e-ISSN: 0975-5160, p-ISSN: 2820-2651

Available online on www.ijtpr.com

International Journal of Toxicological and Pharmacological Research 2023; 13(10); 461-464

Original Research Article

Examining Hematological and Biochemical Characteristics in Children Affected By Iron Deficiency Anemia

Anshul Kumar[1], Yogesh Chandra Sharma[2]

[1]Associate Professor, Department of Pathology, Krishna Mohan Medical College and Hospital, Mathura
[2]Assistant Professor, Department of Pathology, Krishna Mohan Medical College and Hospital, Mathura

Received: 25-07-2023 / Revised: 15-08-2023 / Accepted: 26-09-2023
Corresponding Author: Dr. Yogesh Chandra Sharma
Conflict of interest: Nil

Abstract

Background: Iron deficiency is especially common in expectant mothers and babies. While the frequency of iron deficiency in men is relatively high in adolescence and low throughout early adulthood, it increases with age in men. In women, the shortage typically occurs during the reproductive years. Both sexes have iron insufficiency equally often in infancy. It is often identified between the ages of six and twenty months; infants born preterm have a lower peak incidence at a younger age than infants born at term.

Material and Method: A cross-sectional investigation was carried out at the pathology department. The hospital ward's availability was taken into consideration when choosing the subjects. The hospital offers resources for the diagnosis, management, and surveillance of iron deficiency anemia. This study involved 150 individuals in total. There was no discernible bias towards any one ethnicity, religion, or social background. Two categories of people were included in the study: Group 1 contains 100 IDA Male and 50 IDA Female while Group 2 contains 30 control Male and 20 control Female.

Result: Results were considered to be statistically significant when the two-sided P value was less than 0.05 or ($P < 0.05$). ANOVA (analysis of variance) showed significant P value between mean platelet volume (MPV) in females (8.08 µm3) and males (7.59 µm3) ($P < 0.05$) in iron deficiency anemia patients. On the other hand, the value of white blood cells (WBC) in males (10946.08/cmm) was significantly higher than in females (9470.833/cmm), ($P < 0.05$).

Conclusion: This is due to long-term impacts on immunity, overall physical health, and mental and cognitive abilities. More recently, it has been proposed that iron deficiency and DNA damage are linked. According to this prospective study, iron deficiency anemia is among the most prevalent types of anemia, and in 30.61% of anemia patients, a decline in three biochemical parameters allowed for the diagnosis to be made.

Keywords: Hematological, Biochemical, Children and IDA.

Introduction

Iron deficiency anemia is caused by inadequate iron, as the name suggests. The human body cannot manufacture enough hemoglobin without enough iron, which is why iron deficiency anemia results in fatigue and dyspnea. The most common cause of iron deficiency anemia in the world is parasite infection brought on by roundworms, whipworms, and hookworms, which can induce intestinal bleeding that results in blood loss that is not noticed in the stool. These are particularly significant issues for developing kids. In most impoverished nations, anemia during pregnancy is a result of continuous blood loss from hookworms (where iron is lost) and malaria infections that kill red blood cells (although the iron is recycled). [1] The main factor contributing to iron deficiency anemia in developed nations is premenopausal women's blood loss during menstruation, which is not made up for by dietary or supplement intake. Not just in Bangladesh but globally as well, iron deficiency anemia continues to be the most common cause of anemia. The World Health Report states that 1,788,600 individuals worldwide suffer from iron deficiency anemia. Additionally, the most common illness in the world that causes morbidity is iron deficiency anemia. In Bangladesh, numerous surveys were carried out to determine the prevalence of iron deficiency. 114 healthy, affluent girls were the subjects of a study that showed 42% of the girls had iron levels that were below optimum and 24% of the girls had no iron stored at all. [2]

Only traces of marrow iron were detected in 4–7% of men, 70% of women aged 15–49, and 23% of women aged 50 and beyond in a Finnish study involving 85 men and 54 women. Serum ferritin

levels in a survey of 1105 Canadians revealed that approximately 25% of children, 30% of pregnant women, and 3% of males had significantly lower iron storage. In a study conducted by Looker AC [3], it was found that 9% of toddlers aged up to 2 years, 9% to 11% of adolescent girls, and women of child bearing age were found to be iron deficient. Of these, 3% and 2% to 5%, respectively, had iron deficiency anemia. Additionally, 1% of young men and teenage boys and 7% of males over 50 showed an iron deficit. In Pakistan, anemia affected 30% of adult females and 47% of children. [4] Iron deficiency is especially common in expectant mothers and babies. While the frequency of iron deficiency in men is relatively high in adolescence and low throughout early adulthood, it increases with age in men. In women, the shortage typically occurs during the reproductive years. Both sexes have iron insufficiency equally often in infancy. It is often identified between the ages of six and twenty months; infants born preterm have a lower peak incidence at a younger age than infants born at term. [5]

Material and Methods

A cross-sectional investigation was carried out at the pathology department. The hospital ward's availability was taken into consideration when choosing the subjects. The hospital offers resources for the diagnosis, management, and surveillance of iron deficiency anemia. This study involved 150 individuals in total. There was no discernible bias towards any one ethnicity, religion, or social background. Two categories of people were included in the study:

Group 1 contains 100 IDA Male and 50 IDA Female while Group 2 contains 30 control Male and 20 control Female.

Before the kids were enrolled in the study, their parents gave their informed consent. The parents received a thorough explanation of the process along with the assurance that their child's treatment would not be hampered in any way if they chose to remove them from the trial.

Inclusion Criteria

1. All cases of suspected iron deficiency anaemia belonging the age group of 18 yrs,
2. All the patients having haemoglobin less than 11 gm/dL.

Exclusion Criteria

1. Patients previously transfused with blood with-in 120 days,
2. Patients already on iron therapy.

Blood Samples: The antecubital or dorsal veins were used to venepuncture blood samples, which were then poured into dipotassium EDTA anticoagulant vials. After that, their instructors and parents/guardians gave their informed consent. Every haematological parameter was measured using automated techniques. Sufficient quality control protocols were implemented for every test operation to guarantee the dependability of the outcomes. In the laboratories for biochemistry and haematology, respectively, researches were conducted in the fields of biochemistry and haematology.

Serum Sample: Fill a test tube with entire blood and cover it. Red-toped tubes should be utilized if commercially available tubes are to be used. You can purchase these from Becton Dickinson (BD). Vacutainer is the trade name used by BD for the blood handling tubes. Once the whole blood has been collected, let it clot by keeping it undisturbed at room temperature. It normally takes fifteen to thirty minutes. Centrifuge the clot at 1,000–2,000 ×g for 10 minutes in a chilled centrifuge.

Results

Only when all three biochemical parameters—serum iron, serum ferritin, and % saturation of transferrin—were below normal for the sex was iron deficiency anemia diagnosed. Out of 490 individuals, 150 (30.61%) were found to have iron deficiency anemia based on these criteria.

Table 1: Comparison of biochemical parameters of IDA and control.

Biochemical Parameters	Control (Mean ± SD)	IDA (Mean±SD)
Serum Iron (g/dL)	77.69 ± 4.75	21.15 ± 3.35
Serum Ferritin (ng/mL)	176.89 ± 21.45	10.24 ± 2.56
% saturation of transferrin	26.67 ± 3.78	5.98 ± 1.43
TIBC (g/dL)	320.98 ± 28.99	398.79 ± 23.97

The mean value of serum iron in IDA was 21.15 ± 3.35 g/dL, which is markedly less than that in control. The mean total iron binding capacity was greater in IDA 398.79 ± 23.97 than in control. The mean percentage saturation of transferrin in IDA was found to be 5.98 ± 1.43% that is markedly less than control. The mean serum ferritin in IDA was 10.24 ± 2.56 ng/mL, which is less than control.

Table 2: Showing comparative hematological values for iron deficiency anemic males and females.

Parameters	Male (Mean ± SD)	Female (Mean ± SD)	P value
Haemoglobin (g/dL)	10.17 ± 1.19	10.58 ± 1.11	0.339
ESR (mm)	39.07 ± 27.40	37.71 ± 24.72	0.768
RBC (million/cmm)	4.33 ± 0.72	4.31 ±0.50	0.918
PCV	29.88 ± 3.75	30.78 ±3.28	0.589
MCV (fl)	64.75 ± 5.49	66.57 ± 6.78	0.584
MCH (pg)	24.00 ± 2.93	23.93 ± 2.59	0.87
MCHC (g/dL)	34.76 ± 1.43	34.86 ± 0.98	0.626
RDW %	13.10 ± 2.28	13.98 ± 2.08	0.485
MPV (μm^3)	7.59 ± 0.85	8.08 ± 0.82	0.001
Platelet (x1000/cmm)	345.67 ± 80.99	336.29 ± 82.57	0.567
WBC (/cmm)	10946.08 ± 3786.32	9470.83 ± 2969.49	0.011
Neutrophil (%)	49.32 ± 16.27	49.43 ± 17.50	0.97
Lymphocytes (%)	45.66 ± 15.98	45.85 ± 17.21	0.947
Eosinophil (%)	2.95 ± 1.08	2.48 ± 1.60	0.208
Monocytes (%)	2.13 ± 1.05	2.25 ± 1.05	0.052

The comparison of IDA hematological parameters in boys and girls is displayed in Table 2. Statistical analysis was carried out using Statistical Package for Social Sciences (SPSS) version 11.5, and an independent-sample t-test ($P < 0.05$) and one-way ANOVA test were used for comparison of hematological parameters. Results were considered to be statistically significant when the two-sided P value was less than 0.05 or ($P < 0.05$). ANOVA (analysis of variance) showed significant P value between mean platelet volume (MPV) in females (8.08 μm3) and males (7.59 μm3) ($P < 0.05$) in iron deficiency anemia patients. On the other hand, the value of white blood cells (WBC) in males (10946.08/cmm) was significantly higher than in females (9470.833/cmm), ($P < 0.05$).

Discussion

Out of the 150 IDA patients in our study (100 males and 50 females), 78% fell into the 0–2 age group, 11.3% into the 3–5 age group, 4.7% into the 6–10 age group, and 6% into the 11–18 age group. It should be mentioned that problems for mothers have lately been connected to increasing iron storage and iron supplements. On the other hand, our research revealed that the age group of 0–2 years, which comprises 78% of male and female participants, is the most usually affected by IDA, with a sex ratio of 2.12:1. Patients from the ward and medical OPD were the subjects of these observations. Furthermore, in our setting, hookworm infestation is more typical. Hookworm is the second most common parasitosis in Nepal, with an incidence ranging from 11% to 100%, according to several studies. This may be the likely cause of the previously mentioned discrepancy in the observations. The most affected classes were middle class (31%), high class (15%), and lower class (54%). These findings indicate that those with low incomes and low levels of education are primarily impacted. When it comes to clinical signs, individuals with IDA most frequently complained of weakness, diarrhea, loss of appetite, and focus issues. Furthermore, it is just as common in anemic people who did not have an iron deficiency. Additionally, among IDA and controls, early birth, pale skin, dyspepsia, and headaches were among the other problems that were nearly equally common. While they are indicative of anemia, IDA is not the only cause for concern. These findings are consistent with Elwood's earlier publications. [6] According to our observations, IDA's average MCV was 66.81 FL. In IDA, the average hemoglobin level was 10.41 gm/dL, the average MCH value was 23.97 pg, and the average MCHC value was 34.81%. These observations are similar to the report by Bainton [7], which showed mean MCV to be 74 fl, mean MCH to be 20 pg, mean MCHC to be 28%, and mean hemoglobin to be 7.6 gm/dL in patients with IDA.

The average serum iron level in the IDA group in this study was 21.15 ± 3.35 g/dL, considerably less than that of the control group (77.69 ± 4.75 g/dL). Our finding is very identical to the mean of a research done on elderly people, which was determined to be 22.7 g/dL. [8] The main drawback of measuring blood iron levels is its variability, which can be attributed to physiological as well as technical variables. For example, iron-contaminated glassware and reagents can cause contamination, however this has been significantly decreased with the use of disposable plastic equipment. Of the 100 male and 50 female IDA patients, 42% had improved total iron binding capacity (TIBC) according to the biochemical tests. The mean value of TIBC in IDA was 398.79 ± 23.97μg/dL, which was significantly higher than control group (320.98 ± 28.99 μg/dL). A research conducted on pediatric IDA patients revealed a mean TIBC of 413.6 μg/dL, which is in line with our findings. Iron deficiency anemia can have a normal or even reduced TIBC value, even though

an increased value suggests iron lack. [9] TIBC was therefore excluded from the list of the three biochemical parameters. Rather, we employed percentage saturation of transferrin in the current study, whose value does not overlap with normal values and whose values below 16% are associated with iron shortage and anemia of chronic conditions. [10] Values less than 5% are found only in iron deficiency. Statistical analysis was carried out using ($P < 0.05$); one-way ANOVA test was used for comparison of hematological parameters. ANOVA (analysis of variance) showed significant P value between mean platelet volume (MPV) in females (8.08 μm3) and males (7.59 μm3), ($P < 0.05$) in iron deficiency anemia patients. Besides, the value of white blood cells (WBC) in males (10946.08/cmm) was significantly higher than that in females (9470.833/cmm) ($P < 0.05$). Hematological and biochemical characteristics between IDA and the control group, as well as anemia from other disorders, were statistically significant, according to an ANOVA. It has also demonstrated how important TIBC is to the diagnosis of IDA. Anaemia with a drop in either two of the three biochemical measures was also shown by ANOVA to be associated with a possible iron deficit, whereas anemia with a decrease in just one of the three biochemical parameters did not. The public health system needs to place too much emphasis on this issue due to the accessibility and ease of treatment, as well as the need to educate people about nutrition. The foods that are good for their health and which ones to avoid are unknown to our people.

Conclusion

Worldwide, iron deficiency anemia in children is still regarded as a serious health issue. This is due to long-term impacts on immunity, overall physical health, and mental and cognitive abilities. More recently, it has been proposed that iron deficiency and DNA damage are linked. According to this prospective study, iron deficiency anemia is among the most prevalent types of anemia, and in 30.61% of anemia patients, a decline in three biochemical parameters allowed for the diagnosis to be made.

References

1. Fowler W. Chlorosis-an obituary. Annals of Medical History. 1936; 8:168–177.
2. Scott D. E., Pritchard J. A. Iron deficiency in healthy young college women. The Journal of the American Medical Association. 1967; 199 (12):897–900.
3. Looker A. C., Johnston C. C., Jr., Wahner H. W., Dunn W. L., Calvo M. S., Harris T. B., Heyse S. P., Lindsay R. L. Prevalence of low femoral bone density in older U.S. women from NHANES III. Journal of Bone and Mineral Research. 1995;10(5):796–802.
4. Looker A. C., Dallman P. R., Carroll M. D., Gunter E. W., Johnson C. L. Prevalence of iron deficiency in the United States. The Journal of the American Medical Association. 1997;277 (12):973–976.
5. Valberg L., Sorbie J., Ludwig J., Pelletier O. Serum ferritin and the iron status of Canadians . Canadian Medical Association Journal. 1976; 114(5):417–421.
6. Elwood P. C., Waters W. E., Greene W. J. W., Sweetnam P., Wood M. M. Symptoms and circulating haemoglobin level. Journal of Chronic Diseases. 1969;21(9-10):615–628.
7. Bainton D. F., Ullyot J. L., Farquhar M. G. The development of neutrophilic polymorphonuclear leukocytes in human bone marrow. The Journal of Experimental Medicine. 1971; 134(4):907–934.
8. Brittenham G. M. Disorders of iron metabolism: iron deficiency and overload. Hematology: Basic Principles and Practice. 2000; 3:39 7–428.
9. Lee J. H., Hahn J. S., Lee S. M., Kim J. H., Ko Y. W. Iron related indices in iron deficiency anemia of geriatric Korean patients. Yonsei Medical Journal. 1996;37(2):104–111.
10. Rai S. K., Kubo T., Nakanishi M., Sumi K., Shibata H., Matsuoka A., Shrestha H. G. Status of soil-transmitted helminthic infection in Nepal. The Journal of the Japanese Association for Infectious Diseases. 1994;68(5):625–630.