

*Research Article:*

## Impact of Frequent Blood Donation on Iron Status at Blood Bank of Sulaymaniyah City/Kurdistan Region/Iraq

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### Abstract

**Background:** Iron is a micronutrient that is essential for the production of hemoglobin (Hb) and maintaining the proper functioning of human body cells. Blood donation is an essential component of transfusion medicine for patient care, but it also causes donors to lose iron. To safeguard donors' health, blood banks should monitor their iron levels and ensure they have an adequate amount of iron.

**Aim:** The objective of this study is to assess the iron status of regular blood donors at the Sulaymaniyah City Blood Bank, evaluate the efficacy of Hb as a sole criterion for donor selection, and examine the relationship between donation frequency and variations in red blood cells (RBC) indices and iron profile parameters.

**Methodology:** This comparative cross-sectional study included 221 male blood donors (172 repeat donors and 49 first-time donors). A structured, validated questionnaire was utilized to get information about the donors' age, gender, donation history, diet, and lifestyle. Blood samples were collected from donors to analyze the level of hematological parameters and iron-related parameters.

**Results:** A total of 221 whole blood donors were enrolled; all were male. most participants in both groups were aged 25–39 years, with a higher proportion among first-time donors (73.5%) compared to repeat donors (48.3%). Polycythemia was the main cause of blood donation among repeat donors (84.9%) compared with first-time donors (26.5%), whereas replacement donation was more common in first-time donors (67.3% vs. 7.6%). Lifestyle factors showed notable differences; smoking was more prevalent among repeat donors than first-time donors (70.9% vs. 40.8%). No first-time donors had depleted ferritin level, while 23.3% of repeat donors exhibited low ferritin. Repeat donors had significantly lower ferritin levels ( $P$  value = 0.0001), transferrin saturation ( $P$  = 0.002), and mean corpuscular volume (MCV) ( $P$  value = 0.003) and higher red cell distribution width (RDW) ( $P$  value = 0.0001) compared to first-time donors.

**Conclusion:** Hb levels remained within normal ranges, and ferritin declined progressively with increasing donation frequency, which may not be detected by Hb measurement alone. Monitoring iron stores and red blood cell indices is crucial to maintain donor health and a sustainable blood supply.

**Keywords:** Ferritin, Iron Profile, Blood Donation, Hemoglobin, Red Blood Cell Indices

## 1. Introduction

Iron is a micronutrient that the body needs [1]. This metallic trace element is crucial for a number of biological functions, specifically as it is constituent of heme, a substance that forms the fundamental component of Hb molecule. Because of this role, iron is needed for RBCs to move and carry oxygen to all the body's tissues [2, 3]. Iron is also needed for basic biological processes including the production of deoxyribonucleic acid (DNA), oxygen consumption in a mitochondrial system, regulating cell development, and regulated cell death [3, 4]. The average amount of iron in a healthy adult's body is about 4.0 g for men and 3.500 g for women [5]. Maintaining iron homeostasis is essential, as both iron deficiency and excess are linked to negative health consequences [2].

Blood donation is an important medical procedure that is done for many reasons to ensure that patients receive the blood they need. Since blood cannot be synthetically produced, it must be sourced exclusively from human donors [6]. Each whole blood donation results in the loss of approximately 200–250 mg of iron from the donor's body [7]. Frequent blood donation can result in significant depletion of iron reserves and may lead to iron shortage, with or without the development of anemia. This outcome is a common consequence of repeated donations and is often under-recognized in clinical practice [8]. Current world health organization (WHO) guidelines (2012) prescribe minimum inter-donation intervals of 12 weeks for men and 16 weeks for women, as iron levels in women are generally lower [9]. Serum ferritin and transferrin saturation are widely recognized as more reliable markers of the body's iron stores than hemoglobin levels [10].

Some researches have revealed varying prevalence rates of iron deficiency among blood donors across different regions. In Erbil, 7.97% of participants were found to have iron depletion [11]. In the United States, 19% of donors had absent iron stores, while 42% exhibited low ferritin levels [12]. Studies from India reported iron depletion rates of 9.8% and 28.5% [13, 14]. In African populations, prevalence rates varied: 5.1% in Nigeria and 16.66% in Congo with anemia affecting between 20% and 31.66% of donors in these regions, respectively [15, 16].

Iron deficiency can manifest symptoms even in the absence of anemia, potentially affecting an individual's quality of life [17]. Anemia due to iron deficiency is commonly identified during routine screening; conversely, a lack of iron without anemia frequently remains undetected. Repeated donation of blood is a significant determinant in both iron deficiency without anemia (IDWA) and iron deficiency anemia (IDA) among those who are frequent donors [8] when neglected, low iron levels may result in anemia, which can make you feel dizzy, tired, short of breath, and pale [18].

While numerous studies have examined deficiencies in iron within the city residents, none have specifically addressed this issue among blood donors in Sulaymaniyah city. Thus, this study represents a novel effort to assess the iron content within this group of people across the current

area. This study aims to determine the iron status of typical blood donors at the blood bank in Sulaymaniyah City.

The remainder of this paper is organized as follows. Section 2 describes the materials and methods, Section 3 presents the results and discusses the findings, and Section 4 concludes the study with recommendations for future research.

## 2. Methods and Materials

### 2.1. Blood donors and study design

This comparative cross-sectional research study included two hundred and twenty-one male whole blood donors who attended the blood bank of Sulaymaniyah city from November 2024 to January 2025. Because men donate blood more frequently than women, only male donors took part in the study. There are 49 first-time donors and 172 repeat healthy adult male blood donors who have donated whole blood at least two or more times in the last two years. All participants met the standard blood bank eligibility criteria, had no history of diagnosed hematological disorders, and were not taking iron supplementation at the time of enrollment.

### 2.2. Ethics Approval and Questionnaire

This study was reviewed and approved by the Research Ethics Committee of the College of Health and Medical Technology, Sulaimani Polytechnic University (Approval Code: 23/245; Date: 1 December 2024). We used a structured questionnaire that was made just for this purpose to get information from each donor. This included their age, how often they donated blood in the two years prior, the duration that it remained since their last donation (in months), reasons they donated, if they received iron supplementation, how frequently they ate red meat, drank tea, smoked, or had a drink of alcohol, the level of their blood pressure, and any previous history of hemorrhage.

### 2.3. Laboratory tests and Sample collection

Routine hematological tests, including Hb, hematocrit (Hct), red blood cell count (RBC count), MCV, mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), and RDW, were performed by collecting 20  $\mu$ L of capillary blood using the microcapillary method (MPA) and analyzed with an automated hematology analyzer (Medonic M-series M32M, version 2.3.7r). Additionally, a 5.0 mL blood sample was obtained from each donor via the bleed line after completion of the donation and collected into serum-separating tubes containing clot activator. The samples were left at ambient temperatures for 15 to 30 minutes to let them clot. Then, they were spun at 2,000 rounds per minute for ten minutes in order to get serum.

2.4. Laboratory Assessment of Iron Status

Serum was then used for the direct measurement and calculation of iron-related parameters, including serum ferritin, serum iron, total iron-binding capacity (TIBC), unsaturated iron-binding capacity (UIBC), and transferrin saturation percentage, using an automated immunoassay analyzer (Cobas e 411, version AU0302) and an automated chemistry analyzer (Cobas c 311, version 1.10). Roch Diagnostics, elecsys ferritin, 2024 October, Germany, version 9, defined iron storage depletion as a blood ferritin level less than 30 ng/ml [19, 20].

2.5. Statistical Analysis

Data analysis was done with IBM SPSS Statistics version 25.0. Study participants were described using socio-demographic characteristics, which included percentages and frequencies for categorical variables, as well as minimum and maximum values or means with standard deviations (SD) for continuous variables. The Shapiro–Wilk and Kolmogorov–Smirnov tests were used to find out that continuous variables were not normal. We used independent sample t-tests to compare the means of groups when the data were normally distributed. When this wasn't possible, we used the Mann–Whitney U test. A *p* value of less than 0.05 was thought to be important.

3. Results and Discussion

3.1. Demographic and basic characteristics of participants

The age of participants in the first-time donors ranged from 20 to 55 years, with a mean of  $32.45 \pm 7.38$  years.

Whereas the repeat donors ranged from 19 to 65 years, with a mean of  $38.26 \pm 10.05$  years. The primary reason for blood donation in the repeat donors was polycythemia, accounting for 146.0 participants (84.9%), while replacement donors predominated in the first-time donors, comprising 33.0 participants (67.3%). Regarding the interval since the last donation, which is important for replenishing iron stores, 41.0 donors (23.8%) in the repeat donors' group had an interval of  $\leq 3$  months; the majority, 67.0 donors (39.0%), had an interval of 4–6 months; and only 30.0 donors (17.4%) had intervals of  $\geq 10$  months. In terms of red meat consumption per week, most participants in the repeat donors group consumed red meat either  $\leq 1$  time, 63.0 participants (36.6%); or 2–4 times, 68.0 participants (39.5%).

Smoking was prevalent among the repeat donors, with 122.0 participants (70.9%) reporting a smoking history, whereas most of the first-time donor participants (29.0 participants, 59.2%) were non-smokers (Table 1). Cigarette smoking was the predominant type in both groups. Alcohol consumption was relatively low, with only 5.0 participants (10.2%) in the first-time donors and 27.0 participants (15.7%) in the repeat donors reporting alcohol use; the majority in both groups were non-drinkers. No hypertensive donors were recorded in the first-time donor's group, whereas 21.0 participants (12.2%) in the repeat donor's group had hypertension. A past medical history of blood loss was reported in only 3.0 participants (1.7%) in the repeat donor group, and none in the first-time donors (Table 1).

Table 1: Demographic and clinical characteristics of first-time and repeat blood donors.

| Variables                       | Categories     | First-time donors (n = 49) |                | Repeat donors (n = 172) |                |
|---------------------------------|----------------|----------------------------|----------------|-------------------------|----------------|
|                                 |                | Frequency                  | Percentage (%) | Frequency               | Percentage (%) |
| Age (years)                     | <25            | 5.0                        | 10.2           | 13.0                    | 7.6            |
|                                 | 25–39          | 36.0                       | 73.5           | 83.0                    | 48.3           |
|                                 | 40–55          | 8.0                        | 16.3           | 65.0                    | 37.8           |
|                                 | >55            | 0.0                        | 0.0            | 11.0                    | 6.4            |
| Reason for blood donation       | Polycythemia   | 13.0                       | 26.5           | 146.0                   | 84.9           |
|                                 | Voluntary      | 3.0                        | 6.1            | 13.0                    | 7.6            |
|                                 | Replacement    | 33.0                       | 67.3           | 13.0                    | 7.6            |
| Last donation interval (months) | $\leq 3$       | 0.0                        | 0.0            | 41.0                    | 23.8           |
|                                 | 4–6            | 0.0                        | 0.0            | 67.0                    | 39.0           |
|                                 | 7–9            | 0.0                        | 0.0            | 34.0                    | 19.8           |
|                                 | $\geq 10$      | 0.0                        | 0.0            | 30.0                    | 17.4           |
|                                 | Do not consume | 2.0                        | 4.1            | 16.0                    | 9.3            |
|                                 | $\leq 1$       | 20.0                       | 40.8           | 63.0                    | 36.6           |

|                                   |                      |      |       |       |      |
|-----------------------------------|----------------------|------|-------|-------|------|
| Red meat consumption (times/week) | 2–4                  | 23.0 | 46.9  | 68.0  | 39.5 |
|                                   | 4–6                  | 1.0  | 2.0   | 14.0  | 8.1  |
|                                   | ≥6                   | 3.0  | 6.1   | 11.0  | 6.4  |
| Smoking status                    | Smoker               | 20.0 | 40.8  | 122.0 | 70.9 |
|                                   | Non-smoker           | 29.0 | 59.2  | 50.0  | 29.1 |
|                                   | Cigarette            | 15.0 | 75.0  | 84.0  | 68.8 |
| Type of smoking                   | Water pipe           | 2.0  | 10.0  | 28.0  | 22.9 |
|                                   | Electronic cigarette | 3.0  | 15.0  | 5.0   | 4.0  |
|                                   | Mixed type           | 0.0  | 0.0   | 5.0   | 4.0  |
| Alcohol consumption               | Drinker              | 5.0  | 10.2  | 27.0  | 15.7 |
|                                   | Non-drinker          | 44.0 | 89.8  | 145.0 | 84.3 |
|                                   | Normal               | 49.0 | 100.0 | 151.0 | 87.8 |
| Blood pressure                    | Hypertensive         | 0.0  | 0.0   | 21.0  | 12.2 |
|                                   | Hypotensive          | 0.0  | 0.0   | 0.0   | 0.0  |
| History of blood loss             | History present      | 0.0  | 0.0   | 3.0   | 1.7  |
|                                   | No history present   | 49.0 | 100.0 | 169.0 | 98.3 |

3.2. Blood donation frequency

Distribution of blood donation frequency over the past two years among male donors in the repeat donors and first-time donors’ group. The largest proportion of donors, 61

participants (27.60%), reported donating blood twice, while the smallest group, consisting of 9 participants (4.07%), reported donating six times or more (Figure 1).

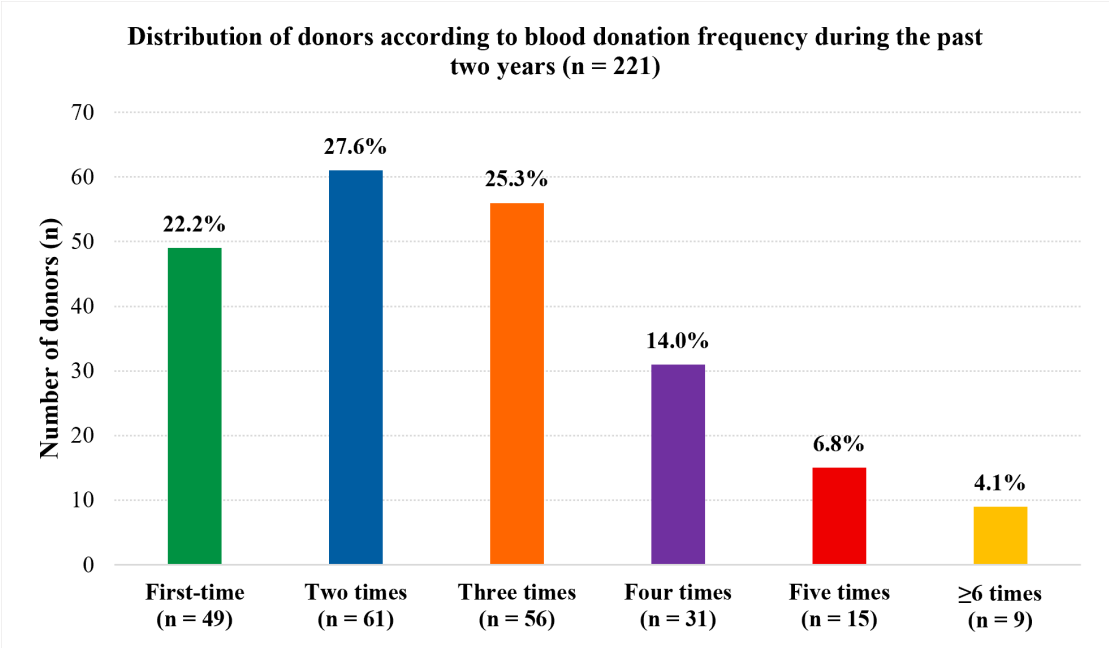


Figure 1: Distribution of blood donors according to the frequency of blood donation during the past two years.

3.3. Distribution of ferritin level

Illustration of the distribution of serum ferritin levels in the first-time donors. None of the participants (0.0%) exhibited depleted ferritin levels, while all 49 participants

(100.0%) had normal ferritin concentrations (Figure 2 A). Distribution of ferritin levels in the repeat donors group. Of these donors, 40 (23.3%) had low ferritin levels, which means they had less iron stored and were more likely to be iron deficient. Conversely, 132 (76.7%) exhibited normal

ferritin levels, indicating adequate iron reserves (Figure 2 B). Blood donation is the most vital part of any successful blood transfusion service. Blood banks have a responsibility to safeguard the well-being of their donors, which includes taking steps to prevent anemia. According to Adu [21], the reported frequency was 27.4%. Likewise, Tailor [14] identified a prevalence rate of 28.5%. But Vinkenoog [19] found that repeat donors had a much higher rate of 42.0%, while first-time donors only rated 1.6%. Conversely, Reddy [13] noted a comparatively lower incidence of 9.8% among routine blood donors. These results indicate that iron deficiency is very common among people who donate blood again. Studies on blood donors have generally shown a wide range of iron deficiency rates. These variations could be due to the place that individuals reside, the food they eat, the presence of parasites, and income level, as well as the guidelines that national blood transfusion programs adhere to [21].

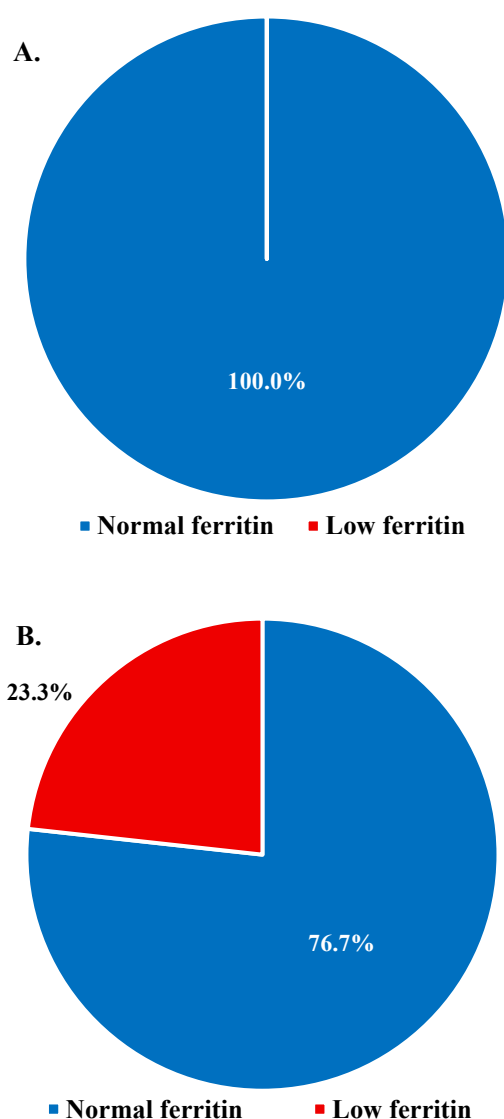


**Figure 2:** The percentage of donors with low and normal ferritin levels. **(A) First-time donors (n = 49):** None of the participants (0.0%) exhibited low ferritin levels, while all participants (100.0%) had normal ferritin concentrations. **(B) Repeat donors:** Of these donors, 23.3% had low ferritin levels, whereas 76.7% exhibited normal ferritin levels.

### 3.4. Statistical summary of the biochemical and hematological parameters

Comparison of hematological parameters between donors in the repeat donors group. It shows that there are big differences between people with low and normal ferritin levels. Donors with low ferritin levels had a lower MCV ( $80.67 \pm 5.71$  fL) than those with normal ferritin levels ( $85.22 \pm 4.55$  fL) ( $p = 0.0001$ ). The low ferritin group also had a much lower MCH level ( $27.12 \pm 1.92$  pg) than the normal ferritin group ( $29.08 \pm 1.47$  pg) ( $p = 0.0001$ ).

The MCHC was also slightly lower in donors who didn't have enough iron ( $33.62 \pm 1.20$  g/dL) than in those who did ( $34.14 \pm 1.10$  g/dL) ( $p = 0.006$ ). The RDW% was higher in the low ferritin group ( $12.54 \pm 1.15$ ) than in the normal ferritin group ( $11.66 \pm 0.52$ ) ( $p = 0.0001$ ). Hemoglobin levels, although generally within the normal range, were significantly lower in iron-depleted donors ( $15.73 \pm 0.96$  g/dL) compared to donors with normal ferritin ( $16.29 \pm 1.10$  g/dL) ( $p = 0.006$ ) (Table 2).

**Table 2:** Comparison of hematological parameters between donors with low and normal ferritin levels.

| Parameters        | Low ferritin     | Normal ferritin  | <i>P</i> value |
|-------------------|------------------|------------------|----------------|
|                   | Mean $\pm$ SD    | Mean $\pm$ SD    |                |
| MCV (fL)          | $80.67 \pm 5.71$ | $85.22 \pm 4.55$ | 0.0001         |
| MCH (pg)          | $27.12 \pm 1.92$ | $29.08 \pm 1.47$ | 0.0001         |
| MCHC (g/dL)       | $33.62 \pm 1.20$ | $34.14 \pm 1.10$ | 0.006          |
| RDW (%)           | $12.54 \pm 1.15$ | $11.66 \pm 0.52$ | 0.0001         |
| Hemoglobin (g/dL) | $15.73 \pm 0.96$ | $16.29 \pm 1.10$ | 0.006          |

Overall statistical analysis of the hematological and biochemical parameters of the studied donors, including minimum and maximum values and *p* values. Among red blood cell indices, the MCV was significantly lower in the repeat donor group ( $84.16 \pm 5.20$  fL) contrasted with the first-time donor's group ( $86.81 \pm 4.27$  fL) ( $P = 0.003$ ). Tailor [14], Singh [22], and Kumar [23] have documented similar patterns.

MCH was slightly lower in the repeat donors ( $28.63 \pm 1.78$  pg) than in first-time donors ( $29.24 \pm 1.45$  pg), even though this difference wasn't statistically significant ( $P = 0.086$ ). Tailor [14], Singh [22], and Kumar [23] showed that there was a big difference between the two groups. MCV and MCH values are typically reduced in individuals with iron deficiency due to impaired hemoglobin synthesis.

MCHC was slightly higher in the repeat donors ( $34.02 \pm 1.14$  g/dL) in comparison with the first-time donors ( $33.70 \pm 1.11$  g/dL), ( $P = 0.047$ ). RDW was significantly elevated in the repeat donors ( $11.87 \pm 0.80$ %) versus first-time donors ( $11.48 \pm 0.53$ %) ( $P = 0.0001$ ). Singh [22] and Li [24] have found similar results, saying that changes in the number of RBCs in repeat donors may be linked to lower levels of ferritin. One important factor that affects complete blood count (CBC) parameters is smoking, according to a study in Sulaimani, Kurdistan, Iraq, smokers exhibited significantly

higher RBC count, Hb levels, and Hct compared to non-smokers, vapers demonstrated the highest RBC count among the subgroups, followed by those who smoked both cigarettes and vapes [25]. Regarding iron status, serum ferritin was markedly lower in the repeat donors ( $85.48 \pm 83.0$  ng/mL) compared to first-time donors ( $209.46 \pm 103.5$  ng/mL) ( $P = 0.0001$ ). Serum iron was slightly lower in repeat donors ( $113.23 \pm 42.48$  µg/dL) compared to first-time donors ( $121.10 \pm 35.40$  µg/dL), even though this difference was not statistically significant ( $P = 0.173$ ). Transferrin saturation was significantly decreased in the repeat donors ( $29.78 \pm 12.12\%$ ) compared to first-time donors ( $35.12 \pm 10.6\%$ ;  $P = 0.002$ ). Wang [26], Waheed [27], and Vhanda [28] also found similar results. They also noticed an

enormous drop in transferrin saturation among people who gave blood often. (Table 3).

The possibility associated with iron shortage is expected to increase if people donate blood more frequently without checking their red blood cell indices. Repeat donors are capable of avoiding suffering from noticeable anemia caused by a lack of iron if they regularly monitor these levels. Finding out about iron deficiency early lets you act quickly by changing your diet and taking supplements. These procedures do not just reduce the quantity of sporadic donor postponements; however, they also contribute to maintaining a healthy group of donors available for subsequent donations [25].

**Table 3:** Statistical analysis of the biochemical and hematological parameters of the studied donors.

| Variables                  | Mean $\pm$ SD<br>(Min-Max)            |                                       | P value |
|----------------------------|---------------------------------------|---------------------------------------|---------|
|                            | First-time donors                     | Repeat donors                         |         |
| RBC ( $\times 10^{12}/L$ ) | $5.33 \pm 0.31$<br>(4.70–6.30)        | $5.67 \pm 0.48$<br>(4.80–7.80)        | 0.0001  |
| Hemoglobin (g/dL)          | $15.58 \pm 0.82$<br>(14.20–17.20)     | $16.16 \pm 1.09$<br>(14.00–19.20)     | 0.001   |
| Hematocrit (%)             | $46.28 \pm 2.55$<br>(41.30–52.30)     | $47.57 \pm 3.55$<br>(40.50–59.30)     | 0.016   |
| MCV (fL)                   | $86.81 \pm 4.27$<br>(75.90–100.20)    | $84.16 \pm 5.20$<br>(62.90–97.60)     | 0.003   |
| MCH (pg)                   | $29.24 \pm 1.45$<br>(26.50–33.20)     | $28.63 \pm 1.78$<br>(21.00–33.60)     | 0.086   |
| MCHC (g/dL)                | $33.7 \pm 1.11$<br>(31.60–38.30)      | $34.02 \pm 1.14$<br>(31.10–36.80)     | 0.047   |
| RDW (%)                    | $11.48 \pm 0.53$<br>(10.60–14.00)     | $11.87 \pm 0.80$<br>(10.70–17.60)     | 0.0001  |
| Serum ferritin (ng/mL)     | $209.46 \pm 103.52$<br>(60.15–471.60) | $85.48 \pm 83.01$<br>(8.44–771.80)    | 0.0001  |
| Serum iron (µg/dL)         | $121.10 \pm 35.40$<br>(59.93–209.41)  | $113.23 \pm 42.48$<br>(30.83–262.45)  | 0.173   |
| UIBC (µg/dL)               | $226.01 \pm 46.96$<br>(118.00–347.20) | $274.15 \pm 67.52$<br>(74.00–432.06)  | 0.0001  |
| TIBC (µg/dL)               | $347.69 \pm 34.98$<br>(290.00–441.00) | $387.40 \pm 49.34$<br>(266.00–528.00) | 0.0001  |
| Transferrin saturation (%) | $35.12 \pm 10.60$<br>(15.00–63.00)    | $29.78 \pm 12.12$<br>(7.00–77.00)     | 0.002   |

### 3.5. Effect of Frequent blood donation on serum ferritin and hemoglobin levels

First-time donors' group had the highest average level of ferritin ( $209.46 \pm 103.52$  ng/mL), which means they had normal iron stores. In contrast, frequent donors who donated two, three, four, and five times over the past two years showed progressively lower ferritin levels of ( $113.30 \pm 109.79$ ), ( $80.07 \pm 61.03$ ), ( $69.95 \pm 66.45$ ), and ( $52.57 \pm 36.76$ ) ng/mL, respectively. Blood donors who gave six or more times had the lowest ferritin level ( $38.93 \pm 29.05$  ng/mL), which shows that their iron stores were very low. Even though ferritin levels changed, the average hemoglobin levels stayed relatively stable for every donation group, with only small changes. The first-time donors group had

an average hemoglobin of ( $15.58 \pm 0.82$  g/dL), whereas donors who gave blood two, three, four, five, and six or more times had mean hemoglobin levels of ( $16.04 \pm 1.02$ ), ( $16.29 \pm 1.12$ ), ( $16.42 \pm 1.32$ ), ( $15.95 \pm 0.68$ ), and ( $15.54 \pm 0.81$ ) g/dL, respectively (Figure 3). The mean serum ferritin level in first-time donors was much higher than in repeat donors ( $P = 0.0001$ ). This result corroborates the findings of Tailor [14], Vinkenoog [19], and Qassadi [29], who similarly reported significantly reduced ferritin levels in individuals who regularly donated blood. Conversely, Abbas [30] indicated that frequent blood donation had a negligible impact on serum ferritin levels and demonstrated no significant variation among healthy male first-time donors. The shorter donation intervals that men are usually allowed to have may explain these differences. The frequency of donations is still the most important factor in lowering iron stores [31]. When

you donate more often, your body needs more iron, which makes repeat donors more likely to run out of it [14]. Also, differences in the threshold values used to define low iron stores could make it harder to understand the data and explain why different studies report different prevalence rates. Our study found that first-time donors had lower average hemoglobin levels in compare to repeat donors. The disparity was statistically significant ( $P = 0.001$ ). Tailor [14] and Kumar [23] also said that people who give blood more than once have higher hemoglobin concentrations. Kebalo [32], On the contrary, found that people who donate blood regularly have decreased hemoglobin levels compared to people who donate blood for the first time. The elevated hemoglobin levels observed in repeat donors may be ascribed to high smoking prevalence (70.9%) in this group; polycythemia in repeat donors is also a strong source of selection bias, enhanced dietary habits within this group of people and the likelihood that frequent donors represent a distinct sample with inherently higher baseline hemoglobin levels relative to first-time donors.

One of the most noteworthy things about this paper is that it takes a look into how donating blood frequently

impacts iron levels. This is still a new field of study in the local area. The results are even more trustworthy considering the sample size is large. However, there are definitely certain aspects you should keep in mind. The sample size was adequate; however, the participants may not accurately reflect the broader donor population, as the study was conducted in the context of a thesis project. Polycythemia affected the selection of participants, particularly among repeat donors, leading to potential selection bias. Additionally, factors such as dietary habits, lifestyle, and initial iron levels were not entirely regulated, potentially leading to complications, which could affect the overall health outcomes of the participants and the validity of the study's findings. Longitudinal research ought to be employed in subsequent studies to monitor iron levels across multiple donation cycles and to evaluate the efficacy of interventions such as routine iron assessment, supplemental iron, dietary guidance and studies that include female donors because this study only includes male donors, such kinds of investigations would provide more evidence for strategies aimed at maintaining the health of regular blood donors.

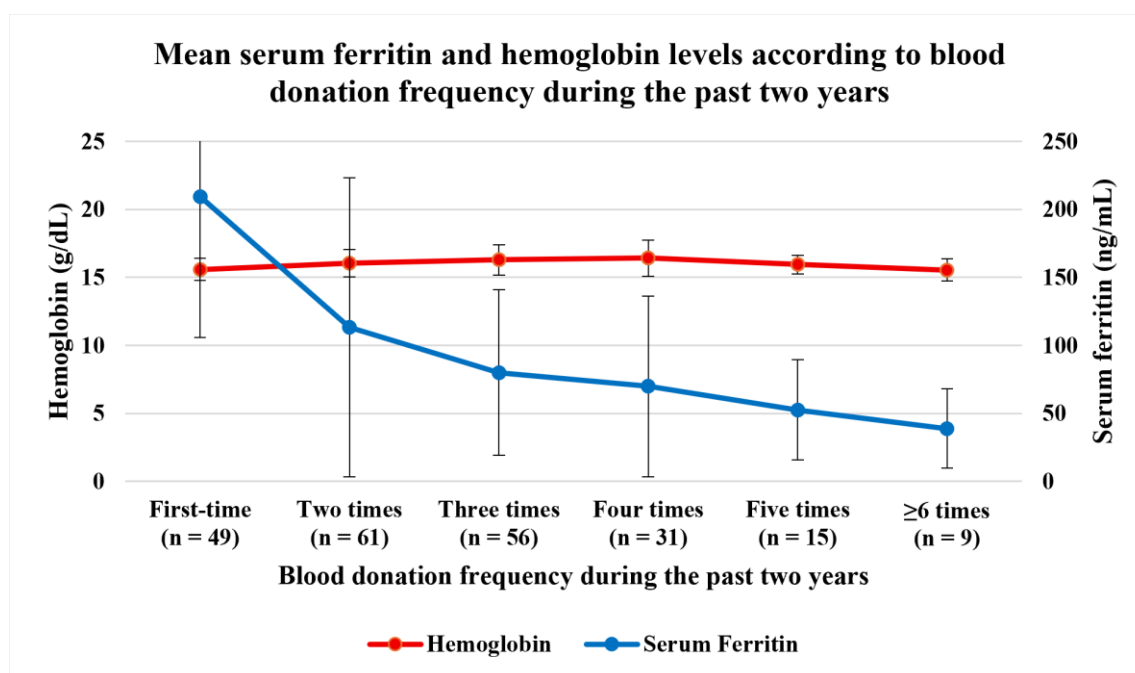


**Figure 3:** Mean serum ferritin and hemoglobin levels according to blood donation frequency during the past two years. Serum ferritin levels progressively decreased with increasing donation frequency, with the lowest ferritin level observed among donors who donated six times or more, indicating reduced iron stores in frequent donors. In contrast, mean hemoglobin levels remained relatively stable across all donation groups with only minor fluctuations.

#### 4. Conclusions

The present research shows that men who donate blood frequently at the Sulaymaniyah City Blood Bank have significantly lower iron storage levels. While levels of hemoglobin stayed mostly in the standard range, the levels of ferritin in the serum and transferrin saturation dropped as donations became more common. This means that the amount of iron in the body was going down even before the person became anemic. Also, red blood cell indices, especially MCV values and RDW values, were affected. This means

that the shape of RBCs changed a little bit because there wasn't as much iron available.

These outcomes demonstrate that checking someone's hemoglobin level alone is not enough to see if they can donate. They also show how important it is to check iron levels regularly, especially in people who donate blood more than once, to continue keeping them healthy and to avoid deficiencies in iron. We recommend using hemoglobin and red blood cell indices together to identify early signs of iron loss. We also suggest keeping an eye on ferritin levels in frequent donors, giving dietary advice, planning to give

supplements with iron to donors who are at risk, and looking at donation intervals in order to allow iron reserves to replenish.

### Authors' contributions:

Conceptualization: H.S.S., H.A.G.; Data Curation: H.S.S.; Investigation: H.S.S.; Data Analysis: H.S.S.; Methodology: H.S.S.; Writing—Original Draft: H.S.S.; Writing—Review and Editing: H.A.G.; Validation: H.A.G.

### Conflict of interest

There is no conflict of interest in the study.

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