

ORIGINAL ARTICLE

Iron Deficiency Anemia in Children From Low Income Profiles

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Abstract

Background Iron deficiency anaemia (IDA) is the most prevalent type of anaemia. Developing countries have a higher prevalence of IDA. In the present study the prevalence of IDA in children aged 5 to 15 years were investigated along with the associated etiological factors.

Methodology This cross sectional study was conducted among the children aged between 5 years and 15 years of age the Nathdawara, Udaipur, Rajasthan. The subjects were selected randomly from the patients visiting the study centre. For collecting sociodemographic data, such as age, gender, and level of education, family history of diabetes, a structured questionnaire was utilised. After histories and physicals were examined, venous blood samples were collected. The following parameters were measured: total iron-binding capacity (TIBC), concentration of Hb, mean corpuscular hemoglobin concentration (MCHC), mean corpuscular volume (MCV), serum iron (SI), ferritin, Ret-He, mean corpuscular hemoglobin (MCH), and hematocrit (Hct). Appropriate statistical analysis was done.

Results In this study, total 390 participants in the age group of 5-15 years were included. Majority of the children enrolled in this study had iron deficiency anemia (71.79%). The mean hemoglobin concentration was 8.65 ± 1.63 g/dL. Among the total 280 children who belonged to the IDA category 58.57% were female and 41.43% were male. This indicates a higher prevalence of IDA among females. Maximum of the children were from the lower socioeconomic category 66.79%. Among total 111 female cases that had IDA, 55 were in the age group of 11-15 years and menorrhagia was present in 36 cases (65.45%).

Conclusion In the present study, the higher prevalence of iron deficiency was reported in the study population of 5-15 years, with a high number of females being affected. Vegetarian children were more affected compared to their nonvegetarian counterparts. Children belonging to the lower socio-economic class were more anemic.

Keywords: Anaemia; Children aged; IDA

1 Introduction

In the 19th Century the term Anemia was coined from anaimia, which means without blood. Anaemia is a disorder where the blood haemoglobin level is below what is considered normal for the patient's age and gender [1]. According to the definition provided by WHO, children aged between 6-59 months with a

hemoglobin concentration below 110 g/L, in 5 years to 11 year old children haemoglobin level below 115 g/L and in 12 years to 14 years old below 120 g/L can be termed as anemic [2]. Approximately 34% of the global population, is affected by iron deficiency, with 80% of those people living in poor nations, where the prevalence of the condition is approximately 40% [3]. Iron deficiency anaemia (IDA) is the most prevalent type of

anaemia and can be brought on by chronic blood loss from excessive menstruation, haemorrhoids, peptic ulcer bleeding, accidents, worm infestation, or an increase in iron requirements during pregnancy, puberty, or infant development. It could also be brought on by inadequate oral intake, achlorhydria, decreased iron absorption following partial or complete removal of the stomach, persistent diarrhoea, or malabsorption [4]. Studies have shown that iron deficiency is linked with the socioeconomic factors. In developing countries inefficient public policies and adverse social structure increases the chances of health inequalities, resulting in the unnecessary health burden. Nutritional deficiency is one of the most common outcome of these health inequalities and most commonly, children are affected by this condition [5]. Multiple studies conducted on children in India have revealed that the prevalence of anaemia in that country ranges from 52% to 96.50% of the total population. In preschool children, the estimated anemia prevalence is 47.4% which is higher compared to the pregnant and non-pregnant women. In summary, this study has concluded that anemia affects approximately one-quarter of the world's population and pre-school age children are ones who are affected by this type more [6].

In a cross-sectional study conducted among children admitted in the hospital with Diarrhea in Nepal, it was shown that one in three children have iron deficiency [7]. At present, there is no study available that has assessed the prevalence of IDA in the current study population. Hence, this study assessed the prevalence of IDA in children aged 5 to 15 years in the selected study site. Additionally, the etiological factors linked to the anaemia in the study population was also investigated.

2 Materials and Methods

2.1 Study subjects

This cross sectional study was conducted among the children aged between 5 years and 15 years of age in the Nathdawara, Udaipur, Rajasthan. The subjects were selected randomly from the patients visiting the study centre. Total 390 participants were included in this study.

2.2 Inclusion criteria

All of the children aged 5 to 15 years and who are going to visit the study centre for various minor conditions or diseases.

2.3 Exclusion criteria

Patients with the following factors were excluded from the study

- Patients with any systemic diseases such as malignancy, infection, renal diseases and with some other chronic disease.
- Patients with history of blood transfusion or iron therapy in the last three months.
- Haemolytic anemia.
- Unwilling patients

2.4 Ethical consideration

Before beginning the study, clearance on its ethical validity was sought and received by the ethics committee of the institute. Before a patient is included in the research project, their written agreement after receiving all relevant information was obtained. During the process of data collection, anonymous identifiers were utilised, all tablets that are used for data collection will be password protected. In order to prevent unauthorised access to the information while it is being transmitted, it was encrypted. All of the participants in the study who are identified as having iron deficiency anaemia at any point over the course of the investigation were informed of their condition and sent to the haematological clinic for further treatment.

Table 1: Number of participants in the study.

Diagnosis	No. of cases	Percentage (%)
Iron Deficiency Anemia	280	71.79
B12 Deficiency Anemia	50	12.82
Mixed Anemia	20	5.13
Hypothyroid	9	2.31
PEM	10	2.56
Malaria	6	1.54
Thalassemia	5	1.28
SLE	3	0.77
Malignancy	3	0.77
Pernicious Anemia	4	1.03
Total	390	100%

2.5 Physical data collection

For collecting sociodemographic data, such as age, gender, and level of education, family history of diabetes, a structured questionnaire was utilised. All the anthropometric measurements such as height, weight of the subjects were done using well established protocol. When the individual is standing perfectly still, their height will be measured down to the next centimetre. In order to obtain an accurate reading of the

participant's weight to the nearest 0.1 kilogramme, a weighing scale was utilised, and the subject was requested to remove their shoes and dress in lightweight clothing.

Table 2: Gender based distribution of participants in IDA.

Sex	No. of cases	Percentage
Females	164	58.57
Males	116	41.43
Total	280	100%

2.6 Laboratory measurement

After histories and physicals was examined, venous blood samples was collected. All venous blood samples was examined using an analyzer at two independent labs. The following parameters was measured: total iron-binding capacity (TIBC), concentration of Hb, mean corpuscular hemoglobin concentration (MCHC),

mean corpuscular volume (MCV), serum iron (SI), ferritin, Ret-He, mean corpuscular hemoglobin (MCH), and hematocrit (Hct). Transferrin saturation (TS) can be calculated using the below mentioned formula : $[TS = (SI/TIBC) \times 100]$ [8]. The iron deficiency anemia was defined as value of Hemoglobin based on the age:

- For children aged 6 years to 11 years the level of Hb below 11.5 g/dL
- For children 12years to 15 years level of Hb lower than 12 g/dL;

Further to the haemoglobin level, two other criteria such as TS lower than 15% and/or ferritin value lower than 15 mg/L was taken into consideration. Based on one of the following criteria the diagnosis of iron efficiency was done where the anaemia is not present: TS level more than 15% and ferritin level more than 15mg/L. Children with normal Hb in accordance with their age, normal TS, and ferritin are diagnostic criteria for iron depletion [9].

Table 3: Relation between Age groups and Sex.

	Females		Males	
	No. of cases	Percentage	No. of cases	Percentage
11-15 Years	50	30.49	44	37.93
5-10 Years	114	69.51	72	62.07
Total	164	100%	116	100%

2.7 Statistical analysis

The presentation of the continuous variables was done as mean. Excel was used to compile all of the data, and Statistical Package for the Social Sciences was used to perform the analysis.

Table 4: Relationship between socio-economic status of the parents and Etiology of Anemia.

Socio-economic Status	No. of cases	Percentage
Upper Class (Class I)	27	9.64
Middle Class (class II + class III)	66	23.57
Lower Class (class IV + class V)	187	66.79
Total	280	100%

3 Result and interpretation

In this study, total 390 participants in the age group of 5-15 years were included. Majority of the children enrolled in this study had iron deficiency anemia which comprises of 71.79% of the study population. The next highest number of children was found

to be Vitamin B12 deficient (12.82%). The mean hemoglobin concentration was 8.65 ± 1.63 g/dL. RDW was 16.87 ± 1.86 , MCV 74.47 ± 13.25 , and MCH was 18.81 ± 4.66 pg. the mean RBC concentration was 0.77 million/cumm, platelet concentration was 4.05 ± 1.29 lakhs/cumm. Mean serum iron concentration was 46.57 ± 16.37 . Serum ferritin level was 18.13 ± 9.51 µg/L. Among the total 280 children who belonged to the IDA category 58.57% were female and 41.43% were male. This indicates a higher prevalence of IDA among females.

Table 5: Relationship between Diet history and Iron deficiency anaemia.

Diet	No. of cases	Percentage
Cereal Based	280	100%
Occasional Non-Veg once a week	100	35.71
Greens	96	34.29
Tea/Coffee	140	50.00

In the IDA female group 69.51% were in the 5-10 years old, followed by the 11-15 years age group. The study shows that 9.64% belonged in the upper

class, 23.57% cases were in the middle class and 66.79% were in the lower socioeconomic category. The common symptoms encountered in the IDA category were weakness which was present in 73.07% cases. 62.98% subjects complained of unexplained fatigue, 47.59% reported shortness of breath. 77.40% cases pale skin was observed.

Table 6: Symptoms of IDA.

Symptoms	No. of cases	Percentage
Generalised Weakness	152	73.07%
Unexplained Fatigue	131	62.98%
Pale skin	161	77.40%
Shortness of breath or chest pain	99	47.59%
Irritability or Dizziness	87	41.82%
Rapid Heartbeat	71	34.13%
Headache	42	20.19%
Picaphagia	39	18.75%
Brittle Nails or Hair loss	34	16.34%
Sore tongue	31	14.90%

Among total 111 female cases that had IDA, 55 were in the age group of 11-15 years and menorrhagia was present in 36 cases (65.45%) Table 9. Among the 16 cases where the presence of parasitic infection was seen, 15 cases had iron deficiency anemia. Among 6 cases malaria was reported but no cases were reported to have iron deficiency anemia in them Table 10.

Table 7: General examination findings in IDA.

	No. of cases	Percentage
Pallor	161	77.40%
koilonychia	32	15.38%
Stomatitis	21	10.09%
Splenomegaly	12	5.76%
Glossitis	4	1.92%
Clubbing	3	1.44%
Hepatomegaly	1	0.48%
Cynosis	0	0%

Table 8: Mean Value of various Parameters obtained in this study.

	RANGE	MEAN	S.D.
Age	5-15	9.32	2.88
Hb (g/dl)	4.2-11.5	8.65	1.63
HCT (%)	28.0-39.0	34.19	2.04
RDW (%)	10.0-20.0	16.87	1.86
MCV (fl)	57.41-121.43	74.47	13.25
MCH (pg)	9.23-37.10	18.81	4.66
MCHC (%)	11.94-35.00	25.3	4.5
RBC (million/cu mm)	0.40-2.10	0.77	0.23
Platelets (lakhs/cu mm)	6.0-7.7	4.05	1.29
Sr. Iron	25.0-104.0	46.57	16.37
TIBC	260.0-670.0	441.19	76.23
S. Ferritin ($\mu\text{g/L}$)	7.0-53.0	18.13	9.51

Table 9: Relation of Blood loss (menorrhagia) and IDA.

	No. of cases	Percentage
Total IDA Females	164	100%
Adolescent Girls (11-15 Years)	55	33.54
Menorrhagia present	36	65.45

Table 10: Relation between Parasitic Infections and Anaemia.

	No. of Cases	IDA cases	Percentage
Warm infestation present	16	15	93.75%
Malaria	6	0	0%

4 Discussion

Anemia is a significant global problem affecting developed as well as developing countries. This particular disease has major consequences for human health and also adversely affects social and economic development of a country. Globally anemia affects 305 million school-aged children. According to the National Family Health Survey (NFHS-3) approximately 70% to 80% children suffers from anemia.

In developing countries a prevalence rate of 29.2% to 79.6% has been reported with 13.6% in South East Asia. In India, the largest number of cases of IDA has been reported affecting almost 147.9 million people. China has the second largest anemic population of 75.8 million followed by Nigeria (24.7 million) [10].

Among the various types of anemia WHO global data show that iron deficiency affects approximately 30% of the world's population. Worldwide 37% of the school-aged children are affected by the iron deficiency anemia [6].

In this study children aged 5-15 years old with a mean age of 9.32 ± 2.88 years was included. IDA was the most common type of anemia as seen in the study population. In a previous report WHO described that although iron deficiency is prevalent across all the age group and involves individuals from both the gender, studies have shown that adolescent girls are more prone to IDA. According to WHO classification adolescent in a population can be defined as the people in the 10-19 year of age group. Girls in the age group of 12 to 15 years are more anemic because in these years the requirement of iron is at its peak. In the United States of America 3% of adolescent girls were found to be anemic [11]. On a similar note, this study also reported that 58.57% females and 41.43% males had IDA. This indicates a higher prevalence of IDA among females. Vidya P Paranjape had reported the similar prevalence rate of iron deficiency among school going children in rural India. A slight difference was reported in the prevalence rate between the male and female subjects. 58.9% of males were diagnosed with IDA compared with the 63.2% female subjects [12].

Among total 111 female cases that had IDA, 55 were in the age group of 11-15 years and menorrhagia was present in 36 cases (65.45%). Verma et al have similarly shown that anemia was more prevalent in menarchal girls as compared to those who did not attend menarche yet [13].

In developing as well as in developed countries sociodemographic factors acts as a major contributing factor for the development of IDA. In Malaysia, a study conducted among school-age children in the age group of 7-12 years has identified several risk factors including poor sanitation, lack of hygiene, restricted access to good nutritional foods and lack of knowl-

edge of nutritional requirements that acts a major contributing factor for iron deficiency [14]. The lower socio-economic status of the parents also has been reported as a major risk factor for the development of IDA. In a study conducted in Kenya among the low-income families it was evident that household food purchasing power acts as an important determinant that affects the nutritional status of the children [15].

In correlation with this finding in the present study higher number of anemic children belonged to the lower socioeconomic status, compared to the middle and higher status children.

In children the level of nutrition frequently causes iron deficiency anemia. A significant correlation has been reported between severe malnutrition, less protein consumption with iron deficiency anemia. However, the diet becomes more relevant when the iron store of the host is lost, i.e. in case of excessive blood loss or in hookworm infection. In these settings, iron supplements have to be provided to the patient to overcome the iron loss [16]. In the present study among the subjects with iron deficiency anemia all the children have cereal based diet. It was noted that in the study population 35.71% children take non vegetarian diet once in a week while the majority of the children were vegetarian. Studies have also shown that Consumption of lower levels of red meat, vegetables, and cereals have been positively associated with the iron deficiency anemia. Studies have shown that patients who take less than 2 servings of the red meat are more prone to develop IDA [17].

In addition to that in 50% of the cases children take tea or coffee regularly. Studies have shown that consumption of tea is significantly associated with the iron deficiency anemia. The absorption of non-heme iron however, non heme iron absorption remain unaffected by tea. Many studies have shown that the risk of anemia increases with increased tea consumption as compared to the non tea drinkers.

In a study conducted among adolescent girls in Ranchi and its surrounding area, Chaturbedi et al have observed that in vegetarians Anemia was higher than nonvegetarians. A statistically significant correlation was also reported with anemia and rice based diet ($r=0.871$). In addition they have also pointed out that post meal consumption of tea and coffee had increased association with anemia. The low intake of iron and vitamin C- rich food also lead to iron deficiency anemia [18].

The prevalence of iron deficiency anemia was reported more in the females with menorrhagia compared to the non-menarcheal counterparts. In a study conducted among school-aged children in Rishikesh, Uttarakhand, the prevalence of anemia was reported as 56.5%. among these anemic subjects 36.5% were menarcheal girls. The most common type of finding

on peripheral blood smear showed the presence of microcytic hypochromic anemia [19].

5 Conclusion

This study has pointed out that the problem of anemia is widespread and is prevalent in a wide population rather than commonly considered groups of pregnant women or lactating women. The young male populations are equally affected by iron deficiency. In spite of the various limitations, this study was able to clearly delineate the various socioeconomic problem associated with the iron deficiency anemia.

Conflict of Interest: No conflicts of interest exist between the authors and the publication of this work.

Ethical consideration: The ethical committee approved the study at Ananta Institute of Medical Science and Research Centre, Rajsamand Udaipur, Rajasthan, India.

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