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Iron Stores in Male Blood Donors in Tehran Regional BloodTransfusion Center

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Abstract

Background: Iron deficiency and its related anemia, which is the world's most widespread nutritional deficiency, can be one of the possible consequences of regular blood donation. This research was carried out to compare iron stores in regular blood donors and first-time blood donors in Tehran Regional Blood Transfusion Center.

Materials and Methods: This study was carried out on 2,149 male blood donors, who were divided into two groups of regular and first-time blood donors. Blood samples were analyzed for red blood cell parameters, serum iron and ferritin, and total iron binding capacity.

Results: The results showed that iron depletion was more common in regular blood donors than in first-time donors. Eleven percent of regular blood donors and 0.8% of first-time blood donors had iron deficiency. Of regular donors, 4.2% suffered from iron deficiency and 2.5% suffered from iron depletion anemia while there was no case of iron deficiency or anemia in first-time donors. Difference between two groups was statistically significant ($p<0.01$). According to the results, 8.9% of regular donors donated more than 4 times during last two years suffered from iron deficiency.

Conclusion: Regular blood donation seems to have an impact on the iron stores of blood donors. However, the prevalence of iron deficiency in Iranian blood donors is lower than donors in other countries. We recommend an annual investigation of iron stores be carried out for blood donors who have given blood more than twice a year.

Keywords: Iron deficiency anemia, Blood donors.

Introduction

Iron deficiency and the anemia caused by it, which are the most common nutritional disorders in the world,[1] are the possible consequences of regular blood donation. A male donor loses about 225 mg iron with each blood donation. Since the body iron stores are limited, iron depletion and the consequent anemia may result if the lost iron is not compensated.[2] In a study reported by Simon in 2002, 8% of men who donated blood 4-5 times per year and 19% of men who donated blood every 8 weeks, suffered from iron deficiency.[3] Iron deficiency anemia may have consequences such as loss of energy, increased risk of infection, and high costs of diagnosis and therapy.[4] Furthermore, iron deficiency anemia will reduce the donors' motivation for donating blood.

Regarding the importance of the issue of iron deficiency in blood donors, several studies have been conducted in many countries. Due to the higher prevalence of anemia among women, studies have most often been performed on women. In our country the majority of blood donors are men, and fewer studies have been performed on male blood donors. Therefore, we evaluated the status of iron deficiency and its anemia resulting among male blood donors in Tehran Regional Blood Transfusion Center.

Materials and Methods

This study is a historical cohort study, involving 1013 first-time male blood donors and 1136 regular male blood donors who were selected by a simple sampling procedure. A questionnaire was filled in to obtain demographic data and evaluate the donors' risk factors for iron deficiency such as number of blood donations in the last two years, total number

of blood donations, history of bleeding or surgery in the last year, and whether or not iron supplements had been taken. Ten milliliters of blood was collected from selected donors and tested for complete blood count, serum iron, total iron binding capacity (TIBC), and serum ferritin. Tests were performed in the laboratories of the central headquarters of the Iranian Blood Transfusion Organization.

Red blood cell parameters were measured using the Sysmex K-1000 cell counter (Sysmex, Japan). Serum concentration of ferritin was measured using the IRMA method with Immunotech kit (Czech). Iron concentration was measured using the colorimetric method with Pars Azmoon kit (Iran). TIBC was measured using sedimentary method with a Darman Kav kit. In order to role out genetic hemoglobinopahies, hemoglobin (Hb) electrophoresis was done on those blood donors with either hemoglobin less than 13.5 g/dl or mean corpucular volume (MCV) less than 80 fL .Depletion of iron stores, iron deficiency, and iron deficiency anemia are defined as below:

- Iron depletion: Serum ferritin less than 20 µg/l; normal transferrin saturation and hemoglobin level.

- Iron deficiency: Serum ferritin less than 20 µg/l, transferrin saturation less than 15%, and normal hemoglobin level.

- Iron deficiency anemia: Serum ferritin less than 20 µg/l, transferrin saturation less than 15%, and hemoglobin less than 13.5 g/dl.5

Data were analyzed using t-test and chi-square statistical tests.

Results

A few samples were dropped out from the study due to hemoglobinopathy, hemolysis, clotted sample, or incomplete questionnaire. The data of 2149 male blood donors were analyzed. Of participants, 1136 (52.9%) were regular and 1013(47.1%) were first-time donors. As presented in table 1, all laboratory variables are significantly lower in regular donors in comparison with first-time donors.

The average age was 43.14±10.4 years for the regular donors group and 39.31±11.77 years for first-time donors. The difference between the mean age of two groups was statistically significant ($p<0.01$). Therefore, the iron stores were compared based on age, and donors were divided into three age groups: less than 30, 30-44, and less than 44 years (table 2). Results show a significant difference in the prevalence of iron-related disorders between first-time and regular donors in all age groups ($p<0.01$).

Overall, 11% of regular donors and 0.8% of first-time donors had iron depletion. In addition, 4.2% of regular donors had iron deficiency. The prevalence of iron deficiency anemia was 2.5% among regular donors, while iron deficiency and iron deficiency anemia were not observed among first-time blood donors, showing a statistically significant difference ($p<0.01$). (Table 3)

In this study, the regular donor group was divided into two sub-groups based on the number of blood donations in the past two years: more than four times in the last two years, and four times or less in the last two years. Table 3 shows the results of a comparison between the prevalence of iron-related disorders in first-time and regular blood donors based on the number of blood donations they had made in the last two years.

Table 1. Comparison of laboratory test results in regular and first-time blood donors

Laboratory Parameters	Regular Donors	First-time Donors	P value
Hemoglobin (g/dl)	15.42 ± 1.09	15.69 ± 0.96	0.001
Hematocrit (%)	44.87 ± 3.17	45.47 ± 2.92	0.001
Ferritin (ng/ml)	66.14 ± 66.7	156.17 ± 107.8	0.001
Iron (µg/dl)	99.8 ± 54.49	107.29 ± 54.57	0.002
Iron-binding capacity (µg/dl)	381.49 ± 80.03	348.81 ± 74.88	0.001
Transferrin saturation (%)	26.13 ± 11.6	30.26 ± 11.2	0.001

Discussion

Results of this study show that depletion of iron stores, which was measured by the serum ferritin concentration, was more frequent among regular donors compared with first-time donors. In this study, 11% of regular donors and 0.8% of first-time donors had iron store depletion. Other studies have also confirmed that body iron stores are reduced in regular blood donors.[6-10] Badar and colleagues in Pakistan have reported the reduction of the average serum ferritin concentration among donors who had donated more than three times in two years. In their study, donors who had a history of 6 or 7 blood donations suffered from iron store depletion.[11] Simon and colleagues showed that depletion of body iron stores, which was measured by ferritin levels, appeared in 8% of men and 38% of women after five blood donations.8 In a study performed in Malaysia, 11% of regular male blood donors suffered from iron store depletion.[12] These results are consistent with our results. Interestingly some studies have shown that blood donation can have a protective effect against cardiovascular disease,[13-15] and it seems that depletion of the body iron stores provide a protective effect against cardiovascular diseases. There are several other studies also showing that long-time regular blood donation is accompanied by a reduction in the susceptibility to cardiovascular disease.[16-19]

The present study showed that the prevalence of iron deficiency is 4.2% among regular donors while it was not observed among first-time donors. In the study performed by Cancado et al in Brazil, iron deficiency was reported in 11% and 31.7% of male and female blood donors, respectively.[20] Lamas et al reported iron deficiency in 7.4% and 11.8% of male and female blood donors in Spain, respectively.[21] According to our results, iron deficiency is more prevalent among regular donors with more than four donations during the previous two years. Javadzadeh et al showed that prevalence of iron deficiency was not significantly increased after up to five donations, but the increase was significant after more than 5 donations among regular donors ($p<0.05$), so that 28% of regular male donors suffered from iron deficiency.[22] In Badar's study, performed in Pakistan, the prevalence of iron deficiency among men who had donated blood 5 to 7 times during the last two years was reported to be 40 to 50%.[11] Results of this study show lower prevalence of iron deficiency among regular donors with more than 4 blood donations during the last two years compared with the Badar's study in Pakistan. Therefore, it is obvious that incidence of iron deficiency increases with the number of blood donations, as confirmed in other studies.[23-26]

Results of our study show that the prevalence of iron deficiency anemia is 2.5% among regular blood donors, while this was not observed in any of the first-time donors. In a study performed in India, 9.5% and 26.7% of male and female regular donors suffered from iron deficiency anemia, respectively.[23] In Javadzadeh's study, the prevalence of iron deficiency anemia among male blood donors was reported to be 16%.[22] In the Indian study, 3% of regular donors with less than ten blood donations and 25% of regular donors with a history of more than 50 blood donations, suffered from anemia.[23]

Table 2. Prevalence of Iron-related disorders in first-time and regular male blood donors, in different age groups

Age groups	Blood donors	Iron store depletion	Iron deficiency	Iron deficiency anemia
Below 30 years	First-time	0.4%	0.0%	0.0%
	Regular	12.3%	4.5%	1.3%
31-45 years	First-time	1.2%	0.0%	0.0%
	Regular	12.2%	4.3%	3%
Above 45 years	First-time	0.6%	0.0%	0.0%
	Regular	9.3%	4.1%	2.3%

Table 3. Prevalence of Iron-related disorders between first-time and regular donors, based on the number of donations given in the last two years

Donors	Iron store depletion	Iron deficiency	Iron deficiency anemia
First-time	0.8%	0.0%	0.0%
Regular	11%	4.2%	2.5%
Regular with more than 4 donations in the last two years	22.6%	8.9%	6.5%
Regular donors with less than 4 donations in the last two years	7.7%	2.8%	1.4%

Conclusion

Regular blood donation has been shown to have an impact on the iron stores of a small fraction of Iranian blood donors. However, the prevalence of iron deficiency in Iranian blood donors is lower when compared to donors in other countries. It could be recommended that annual evaluation of blood donors with more than 2 blood donations annually be performed to assess iron stores.

According to our results, an increase in annual number of blood donations results in reduction of ferritin level, and increases the rate of iron store depletion. The greatest prevalence of iron deficiency and iron deficiency anemia have been observed in donors with more than four donations in the past two years. Therefore, in order to reduce the risk of iron deficiency and iron deficiency anemia in donors, it is suggested that:

1. The status of body iron stores in donors with more than two donations per year should be evaluated by measuring the serum ferritin annually.

2. The minimum acceptable hemoglobin level for blood donors with more than two donations per year should be higher than the other.

3. Iron supplements could be prescribed for donors with hemoglobin levels close to minimum acceptable hemoglobin level.

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