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Some Hematologic Parameters of Blood Donors at the National Blood Transfusion Service (NBTS), Jos, Nigeria

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Abstract

Introduction: A blood donor is expected to be a healthy individual who donates his or her blood for the medical treatment of patients. World Health Organisation (WHO) recommends that only those with good health status should be accepted as blood donors. Full blood count is a standard haematology test that evaluates a blood sample for a variety of basic parameters and partly applicable in the general screening of health. Normal haemoglobin level is one of the requirements for blood donor suitability. Normal haemoglobin alone does not connote normalcy of other haematologic variables. The full blood count of blood donors may reveal other blood measurements that may contribute to the better assessment of donors and standardisation of blood donor selection.

Aim: This research is aimed to evaluate some haematological parameters of assumingly healthy volunteer blood donors at the NBTS (National Blood Transfusion Service), in Jos, Plateau State.

Methods: A total of 102 potential healthy blood donors from Jos City and Du Village participated in the study. We obtained 2.5 ml of venous blood aseptically from each donor into an EDTA container and mixed. The full blood counts of the samples were all analysed. The values gotten were subjected to statistical analysis using the SPSS version 23 software.

Results: The packed cell volume (PCV), total and differential white blood cell counts and platelet count were significantly different compared to local reference ranges. Further, evaluation of the parameters between genders, locations, age groups and occupations of donors, the platelet, PCV and eosinophil counts differed significantly (p=0.042, 0.00 and 0.029 respectively). The average white blood cells (WBC) count was lower among donors in the rural area (p=0.000).

Conclusion: There may be a significant number of apparently healthy blood donors with abnormal haematologic parameters. Full blood count should be included in evaluating blood donors to ensure blood and donor safety.

Keywords: Voluntary blood donors; PCV; Platelets; White blood cells; National blood transfusion service; Blood components; criteria for blood selection

Introduction

A blood donor is an apparently healthy person who donates his or her blood to be used as a medical treatment of other people [1]. The primary categories of blood donors or sources of blood donors include commercial blood donors, family replacement donors, and voluntary blood donors [2]. In modern medicine, blood transfusion is an essential patient management strategy used in saving lives, yet associated with some serious risks for both donor and recipient [3].

The primary goal of any blood transfusion is to provide the component of blood that is essential for life but deficient in a patient. To optimally achieve such goal, donor red blood cells (RBC) and all other blood components must be compatible with the patient's blood [4]. Blood safety is a major global concern because of the untoward events that may occur. One of the most critical steps used to ensure blood safety is blood donor selection [5]. Blood donor eligibility is determined by medical interview, based on national guidelines for donor selection. The criteria for selection of donor include the donor's age, weight, normal temperature, pulse rate, systolic and diastolic blood pressures and haemoglobin (Hb) level. The potential blood donor must not be a sufferer of acute respiratory diseases, cardiovascular disease, epilepsy and Central Nerves System (CNS) disorders [6]. The blood donors must not be at risk of contracting or carrying any blood transfusion transmissible diseases. Because of the high demand for iron among pregnant and lactating women, they are temporarily excluded from blood donation to meet the needs of both mother and baby [7]. It has been recommended by WHO that blood donation should in all cases be entirely voluntary driven by the altruistic motive of saving the life of recipients. However, potential blood donors must be in good health to be accepted as donors of blood for therapeutic use.

The suitability of prospective blood donors should be determined by a pre-donation assessment of his or her health status [8,9]. Healthy individuals can donate up to 450 ml of blood without any significant deleterious effect with only the possibility of short-term temporary

effects on their circulatory system from which recovery is usually rapid [10].

A haematologic profile is a standard test that evaluates a blood sample for a variety of basic measurements of blood cells which gives a tally for each different type of cell in a given blood sample.

A haematology profile determines the amount of haemoglobin and the counts of red blood cells, white blood cells and platelets. The tests for haemoglobin and red blood cells are essential ways to identify anaemia, a condition often caused by insufficient iron in the patient. Testing for white blood cells can reveal some different conditions. Fewer or higher white blood cells than expected can be an indication of infections, failure of production, haematologic pre-malignant and clonal disorders. Generally, a bacterial infection may be suspected among patients with increased total white blood cell counts than normal and haemostatic disorders may be accompanied by low or high platelet counts.

Essentially, oxygen is taken by red blood cells from the lungs to the body tissues, and carbon dioxide is removed from the tissues and organs of the body by the deoxygenated red blood cells to the lungs for elimination among other functions. On the other hand, white blood cells are indispensable for fighting infections in the bloodstream either directly by phagocytosis or *via* mediated immunity [11].

To maximise the benefit of blood transfusion services, the evaluation of the blood donor's haematological parameters is essential in the assessment of suitable blood donors for component donations. Indolent or early blood diseases could be first suspected in apparently healthy blood donor with the resultant benefits of early follow up for diagnosis and intervention. Thus this study was carried out to evaluate the haematological parameters including; total white blood cells (WBC) count, differential WBC counts, platelet (PLT) count and packed cell volume (PCV) among voluntary blood donors in Jos metropolis.

Materials and Methods

Study area

This research was carried out in Jos metropolis of Plateau state. Jos is the capital of Plateau state of Nigeria. It is in the middle belt region of Nigeria, having a population of about 900,000. It lies close to the equator on latitude 9.933N and longitude 8.883E of the Greenwich meridian. It has an altitude of approximately 1,217 m (3,993 ft) above the sea level with an annual average rainfall of 1400 mm (55 inches) with a rainy season from May to October and the cold, dry season within November and April. The average temperature ranges between 21^0C-25^0C (70^0F-77^0F).

Study population and sample size

The study population comprised of apparently healthy voluntary and eligible blood donors who consented to participate in the study. We excluded blood donors that were not willing to participate in the study. Blood donors of all genders and age groups were recruited during blood donation drives organised by the National Blood Transfusion Service (NBTS) in Plateau state. The minimum studied sample size of one hundred and two (102) blood donors was determined using a simples sampling formula described by Daniel and others [12].

Ethical consideration

We obtained ethical clearances from the National Blood Transfusion Service (NBTS), North Central Zonal Centre, Jos, Nigeria, where the samples were collected and the ethical committee of Jos University Teaching Hospital (JUTH) Lamingo-Jos where the study was carried out. Study participants granted written consent to both donate blood and participate in the study.

Sample collection and processing

Three millilitres of venous blood sample was collected into the ETDA bottle from each donor.

Samples were processed according to standard manual techniques in the haematology laboratory.

Laboratory methods

Haemoglobin point-of-care testing: the HemoCue Hb 201system

He haemoglobin concentration of all potential blood donors was determined using a haemoglobin point-of-care testing: the HemoCue Hb 201 system [13]. He Hemocue analyser was powered on, and the daily quality control checks were carried out using RNA medical controls level 1 (low) and level 3 (high) and were confirmed passed by the analyser before the donor haemoglobin estimation was analysed. He blood sample of the donors was collected using a capillary sampling technique, and suficient blood sample was placed onto a plastic film. He curette was filled in one continuous process. He outside of the curette was wiped off with a lint-free wipe to remove excess blood. Caution was taken not to touch the open end of the curette. He blood sample filled curette was placed in the curette holder. He curette holder was gently pushed to its measuring position. He result of the haemoglobin value of the blood donor sample was displayed within 30 seconds. Potential blood donors who had a haemoglobin concentration of 12.5g/dl (125g/L) and above were selected for donation, while those who had haemoglobin level below 125g/L were deferred.

Total white blood cells count: A 1:20 dilution of whole mixed blood in Turk's solution, which comprises of water (97%): glacial acetic acid (2%): gentian violet (1%), which respectively lyses the red cells and stains the nuclei of white cells to be counted under the microscope. We added 20 µl of well-mixed whole blood to 0.38 ml of Turk's solution in a test tube, mixed and stood for 10 minutes. The coverglass was mounted on an improved Neubauer counting chamber until Newton's ring was observed. The improved Neubauer counting chamber was carefully charged with the well-mixed diluted blood using Pasteur pipette. The charged counting chamber was placed in a moist Petri dish for 10 minutes to allow white cells to settle into the same plane. After the 10 minutes of incubation, the counting chamber was placed on the microscope stage and white cells were counted in the four corner squares of the chamberusing 10X objectives of the microscope and observing margin rule. Total white cell count was calculated and expressed in 10^9/L [13,14].

Differential white blood cells count: To examine and report the morphology of cells, a thin blood film of each participating blood donor was prepared on a clean glass slide and stained with Leishman's staining method. Leishman stain is prepared by dissolving 0.15 g of Eosin-Methylene blue in 100 ml Methanol. The stained blood film was allowed to air dry and examined using battlement method under oil immersion objective. The blood film was scanned head to tail to report on morphological details of red blood cells, white blood cells and

platelets. For differential white blood cell count, 100 consecutive white blood cells were counted taking note of the various types of leucocytes. The cells counted, were recorded and reported as percentages [13-15].

Manual platelets count (by microscope): We used an improved Neubauer counting chamber to count platelets manually from the 80 small squares of the ruled chamber using the microscope. A 1:20 dilution of whole blood was made by pipetting 20 µl of well-mixed anticoagulated venous blood to 0.38 ml of platelet diluting fluid (ammonium oxalate). The mixture was allowed to stand for 5 minutes to facilitate the lysing of erythrocytes while coverslip was firmly mounted on the counting chamber. Then the blood-diluent suspension was mixed and Pasteur pipette was used to carefully fill the counting chamber (charged). The charged counting chamber was left in a petri dish chamber for 20-30 minutes to enable the platelet cells settled without the chamber drying. The counting chamber was then placed on the microscope stage, and 40X objective of the microscope was used to count platelets in 80 small squares of the counting chamber. The platelet count was calculated and reported in 10^9/L [14].

Determination of packed cell volume (PCV) by the microhaematocrit method: We collected 4.5 ml of venous blood from each study participant into potassium EDTA anticoagulant bottles.The PCV was determined by the microhaematocrit method: Blood sample was well-mixed and drawn up to a 3/4th length of the plain capillary tube by capillary action. The capillary tube was sealed from the dry end of the tube with plasticine and placed in the groove of the microhaematocrit centrifuge ensuring balance. Capillary tubes were centrifuged at 13,000 ± 2000 rpm for 5 minutes in Hawksley haematocrit centrifuge. Hawksley haematocrit reader was used to read the value of packed cell volume and was reported in percentage [16,17].

Result

Demographic distribution of the study population based on age group, location, gender and occupation is presented in Table 1. Out of the 102 participants; the age group 21-30 had the highest number of participants 55 (53.9%). The rural donors constituted 57 (55.9%) of our donors in this study. The male voluntary blood givers were 60 (58.8%) while students accounted for 42 (41.2%).

The normal total WBC count was recorded in only 75 (73.5%) of study participants, and 27 (26.5%) had counts outside the local normal range (Table 2). The platelet count recorded in 91 (89.2%) subjects was within the normal limits while 11 (10.8%) donors had counts outside normal limits. Normal PCV was recorded in 98 (96.1%) blood donors. The evaluation also revealed that eosinophil count was normal in 82 (80.4%) and abnormal in 20 (19.6%). Neutrophil and lymphocyte counts were within normal range in 97 (95.1%) and 90 (88.2%) respectively (Table 2). The PCV, platelet and eosinophil counts recorded significant statistical differences between the genders (Table 3), while the WBC, monocyte, neutrophil, lymphocyte, neutrophil and basophil counts had no statistical differences on the basis of gender.

The comparison of the haematological parameter by location was represented on Table 4. The total WBC had a statistically significant difference on the basis of location while platelet, monocyte, eosinophil, PCV, neutrophil, lymphocyte and basophil counts recorded no statistically significant differences.

Variables	Donors (N)	Frequency (%)	Variables	Donors (N)	Frequency (%)
Age Group			**Gender**		
=20	14	13.7	Male	60	58.8
21-30	55	53.9	Female	42	41.2
31-40	20	19.6	Total	102	100.0
>40	13	12.7			
Total	102	100.0			
			Occupation		
			Civil Servants	6	5.9
Location			Applicants	7	6.9
Urban	45	44.1	Student	42	41.2
Rural	57	55.9	Business	16	15.7
Total	102	100.0	Artisan	22	21.4
			Farmers	4	3.9
			Others	5	4.9
			Total	102	100.0

Table 1: Demographic distribution of the study population based on age groups, location, gender and occupation of donors

Variables	Normal Values: N (%)	Abnormal Values: N (%)	$\chi 2$	p
WBC	75 (73.5)	27 (26.5)	22.588	0.000
Platelets	91 (89.2)	11 (10.8)	62.745	0.011
PCV	98 (96.1)	4 (3.9)	86.627	0.024
Eosinophil	82 (80.4)	20 (19.6)	37.686	0.000
Neutrophil	97 (95.1)	5 (4.9)	82.980	0.021
Lymphocyte	90 (90.0)	10 (10.0)	64.000	0.018

Table 2: Comparison of the number and percentage of blood donors that showed normal and abnormal haematological variables in relation to local reference ranges

Variables	Male Mean ± SD	Female Mean±SD	T	p-value
Total WBC/mm3	4014.67 ± 1694.02	3652.38 ± 1125.80	1.211	0.229
Platelets (× 109/L)	237891.67 ± 109660.84	280547.62 ± 92355.940	-2.060	0.042
PCV (%)	42.10 ± 2.83	36.21 ± 3.905	8.819	0.000
Monocyte (%)	0.80 ± 0.14	0.71 ± 0.16	0.402	0.688
Eosinophil (%)	5.95 ± 0.86	3.31 ± 0.71	2.215	0.029
Neutrophil (%)	44.32 ± 11.90	47.33 ± 9.47	-1.367	0.175
Basophil (%)	0.17 ± 0.05	0.29 ± 0.09	-1.236	0.219

Table 3: The mean and standard deviation (SD) of haematological variables of blood donors according to gender

Variables	Urban Mean ± SD	Rural Mean ± SD	T	p-Value
Total WBC/mm^3	4660.67 ± 1744.90	3237.72 ± 841.30	5.416	0.000
Platelets(× 10^9/L)	261944.44 ± 119416.30	274017.54 ± 87852.05	4.050	0443
PCV (%)	39.87 ± 5.10	39.53 ± 3.80	0.386	0.700
Monocyte (%)	0.78 ± 0.17	0.75 ± 0.13	0.111	0.912
Eosinophil (%)	4.04 ± 0.81	5.51 ± 0.86	-1.219	0.226
Neutrophil (%)	48.24 ± 8.40	46.44 ± 12.37	0.231	0.228
Lymphocyte (%)	47.49 ± 7.83	49.40 ± 11.32	0960	0.340
Basophil (%)	0.22 ± 0.07	0.21 ± 0.07	0.122	0.903

Table 4: The mean and standard deviation (SD) of haematological variables of blood donors according to location of donors

Discussion

The study was designed to evaluate the haematological parameters which include; white blood cell count white blood cell differential count, platelet count and packed cell volume among voluntary blood donors. The objective of this study was to test the hypothesis that states that no abnormal haematological parameters among apparently healthy blood donors.

The analysis of our data showed that a significant proportion of blood donors had abnormal total white blood cell (WBC) count 27 (26.5%), platelet count 11 (10.8%), packed cell volume (PCV) 4 (3.9%), percentage eosinophil 20 (19.6%), neutrophil 5 (4.9%) and lymphocyte 10 (9.8%) counts. Data further revealed that there were no significant differences in the mean values of haematological variables of donors recruited from the urban area compared to those from the rural area except a significantly higher mean WBC reported among donors from

the urban area compared those from the rural area (4661/mm^3 versus 3238/mm^3; p=0.000).

Our data is in agreement with the work of Nubila et al. on apparently healthy blood donors. In their study, the average total WBC count among their subjects was significantly higher compared to the control [18]. The reason for increased total WBC count may be due to subclinical bacteremia leading to increased circulating phagocytes. Blood taken from donors should, therefore, be kept first at room temperature for effective phagocytosis. Also, a study by Abbass and colleague in 2016 revealed that 13.3% of apparently healthy sudanese blood donors had low platelet count [19]. This is similar to our study which recorded 10.8% of abnormal platelet count. Determination of full blood counts in platelet would provide for the selection of suitable donors for platelet concentrate or apheresis donation

Furthermore, our results concord with the report by Nubila and colleagues, which showed a mild but significant decrease in the mean PCV values among presumably healthy blood donors. This might be explained by the fact that PCV is not one of the screening tests for the selection of suitable blood donors rather haemoglobin concentration. The Hb concentration determination may not translate to donors' PCV due to readers' differences. It may also reflect the acceptance of donors with borderline Hb concentration, to collect blood, to significantly meet the pressure of transfusion demand on the blood service.

A study by Nduka et al. among African and Caucasians residents in the same Nigeria environment reported higher eosinophil counts among their African subjects, concurring with our observation [20]. The higher eosinophils counts in our subjects suggest the need for government, particularly at the grass-root to develop a sustainable community survey programme and intervention for tropical causes of eosinophilia such as parasitic infestations. Slightly higher lymphocyte count among healthy blood donors in our study is similar to a report of work earlier done by Ukaejiofor et al. who had documented lymphocyte count on a slightly higher value in the Nigeria population [21]. There may be need to determine the current local reference ranges for lymphocyte count and other haematologic parameters.

We conclude that healthy blood donors may have a slight but significant increase in total white blood cell, platelet and differential white blood cell counts. We further conclude that individuals with borderline anaemia may scale blood donation selection criteria based on the determination of blood adequacy of donors by haemoglobin concentration only.

Consequently, we recommend full blood count to be included into standard pre-donation tests of potential blood donors. Further to this, only blood donors with adequate parameters should be accepted for whole or blood components donation. Blood donors with abnormal parameters should be assessed further at the clinical unit.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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