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# Complete blood and absolute CD4+ve T lymphocyte counts of whole blood donors at a hospital blood center in Nigeria

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## Abstract

**Background:** Comprehensive routine screening and adequate selection of the prospective whole blood donor protects his health and safety as well as that of the recipient.

**Objectives:** The main objective of this study was to determine the complete blood and absolute CD4+ T lymphocyte cell counts of apparently healthy prospective whole blood donors**.**

**Participants and Methods:** This was a hospital based prospective study. A form was designed by the researchers for data collection. The socio demographic status, complete blood cells and absolute CD4+vel counts of apparently healthy whole blood donors who had tested seronegative for HIV, hepatitis B and C markers was captured . Obtained data was analysed with the statistical package for the social scientist software version 20

**Results:** One hundred male (97.1%) and three female (2.9%) apparently healthy prospective whole blood donors were studied. The median age of study subjects was 30 years. Obtained median blood cell values were 13g/dl, 40%, 4.9/nl and 203.9/nl for haemoglobin concentration, haematocrit, total white cell and platelet counts respectively. The median values for the mean corpuscular haemoglobin concentration (MCHC), mean corpuscular haemoglobin (MCH) and mean corpuscular volume (MCV) of studied blood donors were 32.6g/dl,27.7pg and 85.7fl respectively. Observed prevalence of subnormal blood cell counts for haemoglobin concentration, total white cells and platelets were 12.6%, 25.2%, 13.6% respectively. Also subnormal values for MCHC, MCH, and MCV were 11.7%, 26.2%, 16.5% respectively among studied whole blood donors. No higher than normal blood cell count values were observed. Median values for erythrocyte sedimentation rate and CD4+ T lymphocytes were 8.4mm/hr and 876.2cells/µl respectively. The percentage of subnormal CD4+T lymphocyte count was18.4%

**Conclusion:** A significant percentage of apparently healthy prospective whole blood donors had subnormal blood cell and CD+ve T lymphocyte values. Obtained normal values were comparable with local reference range reports from previous studies in Nigeria and other parts of Africa.

**Keywords:** Blood cell counts; CD4 +ve T lymphocyte; Medical selection; Whole blood donors; Nigeria

## 1 Introduction

Blood transfusion saves life and improves health. Many patients require transfusion but do not have timely access to safe blood. (1, 2) The provision of safe and adequate blood should be an integral part of every national health care policy

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and infrastructure. (1) An effective health system ensures all patients' in need have access to safe effective and quality assured blood products. Blood for transfusion is collected only from healthy individuals known as blood donors after a screening and selection process meant to protect the donor health and patient safety. The other strategies required for blood safety are a better detection of transfusion transmissible infections, physical and chemical treatment of blood and products. Prospective blood donors are screened to exclude those whose health might be compromised by the donation and to protect blood recipients from transmission of infectious agents. (3) The haemoglobin concentration or packed cell volume estimation is the only routine blood cell value used for the screening of prospective whole blood donors in transfusion services centres in Nigeria and some other sub-Saharan African countries. This screening value alone has clear limits as documented in previous African studies (4,5,6 ) The aim of the haemoglobin concentration screening among prospective blood donors is to safeguard individuals from developing anaemia following a donation exercise. Also to ensure that the haemoglobin content of the donated blood meets the required criteria. (7) This practice also protects returning blood donors from donation induced depletion of iron stores and iron deficiency anaemia due to inappropriate repeated donations.( 8, 9) The minimum haemoglobin concentration level recommended by international and national guidelines is 12.0g/dl and 13.5g/dl for females and males respectively as cut offs for whole blood donor selection. (10) However, in some countries including Nigeria the same haemoglobin concentration level of 13.5g/dl is used as cut off in the screening of male and female prospective blood donors in most blood centres. (11) In addition to haemoglobin concentration estimation, prospective blood donors are screened for transfusion transmissible infections such as HIV 1& 2, hepatitis B, C and syphilis in Nigeria. (12) These are parts of measures to ensure blood safety. The red cell indices which include the mean cell volume (MCV), the mean cell haemoglobin (MCH) and the mean cell haemoglobin concentration (MCHC) are haematology parameters useful for predicting subclinical anaemia. (4) The red cell indices, white cell and platelet counts which are components of the complete blood cell count in addition to the haemoglobin concentration are not routinely screened for among prospective whole blood donors in Nigeria. Erythrocyte Sedimentation Rate (ESR) is an old surrogate marker and a red cell screening test. It is widely used in clinical practice for evaluating the inflammatory or acute response, infection, trauma, autoimmune and malignant diseases. (13) The absolute CD4+ T cell count is of immense value in the evaluation of the body immune system of individuals but not required as donor eligibility criteria. (14) Complete blood and absolute CD4+Tcell counts of individuals assess the health and disease conditions. (15) The complete blood count of prospective blood donors is therefore required for their adequate medical screening and selection. In view of this, our study aims to assess the complete blood counts of HIV, Hepatitis B and C negative prospective whole blood donors.

*Objectives of the study*

- To determine the complete blood and absolute CD4+ T cell counts of prospective whole blood donors
- To evaluate the adequacy of the haemoglobin concentration or haematocrit alone for the medical selection of eligible whole blood donors.
- To make recommendations for improving donor selection criteria based on obtained data

## 2 Material and methods

This prospective hospital based study was carried out from August to October 2020 at the blood transfusion unit of the Lagos State University Teaching Hospital (LASUTH), Ikeja, Nigeria. This tertiary health institution and referral hospital serves the blood transfusion needs of patients in Lagos and neighbouring states in south west, Nigeria. LASUTH has over one thousand bed spaces and serves an estimated population of about 22 million residents in Lagos which is the commercial capital city of Nigeria. Lagos coordinates are 6.5$^{o}$N latitude, 3.4$^{o}$ E longitude and 41M above sea level. The study protocol was approved by the hospital research and ethics committee. A form designed by researchers was used to collect sociodemographic data, complete blood counts and absolute CD4+T cell values of prospective whole blood donors. Forms were filled by experienced study medical laboratory scientists and technicians who work in the blood bank at this centre. After giving an informed consent, unselected consecutive prospective whole blood donors were recruited into the study. We enrolled male and female participants aged 18 to 65 years. Inclusion criteria of participants for this study were age ≥ 18 to 65years and a negative HIV, Hepatitis B and C serostatus. The exclusion criteria were age < 18 and >65years or positive HIV or Hepatitis B or C serostatus. Five (5) millilitres of venous whole blood was collected from the cubital vein of every participant into a Potassium-ethylenediamine tetra acetic acid (K-EDTA) containing vacutainer collection tube. After a pre- and post-test counselling, HIV antibodies were tested for in the venous blood sample of every consenting participant using the WHO approved Determine TM HIV-1/2 rapid kits. Hepatitis B surface antigen and hepatitis C antibodies were also tested for in donor plasma using the rapid chromatographic immunoassay kits. Rapid testing was performed in accordance with the product manufacturers' guidelines. Also, the prospective blood donor venous whole blood sample was analysed within six (6) hours of collection for absolute CD4$^{+}$ T cell counts using the Cyflow R Counter (Partec, Germany). Complete blood cell count of participants which included haemoglobin (Hb) levels, haematocrit (Hct), MCHC, MCH, MCV, total white blood cell (TWBC) and platelet counts were assayed with the

Sysmex Kx-2IN,an automated five- part differential haematology analyser (Sysmex Corporation, Japan). ESR of each sample was assayed manually by the westergreen method. Obtained data was analysed with the statistical package for the social scientist software (version 20.0; SPSS, Chicago, IL). The statistical tests used in this current study were the mean and median. Obtained results were presented in simple tables with frequencies, percentages, mean and median values.

## 3 Results

A total of 110 apparently healthy prospective whole blood donors aged 18 to 65 years were initially recruited for this study. Of the enrolled 110 participants, 7 tested positive for either HIV or HCV antibodies and were excluded from data analysis. The complete blood and absolute CD4+T cell counts of 103 eligible participants comprising 100 males and 3 females were statistically analysed**.** The mean age of the study participants was 31.72±7.9 years with a range of 29 to 59 years. The majority 88(85.4%) of the prospective whole blood donors were in the age range 18-39years while 15(14.6%) were in 40-59 years as in **Table 1.** The median haemoglobin value of the prospective whole blood donors was 13.0g/dl with a range of 9.4 to 15.8g/dl. The median total white cell count of donors was 4.9/nl with a range of 2.5 to 7.2.The obtained median value for platelet count was 203.9/nl with a range of 292.0 to 353.0/nl. The median value for the MCHC was 32.6 g/dl with a range of 29.4 to 36.5. The median value for the MCV was 85.7fl with a range of 70.7 to 178.0. The median value for the MCH of studied prospective whole blood donors was 27.7pg with a range of 21.1to 33.1.The median ESR value was 8.4mm/hr with a range of 1 to 57. The median CD4+ve T cell count was 876.2cells/µl with a range of 255 to 1650cells **(Table 2).** The prevalence of subnormal values of haematology parameters in this study for haemoglobin concentration, white cells and platelets counts were 12.6%, 25.2%,13.6% respectively. Also subnormal values obtained for MCHC, MCH, MCV and CD4 counts were 11.7%, 26.2%16.5%,18.4% respectively among whole blood donors. This is presented in **Table 3.**

**Table 1** Age and gender characteristics of studied prospective blood donors

| Age group (years) | Frequency | Percentage |
|---|---|---|
| 18-28 | 41 | 39.8 |
| 29-39 | 47 | 45.6 |
| 40-49 | 11 | 10.7 |
| 50-59 | 4 | 3.9 |
| Total | 103 | 100 |
| Mean age 31.72 ± | 7.9 years | |
| Median age 30 years | | |
| Minimum age | 20 | |
| Maximum age | 59 | |
| Gender | | |
| Male | 100 | 97.1 |
| Female | 3 | 2.9 |

**Table 2** Median blood cell variables and CD4+ cell counts of prospective blood donors

| Haematology variables | Obtained value | Maximum | Minimum | $X^2$ |
|---|---|---|---|---|
| HB g/dl | 13.0 | 15.8 | 9.4 | 1.2 |
| PCVor HCT % | 40 | 50.7 | 31.2 | 3.3 |
| TWCC nl | 4.9 | 7.2 | 2.500 | 2.56 |
| PLT count nl | 203.9 | 353.0 | 292.000 | 55275.9 |
| MCHC g/dl | 32.6 | 36.5 | 29.4 | 1.33 |
| MCH pg | 27.7 | 33.1 | 21.1 | 2.29 |
| MCV fl | 85.7 | 178.0 | 70.7 | 10.79 |
| ESR mm/hr | 8.4 | 57.0 | 1.0 | 8.87 |
| CD4 +ve count | 876.2 | 1650 | 255 | 1577 |

HCT: Haematocrit; HGB: Haemoglobin; TWBCC: Total white blood cell count; PLT: platelets; MCHC: Mean corpuscular haemoglobin concentration; MCH: Mean corpuscular haemoglobin; MCV: Mean corpuscular volume ; CD4 : Cluster of differentiation type 4; ESR:Erythrocyte sedimentation rate

**Table 3** Sub normal blood cell count values among prospective blood donors

| Haematology parameters (normal values) | Frequency of below normal values among blood donors N=103 | Percentages % |
|---|---|---|
| HCT (36-52%) | 13 | 12.6 |
| HB (12-18g/dl) | 13 | 12.6 |
| TWCC (4.0- 11nl) | 26 | 25.2 |
| PLT (150-450nl) | 14 | 13.6 |
| MCHC (32-34g/dl) | 12 | 11.7 |
| MCH ( 27 - 32pg) | 27 | 26.2 |
| MCV ( 80-100 fl) | 17 | 16.5 |
| CD4 (500-1500/µl) | 19 | 18.4 |
| | | |

HCT: Haematocrit; HGB: Haemoglobin; TWBCC: Total white blood cell count; PLT: platelets; MCHC: Mean corpuscular haemoglobin concentration; MCH: Mean corpuscular haemoglobin; MCV: Mean corpuscular volume ; CD4 : Cluster of differentiation type 4

## 4 Discussion

In the current study, we assessed the complete blood cell and absolute CD4+ cell counts of apparently healthy prospective whole blood donors who were HIV antibodies, hepatitis B surface antigen and hepatitis C antibodies seronegative. The assayed parameters were Haemoglobin (Hb) concentration levels, the haematocrit (Hct), total white cell, platelet counts, ESR as well as CD4+ T lymphocyte counts. The suitability of prospective whole blood donors is determined by a pre-donation assessment of his or her health status. (16) The mean and median ages of studied prospective blood donors were 31.72± 7.9 years and 30 years respectively. The majority (85.4%) of the subjects were between 18 and 39 years old. The demographic findings in this study were comparable with reports from previous studies among prospective whole blood donors in Nigeria.(4, 17, 18) The predominance of the younger people in the blood donor pool may be because they have a better knowledge about blood donation. Majority (97%) of the donors enrolled in our study were males. This concurs with previous research findings with male dominated donor pools in Nigeria and other countries in the sub Saharan Africa.(19, 20, 21, 22, 23) This pattern may be explained by some cultural myths about women participation in blood donation in Sub-Saharan Africa.

We observed that the mean haemoglobin concentration and haematocrit of the prospective blood donors were 13.0g/dl and 40% respectively. This corroborates previous research findings among blood donors, (6) but lower than reported by Ayemoba et al (18). Our study recorded a median total white cell count of 4.9/nl among studied subjects. This is comparable with previous reports (15, 18) and at variance with another with subclinical leucopenia among blood donors.(24) The median platelet count of our subjects was 203.9nl which is comparable with reports of previous studies.(15,18,20) We obtained median values for mean cell haemoglobin (MCH), mean cell haemoglobin concentration (MCHC) and a mean cell volume (MCV) of 27.7pg, 32.6g/dl and 85 fl respectively among studied prospective whole blood donors. The obtained red cell indices in these subjects are comparable with previous research reports. (15, 18, 20) The red cell indices would detect donation induced iron deficiency in repeat blood donors.(15) Considering that our participants were healthy, obtained blood cell counts in this study could be useful as reference values for decision making in clinical practice and research among adults. We observed some subnormal values for the blood cell counts; haemoglobin concentration (12.6%), total white cell count(25.2%),platelet count(13.6%). Also the obtained prevalence of subnormal red cell indices were; MCHC (11.7%), MCH (26.2%), MCV (16.5%) among studied prospective whole blood donors. The findings of subnormal blood cell counts among blood donors in our study corroborates previous findings in Nigeria.(5, 24,25) We cannot explain the aetiology of the subnormal blood cell counts as this would require further tests to detect underlying pathology . However, previous studies found out that some viral infections such as HIV, hepatitis B and C which we have excluded among our participants may be responsible for these subnormal counts recorded. (26, 27, 28) We suggest larger studies among first time and regular blood donors and this would include morphology of blood cells in addition to virology screening. ESR and CD4+veT lymphocytes of studied prospective whole blood donors were 8.4mm/hr and 876.2/$mm^3$respectively. Previous studies in Nigeria have reported the upper limit of normal ESR in healthy individuals as 5.0 and 12 mm/hr in adult male and females respectively. (29, 30, 31) Oladepo et al in a previous widespread and comprehensive national study in Nigeria reported the normal reference range of absolute CD4+ T cells among healthy adults as from 365 - 1571 cells/µl. (32) Aina et al also reported a reference range for absolute CD4+ Tcells as 547 - 1327 for both adult men and women in Nigeria.( 33) Obtained CD4+Tcell values in this study are also comparable with reports from other parts of Africa (34,35), but higher than reported in another study in Nigeria.(36) Normal blood cell and absolute CD4+ cell count values of healthy individuals differ in various populations based on age, gender, race, ethnicity, dietary patterns, altitudes, environmental and genetic background factors.(37) ESR and absolute CD4+ cell counts are not required for decision making about eligibility for blood donation but were included in this study because they assess health and disease conditions in clinical practice. The limitation of this study is the small sample size which was as a result of limited resources. Larger sample size needs to be studied for a more robust research.

## 5 Conclusion

In conclusion, some subnormal blood cell counts were observed in this study among apparently healthy prospective whole blood donors. Haemoglobin concentration only is therefore inadequate as a screening tool for blood donation eligibility. This suggests a more comprehensive screening of blood donors to include a complete blood count before accepting for donation. Obtained normal blood cell values are comparable with reports of local reference ranges in our communities and other parts of sub Saharan Africa. Also, there is a male predominance among studied prospective blood donors. We recommend that health education and awareness programmes be frequently organised for the females. Emphasis in these programs would be on the healthy and harmless nature of blood donation. This is critical and should be improved upon in Nigeria and Africa at large to encourage blood donation among the women.

## Compliance with ethical standards

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### *Disclosure of conflict of interest*

The authors declare that they have no competing interests.

### *Statement of informed consent*

Informed consent was obtained from all individual participants included in the study.

*Author's contributions*

All authors contributed to the paper. All authors helped to conceptualise ideas and interpret the findings.

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