Original Article

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Prevalence of Iron Deficiency and Iron Deficiency Anaemia in Adolescent Girls in a Tertiary Care Hospital

Biochemistry Section

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ABSTRACT

Introduction: Iron Deficiency Anaemia (IDA) is a global health problem. It involves population of all age group 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.

Materials and Methods: This cross-sectional study was done in the biochemistry clinical laboratory of Indira Gandhi Institute of Medical Sciences, Patna, Bihar, India for a period of six months (April 2015-October 2015). Haemoglobin estimation was done by Sahli's method. Total iron and Total Iron Binding Capacity (TIBC) estimation was done by Ferrozine method on fully automated chemistry analyzer Olympus AU 400 with the reagent kit available in the market. Ferritin estimation was done by chemiluminesence immunoassay method, using Access 2 (Beckman Coulter).

Results: Out of 200 girls, 50% adolescent girls were found to be anaemic. Of the total, 43.3% were mildly, 3.3% were moderately and 3.3% were severely affected by anaemia.

Conclusion: As prevalence of anaemia is 50%, it needs intervention for its prevention and control. This study will help in planning and implementation of the policy for prevention of iron deficiency and IDA.

Keywords: Adolescence, Females, Haemoglobin

INTRODUCTION

Iron is an important micronutrient which is essential for various functions in 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 reason can affect mental and physical growth resulting in decreased learning capacity and work productivity. IDA is characterized by a defect in haemoglobin synthesis, resulting in hypochromic and microcytic red blood cells [1]. Iron deficiency can result either due to less nutritional supply, increased demand or blood loss due to any reason.

There are many reasons of 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 [2]. Although IDA occurs at all age and involves both the sexes, adolescent girls are more prone to it. The World Health Organization (WHO) defined adolescent as the population of 10-19 years of age [3]. About three fourth of adolescent females do not meet the dietary requirements [4].

According to a study by WHO on anaemia during 1993-2005, worldwide prevalence of anaemia was 25% [5]. According to WHO guidelines for control of IDA, nutritional anaemia 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 anaemia in adolescent girls (15-19 years) is 56%. According to National Nutrition Monitoring Bureau Survey (NNMBS) 2006, the prevalence of anaemia 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. High prevalence of anaemia (Haemoglobin <12 gm%) among adolescent girls in India, causes 1.8% loss of GDP. Daily requirement of iron for adolescent girl is 0.8 mg/1000 Kcal of dietary energy [7]. In 12th five year plan Indian government has set a goal to reduce the load of anaemia in girls and women by 50%. This study will help to make strategy to combat it by cost effective method like iron supplementation and food fortification for adolescent girl and will help to reduce the morbidity and mortality and increase the work productivity.

Therefore, the present study was undertaken to find the prevalence of anaemia in adolescent girls of 10-19 years of age in a tertiary care hospital.

MATERIALS AND METHODS

This cross-sectional study was done in biochemistry clinical laboratory of Indira Gandhi Institute of Medical Sciences, Patna, for a period of six months (April 2015-October 2015). All the patients were informed about the work and written informed consent was taken from each patient. Approval was taken from Institutional Ethical Committee of IGIMS, Patna.

Inclusion Criteria

1. Adolescent girls (10-19 years of age) visiting the Medical Out Patient Department or Emergency Department of IGIMS, Patna.

Exclusion Criteria

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

A total of 200 adolescent girls attending the medical outpatient department or emergency of IGIMS, Patna were taken as cases. 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 haemoglobin, serum iron, TIBC and serum ferritin level was done.

For estimation of blood haemoglobin, 1 ml of venous blood was collected with all aseptic measures in vacutainer containing EDTA. After collection, blood was gently mixed with the anticoagulant.

Haemoglobin estimation was done by Sahli's method.

For the determination of iron, TIBC and ferritin, blood was collected in plain vacutainer. It was left for half an hour to clot. Then it was centrifuged and serum was separated. Serum was kept in deep freezer if estimation could not be done same day. Total iron and TIBC estimation was done by Ferrozine method on 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

Mean value and standard deviation of all the parameter 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. Normal range of haemoglobin, serum iron, serum ferritin and TIBC and mean value of these parameters found in both groups are given in the [Table/Fig-1]. Percentage distribution of study group according to severity is given in [Table/Fig-2].

Age Group (Years)	Haemoglobin (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/Fig-1]: Comparison of haemoglobin, serum iron, ferritin and TIBC in adolescent girls of 10-14 and 15-19 years of age.

Age Group (Years)	Percentage of Adolescents with Anaemia (gm/dL) (<12)	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 years	53%	43.0%	5.6%	4.4%
15-19 years	47%	43.6%	1.0%	2.4%

[Table/Fig-2]: Percentage of adolescent girls having different degree of anaemia.

DISCUSSION

Iron deficiency anaemia is prevalent worldwide. Iron has a major role in human body. According to previous study iron is needed for various functions. Oxygen transport, DNA synthesis, and electron transport are 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 suffering from anaemia and approximately 50% of these cases are due to iron deficiency [9].

IDA, most severe stage of iron deficiency (defined as a low haemoglobin concentration with iron deficiency) was found in 3% of the adolescent females in the United State of America [10].

Although IDA occurs at all age and involves both the sexes, adolescent girls are more prone to it. The WHO defined adolescent 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 peak. More than 50% girls in this age group have been reported to be anaemic [11-14].

The requirement for iron in fact doubles during adolescence as compared to younger age. There is a significant increase in the requirement of iron from 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 anaemia in adolescent girls is 56% (64 million girls) [16]. Prevalence of anaemia 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 anaemia due to increased requirement of iron which in turn is caused by abrupt increase in lean body mass and total blood volume, and menstrual blood loss.

Government of India has made many policies to combat this problem. WHO and UNICEF also started different programs to reduce anaemia in this particular group because if untreated these can affect next generation child resulting in increased morbidity and mortality and decreased productivity.

Only few studies have been done on this topic in Bihar, India, which are cited in [Table/Fig-3] [17-19].

According to district level household survey on reproductive and child health in India, during 2002-2004, 99% of adolescent girls have any anaemia and 19% of them are mildly anaemic, 53% are moderately anaemic and 28% have severe anaemia [17]. In a study done by Twara T et al., in Motihari town of Bihar, the prevalence of anaemia in adolescent girls was found to be 66% [18]. In another study done in Rohtas district of Bihar, the prevalence was 43.2% [19]. In our study, the overall prevalence of anaemia was found to be 50% which is less than the finding in Motihari town and more than the Rohtas district. This finding is slightly lower than UNICEF finding of 56% in India and similar to WHO worldwide finding.

In this study level of haemoglobin, serum iron, and serum ferritin in adolescent girls of 15-19 years is greater than 10-14 years age group; whereas, TIBC is greater in 10-14 years group. Prevalence of anaemia in 10-14 years age is 53%, out of which 43% has mild, 5.6 % moderate and 4.4% severe anaemia. In 15-19 years age group prevalence is 47%, out of which 43.6% have mild, 1% moderate and 2.4% severe anaemia. This indicates severity of anaemia is more in 10-14 years age group than 15-19 years age group. This finding may be due to more bleeding during 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 anaemia in adolescent girls in different parts of India and abroad and data of few studies has been given in [Table/Fig-4]. 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 prevalence in Gujarat is very high compared to our study. This difference may be due to different socioeconomic status, geographical condition, lifestyle, food habits, etc.

According to the worldwide prevalence of anaemia (1993-2005), WHO global database, more than 40% prevalence of anaemia is a severe public health problem and it should be taken care of. In 2013, the government of India introduced national implementation of weekly iron and folic acid supplementation to approximately 120 million adolescent girls [29]. But monitoring for compliance is very necessary.

LIMITATION

Fear of needle prick for sample collection caused non cooperation of adolescent girls from the community towards enrollment in

S. No.	Studies Conducted in Bihar	Prevalence of Anaemia
1	Bihar- by 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	Present study	50%

[Table/Fig-3]: Comparison of results of different studies in Bihar.

S. No.	Studies Conducted in India and Abroad	Prevalence of Anaemia
1	Kotecha PV et al., Vadodara, Gujarat [20]	75%
2	Chaudhary SM and Dhage VR, Nagpur Urban [21]	35.1%
3	Rajaratnam J et al., Tamil Nadu [22]	44.8%
4	Singh J et al., Lucknow [23]	56%
5	Das DK and Biswas R, North 24 Parganas district, West Bengal [24]	45%
6	Biradar SS et al., Belgaum [25]	41.1%
7	Kaur S et al., rural Wardha [26]	59.8%
8	Siddharam S M et al., Hassan district, Karnataka [27]	45.2 %
9	Kanodia P, Eastern part of Nepal [28]	51.3%
10	Present study	50%

[Table/Fig-4]: Comparison of results of different studies in India and abroad.

the study. Therefore, we had to enroll the adolescent girls visiting medical outpatient department or emergency.

As this study was done in a tertiary care hospital, further study in different regions should be done which can reflect the status of iron in adolescent girls of that region and help in planning and policy making for anaemia prevention and control.

CONCLUSION

This study found 50% overall prevalence of anaemia in adolescent girls of 10-19 years. Severity of anaemia is more in 10-14 years of age group in comparison to 15-19 years age group. This needs more emphasis on 10-14 years adolescent girls to combat anaemia, increase productivity, reduce morbidity and mortality and improvement of health status of next generation child.

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