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Original Research Article

Prevalence of iron deficiency anaemia among school going adolescent girls: a cross sectional study

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ABSTRACT

Background: The field of nutrition of women in India that has been sadly neglected pertains to the adolescent girls. The adolescent girls, the young women, the mothers to be, represent an age group which experience a crucial phase of growth. Iron deficiency anaemia is a highly prevalent and seemingly intractable problem, particularly among females of reproductive age group in developing countries. Following early childhood, during the adolescent growth spurts, the risk of iron deficiency and anaemia reappears for both boys and girls, after which it subsides for boys but remains for girls because of menstrual loss. Aim of the study was to find the prevalence of iron deficiency anaemia among school going adolescent girls in the field area of National Institute of Unani Medicine, Bangalore.
Methods: The present study is an observational, cross-sectional, school health survey undertaken to know the prevalence of iron deficiency anaemia among adolescent girls in the field area of NIUM. The present study was completed within a period of 6 months from August 2008 to January 2008. Prevalence of IDA was determined on the basis of RBC indices (MCV, MCHC) and erythrocyte morphology, evaluated from the points of anisocytosis, poikilocytosis, hypochromia and microcytosis on peripheral blood smear examination.
Results: In the study population (240 girls), 25% (60) subjects were affected with various grades of anaemia, i.e., 20.4% (49) were mildly anaemic and 4.6% (11) moderately anaemic. There was no case of severe anaemia. The prevalence of IDA was seen in 11.6% of study population.
Conclusions: The present study provides an indication to initiate the anaemia prophylaxis measures for adolescent girls in India including nutrition education in schools. Adolescent girls should be a target group in any programme that builds demand for sustaining iron supplementation or higher dietary intake.

Keywords: Adolescents, Prevalence, Anaemia, Iron deficiency anaemia

INTRODUCTION

Iron deficiency anaemia is the most common form of malnutrition in the world.[1] It is a condition where blood haemoglobin levels are lower than normal with the dominant cause being iron deficiency.[2] Anaemia with prevalence of 43% in developing countries and 9% in developed nations is a major public health burden in the worldwide.[3] Iron deficiency anaemia (IDA) is widespread in individuals at any stage of life, with greater susceptibility to pregnant-reproductive women and young children, thereby increasing the risk of impaired cognitive and physical development and increased mortality and morbidity rate.[4] The aetiology of anaemia is multifactorial: inherited (Thalassemia and sickle cell), infections (malaria), autoimmune (hemolytic anemia), socioeconomic, demographic, and nutritional (iron, folic acid, and vitamin B12 deficiencies), malabsorption (achlorhydria), chronic diseases (cancer).[5]

Adolescents are vulnerable to ID because of increased iron requirements related to rapid growth. Iron needs are highest in males during peak pubertal development owing to a greater increase in blood volume and myoglobin. After menarche, iron needs continue to remain high in females on account of monthly menstrual blood loss, which averages about 20 mg per month, but may be as high as 58 mg in some individuals. In-spite of increased iron needs, many adolescents, particularly females, may have iron intake of only 10-11 mg per day, out of which 1mg will be absorbed approximately.[6-8] Iron deficiency causes great morbidity in all age groups and adversely affects immune status, physical capacity and work performance of adolescents.[9-11]

Until today, IDA is still the most prevalent and common type of micronutrient deficiency in the developing countries, which results from long-term negative iron imbalance. Usually, deficiency of iron develops gradually and does not have clinically apparent symptoms until anaemia becomes severe. Iron deficiency occurs when the iron losses and requirements, either physiological or pathological, exceeds the amount of iron absorbed from dietary sources. Today, the typical diet of most inhabitants of developing countries is based on cereals or roots and tubers, with little or no meat, fish and ascorbic acid, and with high iron inhibitors. Such a dietary pattern is a major reason for the high prevalence of IDA in economically deprived countries. The presence of parasitic infestation and malaria further aggravates the situation.[12]

Adolescent girls are being targeted for reduction of IDA before childbearing which complements the ongoing efforts to address the problem during pregnancy and infancy because many girls are often already anaemic by the time they become pregnant. Secondly, pregnancy is too short period of time to reduce pre-existing anaemia, particularly when many women do not seek prenatal care until their second or third trimester.[13] Anaemia has been shown to affect mental development and learning capacity. In infancy it may cause a permanent loss of IQ later in life, shortened attention span, irritability, fatigue, difficulty with concentration, lethargy, weakness and increased susceptibility to infection. Consequently, anaemic children tend to do poorly on vocabulary, reading, and other tests.[14] The WHO/ world bank-supported analysis of the global burden of disease ranked IDA as the third leading cause of disability-adjusted life years (DALYs) for females aged 15-44 across the globe.[1] Numerous studies among adolescent girls have shown that the prevalence of anaemia ranges from 22-85% in India.[3,15]

Limited work has been done so far to know the prevalence of IDA among adolescent girls in Karnataka. Many adolescents are in school, which provides an effective and efficient opportunity for reaching target population. Above all, schools are generally considered as one of the most significant social institutions where the development of knowledge and skills, which promote health and prevent disease, can be addressed. Present study is a cross-sectional study carried out to know the prevalence of IDA among school going adolescent girls and to correlate their relation to variables such as: age, social habits, nutritional habits and etiological factors.

METHODS

A school based cross-sectional study was conducted in the field practice area of NIUM during August 2008 to January 2009. Before embarking upon the project, a comprehensive protocol was checked out and put forth for the ethical clearance from the institutional scientific committee of NIUM, Bangalore. After ethical clearance study was started. Students were informed about the study and consent forms were distributed and they were asked to get it signed by their parents/guardians. Through pretested and semi-structured questionnaire, information related to demography, anthropometry, personal history, menstrual history and medical history was obtained. Venous blood samples were drawn for the laboratory investigations. Awareness regarding nutritious diet was created through the lectures delivered to the girls. Informed consent was obtained from the study participants and they were assured of confidentiality and privacy of records.

Sample size

Sample size was calculated taking the studies conducted on the prevalence of anaemia in Vellore (29%), Chandigarh (24%) and Bangalore (39%) as the reference.[15-17] The sample size, at 5% significance level with the permissible error of 20%, was calculated by using formula, $N=4pq/L^2$ (p=present prevalence, q=100-p, L=20% of p). Total 240 subjects were included in this study, which is approximate to the calculated sample size (226).

Inclusion criteria

School going adolescent girls (age 12 to 18 years) were included in the study.

Exclusion criteria

Boys of any age group, girls below 12 years and above 18 years of age and those girls who refused to give consent for participating in the study, were excluded.

The 240 adolescent girls from one government and three private schools were included in the study. A detailed, semi-structured questionnaire was developed, keeping in view the objectives of study. The questionnaire consists of the information regarding demographic profile, family status, anthropometry, personal history, dietary history, relevant history, physical examination, systemic examination and investigations. For taking blood samples, veins of antecubital fossa- median cubital and

cephalic veins were mostly preferred for drawing blood. Tourniquet was applied on her brachium and she was asked to tie a fist. Then the venepuncture site was cleansed with spirit swab and under strict aseptic precaution, 3 ml blood was drawn, tourniquet was removed, and clean sterile cotton ball was placed at the site. Blood was poured immediately into the K_3 EDTA vial and mixed properly in a gentle manner. Slides for peripheral examination were prepared on spot and then stained with Leishman's stain. EDTA blood was analyzed in MDC-4000, 21-parameter, automated haematological analyzer for estimation of Hb, MCV, MCHC and RBC count. Slides were examined for the morphology of RBC's under oil emersion, high power field microscopy by a cytologist under strict quality control. WHO cut-off values of haemoglobin was used for grading of anaemia into mild (Hb 10-11.9 gm/dl), moderate (Hb 7-8.9 gm/dl) and severe (Hb<7 gm/dl).[18,19] Prevalence of IDA was determined on the basis of RBC indices (MCV, MCHC) and erythrocyte morphology, evaluated from the points of anisocytosis, poikilocytosis, hypochromia and microcytosis on peripheral blood smear examination.[20]

Analysis of data

Statistical analysis was performed with Graph Pad Instat demo version 3.00 for Windows (Graph Pad software, San Diego Calif. USA). Results were evaluated and presented in tables and figures in accordance to the purpose of the study. Chi Square test was used. The confidence level was set to <0.05 to define statistical significance.

RESULTS

For better correlation and computation of data total number of participants were divided into 2 subgroups early adolescents (11-14 years), late adolescents (15-18 years).

Table: 1: Distribution of adolescent girls according to age.

Age (Years)	N	Percentage (%)
11-14	186	77.5
15-18	54	22.5
Total	240	100

In present study of 240 girls, 60 were vegetarian and remaining 180 were non-vegetarian, shown in the in Table 2.

Table: 2: Type of diet.

Diet	N	Percentage (%)
Vegetarian	60	25
Non-vegetarian	180	75
Total	240	100

Table 3: Distribution of participants as per the probable aetiology of iron loss or poor iron absorption.

Aetiology	Yes		No	
	N	%	N	%
H/o bleeding	32	13.33	208	86.67
H/o worms in stool	31	13	209	87
H/o walking barefoot	65	27.08	175	72.92
H/o tea/coffee intake	41	17.08	199	82.92
H/o drug intake	26	10.83	214	89.17

Among 240 participants, 60 (25%) were anaemic, 49 (20.4%) had Mild anaemia, 11 (4.6%) had moderate anaemia. There was no case of severe anaemia. Iron deficiency anaemia was seen in 27 (11.25%) adolescent girls.

Table 4: Prevalence of severity of anaemia according to WHO cut-off.

Results	N	Percentage (%)
Mild anaemia	49	20.4
Moderate anaemia	11	4.6
Severe anaemia	0	0
Total anaemia	60	25
Non-anaemia	180	75
Iron deficiency anaemia	27	11.25

In the study population, the overall prevalence of anaemia in vegetarian was 31.6%, out of which 21.7% were mildly anaemic, 10% moderately anaemic and 20% had IDA. Among non-vegetarians, the overall prevalence was 22.8%, out of which 20% were mildly anaemia, 2.8% were the moderately anaemic as well as 8.3% had IDA.

In the study population, 13.33% (32) subjects gave the positive H/O bleeding 13% (26) of worms in stool, 27.08% (65) of walking barefoot, 17.08% (41) of intake of tea/ coffee immediately after intake of food and 10.83% (26) of drug (NSAID, antacids) intake.

Table 5: Socio demographic distribution and prevalence of anaemia and IDA among participants.

Variables	Mild anaemia, n (%)	Moderate anaemia, n (%)	Severe anaemia, n (%)	IDA, n (%)
Age (Years)				
11-14	40 (21.50)	10 (5.38)	0 (0)	26 (13.98)
15-18	9 (16.67)	1 (1.85)	0 (0)	1 (1.85)

Continued.

Variables	Mild anaemia, n (%)	Moderate anaemia, n (%)	Severe anaemia, n (%)	IDA, n (%)
Diet				
Vegetarian	13 (21.7)	6 (10)	0 (0)	12 (20)
Non-vegetarian	36 (20)	5 (2.8)	0 (0)	15 (8.3)
Social class*				
I	0 (0)	0 (0)	0 (0)	0 (0)
II	5 (20)	0 (0)	0 (0)	1 (4)
III	18 (20)	5 (5.56)	0 (0)	12 (13.3)
IV	25 (21)	6 (5.04)	0 (0)	14 (11.76)
V	1 (33.33)	0 (0)	0 (0)	0 (0)

*Kuppuswawamy's socioeconomic Status Scale (Modified for 2007).

Table 6: Prevalence of anaemia and IDA according to probable aetiology.

Aetiology		Anaemic				IDA	Non-IDA
		Mild, n (%)	Moderate, n (%)	Total, n (%)	Non-anaemic, n (%)		
H/o bleeding	+	7 (21.9)	3 (9.4)	10 (31.25)	22 (68.75)	5 (15.6)	27 (84.4)
	-	42 (20.2)	8 (3.8)	50 (24)	158 (76)	22 (10.6)	186 (89.4)
H/o worms in stool	+	9 (29)	4 (13)	13 (42)	18 (58)	9 (29)	22 (71)
	-	40 (19.1)	7 (3.3)	47 (22.5)	162 (77.5)	18 (8.6)	191 (91.4)
H/0 walking barefoot	+	14 (21.5)	5 (7.7)	19 (29.2)	46 (70.8)	13 (20)	52 (80)
	-	35 (20)	6 (3.4)	41 (23.4)	134 (76.6)	14 (8)	161 (92)
H/o tea/ coffee intake	+	12 (29.3)	2 (4.9)	14 (34.2)	27 (65.9)	6 (14.6)	35 (85.4)
	-	37 (18.6)	9 (4.5)	46 (23.1)	153 (76.9)	21 (10.5)	178 (89.4)
H/O drug intake	+	3 (11.5)	2 (7.7)	5 (19.2)	21 (80.8)	2 (7.7)	24 (92.3)
	-	46 (21.5)	9 (4.2)	55 (25.7)	159 (74.3)	25 (11.7)	189 (88.3)

DISCUSSION

The present study was a cross-sectional school-based survey, embarked to know the prevalence of iron deficiency anaemia among adolescent girls in the field area of NIUM. Study population comprised of females of 12-18 years age group. The study showed an overall 25% prevalence of anaemia among adolescent girls, out of which 20.4% were mildly anaemic, 4.6% were moderately anaemic and no case of severe anaemia was found among them. IDA was seen in 11.25% of adolescent girls. Basu et al reported 23.9% prevalence of anaemia and 11.4% prevalence of IDA in school going adolescent girls of Chandigarh in 2005.[16]

The prevalence of anaemia and IDA found in this study is almost similar to the prevalence documented by Basu et al.[16] Whereas, in present study, prevalence of anaemia and IDA is lower than the figures reported in other studies conducted in different parts of the country. The reason could be that Bangalore is a prosperous part of South India and this area is not endemic for malaria, hookworm infestation and haemoglobinopathies.

The limited data on prevalence of anaemia in adolescent girls from Bangalore suggests that present prevalence is more than the prevalence reported by Muttayya et al who found low anaemia prevalence (15.3%) in school-aged girls in Bangalore.[21] The reason could be due to an impact of the twice-yearly school-based intervention programme (deworming and vitamin A supplementation) that have been in place since 2003. Another study from Bangalore conducted by Thankchan et al in the same year documented 39% prevalence of anaemia and 37.5% prevalence of IDA in young women.[17] The reason for high anaemia prevalence in the above cited study could be because only the females of low socio-economic status were included in that study.

Age wise, maximum number of girls in present study belonged to 11-14 years age group (77.5%) as compared to 15-18 years age group (22.5%). In 11-14 years, age group, 26.9% of girls were found to be anaemic with 21.5% having mild anaemia and 5.38% having moderate anaemia. IDA was seen among 26.9% girls. Among the girls of 15-18 years of age group, anaemia prevalence was found to be 18.52%, out of which 16.67% were mildly anaemic and 1.85% were moderately anaemic. IDA was seen among 18.52% of girls. The increased prevalence among the younger age group may be owing to the fact that due to enhanced growth needs for iron, low intakes of iron and/or iron losses due to menstruation, the girls in this age group are at an increased risk. However, the observed difference of anaemia between two age groups was not found significant on the statistical ground ($p>0.05$), but

statistically significant difference was seen for the prevalence of IDA ($p<0.05$).

Shah et al in a preliminary report from Nepal and Goel et al documented that mean Hb level among adolescents increased with increase in age and the prevalence of anaemia decreased with age.[22,23] Similarly, a decreased prevalence of anaemia with increased age of adolescent was noticed by Rajarthan et al.[24] Present study is in accordance with above cited studies. The study conducted by Sidhu et al.[25] On the prevalence of anaemia among adolescent girls of schedule cast community of Punjab documented an increased prevalence of anaemia from 11+ to 15+ ages. The variation of present study from this study may be owing to the fact that it included girls of early adolescent age group only (11-15 years).

Study population were unevenly distributed among various socio-economic classes. 1.25% belonged to socio-economic class I, 10.4% to socio-economic class II, 37.5% to socio-economic class III, 49.6% to socio-economic class IV and 1.25% girls were from socio-economic class V. Anaemia prevalence increased from socio-economic class I to socio-economic class V, maximum prevalence was in socio-economic class V (33.33%) and minimum in socio-economic class I (0%). The anaemia prevalence in socio-economic class II, III and IV was 20%, 25.56% and 26.05% respectively. IDA was maximum in socio-economic class III (13.33%), followed by IV (11.76%), II (4%), with no prevalence in I and V. This may be due to better availability of food in better socio-economic class. Also, in upper socio-economic class mothers were mostly educated and they may be more aware of the nutritional requirements of girls. The difference between various socio-economic classes was statistically insignificant ($p>0.05\%$).

Similar findings were seen by Kaur et al who observed an increasing trend of anaemia prevalence from socio-economic class I (1.9%) to IV (33.2%).[26] Basu et al also documented an increased anaemia prevalence in adolescent girls of rural area of Chandigarh (34.2%) where majority were from lower- and middle-income groups as compared to urban girls (23.9%) who were from middle- and high-income group.[16]

In this study, majority of girls were non-vegetarian (75%) and only few (25%) were vegetarian. Prevalence of anaemia among vegetarians was 31.6%, out of which 21.7% were mildly anaemic and 10% were moderately anaemic. 20% of girls among them had IDA. Whereas, 22.8% prevalence of anaemia was seen among non-vegetarians, out of them 20% had mild anaemia, 2.8% had moderate anaemia and 8.3% had IDA. Anaemia and IDA prevalence was higher among vegetarian than in non-vegetarians. Lack of heme iron derived from animal food coupled with increased use of iron absorption inhibitors like tamarind and coconut, which is widely used in South Indian food, can be the reason for increased prevalence among vegetarians. The difference was found statistically significant for IDA ($p<0.05$) and non-significant for anaemia ($p>0.05$).

The 13.33% subjects in the present study gave the H/O bleeding from various sites, mostly gums and nose, and 86.67% subjects did not give any such history. Anaemia prevalence among those who gave H/O bleeding was 31.25% and 15.6% had IDA. On the other hand, 24% and 10.6% anaemia and IDA prevalence was seen among those who had no such history. The reason could be either because of iron losses directly or indirectly due to vitamin C deficiency as it is one of the causes of bleeding gums and also impairs iron absorption. But the findings were not statistically significant ($p>0.05$).

History of worm infestation was given by 13% study population and remaining 87% had no history of worm infestation. Statistically significant ($p<0.05$) prevalence of anaemia and IDA was seen among girls with history of worm infestation i.e., 42% and 29% respectively than those with no history of worm infestation i.e., 22.5% and 8.6% respectively. This can be explained by the fact that worm infestation causes blood loss via GIT and also impair iron absorption from the intestine.

Layrisse and Roche demonstrated that with the egg counts of over 2000/g of faeces, there was a significant correlation between severity of infestation and degree of anaemia.[2] Kaur et al also found worm infestation as an important etiological factor of anaemia. Similar correlation between worm infestation and degree of anaemia was seen in the study of Goel et al.[19,23]

In present study, 27.08% girls had habit of walking barefoot and 72.92% had no such habit. The prevalence of anaemia and IDA among those walking barefoot was 29.2% and habit of walking barefoot was 23.4% and 8% respectively. The increased prevalence among those walking barefoot could be due to hookworm infestation which gains access to the body through cracks in feet. The difference in IDA prevalence between two groups was statistically significant ($p<0.05$), but the observed difference in prevalence of anaemia was statistically insignificant ($p>0.05$).

Among the study population, 17.08% girls used to take tea/coffee immediately after food and 82.92% were not. Among the tea/coffee users, anaemia prevalence was found to be 34.2% while as 14.6% had IDA. Among those who were not taking tea/coffee, anaemia and IDA prevalence was 23.1% and 10.5% respectively. The increased prevalence of anaemia and IDA among those taking tea/coffee immediately after food could be because of interference in the dietary bioavailability of iron by tannin content of tea/coffee. However, the difference was not statistically significant ($p>0.05$).

Study from Ahmadabad by Verma et al on factors affecting anaemia prevalence among girls of age 6-18 years and the study of Kay also documented significantly

higher prevalence of anaemia among those having habit of consuming tea/coffee.[27,28]

The present study reveals that 10.83% adolescent girls used to take drugs (NSAIDs/antacids) and remaining 89.17% were not taking any medicines. Among the medicine users, anaemia and IDA prevalence was seen to be 19.2% and 7.7% respectively. On the other hand, anaemia and IDA prevalence among the others who did not take any medicine was 25.7% and 11.7% respectively. The prevalence was found more among non-users than users. The reason could be that the study population consisted of young females and the H/O drug intake in them was neither continuous nor too prolonged to alter the acidic environment or to attenuate the gastric mucosa that may otherwise impede iron absorption. Observed difference between the two groups was statistically insignificant (p>0.05).

Verma et al, Kaur et al, Goel et al, Nelson et al and Shatha et al observed in their respective studies that compared to non-vegetarians, more vegetarians are at risk of anaemia.[26-27,29,30]

The limitation of this study was a small sample size and definitive diagnostic tests to measure the iron stores like serum ferritin could not be conducted due to constraints in the time and resources. Besides this study included only school going subjects and school dropouts were not included that may have resulted in the bias.

CONCLUSION

Overall, one fourth of studied adolescent school going girls were anaemic and none among them was having severe anaemia and the prevalence of IDA was 11.25%. Age, vegetarian diet, worm infestation and habit of walking barefoot were significantly associated with IDA. The other factors like socio-economic status, bleeding history, tea/coffee and drug intake did not contribute significantly.

The present study provides an indication to initiate the anaemia prophylaxis measures for adolescent girls in India including nutrition education in schools. Adolescent girls should be a target group in any programme that builds demand for sustaining iron supplementation or higher dietary iron intake. Practical information about nutritional needs must be communicated to young people through all forms of mass media. Further studies with a large sample size and definite diagnostic test to measure the Iron stores are needed to pick up the pre latent cases of IDA and to arrive at the exact estimates of the problem.

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REFERENCES

1. World Bank. World development report: investigating in health. New York: Oxford University Press. 1993.
2. Baker D. Nutritional anaemia: its understanding and control with special reference to the work of WHO. The Am J Clin Nutr. 1979;32:368-417.
3. Habibzadeh F. Anemia in the Middle East. Lancet. 2012;379:1.
4. Khaskheli MN, Baloch S, Baloch AS, Baloch S, Khaskheli FK. Iron deficiency anaemia is still a major killer of pregnant women. Pak J Med Sci. 2016;32:(3):630-4.
5. Mamokem OT, Kana Sop MM, Takougoum Marbou WJ, Telefo BP, Prevalence and Associated Risk Factors of Iron Deficiency Anemia among school teenagers in Mbouda, Western Cameroon: A cross-sectional study. Eur J Med Heal Sci. 2022;4(1).
6. Centres for Disease Control and Prevention. Recommendations to prevent and control iron deficiency in the United States. Morb Mortal Wkly Rep. 1998;47(RR-3):1-29.
7. Provan D. Mechanisms and management of iron deficiency anaemia. Br J Haematol. 1999;105(l1):19-26.
8. Beard JL. Iron biology in immune function, muscle metabolism and neuronal functioning. J Nutr. 2001;131(2S-2):568S-79S.
9. Baker, DM. Nutritional anaemia: its understanding and control with special reference to the work of WHO. Am J Clin Nutr. 1979;32:368-417.
10. Almaz S. Anaemia testing in population-based surveys general information and guidelines for country monitors and program managers. Calverton, Maryland, USA: ORC Macro. 2000.
11. Buckley RH. Iron deficiency anaemia: its relationship to infection susceptibility and host defence. J Pediatr. 1975;86:993.
12. Abbaspour N, Hurrell R, Kelishadi R. Review on iron and its importance for human health. J Res Med Sci. 2014;19(2):164-74.
13. Abu-Ouf NM, Jan MM. The impact of maternal iron deficiency and iron deficiency anemia on child's health. Saudi Med J. 2015;36(2):146-9.
14. Al Sayes. Prevalence of Iron deficiency and iron deficiency anemia among females at university stage. J Med Lab Diagnosis. 2011;2(1):5-11.
15. Chaudhary A, Moses PD, Mony P, Mathai M. Prevalence of anaemia among adolescent girls in the urban slums of Vellore, South India. Trop Doct. 2006;36(3):167-9.
16. Basu S, Basu S, Hazarika R, Parmar V. Prevalence of anaemia among school going adolescents of Chandigarh. Indian Paediatr. 2005;42:593-7.
17. Thankachan P, Muthayya S, Walczyk T, Kurpad AV, Hurrell RF. An analysis of the aetiology of anaemia and iron deficiency in young women of low socioeconomic status in Bangalore, India. Food Nutr Bull. 2007;28(3):328-36.

18. World Health Organization. Control of nutritional anaemia with special reference to iron deficiency. Technical report series no. 580. 1975. Available at: https://apps.who.int/nutrition/publications/micronutrients/anaemia_iron_deficiency/WHO_TRS_580/en/index.html. Accessed on 3 June 2022.
19. Kaur S, Deshmukh PR, Garg BS. Epidemiological correlates of nutritional anaemia in adolescent girls of rural Wardha. Indian J Community Med. 2006;31:255-7.
20. Henry JB. Clinical Diagnosis and Management by Laboratory Methods. New Delhi: Harcourt (India) Pvt Lmtd. 2001;94:485-89.
21. Muttaya S, Thankchan P, Zimmermann MB, Anderson M, Eilander A, Misquith D et al. Low anaemia prevalence in school-aged children in Bangalore, South India: possible effect of school health initiatives. Eur J Clin Nutr. 2007;61:865-69.
22. Shah BK, Gupta P. Anaemia in adolescent girls: a preliminary report from semi-urban Nepal. Indian Paediatr. 2002;39(12):1126-30.
23. Goel S, Gupta BP. Low anaemia prevalence among adolescent of an urban hilly community. IJOCM. 2007;32(1).
24. Rajarthan J, Rajarthan A. Prevalence of anaemia in rural girls of Tamil Nadu. Ind Paed. 2000;37:532-36.
25. Sidhu S, Kumari K, Uppal M. Prevalence of Anaemia among adolescent girls of scheduled caste community of Punjab. Anthropologist. 2005;7(4):265-7.
26. Kaur S, Deshmukh PR, Garg BS. Epidemiological correlates of nutritional anaemia in adolescent girls of rural Wardha. Indian J Community Med. 2006;31:255-7.
27. Verma A, Rawal VS, Kedia G, Kumar D, Chauhan J. Factors influencing anaemia among girls of school going age (6-18 years) from the slums of Ahmadabad city. IJOCM. 2004;29(1):25-6.
28. Kaya M, Pehlivan E, Aydogdu I, Genc M, Gulsen G, Kaya E et al. IDA among students of two primary schools at different socioeconomic conditions in Malatya, Turkey. Inonu Universitesi Tip Fakultesi Dergisi. 2006;13(4):237-42.
29. Nelson M, Bakaliou F, Trivedi A. IDA and physical performance in adolescent girls from different ethical backgrounds. Bri J Nutr. 1994;72:427-33.
30. Shatha S, Nada J, Dhia J. Anaemia among adolescents. Saudi Med J. 2003;24(4):189-94.

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