



## Prevalence of Iron Deficiency and Iron Deficiency Anemia In Adolescent Girls in Tertiary Care Hospital

Avinash Chalke <sup>1</sup>, Rashmita Nevgi <sup>2</sup>, Bhakti Karde <sup>3</sup>, Sarang Waghmare <sup>4</sup>

1,2: Laboratory Technician, Clinical Hematology, T.N Medical College and B.Y.L. Ch Hospital, Mumbai- 400008

3: Laboratory Technician, Clinical Endocrinology, T.N Medical College and B.Y.L. Ch Hospital, Mumbai- 400008

4: Senior Resident, Clinical Hematology, T.N Medical College and B.Y.L. Ch Hospital, Mumbai- 400008

### Abstract

**Background:** Iron Deficiency Anemia (IDA) is a global health problem. It involves a population of all age groups and sex. But adolescent girls are more vulnerable to it. The reasons may be increased iron demand, menstrual blood loss, infection, worm infestation, etc. **Aim:** To find the prevalence of iron deficiency and IDA in adolescent girls in a Tertiary Care Hospital. **Methods:** This cross-sectional study was done in the HEMATOLOGY clinical laboratory. Hemoglobin estimation was done by Sahli's method. Total iron and Total Iron Binding Capacity (TIBC) estimation were done by the Ferrozine method on a fully automated chemistry analyzer Olympus AU 400 with the reagent kit available in the market. Ferritin estimation was done by the chemiluminescence immunoassay method, using Access 2 (Beckman Coulter). **Results:** Out of 200 girls, 50% of adolescent girls were found to be anemic. Of the total, 43.3% were mild, 3.3% were moderately and 3.3% were severely affected by anemia. **Conclusion:** As the prevalence of anemia is 50%, it needs intervention for its prevention and control. This study will help in the planning and implementation of the policy for the prevention of iron deficiency and IDA.

**Keywords:** Iron deficiency Anemia, Adolescent girls, Nutritional deficiency

**Address for correspondence:** Mrs. Rashmita Nevgi, Laboratory Technician, Clinical Hematology, T.N Medical College and B.Y.L. Ch Hospital, Mumbai- 400008 Email: [raswaigster@gmail.com](mailto:raswaigster@gmail.com)

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### Introduction

Iron is an important micronutrient that is essential for various functions in the human body. It is essential for cellular growth and differentiation, oxygen binding, transport and storage, enzymatic reactions, immune function, cognitive function, mental and physical growth, etc. So, deficiency of iron due to either physiological or pathological reasons can affect mental and physical growth resulting in decreased learning capacity and work productivity. IDA is characterized by a defect in hemoglobin synthesis, resulting in hypochromic and microcytic red blood cells. <sup>[1]</sup> Iron deficiency can result either due to less

nutritional supply, increased demand, or blood loss due to any reason. There are many reasons for iron deficiency and IDA in adolescent girls. These may be deficient intake or absorption of iron, increased demand during adolescence, heavy blood loss during menstruation, parasitic infestation, etc. More than half of the world's undernourished population lives in India. <sup>[2]</sup> Although IDA occurs at all ages and involves both sexes, adolescent girls are more prone to it. The World Health Organization (WHO) defined adolescents as the population of 10-19 years of age. <sup>[3]</sup> About three fourth of adolescent females do not meet the dietary requirements. <sup>[4]</sup> According to a study by WHO on anemia during 1993-2005, the worldwide prevalence of anemia was 25%. <sup>[5]</sup> According to WHO guidelines for

the control of IDA, nutritional anemia is a major public health problem in India and is primarily due to iron deficiency. The National Family Health Survey-3 (NFHS-3) data suggests that the prevalence of anemia in adolescent girls (15-19 years) is 56%. According to the National Nutrition Monitoring Bureau Survey (NNMBS) 2006, the prevalence of anemia in adolescent girls (12-14 years) is 68.6% whereas in (15-17 years) it is 69.7%. [6] Iron deficiency is a preventable cause. The high prevalence of anemia (Haemoglobin <12 gm%) among adolescent girls in India, causes a 1.8% loss of GDP. The daily requirement of iron for the adolescent girl is 0.8 mg/1000 Kcal of dietary energy. [7] In the 12<sup>th</sup> five-year plan Indian government has set a goal to reduce the load of anemia in girls and women by 50%. This study will help to make the strategy to combat it by cost-effective methods like iron supplementation and food fortification for adolescent girls and will help to reduce morbidity and mortality and increase work productivity. Therefore, the present study was undertaken to find the prevalence of anemia in adolescent girls 10-19 years of age in a tertiary care hospital.

## Materials and Methods

This cross-sectional study was done in the hematology clinical laboratory of T.N Medical college and B.Y.L Ch Nair Hospital Mumbai from August 2021 to February 2022. All the patients were informed about the work and written informed consent was taken from each patient.

### Exclusion Criteria

1. Adolescent girls suffering from diabetes, hypertension, heart disease, thyroid disorder, tuberculosis, or cancer.
2. Patients are not willing to participate.

A total of 200 adolescent girls attended the medical outpatient department or emergency. All patients were categorized into two groups.

One group comprised 100 adolescent girls of age group 10-14 years and another group of 100 adolescent girls of 15-19 years. Estimation of blood hemoglobin, serum iron, TIBC, and serum ferritin level was done. For estimation of blood hemoglobin, 1 ml of venous blood was collected with all aseptic measures in a vacutainer containing EDTA. After collection, blood was gently mixed with the anticoagulant.

Hemoglobin estimation was done by Sahli's method. For the determination of iron, TIBC, and ferritin, blood was collected in a plain vacutainer. It was left for half an hour to clot. Then it was centrifuged and the serum was separated. The serum was kept in a deep freezer if estimation could not be done the same day. Total iron and TIBC estimation were done by the Ferrozine method on a fully automated chemistry analyzer Olympus AU 400 with the reagent kit available in the market. Internal quality was maintained with control material from Bio-rad company and calibrator from Beckman coulter. External quality control was maintained with materials from CMC, Vellore, India. Ferritin estimation was done by chemiluminescence immunoassay method using Access 2 (Beckman Coulter) with reagent from Beckman Coulter. Quality control material and calibrators were used to maintain the quality and calibrate the chemiluminescent analyzer respectively. *Statistical Analysis:* The mean value and standard deviation of all the parameters were calculated using Graph Pad software.

## Results

There were 200 adolescent girls in the study group, 100 girls were of 10-14 years of age and 100 girls were of 15-19 years. The normal range of hemoglobin, serum iron, serum ferritin, and TIBC and the mean value of these parameters found in both groups are given in [Table-1]. The percentage distribution of the study group according to severity is given in [Table-2].

**[Table-1]:** Comparison of hemoglobin, serum iron, ferritin, and TIBC in adolescent girls of 10-14 and 15-19 years of age.

Age Group (Years)	Hemoglobin (gm%) Normal Range (>12 gm%)	Serum Iron (µg/dL) Normal Range (35-145 µg/dL)	Serum Ferritin (ng/ml) Normal Range (15-291 ng/ml)	Total iron binding capacity (µg/dL) Normal Range (250-450 µg/dL)
10-14	9.8±1.3	58.7±5.6	48.2±2.4	309±10.8
15-19	11.3±2.2	72.0±4.7	54.4±3.2	277±7.9

**[Table-2]:** Percentage of adolescent girls having a different degree of anemia.

Age Group (Years)	Percentage of Adolescents with Anaemia (gm/dL) (<8)	Mild Anaemia Haemoglobin (gm/dL) (10.0-11.9)	Moderate Anaemia Haemoglobin (gm/dL) (8.0 -9.9)	Severe Anaemia Haemoglobin (gm/dL) (<8)
10-14	53%	43.0%	5.6%	4.4%
15-19	47%	43.6%	1.0%	2.4%

## Discussion

Iron deficiency anemia is prevalent worldwide. Iron has a major role in the human body. According to the previous study, iron is needed for various functions. Oxygen transport, DNA synthesis, and electron transport are a few examples. [8] According to a study report by WHO, iron deficiency is nearly 2.5 times more prevalent in comparison to IDA. WHO estimates nearly two billion people suffer from anemia and approximately 50% of these cases are due to iron deficiency. [9] IDA, the most severe stage of iron deficiency (defined as a low hemoglobin concentration with iron deficiency) was found in 3% of adolescent females in the United States of America. [10] Although IDA occurs at all ages and involves both sexes, adolescent girls are more prone to it. The WHO defined adolescents as the population of 10-19 years of age. [3] The highest prevalence is between the ages of 12 and 15 years when requirements are at their peak. More than 50% of girls in this age group have been reported to be anemic. [11-14]

The requirement for iron in fact doubles during adolescence as compared to a younger age. There is a significant increase in the requirement of iron from the preadolescent level of approximately 0.7-0.9 mg iron per day to as much as 1.37-1.88 mg per day in adolescent boys and 1.40-3.27 in adolescent girls. [15] In India, the prevalence of anemia in adolescent girls is 56% (64 million girls). [16] The prevalence of anemia varies in different parts of

the world, different states of a country, and even in different districts of a state. Adolescent girls are more vulnerable to iron deficiency and anemia due to the increased requirement of iron which in turn is caused by an abrupt increase in lean body mass and total blood volume, and menstrual blood loss. The government of India has made many policies to combat this problem. WHO and UNICEF also started different programs to reduce anemia in this particular group because if untreated these can affect next-generation children resulting in increased morbidity and mortality and decreased productivity. Only a few studies have been done on this topic in Bihar, India, which are cited in [Table-3]. [17-19] According to a district-level household survey on reproductive and child health in India, during 2002-2004, 99% of adolescent girls have anemia and 19% of them are mildly anemic, 53% are moderately anemic and 28% have severe anemia. [17] In a study done by Twara T et al., in Motihari town of Bihar, the prevalence of anemia in adolescent girls was found to be 66%. [18] In another study done in the Rohtas district of Bihar, the prevalence was 43.2%. [19] In our study, the overall prevalence of anemia was found to be 50% which is less than the finding in Motihari town and more than in the Rohtas district. This finding is slightly lower than the UNICEF finding of 56% in India and similar to the WHO worldwide finding. In this study level of hemoglobin, serum iron, and serum ferritin in adolescent girls of 15-19 years is greater than the 10-14 years age group; whereas, TIBC is greater in the 10-14 years group. The prevalence

of anemia in 10-14 years of age is 53%, out of which 43% have mild, 5.6 % moderate, and 4.4% severe anemia. In the 15-19 years age group prevalence is 47%, out of which 43.6% have mild, 1% moderate, and 2.4% severe anemia. This indicates the severity of anemia is more in the 10-14 years, age group, than in the 15-19 years age group. This finding may be due to more bleeding during the early years of menarche, less awareness about iron-containing diets, poor personal hygiene, worm infestation, etc. Many studies have been done to find out the prevalence of anemia in adolescent girls in different parts of India and abroad and data from a few studies has been given in (Table 3). Study done in Vadodara [20], Nagpur (Urban area) [21], Tamil Nadu [22] and Lucknow [23] found the prevalence of anaemia in adolescent girls to be 75%, 35.1%, 44.8% and 56% respectively. In other studies, done in North Pargana [24],

Belgaum [25], rural Wardha [26], Hassan [27] and Nepal [28] prevalence was found to be 45%, 41.1%, 59.8%, 45.2% and 51.3% respectively. Prevalence in Nepal, Tamil Nadu, Karnataka, and West Bengal is almost similar but the prevalence in Gujarat is very high compared to our study. This difference may be due to different socioeconomic status, geographical conditions, lifestyle, food habits, etc. According to the worldwide prevalence of anemia (1993-2005), WHO global database, more than 40% prevalence of anemia is a severe public health problem and it should be taken care of. In 2013, the government of India introduced the national implementation of weekly iron and folic acid supplementation to approximately 120 million adolescent girls. [29] But monitoring for compliance is very necessary.

**Table-3:** Comparison of results of different studies in India and abroad.

S. No.	Studies Conducted in India and Abroad	Prevalence of Anaemia
1	District-level health survey on reproductive and child health [17]	99%
2	Twara T et al., in Motihari town, Bihar [18]	66%
3	Mohapatra S et al., Rohtas district, Bihar [19]	43.2%
4	Kotecha PV et al., Vadodara, Gujarat [20]	75%
5	Chaudhary SM and Dhage VR, Nagpur Urban [21]	35.1%
6	Rajaratnam J et al., Tamil Nadu [22]	44.8%
7	Singh J et al., Lucknow [23]	56%
8	Das DK and Biswas R, North 24 Parganas district, West Bengal [24]	45%
9	Biradar SS et al., Belgaum [25]	41.1%
10	Kaur S et al., rural Wardha [26]	59.8%
11	8 Siddharam S M et al., Hassan district, Karnataka [27]	45.2 %
12	Kanodia P, Eastern part of Nepal [28]	51.3%
13	Present study	50 %

## Conclusion

This study found a 50% overall prevalence of anemia in adolescent girls of 10-19 years. The severity of anemia is more in the 10-14 years of age group in comparison to the 15-19 years age group. This needs more emphasis on 10-14 years adolescent girls to combat anemia, increase productivity, reduce morbidity and

mortality, and improvement of the health status of the next-generation child.

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