fasola FA, Otu TI, _Ugwu NI, Durotoye IA, Omokanye KO, *et al*. Blood donation among women in Nigeria: Motivators, barriers and appealing incentives. Vox Sang 2023;118:447-454. https://doi.org/10.1111/vox.13436.

8. Steele WR, Schreiber GB, Guilltinan A. Role of altruistic behavior, empathetic concern and social responsibility motivation in blood donation behavior. Transfusion 2008;48;43-54. https://doi.org/10.1111/j.1537-2995.2007.01481.x

9. Fasola FA, Olaniyi JA, Irabor A, Alonge T, Amaunam S. Characteristics of whole blood donors in a hospital-based blood bank in Nigeria: a one-year review. ISBT Sci Ser 2019;14:352–357. https://doi.org/10.1111/voxs.12484

10. WHO. Blood Safety and availability. Geneva; 2022. Available from https://www.who.int/news-room/fact-sheets/detail/blood-safety-and-availability

11. Halawani AJ. The impact of blood campaigns using mobile blood collection drives on blood supply management during the COVID-19 pandemic. Transfus Apher Sci. 2022;61:103354. https://doi.org/10.1016/j.transci.2022.103354

12. Davison TE, Masser BM, Thorpe R. Growing evidence supports healthy older people continuing to donate blood later in life. Transfusion 2019;59:1166-1170. https://doi.org/10.1111/trf.15237

13. Niazkar HR, Dorgalaleh A, Rad F. First-time Blood Donors Are Double-edged Swords for Blood Transfusion Centres: A Retrospective Study in Southwest Iran. Turk J Hematol 2020;37:30-35. https://doi.org/10.4274/tjh.galenos.2019.2019.0166

14. Aworanti OW, Ogundeji SP, Oladele AQ, Okojie EA. Comparative analysis of Blood Donation practices among students at Nigerian University. Open J Med Res 2022;3:42-49. https://doi.org/10.52417/ojmr.v3i2.390

15. Ugwu N. Pattern of ABO and Rhesus blood group distribution among students of Ebonyi State University Abakaliki, South East Nigeria. Asian J Med Sci 2016;7:101-104. https://doi.org/10.3126/ajms.v7i1.12716

16. Omisakin CT, Esan AJ, Ogunleye AA, Ojo-Bola O, Owoseni MF, Omoniyi DP. Glucose-6-Phosphate Dehydrogenase (G6PD) Deficiency and Sickle Cell Trait among Blood Donors in Nigeria. Am J Public Health Res 2021;2:51-55. https://doi.org/10.12691/ajphr-2-2-3

17. Balogun TM, Aile K, Nnamani AC, Olayinka SK, Salu A. Haematology Parameters of apparently healthy prospective Whole blood donors in a Nigerian hospital setting. Open J Blood Dis. 2023;13:59-68. https://doi.org/10.4236/ojbd.2023.132008

18. National Blood and Safety Standards for Blood Establishments in Nigeria. https://nbsc.gov.ng/wp-content/uploads/2023/05/

19. Azinge IE, Ogunyemi A, Ogamba CF, Jimoh RO. Prevalence of anaemia and associated factors among adults in a select Lagos, Southwest Nigeria population. J Public Health Afr 2023;14:2224. https://doi.org/10.4081/jphia.2023.2224

20. Nwagha TU, Ugwu AO, Nwaekpe CN. Iron supplementation and blood donation in Nigeria: Effect on Hemoglobin, red cell indices, and iron stores - The Ranferon™ study. Ann Afr Med. 2023;22:70-76. https://doi.org/10.4103/aam.aam_248_21

21. Eller LA, Eller MA, Benson O, Kataaha P, Kyabaggu D, Tumusiime R, *et al*. Reference Intervals in Healthy Adult Uganda Blood Donors and Their Impact on Conducting International Vaccine Trials. PLoS ONE. 2008;3:12. https://doi.org/10.1371/journal.pone.0003919

22. Bain BJ, Seed M. Platelet count and platelet size in healthy Africans and West Indians. Clin Lab Haematol 1986;8:43-48. https://doi.org/10.1111/j.1365-2257.1986.tb00074.x