

Relationship Between Frequencies of Blood Donations with Iron Deficiency Anemia

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ABSTRACT

Objective: To see the relationship between frequencies of blood donations with iron deficiency anemia.

Study Design: Cross sectional Study

Place and Duration of Study: This study was conducted at Civil Hospital Karachi, Pakistan in the month of November to December 2015.

Materials and Methods: Total 120 male subjects between the ages of 25 – 40 years of were recruited for this study from the Blood Bank and pathological laboratory civil hospital Karachi.

Results: We found that hemoglobin concentration was significantly higher ($df=118$, $t=6.834$, $p<0.01$) in group A (10.68 ± 2.7) as compared to group B (7.81 ± 1.79) indicating that persons that donate blood frequently have lower hemoglobin levels and are in anemic state.

Conclusion: The current study concluded that iron status of body gets severely affected by frequent blood donations.

Key Words: Iron deficiency anemia, Ferritin, Hemoglobin, Blood donation

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INTRODUCTION

Blood donation is the common practice all over the world because this tissue is easily donated in different life saving conditions. Generally, blood donors are considered to have a good health, and have been reported to live a healthier life and have a lower mortality compared to the general population¹. But the only known significant disadvantage of blood donation is the potential risk of iron deficiency (ID). Iron is an important element in the human metabolism that has a central role in erythropoiesis and many other intracellular processes occurring in the body². Iron deficiency is a global health issue estimated to concern as many as 2.7 billion people effected worldwide with a high prevalence in blood donors¹. It is the most common nutritional deficiency worldwide which leads to reduced work capacity³, impaired scholastic achievements and increase fatigue¹.

The impact of blood donation on iron status has been studied since the late 1970s⁴. Normal iron stores in healthy men are about 1000 mg, whereas in healthy females only about 300 mg. A whole blood donation depletes the donor of approximately 225–250 mg of iron during which up to 425–475 ml of whole blood are withdrawn⁵.

There is 3.2mg of iron present in 1 gram of hemoglobin and in normal persons 50mgs of iron present in 100ml of blood, so when a person donates a single pint it means 225mgs of iron has been lost from body² leading to subsequent mobilization of iron from body stores⁵. Dietary absorption of iron can be up to 3.5–4 mg/day when iron stores are low, less when iron stores are higher⁵. So, The RBC's and hemoglobin count will return to normal values within 4 weeks if person not sufferer from iron deficiency anemia, and longer to recover iron stores. In order to donate frequently, many donors may require iron supplements⁵ because synthesis of hemoglobin, myoglobin, and cleavage of hemoglobin also influence by the action of iron. 30 mgs of iron per day required for synthesis of new molecules of hemoglobin. In Human body, Iron stores in liver, spleen and bone marrow in the form of ferritin and hemosiderin. When the blood loses or donated these storage forms of iron has been activated and give quick supply of iron in blood loss conditions⁶. Hence adequate iron stores are very important in maintenance of the donor's health⁷.

It is recommended internationally that a healthy individual can donate blood up to four times a year i.e. at 3- monthly intervals as iron stores can be depleted if

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blood is donated more frequently. An increase in the frequency of blood donation is liable to result in excessive iron loss and development of iron deficiency anemia⁵ which may be consequence of donating blood at a rate that is beyond the ability of their body to compensate⁷. Studies have reported that continuous repeating donations effect on the serum ferritin level and it will take part in genesis of iron deficiency anemia⁸. The frequency of ID is high in blood donors and more dependent on the frequency of donations than on the cumulated number of donations². It is evident that in donors with repeated donations iron demands increases, even though the absorption of nutritional iron among donors is much more efficient than non-donors, however, a donation frequency of more than 4 units per year cannot be compensated by iron absorption and results in an iron deficiency⁶. Number of studies up till now has addressed this issue but unfortunately very few studies concerning this issue are conducted in Pakistan. So, the object of present study is to see the relationship between frequencies of blood donations with iron deficiency anemia by assessing hemoglobin which is simplest technique to identify anemic donors and serum ferritin which reflect body iron stores.

MATERIALS AND METHODS

Subjects: Total 120 male subjects between the ages of 25 – 40 years of were recruited for this study from the Blood Bank and pathological laboratory civil hospital Karachi. These 120 subjects divided into two different groups; (Group A & B) each group contains 60 subjects. Group A subject donated 4-6 times per year, Group B 7-9 times per year.

Study area: This study was conducted at civil Hospital Karachi, Pakistan in the month of November - December 2015. Karachi is the largest and most populous city in Pakistan and 5th largest metropolitan city in the world. Karachi is the capital of Sindh province. The estimated population is around 23.5 million.

Inclusion/Exclusion criteria: The subjects having history of alcoholism, hepatitis B & C, malaria, malnutrition etc were excluded from this study.

Sample Collection: After given proper information and taken written consent from all participants in this study, 5ml of fresh venous blood was drawn from each subjects by a clean vein puncture from the median cubital vein, 3ml delivered into an iron free dried plain tube and 2ml drawn in hemoglobin meter. The samples were allowed to clot at room temperature and centrifuged to separate the serum. All serum samples were stored at -70°C and kept under these conditions until chemical analysis was performed.

Biochemical Analysis: The hemoglobin levels in whole blood were determined immediately with portable hemoglobin meter. While the serum ferritin

levels were estimated by Enzyme-Linked Immunoassay method (ELISA).

Statistical Analysis: The statistical analysis of data for biochemical analysis was done using SPSS software version 20.0 for windows. Comparisons between two groups were made using the Student's *t*-test. Values of $p < 0.05$ were considered statistically significant.

RESULTS

In the present study we have determined the hemoglobin and ferritin concentration in two different repeated/frequent blood donor groups varying in their frequency of donating blood. Group A subject donated 4-6 times per year while Group B subjects donated 7-9 times per year. Our aim is to see the relationship between frequencies of blood donations with iron deficiency anemia by assessing hemoglobin and serum ferritin levels in Pakistani population. We have found that hemoglobin concentration was significantly higher ($df=118$, $t=6.834$, $p < 0.01$) in group A (10.68 ± 2.7) as compared to group B (7.81 ± 1.79) indicating that by persons that donate blood frequently have lower hemoglobin levels and are in anemic state.

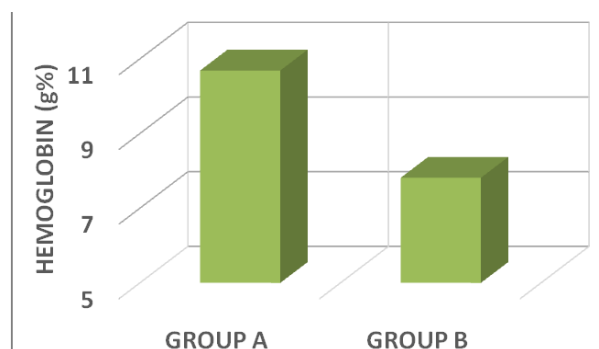


Figure No.1: Hemoglobin

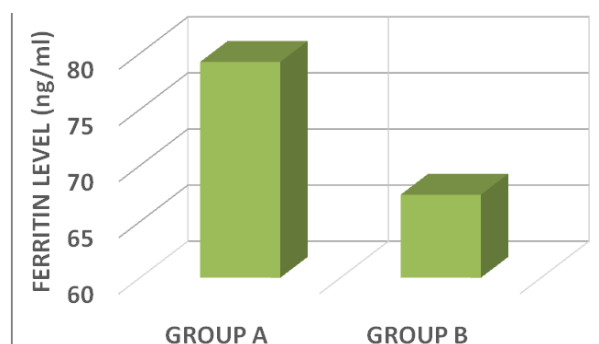


Figure No.2: Serum Ferritin

Statistical analysis of serum ferritin levels showed that concentration of serum ferritin is significantly lower ($df=118$, $t=5.594$, $p < 0.01$) in Group B subjects (67.4 ± 12.25) that donated blood 7-9 times per year as compared to Group A subjects (79.2 ± 10.87) that donated 4-6 times per year indicating frequent blood

donations reducing the iron stores so the ferritin level drops.

In order to understand the relationship between serum ferritin levels and hemoglobin content in both blood donation groups a Pearson's correlation test was performed. The results of correlation showed that there is positive relation between hemoglobin content and ferritin levels in the overall data ($r=0.386$, $p<0.01$) showing that hemoglobin content is dependent upon the ferritin level as ferritin level increases the hemoglobin content also increases and as it drops the hemoglobin content also reduces leading to anemic state. While when correlation analysis was performed on blood donation groups then we found that in group A there is no significant relation between serum ferritin level and hemoglobin content however in group B there is a significant relation ($r=0.482$, $p<0.01$) between serum ferritin level and hemoglobin content.

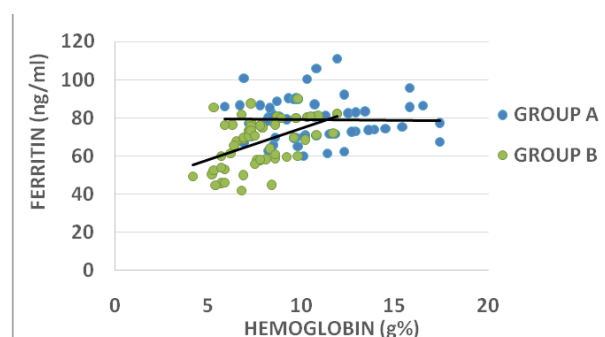


Figure No.3: Correlatoin between ferritin and HB

DISCUSSION

The aim of present study is to find out the relationship between frequencies of blood donations with iron deficiency anemia. For this purpose, hemoglobin content which is the simplest technique to identify anemic donors and serum ferritin levels which are the indicators of body iron stores⁷ have been determined in two different repeated blood donor groups varying in their frequency of donating blood in the manner that group A subject donated 4-6 times per year while Group B subjects donated 7-9 times per year. Findings of the present study showed that frequency of blood donations affecting the health of donor via affecting the iron stores of the body.

Reports have shown that iron depletion is common among blood donors⁵. It has shown that the rate of donation per person depends upon the storage of iron and hemoglobin concentration⁹. It has been recommended internationally that 3 – 4 blood donations per year are authentically safe for a person's health as RBC's and hemoglobin count take at least 4 weeks in order to return to normal values if person not sufferer from iron deficiency anemia¹⁰. It has been evident that following blood donation iron content has been lost to about 0.5 mg per ml of blood donated and if it is not compensated or blood is donated repeatedly then it may

lead to chronic iron deficiency and ultimately to iron deficiency anemia¹¹. Individuals at risk of developing iron deficiency can be detected only by assessing serum ferritin concentration which is the more sensitive indicator of body iron stores⁴. Although, hemoglobin content is measured routinely for assessing the donor's eligibility and a cutoff value of hemoglobin of 12.5 g/dL is often recommended before a blood donation is made¹² but studies have shown that it is a late indicator of iron deficiency and are inadequate to detect the donors having iron deficiency without anemia^{4,13} that's why serum ferritin is considered as a convenient marker of body's iron status⁵. So, that's why in the present study along with measuring the hemoglobin concentration, the serum ferritin content was determined to study the effect of frequent blood donation on iron status of body.

Findings of current study showed that hemoglobin and serum ferritin levels were lower in Group B subjects that donated blood 7-9 times per year as compared to Group A subjects that donated 4-6 times per year indicating that frequent blood donations reducing the iron stores of body as the serum ferritin content reduces eventually leading to loss in hemoglobin content hence developing iron deficiency anemia. These results are in accordance with previous findings that iron deficiency is more prevalent in repeated/frequent blood donors^{1,6,14}. It is reported that among frequent donors 66% woman and 49% men were iron deficient^{14,15}.

CONCLUSION

Hence, from the current study it has been concluded that iron status of body gets severely affected by frequent blood donations so it has been recommended to donate blood 3-4 times a year not more than that. It is also recommended that along with hemoglobin content, the serum ferritin levels must in every blood donor must also be measured before undergoing blood donation. In addition to this it is advised to recommend the use of iron supplements and appropriate diet to the regular donors so that their iron stores will be restored and maintained more effectively.

Conflict of Interest: The study has no conflict of interest to declare by any author.

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