

Research Article

An Observational Study of Childhood Iron Deficiency Anemia and the Factors Affecting the Outcome of Oral Iron Therapy

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ABSTRACT

Aim: To assess the childhood iron deficiency anemia and the factors affecting the outcome of oral iron therapy

Materials and Methods: This hospital-based observational study was conducted in the Department of Paediatrics at... Hospital, over a period of six months. The study population included children aged 1-5 years attending the outpatient department (OPD), casualty, and inpatient department with symptoms suggestive of iron deficiency anemia (IDA). A total of 50 participants were included in the study.

Results: Successful correction of iron deficiency anemia was significantly associated with morning administration of iron therapy, intake on an empty stomach, and co-administration with lime/curd/orange, suggesting improved iron absorption. In contrast, night-time dosing, intake with food or tea/milk, gastrointestinal side effects, hospital admissions, low birth weight, and poor weight-for-height were associated with poorer treatment outcomes. These findings indicate that administration practices, dietary factors, and treatment-related side effects significantly influence the effectiveness of iron therapy.

Conclusion: Factors such as low socioeconomic status, low birth weight, inadequate feeding practices, pica, and parasitic infestation were associated with IDA. Treatment response was significantly influenced by proper iron administration practices and dietary factors, highlighting the importance of caregiver education and nutritional counseling for improving treatment outcomes.

Keywords: Iron Deficiency Anemia, Oral Iron Therapy, Outcome.

INTRODUCTION

Iron deficiency is the most common nutrient deficiency in the world and is a public health problem. According to the World Health Organization (WHO) report in 2008, 24.8% of the world's population is anemic, and iron deficiency (ID) is the cause of anemia in half of the cases. In developing countries, about 40%-50% of children under 5 years suffer from ID.¹ Iron deficiency is defined as a lack of iron in the body that does not prevent the production of hemoglobin, and ID anemia is defined as a decrease in the amount of hemoglobin due to ID. A positive iron balance is achieved in childhood with about 1 mg of iron intake per day. Since about 10% of dietary iron is absorbed, 8-10 mg of dietary iron should be consumed daily. Iron deficiency is most

common in infancy and early childhood and second most common in adolescence. Anemia is described as a decrease in hemoglobin, hematocrit, or red blood cell count. A hemoglobin value that differs by more than 2 standard values from that of children of the same age and gender is considered as anemia.^{2,3} While a hemoglobin value below 11 g/dL in children 6-59 months of age is considered as anemia, 11.5 g/dL in children 5-11 years of age, 12 g/dL in children 12-14 years of age and for women above 15 years of age, and 13 g/dL in men above 15 years of age can be accepted as lower limits for anemia. Causes of ID in children include inadequate dietary iron intake, which is the most common cause, as well as increased iron requirements, bleeding, and intestinal iron absorption

disorders.⁴ Iron is present in small amounts in both breast milk and cow's milk, but about 50% of the iron in breast milk is absorbed, whereas only 10% of the iron in cow's milk is absorbed. Excessive consumption of cow's milk leads to decreased absorption of other nutrients and iron-containing medications. Use of cow's milk during the initial year of life may also lead to ID anemia (IDA) through gastrointestinal occult/overt blood loss due to cow's milk protein-induced colitis.⁵ Iron stores are sufficient for the first 6-9 months of life in term infants.

As per Indian National Family Health Survey-5 (NFHS 2019-21), the prevalence of anemia has increased from 59% to 67% in the last five years. Anemia is still highly prevalent even with the existing National Anemia Control Programs and treatment guidelines. Multiple factors affect the absorption and metabolism of iron. Food items like meat, fish, lemon, and orange juice are enhancers of iron absorption while Tea, Phytates, and Polyphenols inhibit absorption.⁶ In-depth studies examining facilitators and barriers to oral iron therapy are scanty.

The present study was designed to study the various non-modifiable and modifiable factors that affect the outcome of oral iron therapy despite having good compliance.

MATERIALS AND METHODS

After obtaining clearance from institutional ethical committee, this hospital-based observational study was conducted in the Department of Paediatrics at... Hospital, over a period of six months. The study population included children aged 1–5 years attending the outpatient department (OPD), casualty, and inpatient department with symptoms suggestive of iron deficiency anemia (IDA). A total of 50 participants were included in the study.

Inclusion Criteria

- Children in the age group of 1 to 5 years coming to OPD, Casualty, and In-Patient departments, till the desired sample is achieved.
- Children whose parents or guardians give consent to participate in the study were included.

Exclusion Criteria

- Children in the age group less than 1 year and more than 5 years.
- Children whose parents or guardians did not give consent to participate in the study.

Participants with Iron Deficiency Anemia Who Were Not Eligible For Iron Therapy

Lymphoreticular malignancy-blasts in Peripheral smear, Haemolysis-Increased reticulocyte count, Pancytopenia, Congenital heart disease, Hb.

METHODOLOGY

After obtaining a detailed history and performing thorough clinical examination, all 50 enrolled children underwent investigations including complete blood count, serum ferritin, reticulocyte count, iron profile, and stool examination for occult blood and microscopy. Out of these, 30 children were diagnosed with iron deficiency anemia (Hb <11 g/dL and ferritin <12 ng/mL) and were assessed for eligibility to receive iron therapy. Among them, 25 eligible patients received elemental iron at a dose of 3 mg/kg/day in the form of ferrous sulphate syrup for a duration of 2 months, along with counseling regarding drug administration and possible side effects. Statistical analysis. Anemia resolved in 15 children, while 10 children showed no resolution, and factors affecting treatment outcome were subsequently assessed using a structured questionnaire.

Statistical Analysis

Data were collected using a structured questionnaire and entered into Microsoft Excel Home & Student 2019. Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) version 20.0. Chi-square test and Fisher's exact test were used to determine the association of various factors with iron deficiency anemia and factors affecting iron therapy. Paired *t*-test was applied to compare pre- and post-treatment haematological parameters. A *p* value of <0.05 was considered statistically significant.

RESULTS

The table shows that successful correction of iron deficiency anemia was significantly associated with morning administration of iron therapy, intake on an empty stomach, and consumption with lime/curd/orange, suggesting improved iron absorption. In contrast, children with non-corrected IDA more commonly received iron with food or tea/milk, had night-time dosing, and experienced higher rates of nausea/vomiting, loose stools, and hospital admission. Low birth weight and reduced weight-for-height also showed an association with poorer treatment outcomes.

These findings indicate that treatment practices, dietary factors, and gastrointestinal side effects play an important role in the response to iron therapy (Table 1).

The table 2 demonstrates that correction of iron deficiency anemia (IDA) RA1 significantly associated with morning administration of iron therapy, intake on an empty stomach, and administration with lime/curd/orange, which may improve iron absorption. In contrast, children with non-corrected IDA more frequently received iron with food or tea/milk,

had night-time dosing, and experienced higher rates of nausea/vomiting, loose stools, and hospital admissions. Low birth weight and poor weight-for-height also showed an association with treatment response. However, factors such as constipation, stomach pain, and dark stools did not show a significant association with treatment outcome. These findings suggest that timing of iron therapy, dietary practices, and treatment-related side effects significantly influence the effectiveness of iron supplementation.

Table 1: Factors Determining Iron Deficiency Anemia in Children

Parameters	IDA (n=30), n (%) / Mean±SD	Non-IDA (n=20), n (%) / Mean±SD	P value
Females	15 (50)	9 (45)	0.38
Socioeconomic status			<0.001
Lower	5 (17)	2 (10)	
Lower middle	10 (33)	3 (15)	
Upper middle	12 (40)	14 (70)	
Upper	3 (10)	1 (5)	
Birth weight, Mean ± SD	2.47 ± 0.48	2.31 ± 0.52	0.001
Exclusive breastfeeding, Yes	22 (73)	18 (90)	<0.001
Cow milk intake before 1 year, Yes	20 (67)	13 (65)	0.68
Daily calorie intake (%), Mean ± SD	82 ± 8	81 ± 7	0.15
Pica, Yes	9 (30)	2 (10)	<0.001
Blood in stools, Yes	5 (17)	1 (5)	<0.001
Worms in stool, Yes	7 (23)	3 (15)	0.006

Table 2: Factors Affecting Iron Therapy Outcome among Those Who Took Daily Iron Therapy

Parameters	IDA Corrected Yes (n=15), n (%)	IDA Not Corrected No (n=10), n (%)	P value
Low birth weight	5 (33)	5 (50)	0.053
Weight for height	1 (7)	2 (20)	0.024
Time of iron therapy			<0.001
Morning	14 (93)	7 (70)	
Afternoon	1 (7)	0 (0)	
Night	0 (0)	3 (30)	
Empty stomach	9 (60)	3 (30)	0.013
With food	1 (7)	7 (70)	<0.001
With tea/milk	2 (13)	5 (50)	<0.001
With lime/curd/orange	4 (27)	0 (0)	0.004
Nausea/vomiting	4 (27)	5 (50)	0.024
Constipation	2 (13)	2 (20)	0.75
Loose stools	1 (7)	4 (40)	<0.001
Stomach pain	2 (13)	2 (20)	0.77

Hospital admission	1 (7)	5 (50)	<0.001
Dark stools	6 (40)	4 (40)	0.80

DISCUSSION

Iron deficiency anemia (IDA) is the most common anemia worldwide. World Health Organization (WHO) estimates that close to two billion people, or 25% of the world's population, are anemic, and approximately half of them suffer from IDA.⁷ As per the National Family Health Survey-5 (2019-21), between 2015-16 and 2019-21, the prevalence of anemia among children aged 6-59 months increased from 59 percent to 67 percent and continued to be higher among rural children.⁸ This indicates the increasing burden of this disease on our country and the need for effective preventive and treatment strategies. Risk factors associated with a higher prevalence of IDA include low birth weight, high cow's milk intake, low intake of iron-rich complementary foods, and low socioeconomic status. A lot of attention has focused on the prevention and early diagnosis of IDA, yet little research has assessed the treatment and follow-up of those children in whom IDA is diagnosed despite preventive strategies.⁹ In-depth studies examining barriers to oral iron therapy adherence in young children are lacking. Even fewer studies exist to assess facilitators of its adherence.

In our study, 30 out of 50 children were diagnosed with iron deficiency anemia. In our study, 30 out of 50 enrolled children were diagnosed with iron deficiency anemia. The prevalence of iron deficiency anaemia among children aged 1–5 years was found to be 60%. LISBÔA et al in their cross-sectional study included a random sample of 725 male and female children aged less than 60 months.¹⁰ The prevalence of anemia in their study was 37.4%. The greatest prevalence occurred in ages 6 to 24 months (43.0%). It suggests that children under two years of age are more likely to develop IDA. This finding is consistent with other studies by Veira et al.¹¹ This could be attributed to a higher need for iron in this age group due to rapid growth and development combined with a lack of iron intake.

Socioeconomic status showed a significant association with iron deficiency anemia in the present study. Children belonging to lower and lower-middle socioeconomic groups were more frequently affected compared to those from upper-middle socioeconomic status. Similar findings have been reported by Santokh et al¹², suggesting that poor socioeconomic conditions

influence dietary quality and healthcare accessibility

The present study also demonstrated that low birth weight was significantly associated with poor response to iron therapy. Children with low birth weight had lower correction rates compared to children with normal birth weight. Similar findings were reported by Thomson et al¹³, who found birth weight to be an important determinant of iron status. This may be explained by lower neonatal iron stores and increased iron demand during catch-up growth. Exclusive breastfeeding appeared to have a protective effect against IDA. Children who were not exclusively breastfed had a higher risk of developing anemia. Similar observations have been reported in previous studies evaluating infant feeding practices and iron status. Adequate breastfeeding practices may contribute to better nutritional outcomes during early childhood.

In our study, pica, blood in stools, and worm infestation showed significant associations with iron deficiency anemia. Among children with pica, a greater proportion had IDA, supporting previous reports demonstrating a strong association between abnormal eating behaviors and iron deficiency. Chronic blood loss and parasitic infestation may further contribute to depletion of iron stores. Similar findings have been documented in previous literature.

Among children receiving iron therapy, successful correction of IDA was significantly associated with morning administration, intake on an empty stomach, and co-administration with lime, curd, or orange, indicating improved iron absorption. Iron is known to be absorbed best on an empty stomach, and vitamin C enhances absorption by converting ferric iron into the absorbable ferrous form. Similar findings have been reported in earlier studies.**Error! Bookmark not defined.**

Children with non-corrected IDA more commonly received iron with food or tea/milk, had night-time administration, and experienced higher rates of nausea/vomiting and loose stools. Ziegler EE et al¹⁴ demonstrated that milk significantly reduces iron absorption because of calcium-mediated inhibition. Similarly, gastrointestinal side effects may reduce compliance and negatively affect treatment response.

Hospital admissions were also significantly more frequent among children with non-

corrected IDA, suggesting that concurrent illnesses and poorer health status may influence treatment outcomes. However, constipation, stomach pain, and dark stools did not show a statistically significant association with therapeutic response.

Overall, the present findings suggest that socioeconomic conditions, nutritional practices, treatment timing, dietary habits, and treatment-related adverse effects significantly influence both the development of iron deficiency anemia and response to oral iron therapy. Appropriate counseling regarding correct administration of iron supplements and dietary modifications may improve treatment outcomes and reduce the burden of IDA in children.

CONCLUSION

The present study demonstrated a high prevalence of iron deficiency anemia (60%) among children aged 1–5 years. Factors such as low socioeconomic status, low birth weight, inadequate feeding practices, pica, and parasitic infestation were associated with IDA. Successful treatment response was significantly influenced by proper timing and method of iron administration, particularly morning dosing, intake on an empty stomach, and co-administration with vitamin C-rich foods. Dietary practices and treatment-related side effects also affected therapeutic outcomes. These findings emphasize the importance of caregiver education, nutritional counseling, and appropriate iron supplementation practices for improving treatment success and reducing the burden of childhood iron deficiency anemia.

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