African Journal of Laboratory Haematology and Transfusion Science

Vol 3, Issue 2, page 119 - 128 | June 2024 | www.ajlhtsonline.org
ARTICLE DOI: doi.org/10.59708/ajlhts.v3i2.2416
DOI URL: 10.59708/ajlhts.v3i2.2416

ORIGINAL ARTICLE

Relationship between platelet count and ferritin in blood donors in Lagos, Nigeria

Nosimot Omolola Davies, Sarah O. John-Olabode, Olufemi Abiola Oyedeji, Abosede Titilola Abosede.

Department of Haematology and Blood Transfusion, College of Medicine, University of Lagos.

Correspondence to:
Dr. Nosimot Omolola Davies, Department of Haematology and Blood Transfusion, College of Medicine, University of Lagos.
E-mail: ndavies@unilag.edu.ng

ORCID: https://orcid.org/0000-0003-0025-2788

Received 19-03-2024.
Accepted 12-05-2024
Published 30-06-2024

Abstract

Background: Iron deficiency anaemia is a major reason donors are deferred from donation. Iron deficiency is an important donor health concern with adverse consequences even without anaemia. However, iron-deficient donors are usually undetected using the current screening of haemoglobin methods in most Nigerian blood centres. Thrombocytosis has been associated with iron deficiency, and thrombocytopenia has also been reported in severe anaemia. This study assessed the relationship between platelet and ferritin in blood donors.

Materials and Methods: This was a cross-sectional study of blood donors attending the Lagos University Teaching Hospital (LUTH) between March 1st, 2019, and July 31st, 2019. A proforma was used to obtain the sociodemographic information. A donation sample was collected for a complete blood count and ferritin assay. Data was analysed using SPSS version 17.0.

Results: Data from 313 blood donors with an age range between 18 years to 58 years and a mean age of 32.1 ± 9.3 years were analysed. The mean platelet count was 207.6 ± 73.8 X 10^9/L while the median (Inter Quartile Range) for ferritin was 102.7 ng/mL(62.4 ng/Ml -182.0 ng/mL) respectively. There was no statistically significant relationship between platelet count and ferritin among all categories of blood donors (where is the correlation coefficient?). Regular blood donors had significantly lower serum ferritin levels than first-time donors (p = 0.0356). There was, however, no statistically significant difference between regular donors and first-time donors with respect to platelet levels (P= 0.1107)

Conclusion

Platelet count had no statistically significant relationship with ferritin in this study. Multiple blood donors, however, had statistically significant lower ferritin levels compared to first-time donors. There is a need to include a ferritin assay in pre-donation testing, especially in regular donors.

Key words: Platelets, ferritin, blood donors, Lagos, Nigeria.

Introduction

Blood shortage is still a major challenge in sub-Saharan Africa, and most African nations do not meet the WHO requirement of 1% of the country's population being voluntary donors despite the increase in the turnout of voluntary donors over the last two decades. (1) This percentage requirement is further reduced in Nigeria, with a population of over 170 million that requires 1.4 to 1.7 million units of blood per year but has less than 500,000 units, leaving a huge gap in blood availability, which, according to WHO, has a ratio of 0.7units of blood per 1000 inhabitants in Nigeria. (2)

In modern-day transfusion medicine, blood and blood products are irreplaceable forms of treatment for many patients. (3) However, providing enough blood components of excellent quality, blood transfusion services should also entail the safety of blood donors.

Blood donation may be an important cause of iron loss. Several studies have shown that iron deficiency is common in frequent blood donors, particularly women. (4-9) Determination of the haemoglobin concentration is a routine part of the donor selection process both to ensure adequate quality of red cell concentrates collected and to protect the potential donor's health. 10 Indeed, low haemoglobin is globally the most common reason for the deferral of prospective blood donors. (8-10) Nevertheless, only cases of overt low haemoglobin levels and imminent anaemia are detected using this approach, as evidence has shown that some blood donors may be pre-latent or latent iron deficient at the time of donation and may manifest as iron deficiency after blood donation. (11)

Serum iron, serum ferritin concentrations and red cell indices such as mean cell volume (MCV) and mean corpuscular haemoglobin (MCH) can be used with high accuracy and precision. (12) To assess the depletion of iron stores, particularly in non-anaemic blood, with ferritin measurements being used most frequently in developed countries. (13) Serum ferritin levels correlate closely with total body iron stores. (14)

Diagnosing iron deficiency with the current haemoglobin screening method (copper sulphate) used in most blood donation centers in Nigeria has proven ineffective. In a resource-poor country like Nigeria, including ferritin measurement as part of blood donors' work-up has been challenging, mainly due to financial constraints.

Platelet has been noted to have a diphasic response in iron deficiency. Most authors state that reactive thrombocytosis is associated with mild iron deficiency (ID), while severe iron deficiency anaemia is associated with thrombocytopenia, especially when the haemoglobin level is less than 7g/dl (15) and reported platelet count returning within normal values after iron substitution. (16, 17) Platelet count is a simple and cheaper test that can easily be carried out with results obtained timely, and some authors have stated that there is the relationship between platelet and ferritin in iron deficiency. (18, 19) Iron deficiency has been described as a common cause of reactive thrombocytosis, and thus the evaluation of iron status is required in the diagnostic work-up of patients presenting with thrombocytosis. (20)

The aim of this study is to determine the association between platelet and ferritin in apparently healthy individuals. This might help to determine the usefulness of platelet count as an additional testing strategy for decision-making on the appropriateness of iron replacement by blood collection agencies and will contribute to decisions that should preserve an adequate blood supply without harming blood donors.

Materials and Methods

Study site.

The study was conducted at the blood bank clinic of the Lagos University Teaching Hospital (LUTH). The hospital is one of the two teaching hospitals in Lagos State, Nigeria, and serves as a referral Centre for private and public health institutions in Lagos and its environs.

Study design.

The study was a cross-sectional study among blood donors who visited the blood donation clinic of Lagos University Teaching Hospital (LUTH) in Lagos, Nigeria, from March 1st to July 31st, 2019.

Sample size determination.

A study in Port Harcourt, Nigeria, reported a prevalence of 20.6% for iron deficiency anaemia among blood donors. (7) We used this figure to calculate the sample size for this study using the formula n = Z2 p (1-p)/e2, to obtain a minimum sample size of 251. (21, 22)

However, we added 30% to this figure to account for attrition and incomplete data. Therefore, we projected a sample size of 325.

Sampling technique.

A consecutive sampling technique using a structured proforma was administered for all consenting healthy donors.

Exclusion criteria.

Blood donors who failed the copper sulphate screening test, Commercial blood donors, and potential donors who did not fulfil the criteria for blood donation were excluded from the study population.

Sample collection.

Two milliliters each of venous blood was collected into heparinized and EDTA tubes. The blood sample in the heparinized tubes was centrifuged at 3500 rpm for five minutes, and the plasma samples were collected. A full blood count was carried out on the EDTA sample.

Sample analysis.

Serum ferritin assay was carried out according to manufacturer's instruction. (chemiluminescent microparticle immunoassay, Abbott Laboratories, Abbott Park, IL, USA) performed on the Abbott Architect ci4100 (Abbott Laboratories, Abbott Park, IL, USA). Red blood cell parameters were measured using the CELL-DYN Emerald cell counter (Abbott Laboratories, Abbott Park, IL, USA).

Ethics.

Ethical approval was obtained from the ethical committee of The Lagos University Teaching Hospital (Health Researched Committee Assigned number: ADM/DCST/HREC/APP/2050). All participants endorsed a written informed consent form, and confidentiality was ensured by not including their names on the proforma.

Data analysis.

Data obtained was entered into the computer and analyzed using Statistical Package for the Social Sciences for Windows version 17 software (SPSS Inc, Chicago, IL, USA) and Microsoft Excel. Categorical variables were described using frequency and percentages, while continuous variables were described as mean and standard deviation if uniformly distributed or median and interquartile range (IQR) were skewed. The Categorical variables were compared using Pearson's Chi-square test or Fischer's test as appropriate. Continuous variables were compared using the student's t-test. The correlation was performed using Spearman's correlation coefficient. The critical level of statistical significance was set at $P < 0.05$.

Definition of Terms

Normal Ferritin:

Male: (Hb ≥12g/dl, Ferritin 15 - <300ng/ml)

Female: (Hb ≥12g/dl Ferritin 15 - <200ng/ml)

Low ferritin

Iron deficiency: (Hb <12g/dl Ferritin < 15ng/ml)

High ferritin

Male: (Ferritin ≥12g/dl <300g/dl)

Female: (Ferritin ≥12g/dl <200g/dl)

Platelet

Normal platelet (100 - 450 ×109 /L

Low platelet (Thrombocytopenia) <100) *109 /L

High platelet (Thrombocytosis) >450*109

Results

A total of 325 blood donors who gave informed written consent participated in the study, but data was complete in 313 (96.3%). Of these 313 blood donors, 234 (74.8%) were first-time donors, and 79 (25.2%) were regular donors.

Table 1 Compares socio-demographic factors between first time donors and multiple donors. The donors' range age was from 18 years to 58 years, with a mean age of 32.1 ± 9.3, and there was no statistically significant difference between first-time donors and regular donors. Two hundred and eighty-five (91.1%) are males, while 28 (8.9%) are females. Among first-time donors, 208 (88.9%) are males, while 26 (11.1%) are females. Concerning regular donors, 77 (97.5%) are males, while 2 (2.5%) are females. This difference was statistically significant.

There was no statistically significant difference between first-time and regular donors with respect to marital status and educational level, intake of iron supplements, cigarette smoking, and alcohol intake.

Table 2 shows a comparison of hematological and biochemical parameters between first-time donors and regular donors. The overall median and inter-quarter range (IQR) of ferritin were 102.7 and 62.4-182.0, respectively. The median ferritin level was significantly higher in first-time donors compared to regular donors ($p = 0.0176$). The mean platelet concentration was, however, significantly higher in regular donors compared to first-time donors ($p = < 0.0001$).

The mean RBC and Haemoglobin levels were significantly higher in regular donors than in first-time donors, while the mean MCHC was significantly lower in regular donors than in first-time donors.

WBC, RDW, and MPV showed no statistically significant difference between first-time donors and regular donors.

Table 3 shows the percentage distribution of ferritin and platelet parameters between first-time donors and multiple donors. Regular donors had a significantly higher percentage of iron deficiency compared to first time donors ($p = 0.0365$). For platelet parameters, there was no significant difference between first time donors and regular donors.

Table 4: Shows the correlation between platelets and Ferritin. There was a weak positive but insignificant correlation between platelet level and ferritin level among all donors, regular donors, and male donors. The study also showed a weak negative but insignificant correlation between platelet and ferritin among first-time and female donors.

Discussion

In transfusion medicine, the key to donor retention is maintaining the well-being and health of blood donors. Evidence has shown that retaining old donors is easier than recruiting new ones. Therefore, blood banks are responsible for protecting blood donors and preventing them from developing iron deficiency, which has been a major challenge, especially among female donors and regular

donors.

In this study, 3.2% of the participants had demonstrable iron deficiency, which suggests that the copper sulfate method currently used at the center and other hemoglobin estimation methods used in most blood donation centers in Nigeria are inaccurate methods to detect iron deficiency. This agrees with a study by some authors within Nigeria (8, 10, 23). There is, therefore, a great need for improvement in the current method of donor screening to preserve donor health, decrease the deferral rate, and ultimately increase the number of donations.

Ferritin is a good indicator of iron stores and has been used alone or together with iron supplementation to diagnose and manage iron deficiency in blood donors. However, providing the analyzers to perform this test or Point-of-care devices to blood collection centers has been far from being achievable in most third-world countries with the current numerous economic challenges, especially in Nigeria, due to lack of funding. This has made using the ferritin test difficult to ascertain donor eligibility when a donor presents for donation. This is a major reason iron-deficient donors are bled, as observed in the study. However, some authors reported a higher prevalence of iron deficiency among blood donors than in this study. (8, 10, 23, 24) The high prevalence of iron deficiency observed by these authors may be due to different geographical locations where the research was conducted. Differences in dietary habits, worm infestation, poverty, and the policies of the national blood transfusion services are also different. The prevalence of iron deficiency anemia and iron deficiency varies in different populations, and no consistent relationship between the two can be applied throughout the world. (25)

Ferritin is known to be an acute phase reactant that can give elevated values during inflammation; in some instances, patients with low iron stores or ID could have falsely elevated ferritin levels because of inflammation. This study carried out C-reactive protein to exclude falsely elevated ferritin due to inflammation; however, C-reactive protein values were within the accepted range among all subjects.

It was noted in this study that platelet count in regular donors was slightly higher than in first-time donors, even though the results of most subjects still fell within the normal reference range. This finding also correlates with the results reported by Adediran et al., Habib et al and Mozaheb et al. (26, 27, 28)

A study in Yemen, however, did not find any significant difference between ferritin level and platelet count in blood donors who donated blood six times or more and those with blood donation less than six times. (29)

Also, in this study, 4.5% were found to be thrombocytopenic. The exact mechanism of this is not well understood and may be related to the alteration in the activity of iron-dependent enzymes in thrombopoiesis. (30) It may also be due to the fact that iron is required for platelet production, and during IDA, all the stored irons had been used up. According to WHO, individuals with thrombocytopenia should not be accepted as blood donors because of the risk of bleeding at the venipuncture site and because chronic thrombocytopenia may be associated with serious underlying hematological or other systemic diseases. It was also observed that platelet was within normal range among the iron deficient donors.

This study shows there is no significant relationship between platelet and ferritin which agrees with the work of Holbro et al who reported that there was no correlation between serum ferritin and platelet count in their study. (31) Also, Andres et al stated that they were unable to find a significant relationship between platelet counts and EPO levels or Ferritin levels. (32)

Furthermore, among female donors, first-time donors, and iron-deficient donors, there were weak negative correlations, although they were all not statistically significant, which was similar to the report by Kadikoylu et al., who noticed that platelet increases when ferritin falls in patients who were diagnosed with IDA. (33) Koike et al. reported that there is an inverse relationship between platelet and ferritin. (34) Hemendra et al. found an inverse relationship between platelet count and ferritin as well as hemoglobin level ($p < 0.0001$). (35) However, a bigger sample size within these groups might give a better picture of the situation. Platelet count tends to increase during IDA or ID due to stimulation of erythropoiesis to compensate for anaemia. It was also observed that a comparison of platelet and ferritin among all donors, regular donors, and male donors shows a weak positive correlation between ferritin and platelet, respectively.

Conclusion

Despite the correlation, platelet count has no statistically significant relationship with ferritin. Serum ferritin measurement remains the standard in the early detection of iron deficiency among blood donors. It needs to be included in pre-donation testing of blood donors, especially regular donors and female donors so that those at high risk of developing iron deficiency can be identified early enough and receive intervention on time.

The development of rapid or point-of-care ferritin testing at low cost will be useful in resource-poor countries like Nigeria in ensuring the routine testing of serum ferritin among blood donors.

Conflicts of Interest

There are no conflicts of interest.

Table 1: Comparison of socio-demographic characteristics between first time donors and regular donors

Characteristic	Donor Type		Total	*P* value
	First time donor N=234	Regular donor N= 79		
Age(mean±SD)	32.3 ± 9.4	31.6 ±9.1	32.1 ± 9.3	0.5417
18-24	57 (25.1)	17 (23.3)	74 (24.7)	0.180
25-34	80 (35.2)	35 (48.0)	115 (38.3)	
35-44	57 (25.1)	11(15.1)	68 (22.7)	
≥45	33 (14.5)	10 (13.7)	43 (14.3)	
Gender				
Male	204 (88.7)	74 (97.4)	278 (90.9)	0.023
Female	26 (11.3)	2 (2.6)	28 (9.2)	
Marital status				
Married	102 (43.6)	26 (32.9)	128 (40.9)	0.095
Single	132 (56.4)	53 (67.10)	185 (59.1)	

Educational Level				
Nil	13 (5.6)	0 (0.0)	13 (4.2)	0.165
Primary	97 (41.6)	33 (41.8)	130 (41.7)	
Secondary	118 (50.6)	45 (57.0)	163 (52.2)	
Tertiary	5 (2.2)	1(1.3)	6 (1.9)	
Iron supplement				
Yes	21 (9.0)	6 (7.6)	27 (8.6)	0.884
No	213 (91.0)	73 (92.4)	286 (91.4)	
Cigarette smoking				
Yes	22 (9.4)	4(5.1)	26 (8.3)	0.331
No	212 (90.6)	75 (94.9)	287 (91.7)	
Alcohol use				
Yes	80 (34.2)	18 (22.8)	98 (31.3)	0.080
No	154 (65.8)	61 (77.2)	215 (68.7)	

Table 2: Comparison of haematological and biochemical parameters between first time donors and regular donors

Haematological and biochemical parameters	First time donor (Mean ±SD)	Regular donors (Mean ±SD)	Total (Mean ±SD)	*P* value
White cell count (10^9/L)	4.7 ± 1.4	5.0 ± 1.2	4.6 ± 1.4	0.0893
Haemoglobin(g/dl)	14.1 ± 1.2	14.5 ± 1.2	14.2 ± 1.2	0.0101
MCV (fL)	105.4 ± 52.2	86.8 ± 35.9	100.7 ± 49.2	0.0037
RBC(10^{12}/L)	4.6 ± 0.6	5.1 ± 0.5	4.7 ± 0.6	<0.0001
MCH(pg)	31.0 ± 2.8	28.3 ± 2.5	30.3 ± 3.0	<0.0001
MCHC (g/dL)	34.2 ± 1.2	33.5 ± 0.7	34.0 ± 1.1	<0.0001
RDW (%)	13.1 ± 13.6	13.1 ± 1.1	13.1 ± 11.8	0.9559
Platelet (10^9/L)	192.9± 68.1	251.1 ± 73.4	207.6 ± 73.8	<0.0001
MPV (fL)	8.3 ± 0.8	8.2 ± 0.6	8.3 ± 0.7	0.1058
FERRITIN (median, IQR) ng/mL	107.7 (65.6 - 195.1)	77.9 (46.7 - 141.5)	102.7 (62.4 – 182.0)	0.0176

Table 3. Percentage distribution of ferritin and platelet parameters between first time donors and regular donors.

Haematological parameters	First time Donors (%)	Regular Donors (%)	Total (%)	*P* value
Ferritin				
Iron deficiency	4 (1.7)	6 (7.6)	10 (3.2)	
Normal ferritin	221 (94.4)	70 (88.6)	291 (93.0)	
High ferritin	9 (3.9)	3 (3.8)	12 (3.8)	0.0365
Platelets				
Normal Platelets	221 (94.4)	78 (98.7)	299 (95.5)	
Thrombocytopenia	13 (5.6)	1 (1.3)	14 (4.5)	0.1107

Table 4: Correlation between platelets and Ferritin among blood donors.

Status	Platelet (Mean ±SD)	Ferritin (Mean ±SD)	*P* value	*r* value	Remark
All Donors	207.42±76.13	139.51±157.97	0.909	0.007	WPC
Multiple donor	251.1 4± 73.42	125.19±132.57	0.079	0.198	WPC
First-Time donor	192.94± 68.14	144.65±166.12	0.734	-0.023	WNC
Male donors	204.17±74.14	137.87±122.93	0.363	0.055	WPC
Female donors	217.55±83.43	170.08±397.13	0.535	-0.140	WNC

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How to cite this article

Davies NO, John-Olabode SO, Oyedeji OA, Abosede Abosede T. Relationship between platelet count and ferritin in blood donors in Lagos, Nigeria. *Afr J Lab Haem Transf Sci* 2024;3(2): 119-128
DOI: https://doi.org/10.59708/ajlhts.v3i2.2416