## Original Research Article

# A community study on awareness of iron deficiency and screening early adolescents who are likely to be iron deficient in government schools

## Mohana I. Reddy*, Apoorva Parameshwara, Kishore Kumar, Rahul Maski, Vineela Nekkanti, Srinivasan Ranganathan

Department of Pharmacy Practice, PES College of Pharmacy, Hanumanthnagar, Bangalore, India

**\*Correspondence:**
Ms. Mohana I. Reddy,
E-mail: mohanareddy31261@gmail.com

### ABSTRACT

**Background:** Iron deficiency is one of the major concerns of nutritional deficiencies in developing countries. Iron is an essential element for various biological processes. ID can result from inadequate intake or absorption of dietary iron, increased need during growth period of children and blood loss from infection. According to WHO, the prevalence of iron deficiency anaemia is 20% or higher. IDA in children has been linked to increased childhood morbidity and impaired cognitive development and school performance.
**Methods:** A descriptive study was carried out on 413 government school children in Bangalore of age group of 11-16 years. Questionnaires were provided to assess their knowledge. The demographic details of the study subjects like height, weight and physical examination, dietary intake of foods by the children were collected.
**Results:** The paired two sample t-test was used to calculate the significance between the pre and post-educational test. The measure of the subjective data of the parameters as BMI, physical examination, dietary history; indicates that out of 413 students who had undergone assessment for iron deficiency, 70.70% students might be healthy, 14.29%, 10.73% and 4.28% students might be mild, moderate and severely prone to ID respectively.
**Conclusions:** This study provided students with knowledge of ID and awareness of signs and symptoms for early detection of ID.

**Keywords:** Iron deficiency, Students, Awareness, Knowledge assessment

## INTRODUCTION

In humans, iron is the most abundant trace element and is essential for various physiologic processes, including respiration, energy production and cell proliferation. Its main role is to be a part of haemoglobin (Hb), a necessary protein for oxygen transport.[1,2] Iron deficiency (ID) can result from: inadequate dietary iron intake, inappropriate intestinal absorption, improper iron storage and utilization, inappropriate or excessive blood loss.[6]

Symptoms of ID are subtle and non-specific and often only become evident with severe anemia.[3] ID is associated with decreased capacity for work, diminished quality of life, restless leg syndrome (RLS), fatigue, impaired cognitive function and infertility.[4] Specifically in children, iron deficiency can affect their performance in school leading to decreased concentration in studies and poor academic performances.[5]

In 2013 global burden of diseases injuries and risk factors study reported that the most common cause of anemia worldwide was Iron Deficiency Anemia (IDA).[7] It is estimated that 75% of anemia is related to ID and 30% global population suffers from IDA.[8] In India, family health survey suggested that the anemia is prevalent in all age groups and is high among the most vulnerable- nearly 58% in pregnant women, 50% among non-pregnant non lactating women, 56% among adolescent girls of 15-19 years age, 30% among adolescent boys and 80% among children under 3 years of age.[9] In order to address the ID

setback in children, Government of India came up with certain schemes such as Integrated Child Development Schemes (ICDS). National Nutritional Anemia Control Program (NNACP), Weekly Iron and Folic Acid Supplementation (WIFS), National Iron Plus Initiative (NIPI), etc. to combat iron deficiency anemia.[10] Besides, mid-day meals program was launched by Government of Karnataka in 2002 in order to overcome iron deficiency and other micro nutritional deficiencies.[11]

Several measures can be taken to improve iron status in adolescent children which includes, well balanced diet which is rich in iron, other vitamins and minerals involved in iron absorption or in the production of RBC and haemoglobin and also by providing iron supplements to vulnerable subjects.

Diagnosing iron deficiency is complicated because of invasive and exorbitant methods. Hence, children from poor socio-economic status (SES) background fail to be screened for iron deficiency. And also on the other hand, iron deficiency can be detected by physical examination such as: pale appearance of skin, lips, nail beds and conjuctival mucosa.

Nails become flattened, fragile, brittle or spoon shaped i.e., koilonychia, atrophic glossitis, angular cheilitis and stomatitis in tongue and mouth region, unsuitable eating habits such as PICA (eating ice, mud, etc) which can develop in children due to iron deficiency. Mental disturbances such as irritability, headache, decreased concentration etc, may occur.[13,14] Few irreversible neuro degenerative disorders can appear due to chronic iron deficiency in children.[15] ID leads to hypoxia as a result decreased $SPO_2$, fatigue/tiredness are the most common symptoms along with cold hands and feet as well as tachycardia too are observed in children.[16,17]

Screening of target groups in moderate or severe anemia and referring these cases to an appropriate health facility can lessen the prevalence of iron deficiency in children. The aim of the study was to create awareness and to educate about iron deficiency among school children and assess the knowledge gained.

**METHODS**

A community-based study was carried out in the government schools of south Bangalore from September 2019 to February 2020. The institution ethics committee approval was obtained before the conduct of the study, approval for the conduct of study at the government schools was obtained from the headmaster/mistress of government school. The study included school children of either gender and of age between 12-14 years. The enrolled students were educated in the study by providing questionnaire and self-assessment education for body mass index, physical examination and awareness of daily dietary intake.

The demographic details of the recruited subjects were documented. In the current study, the body mass index (BMI) of the students was calculated by using centre of disease control and prevention child and teen BMI calculator.[18] Physical examination included such as respiratory rate, pulse rate, cold hands and feet, fatigue/tiredness, skin, eyes, nails, tongue and mouth was performed to evaluate for any signs of iron deficiency. The enrolled subjects were interviewed about the daily dietary intake of iron, and the adequacy of the daily dietary iron intake was determined using National Institute of Health-office of dietary supplements, iron-fact sheet for health professionals.[25]

A well-designed questionnaire was read out to the study subjects in their regional language (Kannada) and instructed them to answer, in order to assess their baseline knowledge about iron deficiency. Later a health education session about iron deficiency, its signs and symptoms, medical consequences that arise due to iron deficiency and dietary considerations to overcome iron deficiency, was given through the means of videos and charts in regional language. In addition, the students with the signs and symptoms of iron deficiency, low or high BMI, and dietary history of poor iron intake were identified and personalized awareness was given in order to aid the self-assessment of iron deficiency. The questionnaire was re-administered to the subjects to assess the knowledge gained through the health education program. Appropriate scoring was given for all the parameters of the collected data and analysed using Microsoft excel 2017 data analysis tools.

***Sample size calculation***

The sample size was calculated using the formula,

$$N = z^2 \left[ \frac{p(1-p)}{\varepsilon^2} \right]$$

and was found to be 385 and a total of 413 subjects were included in the current study. With the confidence interval 95%, since the total population is very large the population proportion was set to be 50% and the margin of error was set to be 5%.

**RESULTS**

A total of 413 students voluntarily participated in the study, of which 207 (50.12%) were male students and 206 (49.87%) were female students of class V-VII.

**Table 1: Demographics of the study subjects.**

| Criterias | Mean values±SD |
|---|---|
| Age | 12.82±0.78 |
| Height | 139.42±9.28 |
| Weight | 47.81±236.06 |
| BMI | 18.60±3.39 |

The students were provided with a set of 10 questions regarding iron deficiency to assess their baseline knowledge followed by an explanation and well-defined education which aided them in re-attempting the same set of questions provided in pre-test, most of the students had scored complete marks in post-test compared to pre-test.
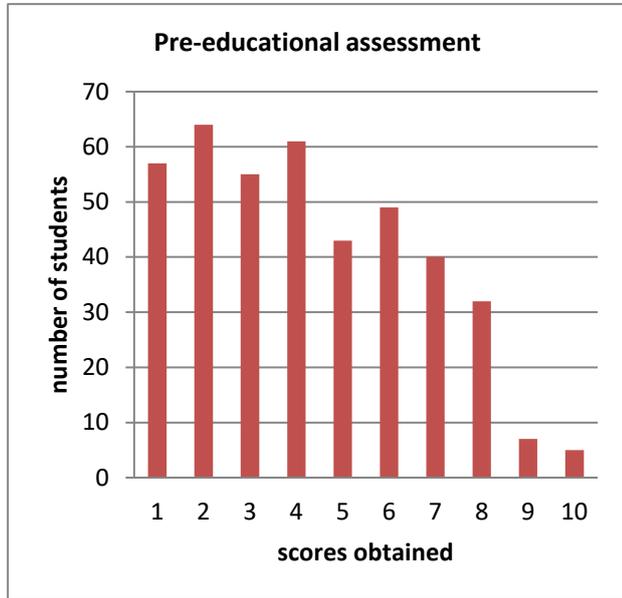


**Figure 1: Chart representing the final scores obtained by students before educational intervention.**
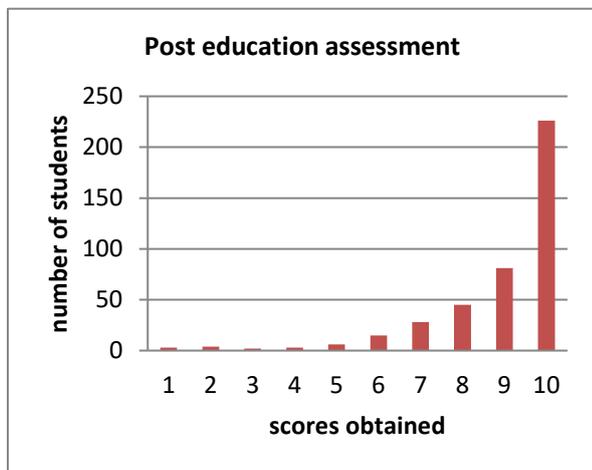


**Figure 2: Chart representing the final scores obtained by the students after educational intervention.**

The paired two sample t-test was calculated using Microsoft excel 2017 and data analysis tools were used to find the significance between the pre-educational test and post-educational test. The p value was found to be 0.0001 which is lesser than $p < 0.05$.

After the educational intervention to complete the analysis of status of iron deficiency in government school students, further data was collected and percentage analysis was performed for the parameters BMI, physical examination, and dietary history.

The height and weight of 413 students were collected and BMI was calculated, of which 71.91% (297) students had healthy BMI, 12.83% (53) students were overweight, 14.77% (61) were underweight, 0.48% (2) were obese.

The physical examination for different parameters such as respiratory rate, pulse rate, cold hands and feet, fatigue/tiredness, skin, eyes, nails, tongue and mouth were examined and found that 47.94% (198) students were healthy, 24.46% (101) students showed signs and symptoms of moderate iron deficiency, 15.50% (64) were mildly iron deficient, and 12.11% (50) students had presented with signs and symptoms of severe iron deficiency.

The daily dietary iron intake of students were calculated by conducting the history of the amount of iron present in per serving of daily diet of various foods, and the scores were given to the dietary intake as per NIH, and the overall score was calculated, the results were found to be 92.25% (381), 5.57% (23), 1.94% (8) and 0.24% (1) of students who were consuming healthy, moderate, mild and poor dietary intake of iron respectively. Further all the three parameters were combined to analyse the percentage of population of students who might be prone to iron deficiency in government schools.

**Table 2: Representation of the students who might be prone to iron deficiency based on the criteria of healthy, mild, moderate, and severe.**

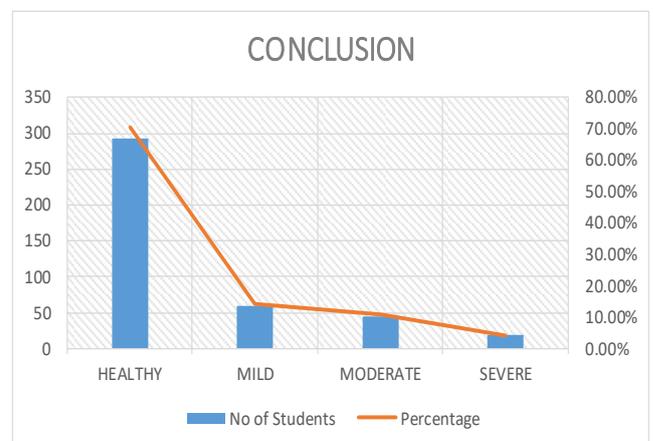| Criterias | No. of students | Percentage (%) |
|---|---|---|
| **Healthy** | 292 | 70.70 |
| **Mild** | 59 | 14.29 |
| **Moderate** | 44 | 10.73 |
| **Severe** | 18 | 4.28 |
| | 413 | 100.00 |



**Figure 3: Signifies the graphical representation of the information in Table 2.**

The conclusion of the measure of the subjective data of all three parameters (BMI, physical examination, dietary history) mentioned above indicates that out of 413 students who had undergone assessment for iron deficiency, 70.70% students might be healthy, 14.29% students might be moderately prone to iron deficiency, 10.73% might be mildly prone to iron deficiency, and 4.28% students might be severely prone to iron deficiency.

## DISCUSSION

IDA is the most common nutritional problem worldwide, occurs more commonly in young children, pregnant women and women of child bearing age, in which 25.4% of children and 47.4% of children in preschool age are reported of IDA according to WHO statistics.[19]

Among 413 students, 207 (50.12%) were males and 206 (49.87%) were females subjects of age group 12-14 years were included and the mean age of the subjects were 13. Whereas in study conducted by Andriastuti et al, the median age of the subjects was found to be 11 years and subjects belonging to age group of 10-18 years had highest prevalence of iron deficiency.[20]

The BMI of the students was determined using their height and weight. The prevalence of underweight, overweight and obesity was 61 (14.77%), 53 (12.83%) and 2 (0.48%) respectively. However, our study findings were in contrast to the findings of Karen et al study, which showed that children who were at risk for overweight and children who were overweight were twice likely to be iron deficient than those who were not overweight.[21] In the current study, the awareness and education about iron deficiency was provided to the students in the regional language i.e. kannada using tools such as videos and charts. The education was not confined to anemia alone, which is a consequence of iron deficiency and is not always seen in every case of iron deficiency. The health education to children about dietary recommendations of iron and self-assessment of iron deficiency will aid in overcoming IDA. Similar finding was observed by Rakesh et al study, which concluded that behavioural change through communication and dietary changes can improve iron deficiency anemia in adolescents.[22]

The pre-post educational tests to assess the subject's knowledge about iron deficiency showed a statistically significant improvement in the knowledge gained due to health education at p=0.0001. Similar outcomes were found in Sant et al study provided questionnaire to assess knowledge and demonstrated significant improvement of understanding and perception of iron deficiency at p=0.001.[23]

In the current study it was found that 381 (92.25%) of students were consuming healthy amount of daily dietary intake of iron, 23 (5.57%) were consuming moderate amount of iron in diet, 8 (1.94%) of students were consuming mild dietary intake of iron and 1 (0.24%) were consuming poor dietary intake of iron. The chances/risk of developing mild, moderate and severe iron deficiency was 59 (14.29%), 44 (10.73%), and 18 (4.28%) respectively, which was contradictory to the outcomes of the Melkem et al study, where adolescents with the mean age of 15±2 years, had developed mild (83.9%), moderate (12.9%), and severe iron deficiency anemia (3.2%). Besides in Melkem et al study, the dietary and nutritional characteristics of the study subjects were found to be 90.4% of the study participants ate meat/poultry less than 2 times a week and 78.9% took citrus fruits less than 2 times a week.[24]

## CONCLUSION

The study majorly focussed on educating and creating awareness in both theoretical and practical manner to the primary school children of government schools in Karnataka. The reason for selecting government schools was because of the lower socio-economic status of the students, which could result in poor nutrition to the children and lack of awareness of iron deficiency by chance or by choice. Although the government came up with mid-day meals programs and several other measures to provide nutritious food for the better health of children, these measures failed to achieve a complete success in preventing iron deficiency, this could be due to lack of proper education and awareness about good nutrition among the students.

## ACKNOWLEDGEMENTS

## REFERENCES

1. Aspuru K, Villa C, Bermejo F, Herrero P, Lopez SG. Optimal management of iron deficiency anemia due to poor dietary intake. Int J Gen Med. 2011;4:741-50.
2. Hentze MW, Muckenthaler MU, Galy B, Camaschella C. Two to tango: regulation of Mammalian iron metabolism. Cell. 2010;142(1):24-38.
3. Schneider JM, Fujii ML, Lamp CL, Lonnerdal B, Dewey KG, Zidenberg CS. Anemia, iron deficiency, and iron deficiency anemia in 12-36-mo-old children from low-income families. Am J Clin Nutr. 2005;82(6):1269-75.
4. Jimenez K, Kulnigg DS, Gasche C. Management of Iron Deficiency Anemia. Gastroenterol Hepatol. 2015;11(4):241-50.

5. Iron needs of babies and children. Paediatr Child Health. 2007;12(4):333-6.
6. Barragan IG, Santoyosanchez A, Oramozpenafiel C. Iron deficiency anaemia. Rev Med Hosp Gen Mex. 2016;79(2):88-97.
7. Okam MM, Koch TA, Tran MH. Iron Supplementation, Response in Iron-Deficiency Anemia: Analysis of Five Trials. Am J Med. 2017;130(8):991.
8. Ausk KJ, Ioannou GN. Is obesity associated with anemia of chronic disease? A population-based study. Obesity. 2008;16(10):2356-61.
9. Ministry of Health and Family Welfare. Guidelines for control of iron deficiency anemia, 2013. Available at: https://www.nhm.gov.in/images/pdf/programmes/child-health/guidelines/Control-of-Iron-Deficiency-Anaemia. Accessed on 16 April 2021.
10. Ministry of Health and Family Welfare. Intensified national iron plus initiative (I-NIPI), 2018. Available at: https://anemiamuktbharat.info/wp-content/uploads/2019/09/Anemia-Mukt-Bharat-Brochure. Accessed on 16 April 2021.
11. Department of public instructions government of Karnataka. Mid-day meals, 2020 Available at: http://schooleducation.kar.nar.in/mms/food.html. Accessed on 16 April 2021.
12. Fulwood R, Johnson CL, Breyner JD. Iron status indicator. National Report on Biochemical Indicators of Diet And Nutrion. 2017;11:73-87.
13. Roganovic J, Starinac K. Iron Deficiency Anemia in Children. Intech open.2016.
14. Soundarya N, Suganthi P. A review on anaemia-types, causes, symptoms and their treatments. J Sci Tech Invest. 2016;1(1):10-7.
15. Youdim MB. Brain iron deficiency and excess; cognitive impairment and neurodegeneration with involvement of striatum and hippocampus. Neurotox Res. 2008;14(1):45-56.
16. Houston BL, Hurrie D, Graham J, Perija B, Rimmer E, Rabbani R, Bernstein CN, et al. Efficacy of iron supplementation on fatigue and physical capacity in non-anaemic iron-deficient adults: a systematic review of randomised controlled trials. BMJ Open. 2018;8(4):19240.
17. US Department of Health and Human Services. Your guide to anaemia, 2011. Available at: https://www.nhlbi.nih.gov/files/docs/public/blood/anemia-yg. Accessed on 16 April 2021.
18. National heart, lung, and blood Institute. Calculate Your Body Mass Index. Available at: https://www.nhlbi.nih.gov/health/educational/lose_wt/BMI/bmicalc.htm. Accessed on 02 February 2020.
19. Hassan NN. The prevalence of iron deficiency anemia in a Saudi University female student. J Microsc Ultrastruct. 2015;3(1):25-8.
20. Andriastuti M, Ilmana G, Nawangwulan SA, Kosasih KA. Prevalence of anemia and iron profile among children and adolescent with low socio-economic status. Int J Pediatr Adolesc Med. 2020;7(2):88-92.
21. Nead KG, Halterman JS, Kaczorowski JM, Auinger P, Weitzman M. Overweight children and adolescents: a risk group for iron deficiency. Pediatrics. 2004;114(1):104-8.
22. Rakesh PS, Rajeswaran T, Ramchandran R, Mathew G, Sheeja JL, Subhagan S, et al. Anaemia among schoolchildren from southern Kerala, India: A cross-sectional study. Natl Med J India. 2015;28(5):225-7.
23. Pasricha SR, Vijaykumar V, Prashanth NS, Sudarshan H, Biggs BA, Black J, et al. A community-based field research project investigating anaemia amongst young children living in rural Karnataka, India: a cross sectional study. BMC Public Health. 2009;9:59.
24. Tesfaye M, Yemane T, Adisu W, Asres Y, Gedefaw L. Anemia and iron deficiency among school adolescents: burden, severity, and determinant factors in southwest Ethiopia. Adolesc Health Med Ther. 2015;6:189-96.
25. NIH. Fact sheet: Iron, 2021. Available at: https://ods.od.nih.gov/factsheets/ironHealthProfessional/. Accessed on 16 April 2021.