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# Effect Of Regular Whole Blood Donation On Body Iron Stores By Calculating Serum Ferritin Level.

[1]Dr. Nikita Vijay Singh Thakur, Junior Resident 3rd Year College, Dr. Panjabrao Deshmukh Memorial Medical College, Amravati.

[2]Dr. Ashish. A. Tayde, Associate professor College, Dr. Panjabrao Deshmukh Memorial Medical College, Amravati.

[3]Dr. Nafees Noman, Asst. Professor College, Dr. Panjabrao Deshmukh Memorial Medical College, Amravati.

[4]Dr. Chetna Aggarwal, Asst. Professor College, Dr. Panjabrao Deshmukh Memorial Medical College, Amravati.

**Corresponding Author:** Dr. Nikita Vijay Singh Thakur, Junior Resident 3rd Year College, Dr. Panjabrao Deshmukh Memorial Medical College, Amravati.

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## Abstract

**Background and objectives:** Only 2-3 % of the total population participates in blood donation. Regular blood donors are at the highest risk for developing low body iron stores leading them to iron deficiency anemia. Routine hemoglobin estimation at the time of donation cannot help us for detecting these iron stores, for this serum ferritin can be used to evaluate the iron stores of the body.

**Materials & Method:** We conducted a cross-sectional study at a tertiary care center hospital blood bank. We collected samples from 211 donors out of which 42 are first-time donors and the remaining are regular donors who came to the blood bank. Serum ferritin estimation along with routine cbc are done for each of them.

**Results:** We collected samples of 212 donors including first-time donors. Results were calculated by comparing the ferritin concentration of first-time and multiple-time donors. Ferritin was found to be decreasing as the number of donations increased though their hemoglobin level are more than 12.5gm/dl. First-time donors have ferritin within the normal range along with hemoglobin.

**Conclusion:** Hemoglobin estimation at the time of blood donation will not rule out whether the donor's body iron stores are normal or not, so to avoid this ferritin-guided donation should be carried out to improve compliance of blood donors. Measurements can be taken to diagnose the early reduction of iron stores and to treat them.

**Keywords:** CBC, Ferritin, Iron stores

## Introduction

Regular blood donation is one of the main causes of body iron store depletion.1 Bleeding results in the movement of iron from body stores. The frequent blood donors either reach stability at a lower level of iron stores or become anemic.

One ml of blood consists of 0.5mg of iron thus a unit of blood (450ml) contains nearly 250 mg of iron, representing about 30% of the average body iron stores (BIS) in males and nearly 80% in females. 2

It is established that iron deficiency anemia is the last stage in the pathogenesis of body iron depletion, and it is apparent that Hb levels by themselves are insufficient data for identifying blood donors with iron deficiency without anemia.

To accomplish the worldwide and nationwide drive to recruit and retain regular and repeat voluntary non-remunerated blood donors, the iron status of the donors must be diagnosed, and essential steps for iron supple mentation should be taken.

Our primary aim is to understand the effect of repeated blood donations on BIS in both male and female regular donors. Since hemoglobin levels may be normal in the presence of reduced iron stores. [3-5]

**Aims & Objective**

➢ To study the pattern of serum ferritin along with the number of donation

➢ To correlate between hemoglobin and ferritin levels of donors

➢ To find out low iron stores in regular donors and modify their lifestyle to maintain their compliance.

**Material & Methods**

**Study design**

This is a cross-sectional study carried out at the Blood Centre of Dr. PDMMC, Amravati over a period of 18 months from January 2021 to June 2022. Tot of al 211 blood donors fitting in donor selection criteria was included in this study. The study was carried out after approval of the institutional ethical committee.

**Donors selection criteria**

Donors were asked to fill donor questionnaire as per NBTC guidelines. Consent was taken in proforma, followed by a physical examination.

Pre donation hemo globin was evaluated by the copper sulfate method based on the specific gravity of the blood.

Samples were collected in two tubes. First (2 ml) in an EDTA tube for CBC, the sample was processed immediately within 1 hr of collection.

The second sample in the plain tube (3 ml) was allowed to clot to obtain serum. Serum from tubes was processed for serum Ferritin level on a Beckman coulter immuno assay analyzer which runs on the principle of Latex agglutination method forming antigen-antibody complex es, turbidimeters measure the reduction of incident light due to complexes.

**Study methodology**

Results of ferritin were collected the next day and data from the donor has been updated according to the results. Data from the donor and CBC and Ferritin were entered in a master chart made on an Excel sheet.

Data from all 211 donors, donors were divided into three main groups depending on their average number of donations in the last two years. While calculating the average donation for these groups we considered a round figure to avoid calculative inconvenience.

According to the number of average two-year donations donors are classified as

Group 1-First time donor.

Group 2- Repeated donors (=5 times)

Group 3- Regular donors (>=5 times)

After dividing them into groups, the average serum ferritin for each group was calculated using formulae. Taking group, I as a control we compared the values of serum ferritin with other groups.

Average hemoglobin was vel then calculated for each group followed by average total hemoglobin level.

**Observations & Results**

Table 1: Group-wise comparison of mean age and gender of donors.

| Groups | Mean | SD |
|---|---|---|
| Group 1(First time donor) (n=44) | 25.89 | 9.35 |
| Group 2 (repeated donor) (n=125) | 35.46 | 11.34 |
| Group 3 (regular donor) (n=42) | 34.10 | 10.71 |
| P | <0.0001 | |

Younger age is associated with group 1 (first-time donor).

The maximum number of donations was seen in Group 2 donors, followed by Group 3 and Group 1 donors. (Table1)

Table 2: Group wise gender distribution of donors.

| Groups | Male | Female | Total |
|---|---|---|---|
| Group 1(First time donor) (n=44) | 38 | 06 | 44 |
| Group 2 (repeated donor) (n=125) | 100 | 25 | 125 |
| Group 3 (regular donor) (n=42) | 41 | 01 | 42 |
| Total | 179 | 32 | 211 |

Males were in the majority in all three groups. Specifically in group 2 male and female donors are more. (Table 2)

Table 3: Group-wise average hemoglobin level of donors.

| Groups | Mean | SD |
|---|---|---|
| Group 1(First time donor) (n=44) | 14.21 | 1.26 |
| Group 2 (repeated donor) (n=125) | 14.02 | 1.05 |
| Group 3 (regular donor) (n=42) | 13.76 | 0.91 |
| p | 0.15 | |

The mean serum Hb level is not showing any specific association with group of the donors. As in all three groups values are not significantly different. (Table 3)

Table 4: Group-wise mean serum ferritin level of donors.

| Groups | Mean | SD |
|---|---|---|
| Group 1(First time donor) (n=44) | 55.11 | 24.46 |
| Group 2 (repeated donor) (n=125) | 34.07 | 21.30 |
| Group 3 (regular donor) (n=42) | 26.20 | 24.27 |
| P | <0.0001 | |

The mean serum ferritin level decreased from group 1 to group 3. The number of donations is inversely related to serum ferritin level according to observation. (Table 4).

Table 5: Association of the number of blood donation and serum ferritin level.

| Number of blood donation | Serum ferritin level(ng/ml) | p |
|---|---|---|
| ≤10 (n=101) | 54.05 ± 23.03 | <0.00001 |
| 11-50 (n=92) | 21.22 ± 13.01 | |
| 51-100 (n=14) | 21.77 ± 12.08 | |
| >100 (n=04) | 16.95 ± 10.07 | |

The mean serum ferritin level decreased as the number of blood donations increased. As the number of donations is increased from less than 10 to more than 100 a significant decrease in Hb levels is found. (Table 5)

Table 6: Association of Gender and serum ferritin level.

| Gender | Serum ferritin level(ng/ml) | p |
|---|---|---|
| Male (n=179) | 38.63 ± 25.35 | 0.01 |
| Female (n=32) | 27.16 ± 17.30 | |

Mean serum ferritin level was reduced more among female donors than the males. (Table 6)

**Discussion**

In this cross-sectional study, we studied blood donors who are coming to tertiary care hospital blood bank as regular donors and also who donated blood for the first time. Serum ferritin levels were calculated as an iron store indicator of the body. Female donors are also evaluated for their iron stores. Serum ferritin of both regular first-time donors was compared. We have also

included regular blood donors who have donated more than fifty times in their lifetime.

The mean serum ferritin values of first-time female donors are relatively lower as compared to first-time male donors. This may be because of the high-calorie intake of males as compared with females. The differences we have observed between male and female first time donors can partly be explained by the effect of the menstrual cycle on iron stores. After menopause, this additional iron loss is no longer present and women's ferritin levels increase 6Our study also showed a higher number of iron-deficient female donors compared to male donors. This was seen both in the first time and by regular blood donors.

The mean serum ferritin of both the male and female was found to be at the lower side as the number of donations increased. Multiple studies have found that an increase in the number of donations results in decreased iron stores, even though hemoglobin levels remain above the threshold for donation.[6,7] Majority of male donors have adequate iron stores at the first donation; however, these were less as compared to their Western counterparts as was shown in a study done by histochemical quantitation of iron stores.8 There was a significant inverse correlation of the frequency of blood donations with the serum ferritin. 1,9 The reason for iron deficiency in donors with repeated donations is that the iron demands increase with the number of annual blood donations.10 Even though the absorption of nutritional iron among donors is much more efficient than among non-donors, a donation frequency of 4-5 units per year cannot be compensated by iron absorption and results in an iron deficiency. [9,10,11] As the number of donations increased the number of donors with deficient iron stores also increased. This can be concluded by lower ferritin values in regular donors with respect to first-time donor. These results are similar to those reported by other authors. [6,12,13]

Table 7:

| Name of study | Mean age(yr) | Range(yr) | n |
|---|---|---|---|
| Present study | 32.2 | 18-65 | 211 |
| Salvin et al [14] | 42.5 | 16-77 | 3049 |
| Abdullah SM[18] | 29.2 | 19-50 | 182 |
| VHANDA et al[15] | 23 | 19-27 | 190 |

In the present study total of 211 donors were selected and were divided into age groups (Table 1) at ten years interval and the most common age group was found to be 21-30 yrs, which includes 39.80% of donors with a mean age of 32.2. Our study correlates with the study of Abdullah SM where the mean age was found to be 29.2 years.

Table 8

| Study | Male | Female |
|---|---|---|
| Present study | 84.83% | 15.17% |
| Mittal et al[16] | 81% | 19% |
| Deepa et al[17] | 88.2% | 11.8% |
| VHANDA et al [15] | 57.36% | 42.64% |
| Salvin et al [14] | 52.18% | 47.82% |

In the present study, (Table 2) the majority, 179 (84. 83%) donors were males and 32 (15.17%) were females. Our study correlates with the study of Mittal et al and Deepa et al where in most of the donors were males (>80%).

Table 9:

| Study | Mean weight(kg) | Range |
|---|---|---|
| Present study | 68.1 | 50-124 |
| Salvin et al [14] | 80.2 | 45-163 |

Remove weight In the present study, the majority i.e. 71 (33.65%) donors had blood Hb levels of 13.1-14 gm/dl followed by 52 (24.64%) had 12-13 gm/dl, 51 (24.17%) had 14.1-15 gm/dl, 27 (12.80%) had 15.1-16 gm/dl, 08 (3.79%) had 16.1-17 gm/dl and 02 (0.95%) had 17.1-18 gm/dl. The mean blood Hb level of the blood donors was

14.0 + 1.1 gm/dl. Our study correlates with the study of Deepa DG et al and Salvin et al.

Table 10:

| Study | Avg hb(g/dl) | Range |
|---|---|---|
| Present study | 14.0 g/dl | 12-17.8 |
| Deepa DG et al [17] | 13.94 | 12.5-17.1 |
| Salvin et al [14] | 14.1 | 9.2-18.9 |

In the present study, (Table 3) majority i.e., 71 (33.65%) donors had blood Hb level of 13.1-14 gm/dl followed by 52 (24.64%) had 12-13 gm/dl, 51 (24.17%) had 14.1-15 gm/dl, 27 (12.80%) had 15.1-16 gm/dl, 08 (3.79%) had 16.1-17 gm/dl and 02 (0.95%) had 17.1-18 gm/dl. The mean blood Hb level of the blood donors was 14.0 + 1.1 gm/dl. Our study correlates with the study of Deepa DG et al and Salvin et al.

Table 11:

| Study for age at first donation | Mean(yr) | Range |
|---|---|---|
| Present study | 22.5 | 18-54 |
| Abdullah SM [18] | 26 | 19-35 |
| Mittal et al [16] | 23.6 | 18-50 |

No need age In the present study, among majority i.e. 100 (47.39%) of the donors age at first donation was 21-30 years followed by 99 (46.92%) had 18-20 years, 09 (4.27%) had 31-40 years, 03 (1.42%) had >40 years. Mean age at first donation of the blood donors was 22.5 + 5.3 years. Our study correlates with study of Abdullah SM and Mittal et al.

**Conclusion**

➢ From our results, we conclude that repeat donors have considerably lower ferritin levels and smaller differences between sexes in comparison to first-time donors.

➢ This study shows that there is a high prevalence of reduced iron stores, especially among regular blood donors, despite these donors being eligible to give blood according to the current guidelines.

➢ The use of parameters that reflect iron status more accurately (serum iron concentration and ferritin level) would ensure a safer blood donation process for donors.

➢ Hemoglobin estimation alone may not be enough to evaluate donor safety prior to phlebotomy. In our country, the iron stores in females are low, especially in the reproductive age group. Hence, serum ferritin evaluation needs to be included in the testing of first-time female donors for donor safety.

➢ Alternative suitable point-of-care platforms for the measurement of iron stores, precluding real-time ferritin measurement.

➢ The development of such tests could be of immense benefit for optimal targeting of iron deficiency control strategies.

**Reference**

1. Finch CA, Cook JD, Labbe RF, Culala M. Effect of blood donation on iron stores as evaluated by serum ferritin. Blood. 1977 Sep; 50(3):441–7.

2. Kiss JE, Birch RJ, Steele WR, Wright DJ, Cable RG. Quantification of body iron and iron absorption in the REDS-II Donor Iron Status Evaluation (RISE) study. Transfusion. 2017;57(7): 1656–64.

3. Milman N, Sondergard M. Iron stores in male donors evaluated by serum ferritin. Transfusion 1984; 24: 464-8.

4. Alvarez-Ossorio L, Kirchner H, Kluter H, Schlenke P. Low ferritin levels indicate the need for iron supplementation: strategy to minimize iron-depletion in regular blood donors. Transfus Med 2000; 10: 107-12.

5. Akarsu S, Kilic M, Yilmaz E, Aydin M, Taskin E, Aygun AD. Frequency of hypo ferritin Mia, iron deficiency and iron deficiency anemia in outpatients. Acta Hae matol 2006;116: 4

6. Milman N, Kirchhoff M. Influence of blood donation on iron stores assessed by serum ferritin and haemoglobin in a population survey of 1433 Danish males. Eur J Hae matol 1991; 47:134-9.

7. Di Angel Antonio E, Thompson SG, Kaptoge S, Moore C, Walker M, Armitage J, et al. Efficiency and safety of varying the frequency of whole blood donation (INTERVAL): a randomised trial of 45 000 donors. Lancet. 2017; 390 (10110): 2360–71

8. Banerji L, Sood SK, Ramalin gaswami V. Geo graphic pathology of iron deficiency with special reference to India I. Histochemical quantitation of iron stores in population groups. Am J Clin Nutr 1968; 21: 1139-48

9. Cannado RD, Chiat tone CS, Alonso FF, Langhi Junior DM, Alves, Rde C. Iron deficiency in blood donors. Sao Paulo Med J 2001; 119:132-4.

10. Simon TL. Iron, iron everywhere but not enough to donate. Transfusion 2002;42(6):664- 5. https:// doi.org/ 10.1046/ j.1537-2995. 2002. 00121. x; PMid: 12147015

11. Garry PJ, Koehler KM, Simon TL. Iron stores and iron absorption: effects of repeated blood donations. Am J Clin Nutr 1995; 62: 611-20.

12. Norashikin J, Roshan TM, Ros line H, Zaidah AW, Suhair AA, Rapiaah M. A study of serum ferritin levels among male blood donors in Hospital University sains Malaysia. Southeast Asian J Trop Med Public Health 2006; 37:370-3

13. Javad Zadeh Shah Shahani H, Attar M, Taher Yavari M. A study of the prevalence of iron deficiency and its related factors in blood donors of Yazd, Iran, 2003. Transfus Med 2005; 15: 287-93.

14. Salvin HE, Pasricha SR, Marks DC, Speedy J. Iron deficiency in blood donors: a national cross-sectional study. Transfusion. 2014 Oct; 54 (10): 24 34-44. doi: 10.1111/trf.12647. Epub 2014 Apr 17. PMID: 24738792.

15. Vhanda D, Chinowaita F, Nkomo S, Timire C, Kouamou V. Effects of repeated blood donation on iron status of blood donors in Zimbabwe: A cross-sectional study. Health Sci Rep. 2021 Nov 2;4 (4): e426. doi: 10. 1002/ hsr2.426. PMID: 3475 4947; PMCID: PMC 856 2310.

16. Mittal R, Marwaha N, Basu S, Mohan H, Ravikumar A. Evaluation of iron stores in blood donors by serum ferritin. Indian Journal of Med Res. 2006;124(6):641-6. PMid:17287551

17. G. DD, P. A, Hamsavardhini S, S. T. R. A study of serum ferritin levels among voluntary blood donors. Int J Res Med Sci [Internet]. 2017 Nov. 25 [cited 2023 Jan. 24]; 5 (12):5322- 9. Available from: https:// www. msj online. org/ index. php/ijrms/article/view/4095

18. Abdullah SM. The effect of repeated blood donations on the iron status of male Saudi blood donors. Blood Transfus. 2011 Apr; 9(2):167–7