

## Original Research Article

**A Study of Iron Status Among Regular Voluntary Blood Donors at a Tertiary Care Centre in Western Part of Rajasthan, India**Manoj Saini<sup>1</sup>, Dev Raj Arya<sup>2</sup>, NL Mahawer<sup>3</sup>, Arun Bharti<sup>4</sup>, Prem Kumar<sup>5</sup><sup>1</sup>Resident, Department of Immunohematology & Transfusion Medicine, Sardar Patel Medical College & Associated Group of Hospitals, Bikaner, Rajasthan, India.<sup>2</sup>Professor, Department of Immunohematology & Transfusion Medicine, Sardar Patel Medical College & Associated Group of Hospitals, Bikaner, Rajasthan, India.<sup>3</sup> Professor, Department of Immunohematology & Transfusion Medicine, Sardar Patel Medical College & Associated Group of Hospitals, Bikaner, Rajasthan, India.<sup>4</sup>Associate Professor, Department of Immunohematology & Transfusion Medicine, Sardar Patel Medical College & Associated Group of Hospitals, Bikaner, Rajasthan, India.<sup>5</sup>Resident, Department of Immunohematology & Transfusion Medicine, Sardar Patel Medical College & Associated Group of Hospitals, Bikaner, Rajasthan, India.

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**Abstract**

**Introduction** Regular blood donation can lead to pre-clinical iron deficiency as well as iron deficiency anemia. Estimation of haemoglobin and hematocrit levels alone in voluntary blood donors may not be adequate. Study was done using a combination of hematological and iron status parameters (serum ferritin). **Methodology:** A cross sectional study consisted of 500 blood donors who donated for the first time (control group n=100) and regular blood donors (test group n=400). Pre-donation haemoglobin assessment was done by hemo-cue method. Venous whole blood was drawn before donation into an EDTA anti-coagulated tube for CBC and plain tube for estimation of serum ferritin by ELISA method. The regular blood donors were divided into four groups, according to the total number of previous donations they had given. Group I (donated 4-5 times), Group II (donated 6-10 times), Group III (donated 11-20 times) and group IV (donated >20 times). **Results:** First time donors (n=100) had higher mean serum ferritin levels than those in repeat donors (n=400). 9.4% (47) of blood donors had depleted iron stores (serum ferritin 15-20 µg/L) and 27% (135) of donors had deficient iron stores (serum ferritin < 15 µg/L). Serum ferritin levels were markedly reduced in donors who donated >20 times and within 3-5 months of last donation. Prevalence of iron deficiency significantly increased with regular blood donation. **Conclusion** This study shows a significant correlation between the frequency of donations and decreased iron stores (ferritin). It is concluded that a high prevalence of iron deficiency is present among regular blood donors. Iron supplementation needs to be considered in regular, repeat voluntary blood donors with iron deficiency.

**Keywords:** Iron Status, Blood Donors, Haemoglobin, Serum Ferritin.

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**Introduction**

Blood globally represents life itself, as the element of divine life that functions within the human body. Blood is life-giving. Blood is sometimes even seen as a synonym for life. Blood is a fluid connective tissue that flows in the vessels of all human beings, with its circulation in the body, it brings passion, vita and life to cells and tissues. This red vital liquid forms about 7% of human body weight. Blood donors are healthy subjects who donate their whole blood or

blood components[1]. A Regular Voluntary Non-remunerated Blood Donor is the one who has donated at least three times, the last donation being within the previous year, and continues to donate regularly at least once per year[2]. In India, according to the Drugs and Cosmetic Act, 1940, for blood donation, the minimum acceptable haemoglobin is 12.5g/dl. Donors are permitted to donate with a three-month gap between subsequent donations. In one complete whole blood donation (450 ml), almost 250 mg of iron is moved out of the body[3]. Regular donation may be one of the important causes of iron loss in blood donors. Bleeding (donation) results in movement of iron from body stores[4]. Iron deficiency is often observed in long-term regular blood donors[5]. Screening for hemoglobin concentration (Hb) is a conventional part of the donor selection process, both in order to assure adequate quality of red cell concentrates collected and to safeguard the potential donor's health[6]. Considering donors deferred for low Hb constitutes a

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significant percentage of the total donor population. Maintenance of the blood donation chain requires monitoring and constant care of donors. Since the only disadvantage known as blood donation is the potential risk of iron deficiency. Currently, iron deficiency is one of the temporary limiting factors of blood donation in the world. If the blood donation continued without compensation for the wasted iron, it can cause iron depletion, iron store deficiency and, in advanced stages, iron deficiency anemia. Donors can be presented as low-level hemoglobin in the blood donation screening. This is one of the main causes of temporary blood donation deferral. According to WHO, blood donation by 1% of the population is generally taken as the minimum need to meet a nation's basic requirements for blood, while the requirements are higher in countries with more advanced health care systems[7]. However, there is no evidentiary support or accessible statistical model to substantiate this hypothesis. As per the above norm, India's demand for blood is around 13.1 million blood units (1% of the 1.3 billion populations in 2017). In 2017, the annual collection of blood in India was 11,094,145 (11 million)[8]. At our center, total whole blood collection during the year 2020 (from 1<sup>st</sup> January to 31<sup>st</sup> December) was 27450 units. Out of these, 25504 units were collected from voluntary donors and 1946 units were from replacement donors. The goal of this study is to evaluate iron status, specifically body iron stores, through additional laboratory examinations. It is concerning to know if iron deficiency could be one of the possible reasons for the decrease in statistics of blood donation. Considering all these reasons and having a huge pool of repeat voluntary non remunerated blood donors, we sought out to conduct this study. Our primary aim is to understand the effect of repeated blood donations on body iron stores in regular blood donors.

#### Materials and Methods

This cross-sectional study was performed between January 2020 and December 2020. During the above period, a total of 500 healthy blood donors (including male and female, voluntary, first time and repeat donors) aged between 18 and 65 years were selected by random sampling method, who donated blood at our blood bank representing the healthy population of western Rajasthan.

The selected donors were asked specific questions as per the donor questionnaire. The proposal for this study was approved by the Departmental Ethics Committee of Immuno-Haematology &

Transfusion Medicine Sardar Patel Medical College & Associated Group of Hospitals, Bikaner, Rajasthan. Written consent for blood donation and blood testing was taken from each donor. Eligible donors (both male and female between the ages of 18 and 65) were divided into two groups: the control group, which consisted of donors donating blood for the first time, and the test group, which consisted of donors who had donated one or more times in the previous year and had donated at least three times. The test group was again sub divided into subgroups which included those who have donated up to 4-5 times, 6 to 10 times, 11 to 20 times, and more than 20 donations. Pre-donation hemoglobin was estimated using the Haemocue method.

#### Collection of Sample

Just before blood donation, 07 ml venous blood sample was collected and divided 02ml into an anticoagulated test tube containing EDTA for determination of hemoglobin (Hb), hematocrit (Hct) MCHC, MCV, MCH, TRBC and RDW, and 05 ml in plain tube for estimation of serum Ferritin. Following collection, CBC was performed by a three-part hematology analyzer on blood samples collected into EDTA tube and plain tube samples used for estimation of serum ferritin concentrations by the ELISA method. Data thus collected was compared by entering into excel sheet and primer software was analyzed with the help of appropriate descriptive and analytical statistics and tests of significance. Correlation between ferritin levels and different variables were tested by the Pearson correlation coefficient.  $p < 0.05$  was considered as statistically significant. In this study, iron status is classified as (a) depleted, when serum ferritin (SF) value is  $< 15\text{ng/ml}$ ; (b) reduced, when value ranges between  $15\text{-}20\text{ng/ml}$ ; (c) normal value between  $20\text{-}300\text{ng/ml}$ . Iron deficiency anemia is considered present when SF is  $< 15\text{ng/ml}$ .

#### Results

500 regular blood donors between 18-65 years were included in the study. Donors were divided into two groups according to the number of donations. The blood donors in the control group ( $n = 100$ ) were first time donors with no previous history of donation. The donors in the test group ( $n = 400$ ) had donated blood three times in the past. In our study, a total of 500 donors were selected on a random basis. Out of 500, only 2 were females and the rest 498 were males.

**Table 1: Sociodemographic Profile of Study Population (n=500)**

Sr. no/ Socio demographic profile.	Parameters	Control group	Test group
Food habit	Vegeterian	76	283
	Non-Vegeterian	24	117
Locality	Rural	55	86
	Urban	45	314
Occupation	Student	32	61
	Private Job	52	288
	Govt Job	16	51
Education	UG	33	206
	PG	12	47
	10+2 std	28	82
	UP TP 10 <sup>th</sup> std	27	65

**Table 2: Distribution Of Donors On Basis Of Serum Ferritin in ng/ml (n=500)**

S.Ferritin in ng/ml	<15	≥15	TOTAL
Control Group	17	83	100
Test Group	118	282	400
Total	135(27%)	365(73%)	500

Chi sq value =6.35 df = 1, p=0.0117

**Table 3: Distribution Of Donors on Basis of Food Habit and S.Ferritin (<15 ng/ml) (n=135)**

Food Habit	Non-Veg	Veg	Donors (having SF <15)
Control Group	6	11	17
Test Group	32	86	118
Total	38(28.14%)	97(71.85%)	135

Chi sq value =8.76 df =1 p=0.0031

**Table 4: Distribution of Donors on Basis of Time Since Last Donation and S. Ferritin (<15ng/ml) IN TEST GROUP(n=400)**

Time Since Last Donation	Total No of Donors	No of Donors Having Sf<15	Percentage in Respective Group
≤5 months	40	18	18/40=(45%)
6-8 months	210	59	59/210=(28%)
9-12 months	150	41	41/150=(27%)
Total	400	118	118/400(29.5%)

Chi sq value =6.087, df = 2, p=0.0477

**Table 5: Comparison of Different Parameters in Control and Test Group**

Parameters	Control Group (N=100)	Test Group (N=400)	P value
Age in yrs	29.74±8.89	30.67±7.05	0.2649
Hb gm/dl	14.02±0.83	13.63±0.87	0.0001
HCT %	40.73±2.87	39.87±3.23	0.0153
MCV fl	89.6±7.80	87.76±6.99	0.0180
MCHC	35.17±1.45	34.28±2.16	0.0001
MCH pg	31.89±3.37	30.03±3.22	0.0001
RDW %	13.9±1.23	14.90±1.83	0.0001
SERUM FERRITIN ng/ml	73.8±64.49	58.08±64.76	0.0303

## Discussion

Although several studies have indicated that repeated blood donation induces iron depletion and iron deficiency, all blood centers still test only hemoglobin as an indicator for selecting the donors[9].

The present study, which was done by testing various parameters such as hemoglobin, RBC indices and serum ferritin level, showed the importance of measuring the iron store. The potential for an individual donor to give blood without developing iron-deficiency anaemia is dependent on many factors, such as differences in nutritional iron intake, the prevalence of iron deficiency in the particular population, menstrual iron loss in females, the frequency of blood donation, the use of supplemental iron, as well as the capacity to absorb iron[10,11]. The present study has a maximum number of donors in the age group of 21-30 yrs, which is also the maximum number of young populations of any country. These donors are young, free from diseases and determination to do something for society. Vijatha et al[12], Tailor et al, Deepadevi et al[14], Romilla et al[9] and Akanmu et al[15] has similar age group population, while Reddy et al[16], Nadarajan et al[17] and Boulahariss et al[18] have different population age groups of 31-40 yrs. In our study, we found that the serum ferritin decreases with increased frequency of total donation. Similar results were also found in studies conducted by Tailor et al[13], Reddy K et al, Vijatha T et al[12], Deepadevi et al, Nadarajan et al, Saleh M. Abdullah et al[19]. In contrast, Romilla et al[9] found that the frequency of donations per year was more predictive of decreased iron stores, rather than the number of lifetime donations. Jayantilal tailor et al[13] found that serum ferritin was markedly reduced in donors > 20-time donation frequency and serum ferritin was markedly reduced with last donation within 3-5 months. In our study, the mean value of SF in fresh donors was 73.80 and the mean value of SF in regular donors was 58.08 ng/ml. Maximum studies have the same value in which there are significant decreases in SF levels in regular donors.

On comparing the stages of iron deficiency. It was observed that 9.4% of the studied population (n=500) was iron deficient, with SF ranging from 15-20 ng/ml. This 9.4% population is composed of the fresh population (2.4%) and the regular population (6.6%). While

27% of the studied population having a ferritin level of less than 15 means iron depleted stage, it is a significant valuable and alarming situation in the donor pool. Out of 27%, fresh donors consist of 3.4% and regular donors consist of 23.6%. If these donors are not informed about their iron deficiency, they will quickly become anemic and deferred due to low haemoglobin levels. On studying the CBC parameters, it was observed that there is a gradual decrease in all the parameters of CBC like HB, HCT, MCV, MCH, MCHC and RDW in regular donors compared to fresh donors. Similar finding were also reported by Vijatha et al[12], Tailor et al[13], Okpokam et al<sup>20</sup> and Reddy et al[16] but in contrast to studies of Deepa et al and Nadarajan et al[17]. We found a significant association between dietary history and serum ferritin levels. Many of our donors stated that they consume non-vegetarian food once or twice a week. similar to findings in a study by Deepadevi et al This is in contrast to the study by Romilla Mittal et al[9] who found no difference in the iron profile of vegetarians and non-vegetarian. However, Richard et al[21] and Leggett et al[22] showed that ferritin concentration was related to the amount of meat consumed in the diet, with vegetarians having lower concentrations of serum ferritin.

## Conclusion

Our study found that regular blood donors had low iron stores (decreased serum ferritin seen in 27% of donors), despite these donors being eligible to give blood according to the current guidelines (haemoglobin > 12.5g/dL). Using the current guidelines (Hb > 12.5g/dL) for donation, donors' true iron status is not reflected. Serum ferritin along with CBC parameters reflect the true iron status more accurately, measuring serum ferritin in addition to Hb will protect the donors and ensure safer blood donation. Measurement of serum ferritin should be recommended when more than one donation is given per year and donors who donate more than once a year should receive iron supplements.

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