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# NUTRITIONAL IRON DEFICIENCY ANAEMIA: MAGNITUDE AND ITS CONTRIBUTING FACTORS AMONG SCHOOL AGE CHILDREN IN GUNTUR, INDIA: A HOSPITAL BASED STUDY

Pediatrics

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## ABSTRACT

Anaemia is a significant global problem affecting both developing countries and developed countries. But the incidence of nutritional anaemia is more common in the developing countries. This particular haematological disorder has major consequences for human health and also adversely affects social and economic development of a country. The aim of the study is to assess the prevalence of Iron deficiency anaemia and to determine the etiological factors contributing to Iron deficiency anaemia in 5-15 years children. Out of 300 anaemic children, 208 (69.33%) children have iron deficiency, 34 (11.33%) children have B12 deficiency anaemia. Among 208 children, 9 (4.30%) children are have mild anaemia, 132 (63.50%) children are have moderate anaemia and 67 (32.20%) children have severe anaemia. Severity of iron deficiency anaemia were high in females compared with male children. Relationship between aetiology and severity of anaemia is shown statistically significant (P<0.001). This study was conducted among both rural and urban children hence; it had shown a wider picture of the prevalence of this deadly health burden.

## KEYWORDS

Iron Deficiency Anaemia, Nutritional Anaemia, Anaemia in school age children

## INTRODUCTION:

Paediatric Hematology is a sub-speciality of paediatrics and a sine qua non of the modern teaching institutions. Among the haematological disorders, Anaemia is the commonest entity of multiple aetiologies.

The word anaemia was introduced in 19th century from a Greek word anaimia, from an- 'without' + haima 'blood'. Anaemia is a condition in which the haemoglobin in the blood is below the normal range appropriate for age and sex[1]. Anaemia is a quantitative deficiency of haemoglobin which results in decrease in number of erythrocytes and results in pallor, fatiguability, weakness and breathlessness.

Anaemia is the most widespread global issue prevalent in the developing nations like India, particularly in children and females[2,3].

Anaemia is a common disorder of blood, which affects almost a quarter of the people across the globe. Iron deficiency anaemia is being most common affecting over a billion peoples across the globe. As per data in 2013, anaemia has caused over 183000 deaths[4].

Prevalence of anaemia is reported more in rural areas than in urban area due to low income, illiteracy and poor economic conditions. The commonest form of anaemia is iron deficiency anaemia which is either caused by chronic blood loss due to excessive menstruation, bleeding from peptic ulcers, haemorrhoids, worm infestation, accidents or either by increase demand of iron during pregnancy, adolescence or growing children. It may also occur due to poor oral intake, decreased absorption of iron after a partial or total removal of the stomach, achlorhydria, chronic diarrhoea or malabsorption. Numerous studies among children have shown that the prevalence of anaemia ranges from 52-96.50% in India.

The most important and potential problem that arises with iron deficiency is retarded sychomotor and cognitive development in children. Although the extent of the developmental difficulty varies with individual child, however, studies have shown that marked iron deficiency can cause CNS damage[5]. This defect in the CNS eventually causes damage in the cognition and affects the learning process.

Studies have also shown that iron deficiency also disrupts several metabolic processes which are involved in the brain functioning including the production of neurotransmitters. Iron deficiency leads to alteration in serotonin, GABA and dopamine levels. In addition, various other metabolic pathways needs iron as a co-factor namely protein synthesis, organogenesis, and so on. Studies have pointed out that in experimental animals iron deficiency results in decreased levels of GABA in brain. All these alterations in the neurotransmitters levels are irreversible and this could not the reversed even after the iron rehabilitation therapy was introduced[6]. In iron deficiency anaemia the level of circulating haemoglobin in the body is also decreased that severely affects the normal physiological functioning of an individual. Iron deficient erythropoiesis will affect the working capacity in adolescents.

Aetiology of anaemia is multi-factorial. If anaemia is left untreated, it will lead to reduced body functions, decreased performance, slowdown normal physiology, increased co-morbid conditions and thus functional independence and mortality[7].

The aim of the study is to assess the prevalence of Iron deficiency anaemia and to determine the etiological factors contributing to Iron deficiency anaemia in 5-15 years children.

## MATERIALS AND METHODS:

**STUDY SETTING:** The present study was carried out in the Department of Paediatrics, Katuri Medical College and Hospital, Guntur from November 2016 to October 2018 (2 Years).

**STUDY SAMPLE:** This study was conducted on 300 Anaemic children aged between 5 to 15 years presenting to the Department of Paediatrics, Katuri Medical College and Hospital.

**STUDY DESIGN:** This is Cross-sectional observational study.

**METHODS:** The study was approved by local ethical committee. Written informed consent was taken from all patients attending OPD/IPD with clinical features of anaemia or for a routine check up or immunization. Every patient was evaluated by taking a detailed history including complaints, family history, past history, including worm infestation, pica and a thorough clinical examination was done. The symptoms were noted and analyzed on a standard format.

Haemoglobin was measured in all the subjects by electronic counter method (Horiba Pentra Es60). Children with haemoglobin level less than cut off values were considered by following WHO criteria. After the initial evaluation of Hb level, the following investigations were done: Complete blood picture including red cell distribution width, peripheral smear examination, reticulocyte count, ESR, Iron profile (serum iron, total iron binding capacity, serum ferritin), liver function tests, thyroid function tests, and renal function tests, LDH and stool examination were done.

Special tests like bone marrow examination, Serum vitamin B12 level, RBC folate levels, upper gastrointestinal endoscopy, colonoscopy,

haemoglobin electrophoresis and autoimmune profile tests were done wherever necessary.

**INCLUSION CRITERIA:**

1. Children between age group of 5 to 15 years attending Paediatric IN/Out-Patient Department, KMCH, Guntur.
2. Children coming to hospital for general check up and treatment of minor ailments.

**EXCLUSION CRITERIA:**

1. Age less than 5 years and more than 15 years are excluded.
2. Who were already diagnosed elsewhere.
3. Who were on treatment prior to admission to hospital.
4. Cases of Anaemia due to chronic infections and chronic renal failure, chronic liver diseases or any other chronic illnesses.
5. Whose parents/guardians denied participating in the study.

**Data analysis and statistical methods:**

Data entry and statistical analysis were performed with the help of Microsoft excel 2007. The collected and recorded data was entered in an excel sheet and results were analyzed by taking mean values and standard deviation (SD). Categorical variables were presented as numbers and percentages.

**RESULTS:**

In a total of 300 anaemia children, 162 (54%) are females and 138 (46%) are males. It was observed that the incidence of anaemia is more in females compared with males.

**Table 1: Diagnosis**

| Variable(s) | Number of cases | Percentage (%) |
|---|---|---|
| **Sex (N=300)** | | |
| Females | 162 | 54.0 |
| Males | 138 | 46.0 |
| **Diagnosis (N=300)** | | |
| Iron Deficiency Anaemia | 208 | 69.33 |
| B12 Deficiency Anaemia | 34 | 11.33 |
| Mixed Anaemia | 20 | 6.66 |
| Hypothyroid | 10 | 33.33 |
| PEM | 9 | 3 |
| Malaria | 6 | 2 |
| Thalassemia Intermedia | 5 | 1.66 |
| SLE | 3 | 1 |
| Malignancy | 3 | 1 |
| Pernicious Anaemia | 2 | 0.66 |
| **Type of Anaemia** | | |
| Mild Anaemia | 12 | 4.0 |
| Moderate Anaemia | 187 | 62.33 |
| Severe Anaemia | 101 | 33.67 |

Table 1 shows majority of the children enrolled in this study is found to have iron deficiency anaemia comprising of 208 (69.33%) out of 300. The next highest number of children was found to have Vitamin B12 deficiency comprising of 34 (11.33%), 20 (6.66%) children have mixed type of anaemia. Among the rest of the children, 9 (3%) children have protein energy malnutrition, 6 (2.0%) children have Malaria, 5 (1.66%) have Thalassemia intermedia, 3 (1%) have SLE, 3 (1%) have malignancy and 2 (0.66%) have pernicious anaemia. Out of 300 anaemia children, 12 (4.0%) children are having mild anaemia, 187 (62.33%) children are having moderate anaemia and 101 (33.67%) are having severe anaemia.

**Table 2: Relationship between aetiology and severity of anaemia**

| | Severity of iron deficiency anaemia | | | |
|---|---|---|---|---|
| **Etiology** | **Mild N (%)** | **Moderate N (%)** | **Severe N (%)** | **Total** |
| Iron Deficiency Anaemia | 9 (4.32%) | 132 (63.46%) | 67 (32.22%) | 208 (69.33%) |
| B12 Deficiency Anaemia | 3 (8.80%) | 20 (58.80%) | 11 (32.40%) | 34 (11.33%) |
| Mixed Anaemia | 0 (0.0%) | 20 (100.0%) | 0 (0.0%) | 20 (6.66%) |
| Hypothyroid | 0 (0.0%) | 8 (80.0%) | 2 (20.0%) | 10 (3.33%) |
| PEM | 0 (0.0%) | 0 (0.0%) | 9 (100.0%) | 9 (3.0%) |
| Malaria | 0 (0.0%) | 4 (66.70%) | 2 (33.30%) | 6 (2.0%) |
| Thalassemia Intermedia | 0 (0.0%) | 1 (20.0%) | 4 (20.0%) | 5v(1.66%) |
| SLE | 0 (0.0%) | 0 (0.0%) | 3 (100.0%) | 3 (1.0%) |
| Malignancy | 0 (0.0%) | 0 (0.0%) | 3 (100.0%) | 3 (1.0%) |
| Pernicious Anaemia | 0 (0.0%) | 2 (100.0%) | 0 (0.0%) | 2 (0.66%) |
| Total | 12 (4.0%) | 187 (62.33%) | 101 (33.67%) | 300 (100.0%) |

Table 2 shows severity of anaemia in various aetiologies. In Iron deficiency anaemia 9 (4.32%) children were having Mild anaemia, 132 (63.46%) were having moderate anaemia and 67 (32.22%) were having Severe anaemia. Similar results are with B12 deficiency anaemia.

**Table 3: Prevalence of iron deficiency anaemia (n=208)**

| Variable(s) | Number of cases | Percentage (%) |
|---|---|---|
| **Sex (N=208)** | | |
| Males | 111 | 53.36 |
| Females | 97 | 46.63 |
| **Socio-economic status (N=208)** | | |
| Upper Class (Class I) | 7 | 3.37 |
| Middle Class (class II +class III) | 69 | 33.17 |
| Lower Class (class IV +class V) | 132 | 63.46 |
| **Area (N=208)** | | |
| Rural | 141 | 67.78 |
| Urban | 67 | 32.21 |
| **Symptoms** | | |
| Pale skin | 161 | 77.40 |
| Generalised Weakness | 152 | 73.07 |
| UnexplainedFatigue | 131 | 62.98 |
| Shortness of breath or chest pain | 99 | 47.59 |
| Irritability or Dizziness | 87 | 41.82 |
| Rapid Heartbeat | 71 | 34.13 |
| Headache | 42 | 20.19 |
| Pica | 39 | 18.75 |
| Brittle Nails or Hair loss | 34 | 16.34 |
| Sore tongue | 31 | 14.90 |
| **Type of Anaemia** | | |
| Mild Anaemia | 9 | 4.30 |
| Moderate Anaemia | 132 | 63.50 |
| Severe Anaemia | 67 | 32.20 |

Analysis of sex wise incidence of IDA showed that 111 female children and 97 male children out of 208 were suffering from IDA. The incidence of IDA was slightly more in female children than male children comprising of 53.36% and 46.63% respectively. Economic status is evaluated by using Modified Kuppuswamy Scale in anaemic children. Out of 208 of IDA children, 132 (63.46%) children have low socio-economic background, 69 (33.17%) children are in middle class, and 7(3.37%) children are in upper class.

Out of 208 IDA patients, it showed that highest incidence of anaemia was observed in 141 children out of 208 (67.78%) who were hailing from rural areas and the remaining 67 children out of 208 (32.21%) were from urban areas.

In a total of 208 Iron deficiency Anaemia children, the highest number of percentages of signs and symptoms of anaemia children are pale skin, followed generalised weakness, unexplained fatigue, shortness of breath or chest pain, irritability or dizziness.

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**Table 4: Sex wise distribution of Anaemia**

| | | | Severity of iron deficiency anaemia | | | Total |
|---|---|---|---|---|---|---|
| | | | Mild | Moderate | Severe | |
| SEX | Females | Count | 3 | 74 | 34 | 111 |
| | | % within SEX | 2.7% | 66.7% | 30.6% | 100.0% |
| | | % within Anaemia | 33.3% | 56.1% | 50.7% | 53.4% |
| | Males | Count | 6 | 58 | 33 | 97 |
| | | % within SEX | 6.2% | 59.8% | 34.0% | 100.0% |
| | | % within Anaemia | 66.7% | 43.9% | 49.3% | 46.6% |
| Total | | Count | 9 | 132 | 67 | 208 |
| | | % within SEX | 4.3% | 63.5% | 32.2% | 100.0% |
| | | % within Anaemia | 100.0% | 100.0% | 100.0% | 100.0% |

*Chi-Square value = 2.021, P Value = 0.364 (Not Sig.)*

The incidence of moderate to severe anaemia is more in both the sexes with minor difference comprising of 199 (95.7%) and small number of children of both sexes were having mild anaemia [9 (4.32%)]. Moreover, females [108 (97.3%)] are having higher severity of iron deficiency than males [91 (93.8%)]. However, the association between sex and severity of iron deficiency is shown not significant. (P = 0.364, Not Sig.).

## DISCUSSION:

The present study was undertaken to evaluate the prevalence of anaemia in 5-15 years old children. Moreover, the influence of various parameters such as age, sex, socioeconomic status of the parents were also investigated. This cross-sectional study was carried out in the Department of Paediatrics, Katuri Medical College and Hospital in children aged between 5 to 15 years of age who were evaluated in the hospital during the study period.

In this study children aged 5-15 years old with a mean age of 9.32±2.88 years was included. In this study, the prevalence of anaemia was more in female children. The present study was in correlation within Rani and Bandrapalli (2017)[8], Verma et al. (1998)[9], Unnikrishnan SR and Laxmi Charan (2017)[10], Al-Zabedi et al. (2014)[11].

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 anaemic because in these years the requirement of iron is at its peak[12].

The present study population about 68.47% of females were in the age group of 5-10 year and thus they were still might not have reached the age of menarche. This could be one of the reasons that although in general anaemia was more prevalent in females most of them were moderately anaemic. Verma et al. (1998) have similarly shown that anaemia was more prevalent in menarchal girls as compared to those who did not attain menarche yet[13].

In this study, 141 (67.78%) children having iron deficiency anaemia are from rural area. Vidya P Paranjape (2014)[14] had reported the similar prevalence rate of iron deficiency among school going children in rural India. In this study, 132 (63.56%) children having iron deficiency anaemia belong to lower socio-economic class. The lower socio-economic status of the parents also has been reported as a major risk factor for the development of IDA. Similar study conducted in Kenya among the low income families, it was evident that household economy acts as an important determinant that affects the nutritional status of the children[15]. Rani and Bandrapalli (2017) have also reported that with the improvement of the socioeconomic status, the prevalence of anaemia decreases. the high prevalence of anaemia was reported in children belonging to the class IV[16]. In contrast, Chopra et al. (2011) have observed a high prevalence of anaemia among children belonging to the upper and upper middle socioeconomic class[17].

Dietary factors play an important role in the development of iron deficiency anaemia. A significant correlation has been reported between severe malnutrition, less protein consumption with iron deficiency anaemia. In the present study among the subjects with iron deficiency anaemia, all the children have cereal based diet. It was noted that in the study population only 27.88% children take non vegetarian diet once in a week while the majority of the children were vegetarian.Studies have shown that patients who take less than 2 servings of the red meat per week are more prone to develop IDA[18]. Desalegn et al. (2014) have reported that children who do not consume protein rich food are more likely to develop iron deficiency anaemia than those who consume protein-rich foods[19]. In a study of Chaturbedi et al. (2017), have observed that in vegetarians, anaemia was higher than non-vegetarians. In addition they have also pointed out that post meal consumption of tea and coffee had increased association with anaemia[20].

The common sign and symptoms of iron-deficiency anaemia are characterized by pallor because of reduced oxyhaemoglobin concentration in the skin and in the mucous membrane.
In severely anaemic individual troubled breathing, lightheadedness and hair loss have also been reported. Unnikrishnan et al. (2017), classified the study subjects primarily based on the physical examination. In their study, they have shown that depending on the presence of mucosal and conjunctival pallor, nail changes, and associated symptoms 30% girls and 20% boys were successfully identified clinically as having anaemia[21].

Highly statistical significance between the aetiology and severity of anaemia was found in this study. Similarly, Gomber et al. (2003) found that the most common type of anaemia was due to iron deficiency, followed by the vitamin B12 deficiency anaemia[22].

## CONCLUSION:

In the present study, the higher prevalence of iron deficiency was reported with a high number of females being affected. This study was conducted among both rural and urban children hence; it had shown a wider picture of the prevalence of this deadly health burden. The prevalence of anaemia is higher in the 5-10 years age group. Vegetarian children were more affected compared to their non-vegetarian counterparts. Children belonging to the lower socio-economic class were more anaemic. Among anaemic children majority of the children had moderate grade anaemia. Anaemia also leads to decreased physical activity and weakness that have negative consequences on learning and school achievements. This study has pointed out that the problem of anaemia is widespread and is prevalent in a wide population rather than commonly considered groups of pregnant women or lactating women.

### Limitation of the study:

1. Only single fecal samples were evaluated, because of limited resource and also the parents and children were reluctant to provide the stool sample for the study. This limits the estimation of parasitic estimation accurately. Therefore, there are chances that underestimation of the prevalence of intestinal infection might occur in this study.
2. The descriptive diet assessment was not possible in this study as parents were reluctant to answer the lengthy dietary assessment questionnaire. A detailed analysis of the dietary assessment was needed to point out the exact association between the diet and the anaemia.
3. Finally, the small study area had made the scope of his study limited. A prospective longitudinal study multi-centre study is needed to validate the findings observed in this study.

### Recommendations:

1. A multilateral approach to be taken for better utilization of health infrastructure that can generate a general awareness against this disease.
2. Implementation of timely monitoring haemoglobin level at all the private and public schools.
3. Consumption of green leafy vegetables along with meat consumption twice a week and eating Vitamin-C rich fruits should be encouraged and should be included in the diet plan.
4. Overall improvement in sanitation also avoids parasitic infections and improves well being of children.
5. Provision of prophylactic Iron supplements to menarcheal girls with signs of anaemia will avoid severity of anaemia.

### Conflict of Interest:

There is no conflict of interest among the authors.

**Ethical Approval:** Necessary approval was taken from the institution and informed consent was taken from the parents/guardians of the patient.

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