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Evaluation of Anemia among Deferred Prospective Blood Donors at Kenyatta National Hospital, Kenya

Authors
Njenga Kariuki John[1*], Kahato Michael Ngugi[1], Valerie Magutu[2], Wacuka Njoroge[3]
[1]Department of Medical Laboratory Sciences, School of Biomedical Sciences, College of Health Sciences, Jomo Kenyatta University of Agriculture and Technology, P.O. Box 62000-00200, Nairobi, Kenya
[2]Department Department of Human Pathology, Thematic unit of Hematology and Blood Transfusion, College of Health Sciences, University of Nairobi, P.O Box 30197-00100, Nairobi, Kenya
[3]Department of Medical Laboratory Sciences, School of medicine, Kenyatta University, P.O. Box 43844-00200, Nairobi, Kenya
*Corresponding Author
Njenga Kariuki John
P.O. BOX 2268- 30100 Eldoret, Kenya
Contact No: +254728306923, Mob: *johnkush.njenga@gmail.com*

Abstract
Introduction: *Blood transfusion has over the years saved millions of lives around the world. However, majority of developing countries are not in a position to meet the high demand for blood in its hospitals. A large number of donor deferrals are pre-donation, temporary deferrals being the most common with anemia as a leading cause. Anemia is a potentially treatable and preventable cause of temporary deferral It is, therefore imperative to study low hemoglobin (anemia) among deferred donor population to enable development of mitigation measures and ultimately increase blood supply. The main objective of this study was to evaluate anemia among deferred anemic prospective blood donors at Kenyatta National Hospital.*
Methodology: *Descriptive cross–sectional study of 138 participants was assessed for anemia using point of care hemoglobin analyzer (Stat-Site® M^{Hgb}). Three (3) ml EDTA venous blood sample was collected and analyzed for hemoglobin and red blood cells indices using automated hematology analyzer (Sysmex) and peripheral blood film.*
Results: *Low hemoglobin deferral accounted for 162 (10.1%) using point of care hemoglobin analyzer. Three types of anemia were identified among the participants; normocytic normochromic (72.7%), microcytic hypochromic (15.9%) and normocytic hypochromic (6.8%).*
Conclusion: *A signicant number 96 (69.6%) of prospective blood donors deferred of low Hb by POC analyzer were found not to be anemic using standard methods. This study recommends urgent remedies should be sought to address lose of prospective blood donors due to variation in hemoglobin screening by hemoglobin analyzers and review of donor hemoglobin cut-off value.*
Keywords: *Donor deferrals, hemoglobin, blood donors.*

Introduction

Approximately 10% of prospective donors willing to donate whole blood are deferred due to low hemoglobin[(1,2,3)]. A large number of donor deferrals are pre-donation, temporary deferrals being the most common with anemia as a leading cause. Deferral of donors is done to protect donors from

severe anemia, and also to ensure donated blood meets the standard hemoglobin content. Several factors are associated with low hemoglobin levels and might be used as predictors of donor deferral such as donation frequency, health status, sex, and age[4]. A study by Ahmad et al.,[5] revealed donor deferrals can be grouped into; recipients' safety and donors' safety. Recipients' safety accounted for 32% and those deferred of donors' safety were 61% based on hemoglobin levels. Normocytic normochromic anemia is regarded as the leading cause of anemia among blood donors but it is rarely used as a diagnosing tool. Low iron intake, menstrual blood loss, parasitic infection, poor iron absorption and pregnancy are considered as some of the underlying causes[6].

According to the World Health Organization[7] for a country to have sufficient blood supply at least 1% of the population should donate once yearly. The practice of blood transfusion has over the years saved millions of lives around the world. It has proven to be an essential part of certain surgical procedures, complex medical conditions and in chronic and acute medical complications[8]. In Kenya, shortage of blood is a common problem experienced in hospitals and Kenya National Blood Transfusion Service (KBTS) especially when disaster strikes. KNBTS collects approximately 135,000 units of blood from voluntary blood donors and about 20,000 units are collected by public hospitals from both replacement and voluntary blood donors yearly. Kenya's current blood supply needs are estimated to be 250 000 units per year[9].

There are several stages involved in pre-donation screening and include; donor registration, counseling, physical and medical examination[10]. These screening services are done by trained medical staff. Registration entails obtaining demographic information and answering a brief donor questionnaire that may lead to self-deferral. Counseling is accompanied by physical and medical screening that includes; the assessment of hemoglobin levels, body weight, blood pressure and general appearance[10]. Abnormalities detected during these stages ultimately lead to donor deferral that can be classified in to three categories; temporary short time (1 day to 57 days), temporary long time (57 days to 1 year) and permanent deferral (permanent or many years)[11]. Deferral of donors often leaves a negative impact and majority of them may refuse to donate even if it is temporary deferral[12,13]. According to the Kenya National blood transfusion service policy guidelines all donors must consent prior to blood donation.

In many resource-limited countries, replacement and family donors take the lead by contributing to approximately 75% to 80% of total blood donation; this is contrary to World Health Organization that recommends 80% to 90% blood donations should come from voluntary donors[11]. Replacement donations come from either friends or relatives and in some cases 'undercover paid donors' at times hide under this category. Paid donor poses a great danger of anemia and transfusion-transmitted infections (TTIs) like HIV compared to voluntary donors[9].

Anemia affects a quarter of the world's population, contributing to 8.9% of total global burden. Iron deficiency is the predominant cause of anemia across countries and in both genders and contributes significantly to donor deferral[14]. According to a study by Kimani et al.[15], perennial blood shortage in Kenya is attributed to weak infrastructure in terms of blood centres, transport systems, lack of financial resources, poor laboratory systems and poor co-ordination of blood services. Identification of anemia and treatment of underlying conditions is crucial in improving the quality of life, alleviate symptoms and reduce the need for blood transfusions[15].

Hemoglobinometry is a hematology investigation technique used to identify anemia based on hemoglobin content. Hemoglobin concentration is routinely measured using automated hematology analyzers. Although, these are very accurate and reliable, they are expensive and experience problems of samples transport to the laboratory. In poor resource settings where automated hematology analyzers are not available other methods of low price that require less skill are highly needed.

Capillary blood collected by finger-prick is normally used to determine hemoglobin content among blood donors. Copper sulfate method and Hb point of care analyzers are commonly used to screen prospective donors for anemia[(1)]. The main objective of this study was to evaluate anemia among deferred anemic prospective blood donors using standard methods and WHO anemia classification. The outcome will help development of mitigation measures and ultimately increase blood supply

Methodology

A descriptive cross-sectional study was used in this study in the months of October and November 2018. Study participants were prospective blood donors who were deferred of low hemoglobin (below 12.5 g/dl). The study population composed of males and females of 18 years and above. Potential donors deferred for other reasons other than anemia were excluded from the study. Convenience sampling method was used to sample one hundred and thirty eight (138) study participants. Ethical approval for this research was sought from Kenyatta National Hospital-University of Nairobi Ethical Review Committee (KNH-UON ERC).

All potential blood donors were screened for hemoglobin levels using point of care haemoglobin analyzer. Those deferred and meet all inclusion criteria were requested to consent and give a venous blood sample. Approximately 3ml of blood was collected and transferred into an EDTA K_3 tube. The samples were then be analyzed in the laboratory within 4 hours using automated hematology analyzer (Sysmex). A peripheral blood film was prepared and stained using a Romanowsky stain. Morphological assessment of red blood cells was done using oil emersion and hematology microscope.

All results including peripheral blood findings and complete blood count results were coded and entered into excel sheet for analysis. Statistical analysis of the data collected was done using Statistical package for Social Sciences (SPSS). Categorical variables of possible association between genders, age and types of anemia was analyzed using Intra class Correlation Coefficient (ICC). Analyzed data was presented using graphs and frequency tables. Descriptive statistics was presented as; percentage, range, mean and standard deviation.

Results

During this study a total of 1594 prospective blood donors presented to donate blood at blood donation unit. Out of these, males were 1419 (89%) and females were 175 (11%). A total of 416 (26%) potential donors were disqualified due to varied reasons. Low hemoglobin deferral accounted for 162 (10.1%) using point of care haemoglobin analyzer. Twenty four (24) legible study participants did not consent to participate in the study. Consenting participants were assessed for anemia using automated hematology analyzer and peripheral blood film. Red blood cell indices and morphological characteristic of red blood cells were used to determine and classify anemia. Males with Hb below 13.0 g/dl and females with Hb below 12.0 were termed as anemic.

Standard methods (complete blood count and peripheral blood film) found fourteen (56%) males and eighty two (72%) females differed of Hb below 12.5g/dl not to be anemic using WHO (2017) anemia classification. This statistic revealed ninety six (96) forming 69.6% initially deferred of low hemoglobin using point of care haemoglobin analyzer were suitable for donation. The mean (SD) hemoglobin concentration of the 138 participants was 12.9 g/dl (1.5) and 12.6 g/dl (1.7) for males and females respectively. Both genders recorded cases of mild, moderate and severe anemia. Majority of anemic participants had mild anemia 25 (60%), moderate anemia were 10 (24%) and severe anemia was least with 7 (17%). Females had the highest number of severe anemia cases compared to males. Males recorded the highest hemoglobin level compared to females, 16.1 g/dl and 15.6 g/dl respectively. On the other hand, females recorded the least hemoglobin compared to males 6.9 g/dl

and 7.7 g/dl respectively (Table 1). Hemoglobin distribution is shown below (Figure 1).

Table 1: Participants hemoglobin frequencies, mean and severity of anemia

	Males	Females	Total
Non – anemia (Males Hb>13.0, Females Hb>12.0)g/dl	14	82	96
Mild anemia (Males Hb11-12.9) (Female Hb11-11.9)g/dl	8	17	25
Moderate anemia (Hb 8-10.9) g/dl	2	8	10
Severe anemia Hb(< 8.0) g/dl	1	6	7
Maximum hemoglobin (g/dl)	16.1	15.6	
Minimum hemoglobin (g/dl)	7.7	6.9	
Mean (SD)Hb (g/dl)	12.9(1.4)	12.6(1.7)	

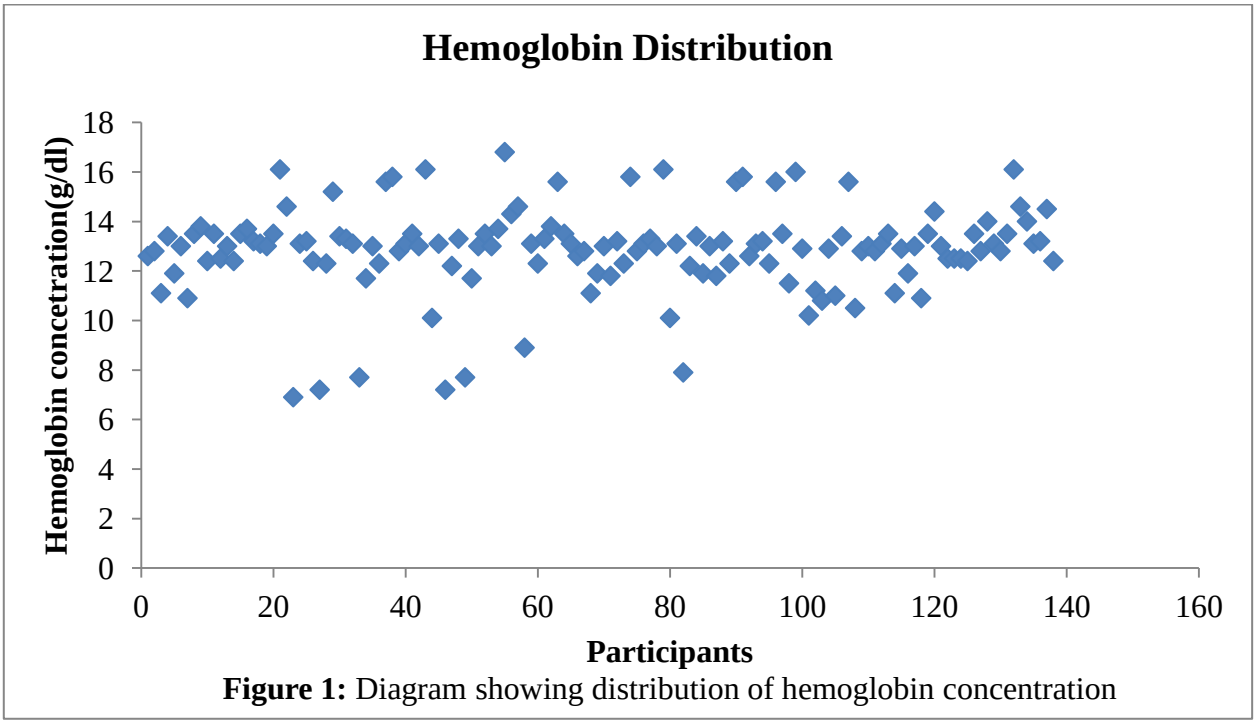

Figure 1: Diagram showing distribution of hemoglobin concentration

Using hemoglobin point of care analyzer all 138 participants had recorded hemoglobin slightly below 12.5 g/dl with mean (SD) hemoglobin of 10.5(1.3) g/dl. However, using automated hematology analyzer all participants had mean (SD) hemoglobin of 12.7 (1.6) g/dl. The point of care analyzer gave mean (SD) of 10.4 (1.2) g/dl and 10.6 (1.5) g/dl for females and males respectively. On the other hand, automated hematology analyzer gave mean (SD) value of 12.6 (1.7) g/dl for females and 12.9 (1.5) g/dl males respectively. The lowest hemoglobin recorded by two analyzers was 6.2 g/dl and 6.9g/dl using POC and automated hematology analyzer respectively.

Out of 138 study participants, age group 28 – 32 years had the highest representation 27% closely followed by age group 23-27 years, (24%). However, participanats aged fifty eight (58) years and above recorded the least representation 1%. (See table 2). Female participants were the majority compared to males 133(82%) and 25 (18%) respectively.

Table 2: Distribution of age groups

Age in years	Frequency	Percent
18-22	25	18%
23-27	33	24%
28-32	37	27%
33-37	18	13%
38-42	11	8%
43-47	8	6%
48-52	3	2%
53-57	2	1%
58-62	1	1%
Above 63	0	0%

Three types of anemia were indetified using red cells indices and morphological features of 42 (30.4%) participants diagnosed with anemia. These were normocytic hypochromic 3 (6.8%), microcytic hypochromic 6 (15.9%) and normocytic normochromic 32 (72.7%). Comparative analysis of types of anemia against age groups, gender and severity of anemia was performed and no association was establised. Majority of females were anemic compared to males, respectively. Age group 23-27 years recorded the highest number of anemic participants. Normocytic normochromic anemia was common in both genders and age groups. Mild anemia affected majority of participants 23(54.7%) in this study (Table 3 Table 4 and,Table 5).

Table 3: Distribution of gender in relation morphological types of anemia

Type of anemia		Normocytic normochromic	Microcytic hypochromic	Normocytic Hypochromic	Total
Gender	Males	9	1	1	11
	Females	23	6	2	31

Table 4: Distribution of age groups in relation to morphological typesanemia

Type of anemia		Normocytic normochromic	Microcytic Hypochromic	Normocytic Hypochromic	Total
Age category	18-22	5	0	0	5
	23-27	11	1	0	14
	28-32	6	1	2	9
	33-37	4	0	1	5
	38- 42	3	1	0	4
	43-47	1	2	0	3
	48-52	1	1	0	2
	53-57	1	1	0	2
	58- 62	0	0	0	0
	Above 63	0	0	0	0

Table 5: Distribution of morphological types of anemia in relation to severity of anemia

Severity of anemia	Normocytic normochromic	Microcytic hypochromic	Normocytic Hypochromic	Total
Mild anemia	21	0	2	23
Moderate anemia	9	2	1	12
Severe anemia	0	7	0	7

Discussions

Despite many initiatives, interventions and programs adopted by various blood transfusion centres, adequate blood supply remains to be a challenge in both public and private hospitals in poor-resource settings. Majority of prospective donors are disqualified for reasons which are often temporal like low hemoglobin count. This study revealed that deferral rate among donors was slightly high at 26 %. Point of care haemoglobin analyzer found 10.1% as unfit to donate due to Hb

levels below 12.5g/dl. This figure compares well with 10% reported in a study in the United States with the same cut-off level of 12.5g/dl regardless of ethnicity, gender and age[1]. In both studies some non-anemic females were deferred (those with Hb between 12.0 g/dl and 12.5g/dl) and anemic males were allowed to donate (those with Hb between 12.5 and g/dl 13g/dl). There are varied reasons that contribute to disparity in deferral rates among countries, these differences could be due to distinct socioeconomic status and different donor recruitment criteria[16].

During this study it was noted more males presented to donate 1419 (89%) compared to females 75 (11%), a similar rate was reported by Antwi-baffour et al.[11]. This study further illustrate more females were deferred due to anemiacompared to males, 133(82%) and 25 (18%) respectively. According to World Health Organization statistics, approximately two billion persons are affected by anemia. Women in developing nations bear the highest burden with almost 64% being anemic[7]. The average hemoglobin level among study participants revealed males have higher hemoglobin levels (12.9g/dl) compared to females (12.6g/dl).This is attributed to a false belief that females have less blood. Even though, physiological factors like monthly period may expose women to conditions such as anemia. Pre –donation counseling and regular medical check-up may help monitoring blood levels and possibly inform whether one should donate or not[11]. This study further showed majority of blood donation participants were young donors in the age group 28 - 31 years. According to Agbovi et al., [12], failure to be requested to donate blood was cited as the main reasons for hesitation to donate blood.

Our study identified three types of anemia based on red blood cell indices and morphological characteristic of red cells. These were normocytic normochromic, microcytic hypochromic and normocytic hypochromic anemia. Normocytic normochromic anemia had the highest frequency (76.7%) while normocytic hypochromic had the least frequency (6.8%). This statistic is similar to a study by Antwi-baffour et al.,[11]. The study also demonstarted prevalence of anemia is significantl higher in females than males. Again, 59.5% out of the 42 classified as anemic presented with mild anemia against16.7 % with severe anemia. This stastistic shows majority of potential donors can have their hemoglobin levels improved if appropriate medical interventions and advice are initiated[7].

In addition, statistical analysis showed no relationship between morphological type of anemia and gender (P>0.05). The same statistic revealed no relationship between morphological type of anemia and age (P>0.05), neither was there a relationship between severity of anemia and participants age (p>0.05). This phenomena can be explained by the fact that study participansts were relatively healtly persons who had all features required for blood donation as healthly donors prior to hemoglobin screening. However, a significant relationship was identified between types of anemia and severity of anemia (P < 0.05). This statistic compares well with a study by Antwi-baffour et al.,[11].

Noting the multifactorial nature of anemia, an integrated approach should be implemented to mitigate the disease. To effectively eradicate it, causative agents must be identified and appropriate intervention adopted. From this study automated hematology analyzer demonstrates a superior reliability and is less likely to result in false deferral of donors than point of care analyzers. Therefore, blood donation centres should consider using standard haematological analyzers to screen all potential blood donors to minimize deferral of non-anemic donors. Further studies should be done to assess validity of hemoglobin screening with point of care haemoglobin analyzers compared to automated hematology analyzers.

Conclusions

From this study low hemoglobin has been cited as a major contributor to donor deferral.Normochromic normocytic anemia was found to be the leading casuse of deferral among prospective donors. In order to reduce deferral rates among potential donors, pre –donation counseling and regular

medical check-up should be adopted to help monitor hemoglobin levels and possibly inform whether one should donate or not. Finally, donor recruitment criteria should be should be compared with WHO classification of anemia to avoid recruiting anemic or deferring non –anemic prospective blood donors.

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