Research Article

An Epidemiological Study of Iron Deficiency Anaemia in Adolescents- Tertiary Care Centre Study

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ABSTRACT

Background: Adolescents constitute over 21.4% of the population in India. This age group needs special attention because of the turmoil of adolescence, which they face the different stages of development, different circumstances, their different needs. Anaemia leads to poor cognitive function and motor development outcomes in adolescents. Iron deficiency anaemia is most common anaemia out of all nutritional anaemia1

Method and Material: It was a single centre cross-sectional, clinical observational study done in Department of pediatrics and Medicine, Assam Medical college and Hospital, Dibrugarh, Assam, during the period 1st june 2021 to 31thMay2022 (12 months). A sample of 200 patients were included in the study. A detailed clinical history and physical examinations were carried out. All cases are selected according to inclusion and exclusion criteria from outdoor and indoor after evaluation and informed consent was taken enrolled for study. Ethical committee permission was taken before conducting the study. Complete blood count, serum ferritin, and anthropometric measurement, food habits, socioeconomic status was taken. All data are put in predesigned proforma and analysed in Microsoft excel and Statistical Package for Social Sciences (SPSS for Windows, version 20.0, Chicago, SPSS Inc.).

Results: Out of 200 adolescents prevalence of anaemia in adolescents is 51%.Prevalence of IDA in all anaemic adolescents is 34.3% and non IDA (other anaemia).IDA in male adolescents is-16.5% and that of female adolescents is 18.8%.Female adolescents of 14-18 years having higher rate of IDA. Consumption of junk food associated with high prevalence of IDA. Adolescents has low BMI developed -60% IDA, Overweight-14.2% IDA and Normal BMI-7% IDA. Upper lower and lower socioeconomic class having high prevalence of IDA.

Key Words: *Prevalence, iron deficiency anemia (IDA), Adolescents.SD-standard deviation, BMI- body mass index*

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INTRODUCTION

Anaemia is a condition in which the haemoglobin (Hb) concentration in the blood is lower than the normal value for the age and gender. Anaemia afflicts approximately one-third of the world's population with over 800 million women and children affected[1,2].

When haemoglobin concentrations in RBC decrease, the capacity of the HB molecules to carry oxygen decreases and tissue demand is not met, resulting in symptoms such as generalised weakness, fatigue, reduced physical working capacity, and shortness of breath, among others[2].

Anaemia was estimated to account for more than 68 million disabled people per year in 2010, which was more than the combined estimate for major depression, chronic respiratory diseases, and injuries[1].

Adolescents constitute over 21.4% of the population in India. This age group needs special attention because of the turmoil of adolescence which they face the different stages of development, different circumstances that they come across, their different needs and diverse problems. Women's health is particularly vulnerable during adolescence because of a growth spurt, the onset of menstruation, low iron intake brought on by unhealthful eating choices, and gender bias. In India, more than 60% of adolescent girls suffer from iron deficiency anaemia. The anaemic teenage females have impaired growth and development as they mature into adult women. Both physical and emotional health are impacted[1].

Anaemia is leads to poor cognitive function and motor development outcomes in children, can cause fatigue, low performance, and productivity during pregnancy, and is linked to poor birth outcomes (including low birth weight and prematurity) as well as maternal and perinatal mortality[3].

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Therefore, anaemia has a substantial impact on both human health and the social and economic advancement of low- and middle-class families.

In many low- and middle-income nations, women and adolescents frequently consume diets with low levels of bio available iron[4].

Adolescents' eating habits are also influenced by a variety of factors, such as their own self-esteem and body image, which cause them to skip meals in an effort to lose weight, and peer pressure, which encourages them to engage in unhealthy eating behaviours that put them at risk for iron deficiency anaemia.

The high prevalence is primarily caused by poverty, inadequate diet, pregnancy and breastfeeding, late diagnosis, and limited access to health services in developing nations, including India[5].

In adolescence, development occurs in three periods and these are shown in Table 1.1.

Table 1.1: Periods of development in adolescence[14]

Early adolescence	(10 -13 years)
Middle adolescence	(14 – 16 years)
Late adolescence	(17 -19 years)

One of the micronutrients is iron. It is employed in the production of haemoglobin, the movement of oxygen, the growth of the brain, the control of body temperature, and the contraction of muscles. Iron deficiency is referred to as a decrease in the body's iron levels. The most frequent etiological factor for anaemia is iron deficiency. Iron deficiency anaemia is the term used to describe the low haemoglobin level[6].

EPIDEMIOLOGICAL FACTORS OF IRON DEFFICIENCY ANAEMIA AMONG ADOLESCENTS:[1,3]
1) **Decrease iron in diet**: Pure vegetarian diet, poor intake, diet rich in soyabean, Binge eating , fear of obesity, junk foods etc
2) **Poor absorption:**Foodcontainingphytates,tannin,polyphenols,malabsorption syndrome etc
3) **Blood loss:** Menorrhagia, Gastric erosion, haemorrhoids, haematuria etc
4) Poor socioeconomic status of family.
5) History of worm infestation

JUSTIFICATION: In a comprehensive national nutrition survey in 2016-2018 as "**Adolescents, diets and nutrition**" contributed by **MoHFW**(govt.of india), **UNICEF** and **POPULATION COUNCIL** combine study issued as CNNS thematic report in January 2019 that prevalence of anaemia among adolescents in Assam average is 38.05% out of which iron deficiency anaemia average in adolescents is-14.5%**[1].** Therefore this study is planned to find out the proportion of anaemia, iron deficiency anaemia among adolescents and epidemiological factors associated with it and their correlation with iron deficiency anaemia (IDA)in this region of Assam.

AIMS AND OBJECTIVES:
AIM: To study the epidemiological factors of iron deficiency anaemia amongst adolescents attending the department of paediatrics and medicine**.**

OBJECTIVES:
Primary: To determine the epidemiological profile of iron deficiency anaemia among adolescents attending Outdoor and Indoor in the department of paediatrics and medicine.

Secondary: To assess the proportion of iron deficiency anaemia amongst adolescents attending Outdoor and Indoor of the department of paediatrics and medicine.

MATERIALS AND METHODS:
1) **PLACE OF STUDY** **:** Department of Paediatrics and medicine, Assam Medical College and Hospital, Dibrugarh

2) **DURATION OF STUDY:**One year

3) **TYPE OF STUDY** **:** Hospital based cross sectional study.

4) **STUDY POPULATION :** Adolescents(10 -18 years) attending the Department of Paediatrics and Medicine of

Assam Medical College & Hospital, Dibrugarh, fulfilling the inclusion and exclusion criteria.

5) **Sample size**: Considering 95% confidence interval with absolute precession of 5% and proportion of iron deficiency anaemia in adolescents average to be 14.5%[**1**]. Sample **size** is calculated and rounded of to be two hundred**.**

6) **Inclusion criteria**:
   a) Children between 10 to 18 years age group.
   c) Haemoglobin levels below the following cut-off values:

   Girls aged 10-18yrs Hb<12gm/dl
   Boys aged 10-14 years Hb<12gm/dl
   Boys aged 15-18 years Hb <13gm/dl

7) **Exclusion criteria**:
   a. Children less than 10 years and more than 18 years
   b. Those not giving consent
   c. Those with known haematological disease (alastic anaemia, thalassemia, polycythemia, haemophillia, leukemia etc.) and/or evidence of apparent chronic infection (chronic kidney disease, anamia of chronic disease, Tuberculosis, malaria etc)

Case definition :
Anaemia – define as a reduction of haemoglobin concentration or red blood cell(RBC)

Volume below the range of values occurring healthy persons according to age and sex[7].

According to the World Health Organization criteria, anemia is defined as blood hemoglobin (Hb) concentration <130 g/L (<13 g/dL) or hematocrit (Hct) <39% in adult males; Hb <120 g/L (<12 g/dL) or Hct <37% in adult females[1].

Girls aged 10-18yrs Hb<12gm/dl
Boys aged 10-14 years Hb<12gm/dl
Boys aged 15-18 years Hb <13gm/dl

population	Non anamia	Mild anamia	Moderate anamia	Severe anamia
5-11 years	≥11.5	11-11.4	8-10.9	<7
12-14 years	≥ 12	11-11.9	8-10.9	<8
More than 15 years	≥ 13	11.12.9	8-10.9	<8

Fig: WHO classification of anaemia according to age and severity[8].

Selection of cases: All adolescents selected randomly from OPD and IPD after conselling for participating in the study, consent was taken, enrolled for study Detailed clinical examination of the adolescents was performed. In General Examination special emphasis was given on pallor, koilonichiya, brittle nail, exertion, palpitation, hook worm infestations, junk foods, food habits, socioeconomic status etc.. Systemic Examination includes cardiovascular System, gastrointestinal system and Respiratory System. The findings were recorded in the predesigned proforma, Once my target was over, I stopped case enrolment for my study.

Laboratory criteria[8]:
➢ Haemoglobin gm/dl%(below cut off levels according to age and sex)
➢ Mean corpuscular volume (MCV)(<80 fl)and
➢ Low serum ferritin<15μg/l or (<30 ng/ml), in absence of inflammation of patient

Methodology :
   Ethical clearance : Institutional Ethics Committee (human) clearance has been taken before conducting study.
   Consent: Children fulfilling the inclusion criteria were identified. Informed and written consent were taken from the parents / guardian after explaining properly about the study. These cases were then enrolled in the study.
   a) After enrolment of the case a detailed history was taken including family history, genetic disease, tuberculosis and chronic diseases etc

   b) Hb(gm/dl),MCV,{automated analyzer}**:**
   An automated haematological analyzer typically performs the CBC, counting cells and gathering data on their size and composition. Hemoglobin concentration is measured, and the measurements of red blood cells and haemoglobin are used to calculate the red blood cell indices.

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c) **SERUM FERRITIN (IMMUNE ELIZA)** :According to the Assam Medical College's and Hospital's accepted standard procedure. Using Roche kits and the Hitachi 912 clinical analyzer, immuno-turbidimetry is the method of choice for measuring ferritin. Antigen/antibody complexes are created when latex-bound ferritin antibodies interact with the antigen in the sample. This is turbidimetrically measured after agglutination. Using commercial kits and the COBAS E411 analyzer, serum ferritin was quantified (Roche diagnostics, Germany). Test principle: Sandwich principle, Total duration of assay: 18 minutes.

d) **Body Mass Index (BMI):** A digital weighing scale was used to measure weight, and it was kept on a stable level surface and regularly compared to known weights. It was done three reads. In order to measure individuals' height, they were instructed to stand on a stadiometer with their backs to the wall, heels together, and gaze ahead. Height was recorded to the nearest cm. Three readings on average were taken. Using the formula below, the BMI was determined for the appropriate weight (in kg) and height (in metres).
BMI = kg of weight/
Length in metre[9].
Body Mass Index is based on the updated consensus recommendations for Indian paediatric age group chart (2015-IAP).

e) The received data was recorded in predesigned proforma.

f) Data was analysed and tabulated at the end of study.

SAMPLECOLLECTION :

About 4ml of blood will be collected for 2 samples one in EDTA containing vial 2ml another in clot activator vial 2ml from each child from peripheral veins after proper aseptic and antiseptic method.

Statistical analysis: Statistical Package for Social Sciences (SPSS for Windows, version 20.0, Chicago, SPSS Inc.) and in word used to perform the statistical analysis of the data. The mean and standard deviation of results for continuous measures. Discreate data are analysed using the Chi square test and Fischer's exact test (where the cell counts were 5 or 0), and they are represented as percentages. The level of statistical significance for each analysis was set at 5% ($p\ 0.05$).

RESULTS AND OBSERVATION :

TOTAL POPULATION	Number(N)	prevalence
Anaemic adolescents	102	51 %
Non Anaemic adolescents	98	49%

Fig:1-Prevalence of anaemia in adolescents

Table: 2-Severity of anaemia of adolescents according to gender (*fisher's exact test)

Severity of anaemia	Mild		Moderate		Severe		p-value
	N	%	N	%	N	%	
Male(115)	32	27	21	18.2	7	6	0.045
Female(85)	12	14	22	25.8	8	9.4	

Table:3 Prevalence of IDA and Non IDA

Population (200)	Number	Prevalence
Adolescents with IDA	35	17.5%
Adolescents without IDA	165	82.5%

IDA	Number	prevalence
male	19	48.5%
Female	16	51.5%

Fig : 4- prevalence of IDA as per gender

Parameters	IDA mean SD	Non IDA mean SD	P- value
Hb -gm/dl	8.91± 1.39	11.70±1.25	0.001
MCV-fl	49.38±9.78	71.59±8.90	0.001

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Fig : 5 Relation between IDA and Non IDA adolescents with parameters

Table:6- Junk food and relation withIDA and non IDA in adolescents

Junk food	Number	IDA	Non IDA	P value
YES	116	31	60	0.0026
NO	84	4	42	

Table : 7- Co-relation of BMI and IDA and without IDA

BMI	IDA	Without IDA	Prevalence IDA	P -value
LOW(38)	23	15	60%	
NORMAL(155)	11	144	7%	<0.001
OVER WEIGHT(7)	1	6	14.2%	

Population of IDA	IDA	Without IDA	P-value
Helminthiasis	20	49	0.0037
No helminthiasis	15	116	

Fig: 8-Prevalence of IDA and without IDA in helminthiasis

Socioeconomic class	IDA	Prevalence
Upper class(7)	0	0%
Upper middle(20)	1	5%
Lower middle(32)	3	9.3%
Upper lower(87)	12	13.7%
Lower(54)	19	35.1%

Fig: 9- Prevalence of IDA according to socioeconomic class

DISCUSSION:

This study present hospital based cross sectional study was undertaken to study the epidemiological factors of iron deficiency anaemia amongst adolescents attending the department of paediatrics and medicine and data were analysed , compared with the age, gender and epidemiological parameters are also compared with different group of adolescents . The similarities of findings are noted and the disparities which were observed are tried to explain as far as possible with detailed discussion.

1) Prevalence of anaemia in adolescents

Prevalence of anaemia amongst the adolescents in this region is 51% which is approximately similar to different studies like UNISCEF with ministry of govt. of India conducted "Adolescents, diets and nutrition: growing well in a changing world" conducted 2016 to 2018 stated that anemia affects 32% girls 10-14 years and 48% girls 15-19 years. Among boys 10-19 years, ~20% are anaemic[1]. CNNS thematic report in January 2019 prevalence of anaemia among adolescents in Assam average is 38.05%.

In another National level surveys (DLHS-2 and NNMB) conducted in 2002 documented that the overall prevalence of anemia was in the range of 69-98% amongst adolescent girls[10].

NFHS-4 (2015-2016) reported an insignificant decreased (2%) over last 10 years in the prevalence of anemia amongst adolescent girls in the age group of 15-19 years (54%)[11].

2) Severity of anaemia amongst adolescents

It has been seen that most of anaemic adolescents having mild anaemia followed by moderate and severe anaemia. Severe form of anaemia more in older age group of adolescents which is similar to different study conducted in different state of India for nutritional survey[1].

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In another study Prevalence of anaemia in adolescent girls 2020 in age-wise distribution of anaemia showed prevalence of anaemia was highest (69%) in 18 - 19 years age group and least (37.5%) in the age group of 16 to 17 years. Most of subjects with anaemia were having mild anaemia (80.2%) followed by moderate anaemia (19.2%) and severe anaemia (0.6%) [12].

3) Prevalence of IDA amongst adolescents
Prevalence of IDA amongst the adolescents in my study is 17.5% which is nearly consistent with the UNICEF study for Assam as average of 14.5 % for all adolescents of different region of assam[1].

In another WHO study 2016 in India Iron deficiency affects 24% of females aged 10 to 14 and 39% of girls aged 15 to 19. Boys aged 10 to 19 who are iron deficient make about 10% of the population[8].

4) IDA and Non IDA (other nutritional anaemia) proportion is evaluated. It has been seen that out of all nutritional deficient anaemia about 35% adolescents having IDA and 67% non IDA.

It was found that than 50% IDA amongst the anaemic adolescents in different region of India and for Assam it is about 40% in an average UNICEF study from 2016 -20018 in india[1].

According to the most recent NNMB 2012 data, more than 60% of Indian adolescent boys and girls consumed less iron than the RDA. Only 20% of them exceeded the RDA for iron by more than 70%[60].

5) IDA according to gender and age
In my study it has seen that IDA
                    10-13 years girls—18.3% amongst girls
14-18 years girls---61% amongst girls
                    10-18 years male ----37% amongst males

In UNICEF study 2016 -2018 in[1]
Iron deficiency affects 24% girls 10-14 years and girls 15-19 years ~59%
10% boys 10-19 years are iron deficient.
In another study 4th April 2021 published

Girls had almost a three times higher prevalence of iron deficiency anaemia compared to adolescent boys (31% vs. 12%). Around 12% of adolescents had anaemia and iron deficiency, 10% were iron deficient[10].

6) junk food relation with iron deficiency anaemia
In my study it is seen that junk food consumption associated with IDA and is more prevalent than other anaemia. It is statically significant P- value <.0026. It also found IDA is more common in daily consumption of junk food rather than those 3 days in a week.

In study like UNISCEF with ministry of govt. of India conducted "Adolescents, diets and nutrition: growing well in a changing world" conducted 2016 to 2018 stated that two percent adolescents reported at least thrice a week consumption of junk foods. Adolescent girls and boys consumption junk food having more prone to developed anaemia and IDA[1].

In another study It was revealed that the adolescents consume junk food more calories, fats and carbohydrates and less proteins, vitamins, iron and dietary fibre as per RDA requirements which is a serious concern and which may also be another predisposing factor for development of obesity and anaemia[14].

10) IDA with relation to BMI[15]
In our study it has been seen that IDA is most common in low BMI(60%) followed by over weight(14.2%) adolescents rather than normal BMI(7%) adolescents. It is statically significant p -value is <0.001
It also consistent with study of UNISCEF with ministry of govt. of india conducted "Adolescents, diets and nutrition: growing well in a changing world" conducted 2016 to 2018 stated that IDA is more common in low BMI and over weight adolescents[1].

7) Helminthiasis related to IDA
In our study found that helminthiasis is a etiological factor of IDA as it statistically significant.
It is also mention in study UNISCEF with ministry of govt. of india from 2016-2018 stated that hook worm infestation and other disease causes of blood losses was associated with IDA.

CONCLUSION

The present study was conducted to assess - the clinico-epidemiological factors of iron deficiency anaemia amongst adolescents attending OPD and IPD in the department of paediatrics and medicine Assam medical college and Hospital and compared with findings of other studies.

In our study found that 17.5% adolescents has iron deficiency anaemia.
And prevalence of anaemia amongst adolescence in this part of north-east 52%.
Amongst all anaemic adolescents IDA is- 34.4%
Majority of study subjects having mild to moderate anaemia.

Female adolescents has higher rate of IDA compare to male adolescents and 16-18 years age group male population has higher rate of IDA than female adolescents.

Adolescents belongs to lower socioeconomic class and poor hygienic condition had a significant association with high rate of IDA.

Certain food habits are significantly associated with higher rate of IDA like junk foods, vegetarian diet and tea intake within one hour of food.

Few study results are not statistically significant most of results are statistically significant.

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