Section: Pathology

Original Research Article

IMPACT OF REGULAR BLOOD DONATIONS ON RED CELL PARAMETERS: A COMPARATIVE STUDY OF FIRST-TIME AND REGULAR DONORS

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ABSTRACT

Background: Blood donation is a critical component of healthcare systems worldwide, providing life-saving resources for various medical procedures and emergencies. However, the impact of repeated blood donations on donor's hematological parameters, particularly red cell indices, remains a subject of ongoing research and concern. This study aims to investigate the differences in red cell parameters between first-time and repeat blood donors.

Materials and Methods: A total of 200 voluntary blood donors, aged 19 to 54 years, were categorized based on their lifetime blood donations into five groups: Group 1 (1-5 donations), Group 2 (6-10 donations), Group 3 (11-20 donations), Group 4 (>20 donations), and Group 5 (regular donors deferred due to low hemoglobin). The study evaluated hemoglobin (Hb), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), hematocrit (HCT), and serum ferritin levels across these groups.

Results: Results indicated no significant differences in mean Hb, MCV, MCH, and MCHC levels between the groups, aligning with findings from previous studies by Norashikin et al., Adediran et al., and Alexander et al. However, the mean serum ferritin levels showed statistically significant differences, with Group 1 having 82.37 ng/mL, Group 2 with 118.25 ng/mL, Group 3 with 124.31 ng/mL, Group 4 with 106.11 ng/mL, and Group 5 with 58.09 ng/mL. Additionally, 40% of donors in Group 4 and 36.6% in Group 5 had reduced body iron stores, compared to 16.1% in Group 1.

Conclusion: The study highlights the effects of repeated blood donations on red cell parameters by comparing first-time and regular donors. The data indicate no significant differences in overall hemoglobin levels or red cell indices like MCV, MCH, and MCHC between these groups. Therefore, regular monitoring of iron stores and appropriate iron supplementation for donors are recommended to prevent iron deficiency.

Keywords: Regular blood donation, red cell parameters, subclinical iron deficiency.

INTRODUCTION

Blood donation is a critical component of healthcare systems worldwide, providing life-saving resources for various medical procedures and emergencies. However, the impact of repeated blood donations on donor's hematological parameters, particularly red cell indices, remains a subject of ongoing research and concern. This study aims to investigate the differences in red cell parameters between first-time and repeat blood donors, with a focus on hemoglobin (Hb), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH),

mean corpuscular hemoglobin concentration (MCHC), hematocrit (HCT), and serum ferritin levels.

Previous studies have explored the effects of repeated blood donations on donor iron status and hematological parameters. However, the results have been inconsistent, necessitating further investigation. Understanding these effects is crucial for maintaining donor health and ensuring the quality of donated blood. This study seeks to contribute to the existing body of knowledge by comparing red cell parameters across different donor groups based on their lifetime donation frequency.

The findings of this research have important implications for blood donation practices, donor management, and the development of strategies to prevent iron deficiency among regular donors. By examining the relationship between donation frequency and red cell parameters, this study aims to provide valuable insights that can inform donor screening protocols and iron supplementation recommendations.

MATERIALS AND METHODS

Study Design and Participants

This descriptive study involved a total of 200 voluntary blood donors, aged 19 to 54 years. Participants were categorized into five groups based on their lifetime blood donations:

- Group 1: 1-5 donations
- Group 2: 6-10 donations
- Group 3: 11-20 donations
- Group 4: >20 donations
- Group 5: Regular donors deferred due to low hemoglobin

Data Collection

For each participant, the following red cell parameters were measured:

1. Hemoglobin (Hb)
2. Mean corpuscular volume (MCV)
3. Mean corpuscular hemoglobin (MCH)
4. Mean corpuscular hemoglobin concentration (MCHC)
5. Hematocrit (HCT)
6. Serum ferritin levels

Blood samples were collected and analyzed using standard laboratory techniques. Serum ferritin levels were measured to assess iron stores in the participants.

Data Analysis

Statistical analysis was performed to compare the mean values of Hb, MCV, MCH, MCHC, HCT, and serum ferritin levels across the five groups. Statistical analyses were performed using IBM Corp. Released in 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp. Additionally, the prevalence of reduced body iron stores (defined by serum ferritin levels) was calculated for each group.

Ethical Considerations

The study was conducted in accordance with ethical guidelines for human subject research. Informed consent was obtained from all participants, and confidentiality of personal information was maintained throughout the study. Ethical committee approval for the study was taken from the Institutional Ethics Committee of Kempegowda Institute of Medical Sciences, Bangalore, with IEC number KIMS/IEC/D099/2019.

RESULTS

A total of 200 voluntary blood donors were included in the study.
The donors were in between 19 and 54 years of age.

Table 1: Distribution of study subjects based on total number of life time blood donations

Distribution of study subjects based on total number of life time blood donations			
Variable	**Category**	**n**	**%**
Groups	Group 1	87	43.5%
	Group 2	62	31.0%
	Group 3	16	8.0%
	Group 4	5	2.5%
	Group 5	30	15.0%

Note: Group 1 – Total Life time blood donations= 1-5 times, Group 2: 6-10 times, Group 3: 11-20 times, Group 4: > 20 times & Group 5: (regular donor deferred in current donation due to low Hb [< 12 gm % Hb]

Based on the total number of lifetime donations, 43% donors were in group 1 (n = 87), Group 2 had 62% (n=62), Group 3 had 8% (n=16), Group 4 had 2.5% (n=5), Group 5 had 15% (n=30).

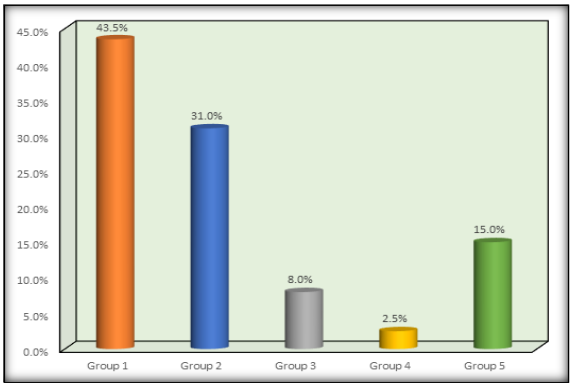

Figure 1: Distribution of study subjects based on total number of life time blood donations.

Table 2: Comparison of mean Haemoglobin levels between 5 groups

Comparison of mean Haemoglobin levels between 5 groups using One-way ANOVA Test							
Parameter	**Groups**	**N**	**Mean**	**SD**	**Min**	**Max**	**p-value**
Hb	Group 1	87	13.68	1.11	12	16.3	<0.001*
	Group 2	62	13.85	1.40	12	18.6	
	Group 3	16	13.66	1.09	12.1	15.9	
	Group 4	5	13.76	0.85	12.5	14.9	
	Group 5	30	10.81	0.99	7.7	11.9	

* - Statistically Significant

Table 3: Comparison of mean MCV levels between 5 groups

Comparison of mean MCV levels between 5 groups using One-way ANOVA Test							
Parameter	**Groups**	**N**	**Mean**	**SD**	**Min**	**Max**	**p-value**
MCV	Group 1	87	89.42	5.51	78.2	104.7	0.008*
	Group 2	62	91.77	7.56	77.3	111.6	
	Group 3	16	90.83	5.30	85.3	105.1	
	Group 4	5	90.38	1.88	88.1	92.4	
	Group 5	30	85.78	11.57	55.5	101.5	

* - Statistically Significant

Table 4: Comparison of mean MCH levels between 5 groups

Comparison of mean MCH levels between 5 groups using One-way ANOVA Test							
Parameter	**Groups**	**N**	**Mean**	**SD**	**Min**	**Max**	**p-value**
MCH	Group 1	87	29.28	2.21	22.7	35.4	<0.001*
	Group 2	62	30.12	2.49	25.4	36.8	
	Group 3	16	29.48	2.13	25.8	34.6	
	Group 4	5	28.92	1.80	26.2	30.5	
	Group 5	30	25.68	4.68	14.1	34.4	

* - Statistically Significant

Table 5: Comparison of mean MCHC levels between 5 groups

Comparison of mean MCHC levels between 5 groups using One-way ANOVA Test							
Parameter	**Groups**	**N**	**Mean**	**SD**	**Min**	**Max**	**p-value**
MCHC	Group 1	87	32.72	1.82	26.7	36.7	<0.001*
	Group 2	62	32.70	2.35	24	36.7	
	Group 3	16	32.51	2.14	26.8	35.9	
	Group 4	5	31.98	1.68	29.8	34.2	
	Group 5	30	29.69	2.48	25.4	34.2	

* - Statistically Significant

Table 6: Comparison of mean HCT levels between 5 groups

Comparison of mean HCT levels between 5 groups using One-way ANOVA Test							
Parameter	**Groups**	**N**	**Mean**	**SD**	**Min**	**Max**	**p-value**
HCT	Group 1	87	41.96	3.75	35.7	50.6	<0.001*
	Group 2	62	42.21	4.48	33.5	55.6	
	Group 3	16	42.17	3.59	36.5	48.4	
	Group 4	5	43.10	3.33	40.2	46.7	
	Group 5	30	36.54	2.97	27.4	44.1	

* - Statistically Significant

Table 7: Comparison of mean Serum Ferritin levels between 5 groups

Comparison of mean Serum Ferritin levels between 5 groups using Kruskal Wallis Test							
Parameter	**Groups**	**N**	**Mean**	**SD**	**Min**	**Max**	**p-value**
Serum Ferritin	Group 1	87	82.376	59.280	6.28	236.00	<0.001*
	Group 2	62	118.253	132.490	13.70	941.00	
	Group 3	16	124.310	79.520	45.42	336.00	
	Group 4	5	106.110	134.525	17.49	341.00	
	Group 5	30	58.095	66.796	1.66	296.00	

* - Statistically Significant

The mean serum ferritin level was 82.37 in Group 1, 118.25 in Group 2, 124.31 in Group 3, 106.11 in Group 4 and 58.09 in Group 5 which was statistically significant.

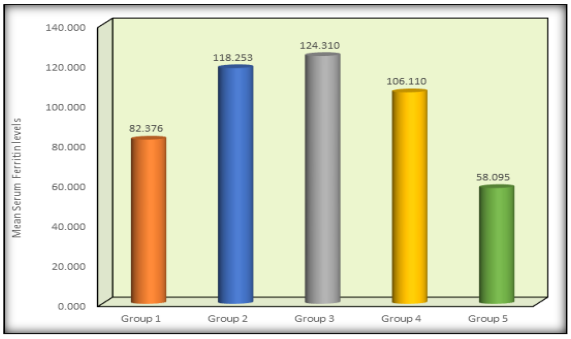

Figure 2: Mean Serum Ferritin levels between 5 groups

In our study, 40% of donors in group 4 and 36.6% of donors in group 5 had reduced body iron stores compared to 16.1% of donors in group 1. Across the groups, there is a presence of donors with varying degrees of iron deficiency, primarily reflected in Groups 1 and 4. Group 1 demonstrates a larger base of donors but with minimal movement into more severe stages, while Group 4, though smaller, shows a significant proportion facing initial iron deficiency. Groups 2 and 3 indicate healthier iron stores overall, with Group 3 having none classified as deficient.

DISCUSSIONS

SENSITIVITY OF HEMOGLOBIN AS INDICATOR OF IRON DEFICIENCY

All blood centrs have minimum Hb requirement for donation. In the present study, done in Kempegowda Institute of Medical Sciences Blood Centre, donors with Hb 12-17g% were included. However, there are studies showing that Hb measurement alone is inadequate to detect donors with iron deficiency anemia as they maybe in the early stages of iron deficiency. This results in accepting many iron depleted donors with normal Hb values.

In the present study, we noted that there was no significant difference in mean Hb between the groups. Norashikin et al, in a prospective study on male blood donors found that the sensitivity of Hb concentration as an indicator of iron deficiency in repeat donors was only 40%.[1] Adediran et al, in another study found that Hb in the study and control groups were not significantly different.[2] Alexander et al. did not observe significant correlation between the number of donations and Hb levels.[3] Reddy k et al noted that the mean Hb and Hct values were significantly lower in Group III in comparison to Group I.[4]

In our study we also found that the p value with regard to the number of donations within last year (frequency of donation) and haemoglobin levels were not a significant finding. This is similar to the study by Finch et al, Deepa DG et al, Abdulla S M and Nadarajan.[5,6,7,8] This is in contrast to study by Mahida V I et al who found gradual decrease in haemoglobin, as number of donation increased and observed significant correlation in donors donating 21-50 and >50 times.[9]

SENSITIVITY OF RED CELL INDICES AS INDICATOR OF IRON DEFICIENCY

In the present study, we did not observe any correlation between number of donations and MCV, MCH, MCHC values. Deepa D G et al, Reddy k et al and Thomas V et al did not observe any correlation between the number of donations and the MCV and MCH values.[6,10,11] Abdullah S M,[7] also found that MCV and MCH values when comparing all donor groups with each other were not statistically significant. This is in contrast to study by Mahida V I et al who found gradual decrease in MCV, MCH and RDW as number of donation increased and observed significant correlation in donors donating 21-50 and >50 times.[9] Alexander et al. and Tailor H J et al also found an association between reduced MCV and MCH levels and an increasing frequency of blood donation.[3,12]

In our study 9.5%, 2.5%, 3.5% donors were in stage 1, 2 and 3 iron deficiency respectively. Donors in stage 2 iron deficiency will be pushed to stage 3 on further donation without checking serum ferritin levels.

Table 8: Comparison of stages of iron deficiency in present study with other studies

	Stage 1 (reduced iron balance)	**Stage 2 serum ferritin <15 µg/L (iron deficiency erythropoiesis with normal Hb)**	**Stage 3 serum ferritin <15 µg/L (with Hb <12 g/dL)**
Our study	9.5%	2.5%	3.5%

Tailor H J et al [12]	6.76%	24.85%	10.83%
Reddy K et al [10]	9.8%	11.2%	4.8%
Thomas V et al [11]	12.3%	10%	-

CONCLUSION

This study decisively highlights the impact of repeated blood donations on red cell parameters by providing a clear comparison between first-time and regular donors. The data unequivocally show that while overall hemoglobin levels and other red cell indices such as MCV, MCH, and MCHC do not display significant differences across the groups, the variations in serum ferritin levels are striking and cannot be overlooked. With a significant percentage of donors exhibiting reduced body iron stores, it is imperative to implement routine assessments of iron status and to provide appropriate iron supplementation for those identified as at risk.

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