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Original Research Article

Prevalence of anemia among school going adolescent girls in rural area of Pune, Maharashtra, India

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ABSTRACT

Background: Anemia is like the tip of an iceberg, as majority of anemic subjects are asymptomatic. Low iron diet for longer period perpetuates an inter-generational cycle of anemia, anemic women giving birth to anemic children. This situation is more acute in rural area due to their dietary habits, illiterate parents, socio-economic status, misconception about food, religions belief, menstruation and physical activity.
Methods: This descriptive cross-sectional study was conducted in rural field practice area of Rural Heath Training Centre (RHTC) under department of community medicine, Bharati Vidyapeeth Medical college Pune, Maharashtra, India. There are 11 villages under RHTC Lavale: Out of them one village viz. Pirangut village was randomly selected. (by using random sampling method). This study was conducted in 2013. Total 740 senior secondary school girls studying in class 6th to 12th (10-19 age group) were included. Hb level was measured by Sahli′s hemoglobinometer. Chi square was used to test for association between qualitative variables, and p-value less than 0.05 was considered significant.
Results: The Hb level of girls reveal that majority 648 (87.6%) of them were anemic. It was found that 305 (47.06%) and 340 (52.48%) were suffering from mild and moderate anemia while 3 (0.46%) had severe anemia. The significant association was found with BMI for age.
Conclusions: Active measures to decrease the prevalence of anemia through educating these girls and their mothers, school diet supplementation, providing low cost diet.

Keywords: Adolescent girl, Anemia, Iron

INTRODUCTION

Adolescent girls are at a risk of suffering from a multitude of nutritional problems like deficient calorie intake, Malnutrition, Nutritional Iron-deficiency anemia etc. Anemia is like the tip of an iceberg, as majority of anemic subjects are asymptomatic. An iron deficient diet, year after year, perpetuates an inter-generational cycle of anemia, anemic women giving birth to infants who are born with iron stores and grow to become anemic children.[1] This situation is more acute in rural area due to their dietary habits, illiterate parents, socio-economic status, misconception related to different food, religions belief, onset of menstruation and physical activity.

There is inadequate information about the cause, consequences of anemia and the importance of iron supplementation and iron rich food into their diets. Thus, anemia is a global public health problem. Taking all these issues into consideration the following study was undertaken to find out the prevalence of anemia school going adolescent girls in rural area of Pune Maharashtra.

METHODS

This descriptive cross-sectional study was conducted in rural field practice area of RHTC (Rural Heath Training Centre) under department of community medicine, Bharati Vidyapeeth Medical College, Pune, Maharashtra, India. There are eleven villages under RHTC Lavale: Out of them one village viz. Pirangut village was randomly selected. (by using random sampling method). Pirangut is a village in Mulshi taluka in Pune district in Maharashtra State. This study was conducted in 2013. This study was carried out in senior secondary school amongst girls studying in class 6th to 12th (10-19 age group). The minimum sample size was determined by the formula = 4 PQ/L^2

Where p = 37.5% (prevalence of anemia among rural adolescent girls in 10-19 age group[2]

Q = 100-37.5 L= (3.6) (10% of 37.5)

= 4 × 37.5 × 62.5/3.6 × 3.6

= 9375/12.96 = 723 sample size.

Therefore, required sample size was 723.The strength of girls in the selected school was 740. So, all girls were included in this study.

Inclusion criteria

- All adolescent school going girls (10-19 age group) and resident of village were included.

Exclusion criteria

- All married adolescents' girls in school.

The girls were selected according to WHO criteria for the adolescence that is 10-19 years (2005)[3] The school authorities were contacted and explained about the study. After obtaining the permission from school authorities, interviews and Hb investigation dates were fixed for each class. A verbal consent of the adolescent girls was taken before administering the questionnaires and assured of confidentiality.

School records were used for getting accurate age information. The investigator distributed the pre-designed, pre-tested questionnaires (in local Marathi language). The girls were instructed on how to fill the questionnaires and explained about each question with help of female teacher and social workers. Questionnaires' included socio demographic data, dietary intake (24 hours recall method) Menstrual history and menstrual problems, anemia, anthropometric examination was done. Weight, height and BMI were recorded. Anthropometric measurement was converted to BMI for age and percentile.

The height was taken barefooted in centimeter using standard measuring tape.[4] A vertical tape fixed perpendicular to the ground on the wall was used as scale. This tape was non stretchable. It was fixed with transparent adhesive tape and care was taken to see that there was no fold or tilting to any side. Height was recorded to the nearest 1cm.The weight was measured in kilogram without shoes using a standard machine having precision of 0.5 kg. The body mass index 5 was calculated as weight (kg)/height (m^2).

Percentile is the most commonly used indicator to assess the size and growth patterns of individual children. (2-20 years). The percentile indicates the relative position of the child BMI among children of the same sex and age. (CDC 2000) was used for BMI for age calculation 6 These consisted of estimation of haemoglobin by Sahli′s method.[7,8] The results of the haemoglobin estimations were conveyed to the all the girls and anemic girls were informed about their current anemic status. Dietary intake was calculated by using 24 hours recall method.[9]

Iron intake for Adolescent girls.10-12 age group = 18.9 mg/day 13-15 age = 28 mg/day 15-19 age = 29.9 mg/day.[5] Anemia was classified as mild moderate and severe as per WHO classification.[10]

As per the classification: mild anemia (10-12 gm/dl), moderate 7-10 gm/dl and severe <7 gm/dl respectively.

Statistical analysis

The data so collected was compiled in MS excel. The electronic record set as created above, was imported to SPSS 20.0 (Statistical Package for the Social Sciences). In case of attributes (i.e., qualitative variables) the frequency along with percent-frequency distributions were generated for quick understanding of the over-all status of girls. For quantitative variables under study, normally mean and standard deviation were calculated and analysed. Statistical significance of any association may be prevalent between two qualitative variables was tested using the popular Chi-square test. While testing of various hypothesis, statistical significance (i.e., rejection of null hypothesis and acceptance of research hypothesis) was considered at ($p<0.05$).

RESULTS

The 740 girls studying in class 6th to 12th (10-19 age group) in the senior secondary school located at Pirangut village were studied.

Sociodemographic characteristic

Table 1 indicates the distribution of adolescent girls by early and late adolescent phase. The ration of the early adolescent (10-14th years) and late adolescent (15-19 years) is nearly 50: 50. Majority of girls belonged to families with socio economic Group II (30.34%) and

Group III (30.13%) followed by Group I (17.82%). Majority 456 (61.6%) of girls were belonged to nuclear family than joint family 284 (38.3%). The mean height was 153.6 cm (SD 6.23) and mean weight was 43 kg (SD 8.48). In this present study overall 511 (69%) (5-85 percentile) girls were healthy weight, 183 (24.7) (<5 percentile) were underweight and 29 (3.9%) were overweight.

Table 1: Socio-demographic characteristic of adolescent girl (n = 740).

Adolescent phase	Total	%
Early adolescent (10-14 years)	355	48%
Late adolescent (15-19 years)	385	52%
Total (10-19 years)	740	100%
Socio-economic - status		
I	132	17.82%
II	228	30.84%
III	223	30.13%
IV	123	16.62%
V	34	4.59%
Total	740	100%
Type of family		
Joint	284	38.37%
Nuclear	456	61.63%
Total	740	100%
BMI for age		
Underweight (<5)	183	24.72%
Healthy weight (5-85)	511	69.05%
Overweight (85-95)	29	3.94%
Obese (>95th)	17	2.29%
Total	740	100.0%
Type of diet		
Vegetarian	234	31.7%
Mixed	506	68.3%
Total	740	100.0%
History of worm infestation		
Yes	40	5.40%
No	700	94.6%
Total	740	100.0%

It has to be noted that none of girls reported to be a strict non- vegetarian. Hence, study classified the adolescent girls into those taking vegetarian and mixed diet as shown in Table 1. Majority 506 (68.3%) of adolescent girls were consuming mixed diet while only 234 (31.6%) were consuming vegetarian diet. Worm infestation is one of the contributing factors for anemia especially in rural area. However, it is interesting to note that only a very few 40 (5.4%) girls had the history of worm infestation in last six months.

In the present cross-sectional study anemic status of a girl was appropriately measured by the assessment of Hb level by Sahli's hemogobinometer in blood. According to the WHO criteria, the cut off level of the haemoglobin concentration in blood for the diagnosis of anemia is l <12 gm/dl for adolescent girls. Out of 740 girls in the study, The Hb level of girls reveal that majority 648 (87.6%) of them were anemic, as shown in the Table 2. The mean haemoglobin was 9.8 mg/dl (SD 1.3). The 648 (87.6%) girls, who were anemic, were further classified by the degree of anemic. It was found that 305 (47.06%) and 340 (52.48%) were suffering from mild and moderate anemia while 3 (0.46%) had severe anemia respectively as in Table 3.

Table 2: Distribution of adolescent girl by their anemic status (n = 740).

Anemic status	Total	%
No anemia (≥12 gm/dl)	92	12.4%
Anemia (<12 gm/dl)	648	87.6%
Total	740	100.0%

Table 3: Distribution of adolescent girl by degree of anemia (n = 648).

Anemic status	Total	%
Mild (10-12 gm/dl)	305	47.06%
Moderate (7-10 gm/dl	340	52.48%
Severe (<7 gm/dl)	3	0.46%
Total	648	100.0%

Table 4: Distribution of girls according to socio economic status and prevalence of anemia (n = 740).

Socio-economic - status	Absent (%)	Present (%)	Total (%)
I	13 (9.8%)	119 (90.2%)	132 (100.0%)
II	24 (10.5%)	204 (89.5%)	228 (100.0%)
III	32 (14.3%)	191 (85.7%)	223 (100.0%)
IV	16 (13.0%)	107 (87.0%)	123 (100.0%)
V	7 (20.6%)	27 (79.4%)	34 (100.0%)
Total	92 (12.4%)	648 (87.6%)	740 (100.0%)

(χ^2 = 4.438, df = 4, p = 0.350 >0.05) NS.

Socio economic status and anemia (n = 740)

In this study statistically indicates no significant association (p = 0.350 >0.05) was found between socio economic status and prevalence of anemia as shown in Table 4. Furthermore, irrespective of their socio-economic status; anemia was high in every group. This might be due because of all adolescent girls' belonged to

same area with similar cooking or eating practices and their culture beliefs related to food.

BMI for age (percentile) and anemia status

It is important to record that highest prevalence of anemia was 78(97.27%) among girls below BMI <5 percentile while lowest (82.4%) in obese girls. This study showed significant association between BMI for age and anemic status. (p = 0.000 <0.05) as shown in Table 5.

Iron intake and anemia

It was observed in this study that majority 450 (60.8%) of girls were consuming three meals/day while 259 (35%) were consuming two meals/day. Only few of them 31 (4.1%) were consuming four meals a day.

An analysis based on the study shows that daily iron intake various from 2-17 mg/day. The iron intake is alarming as almost all 622 (84.1%) of girls had iron intake of below <8 mg/day. This indicate that there is inadequate intake iron rich food in their daily diet as shown in Table 6.

Age wise - distribution of girls according to their mean iron intake

Further, age wise - distribution of girls according to their mean iron intake was done in Table 7 shows that girls every age group were taking below the RDA as per their age. The mean iron intake was 6.3 mg/dl±2.2 which not even a 25% of RDA (mg/day) values.

Haemoglobin level and anemia status

A scatter plot was plotted to determine if there is a linear relationship between the haemoglobin level and iron intake. The scatter plot of 740 study girl (10-19 years) between the variable haemoglobin level of blood and Iron intake (mg.) day is shown in Figure 1. This scatter plot indicates that there is a linear relationship between the variables "Hb level of blood" and "Iron intake (mg.) per day".

Table 5: BMI for age (percentile) and anemia status (n = 740).

	Anemia		
BMI for age	**Present (%)**	**Absent (%)**	**Total (%)**
Underweight (< 5)	178 (97.27%)	5 (2.73%)	183 (100.0%)
Healthy weight (5-85)	431 (84.3%)	80 (15.7%)	511 (100.0%)
Overweight (85-95)	25 (86.2%)	4 (13.8%)	29 (100.0%)
Obese (> 95th)	14 (82.4%)	3 (17.6%)	17 (100.0%)
Total	648 (87.6%)	92 (12.4%)	740 (100.0%)

$\chi^2 = 21.167$, df = 3, p = 0.000 < 0.05 S.

Table 6: Distribution of girls (10-19 years) by daily iron intake (mg/day) (n = 740).

Daily iron intake (mg/day)	No. of girls	%
< 8 mg	622	84.1%
≥ 8 mg	118	15.9%
Total	740	100.0%

Table 7: Age wise - distribution of girls according to their mean iron intake (n = 740).

Age group	Recommended daily allowance (RDA) of iron (mg/day)	Mean iron intake±SD
10-12	18.9	6.6±2.1
13-15	28	6.2±2.2
16-19	29.9	6.2±2.0

Since it is observed that a linear relationship exists between the two variables (Hb and iron intake), the regression analysis was performed to predict the Hb level of blood (i.e., anemic status of a girl) based on her daily intake of iron (mg.). The simple linear regression analysis using "Hb level" as dependent variable (Y) and "Iron intake (mg.) per day" as independent variable (X) establishes the following results:

- The correlation coefficient between "Hb level" and "Iron intake (mg) per day" is moderately positive (0.252)
- The linear equation (model) to predict the HB level of blood of a rural school going girl (10-19 years): Y = a+ b X. In this case, the values of a, b, X, and Y are as follows:

a = 8.872
b = 0.155 (regression co-efficient of Y in X/slope of linear model)
X = Iron intake (mg.) per day (known value of independent variable)
Y = HB level (predicted value of dependent variable).

Tea intake and anemia

Dietary iron absorption from a meal is determined by iron status, heme- and non-heme-iron contents, and amounts

of various dietary factors that influence iron absorption like intake of tea.

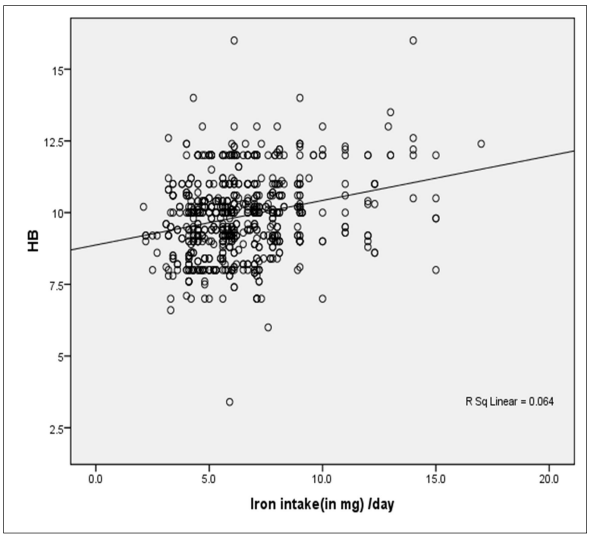

Figure 1: This scatter plot indicates that there is a linear relationship between the variables Hb level and iron intake (mg) per day.

Table 8: Distribution of girls who consume tea and anemia status (n = 740).

Tea cup/day	Anemia status		Total (%)
	Present (%)	Absent (%)	
Yes	580 (87.5%)	85 (12.7%)	665 (100.0%)
No	68 (90.6%)	7 (9.3%)	75 (100.0%)
Total	648 (87.5%)	92 (12.4%)	740 (100.0%)

p = 0.39 >0.05 NS.

Table 8 reveals that the proportion of anemic girls 665 (89.8%) drink tea daily while and 75 (10.1%) girls do not drink tea. Study finding suggest that there is no statically significant association between tea intake and prevalence of anemia (p = 0.39 >0.05).

Worm infestation and anemia status

As mentioned earlier history of worm infestation was found among 40 (5.4%) in last six month, as shown in the Table 9. In the present study shows 40 (5.4%) girls had worm infestation out of which only 2 had no anemia, while 11 (27.1%) had mild 26 (65%) moderate and 1 (2.5%) severe anemia respectively.

Table 9: Distribution of girls by history of worm infestation in last 6 months and anemia (n = 740).

Worm history (within 6 months)	Anemia		Total (%)
	Present (%)	Absent (%)	
Yes	38 (95.0%)	2 (5.0%)	40 (100.0%)
No	610 (87.1%)	90 (12.9%)	700 (100.0%)
Total	648 (87.6%)	92 (12.4%)	740 (100.0%)

$\chi^2 = 2.146$ df = 1 (0.143 >0.05) NS.

Table 9 shows that there is not much difference in the percentage of anemic girls between worm-infested (in last 6 months) girls (95.0 %) and non-worm-infested girls (87.1%). The statistical test for association found no statistically significant association between anemia and worm -infestation (p = 0.143 >0.05).

It is observed that out of 740 girls i.e. majority 622 (84.05%) of these girls attained menarche. It was found that prevalence of menstrual disorders was 228 (41.4%) amongst anemic girls while it was 32 (44.4%) among non-anemia girls. The chi-square test shows there is no significant association (p = 0.698 >0.05).

DISCUSSION

The ration of the early adolescent (10-14th years) and late adolescent (15-19 years) is nearly 50:50. Majority of girls belonged to families with socio economic Group II (30.34%) and Group III (30.13%) followed by Group I (17.82%). Majority 456 (61.6%) of girls were belonged to nuclear family than joint family 284 (38.3%). The mean height was 153.6 cm (SD 6.23) and mean weight was 43 kg (SD 8.48). In this present study overall 511 (69%) (5-85 percentile) girls were healthy weight, 183 (24.7) (<5 percentile) were underweight and 29 (3.9%) were overweight. Majority 506 (68.3%) of adolescent girls were consuming mixed diet while only 234 (31.6%) were consuming vegetarian diet. A very few 40 (5.4%) girls had the history of worm infestation in last six month. Out of 740 girls, majority 648 (87.6%) of them were anemic. The mean hemoglobin was 9.8 mg/dl (SD 1.3). Thakar A et al, conducted a study among senior secondary adolescent girls (10-19) residing in Shimla city showed a similar high prevalence of anemia in 84.4% girl.[11] Kaur S et al, found anemia among 59.8% rural adolescent girls.[12] The varying degree of prevalence of anemia observed in different studied among adolescents girls may be because of the multi factorial etiology of anemia.[13,14]

Out of 648 (87.6%) anemic girls, it was found that 305 (47.06%) and 340 (52.48%) were suffering from mild and moderate anemia while 3 (0.46%) had severe anemia.

The prevalence of severe anemia was higher in Hyderabad study where out of 1489 adolescent girls; 28.8% were mildly anemic, 35.2% moderately anemia, 34.1% were severely anemia while only 7.9% were found to be normal.[15] Goyle A and Prakash S conducted a study to determine the iron status of adolescents girls (10-15 years) attending a government school in Jaipur city, Rajasthan.[16] Of the 109 subject, 4 (3.7%) had normal level of haemoglobin, 34 (31.2%) suffered from mild deficiency and 71 (65.1%) suffered from the moderate deficiency.

Table 3, in this study statistically no significant association (p = 0.350 >0.05) was found between socio economic status and prevalence of anemia. Similarly, Siddharam SM et al, found that socioeconomic status were not significantly associated with anemia.[13] However, Gawarika R et al, found in their study that the overall percent prevalence of anemia among the adolescent girls of weaker economic group was 96.5% and among of middle or higher middle income group was 65.18%.[17] The prevalence of severe anemia among the adolescent girls of weaker group was 11.0% and among girls of middle or higher income group was 2.63%.

Table 4, This study showed significant association between BMI for age and anemic status. (p = 0.000 <0.05) Bentley ME et al, in their study mentioned that respondents with a BMI less than 18.5 kg/m^2 were observed to be marginally significantly more likely to be anemic (OR¼1.14, 95% CI¼1.00, 1.29) than those with a normal BMI (18.5 - 24.9 kg/m^2).[18] In contrast overweight respondents with a BMI ≥25 kg/m^2 were observed to be significantly less likely to be anemic than those with a normal BMI (OR¼ 0.76, 95% CI¼ 0.62, 0.93). Hanan S et al observed in their study that 19 (38%) girls were underweight including 8 (42.07%) anemic girls having BMI <18.5 indicating the acute or chronic malnutrition, while 30 (60%) girls had normal BMI.[19] And only one anemic girl was overweight having BMI >24.9.

Daily iron intake is important determinant of anemia status. All the iron needed for the biological functions comes from diet.[20] Iron deficiency also coexists with type of diet; strict vegetarian diet increases the risk of iron deficiency anemia.[21]

Iron requirement for growth refers to the iron needed for expansion of blood volume and need for increase in lean body mass.[22] The peak requirement for absorbed iron in girls reaches a maximum of approximately 1.5 mg/day during puberty and remains at about 1.3 mg/day after puberty to replace menstrual blood loss. The deficiency gets further aggravated by not eating high iron containing foods (such as meat) as well as poor bioavailability of iron due to food habits.[23] In this study iron intake various from 2-17 mg/day. The mean iron intake was 6.3±2.2 mg/dl which not even a 25% of RDA (mg/day) (Table 6) Likewise Maliya CH et al, finding showed average iron intake was 13.2±2.5 mg/day was deficient by 48.2%.[24] Alaofè H et al, studied association between dietary iron intake and iron status in 100 adolescent girls aged 14-16 years from Benin.[25] While 73% of adolescents met the recommendations for dietary iron intake, only 27% had estimated absorbable iron intake above the average requirement for absorbed iron.

Table 8, there is no statically significant association between tea intake and prevalence of anemia (p = 0.39 >0.05). Verma A et al, also pointed out in their study that anemia was significantly higher among those having the post meal habit of consuming tea/coffee (94.4%) (p <0.01).[26] The statistical test for association found no statistically significant association between anemia and worm-infestation (p = 0.143 >0.05) as shows in Table 9. Kaur S et al, stated that 65 (10.3%) had history of worm infestation and they also found that worm infestation is strong predictor to anemia (OR = 5.45, Cl = 2.55-11.62).[12]

The chi-square test shows there is no significant association (p = 0.698 >0.05) between anemia status and menstruation disorder. Goel S et al, observed that 30 (53.6%) anemia females had menstrual problems like menorrhagia, polymenorrhea or irregular menstrual cycle as compared to 22 (6.6%) non anemia female (p <0.05).[27]

CONCLUSION

In the present study overall prevalence of anemia was found to be high. Active interventions are required to decrease the prevalence of anemia through educating these adolescent girls and by providing free low-cost school diet supplementation and secondly, there is constant need to improve data collection on adolescent girls health especially; in rural India.

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REFERENCES

1. UNICEF India. UNICEF Resource Centre. The State of the World's Children 2011 adolescence: an age of opportunity. Available at: https://www.unicef.org/sowc2011/fullreport.php. Accessed on 23rd December 2014.
2. Vasanthi G, Fawashe AB, Susie H, Sujatha T, Raman L. Iron nutritional status of adolescent girls from rural area and urban slum. Ind Pediat. 1994;31:127-32.
3. World Health Organization. Child adolescent mental health policies and plans. Mental health policy and service guidance package, 2005. Available at: https://www.who.int/mental_health/policy/Childado_mh_module.pdf. Accessed on 14th December 2014.
4. Dasgupta A, Butt A, Saha TK, Basu G, Chattopadhyay A, Mukherjee A. Assessment of

malnutrition among adolescents: can BMI be replaced by MUAC. Indian J Comm Med. 2010;35(2):276-9.
5. Dietary Guidelines for Indians: A Manual National Institute of Nutrition India. 2007:43.
6. Kuczmarski RJ, Ogden CL, Guo SS. 2000 CDC growth charts for the United States: Methods and development. National Center for Health Statistics. Vital Health Stat. 2002;11:246.
7. Arora P, Dhuria M, Srivastava R, Bajpai R. Perceptions and practices regarding menstruation among adolescent girls in a semi-urban area of Delhi. Ind J Mater Child Health. 2011;13:3.
8. Singh J, Singh JV, Srivastiva AK, Suryakant. Health status of a girls in slum of Lucknow. IJCM. 2006;30(2):102-3.
9. Yunsheng, Olendzki BC, Pagoto SL, Hurley TG, Magner RP, Ockene IS, et al. Number of 24-hour diet recalls needed to estimate energy intake. Ann Epidemiol. 2009;19(8):553-9.
10. World Health Organization. Control of Nutritional Anaemia with Special Reference to Iron Deficiency Anaemia. WHO, Geneva. Tech Report Series; 1975:No.580.
11. Thakur A, Bhardwaj AK, Parashar A, Sharma D. Epidemiological correlates of nutritional anaemia among adolescent girls of a hilly state. Indian J Mate Child Health. 2011;13:3.
12. Kaur S, Deshmukh PR, Garg BS. Epidemiological correlates of nutritional anemia in adolescent girls of rural Wardha. Indian J Comm Med. 2006;31(4):255-8.
13. Siddharam SM, Venketesh GM, Thejeshwari HL. A study of anemia among adolescent girls in rural area of Hassan district, Karnataka, South India. Int J Biol Med Res. 2011;2(4):922-4.
14. Sampathkumar V, Rajaratnam A. Prevalence of anaemia and hookworm infestation among adolescent girls in one rural block of Tamil Nadu. Indian J Matern Child Health. 1997;8(3-4):73-5.
15. Gulla S, Devi K, Vijayalakshmi V. Prevalence of malnutrition among adolescent girls living in urban slums. IJMCH. 2010;12:4.
16. Goyle A, Prakash S. Iron status of adolescents girls (10-15 years) attending a government school in Jaipur city, Rajasthan, India Mal J Nutr. 2009;15(1):205-11.
17. Gawarika R, Gawarika S, Mishra AK. Prevalence of anaemia girls belonging to different economic group. IJCM. 2006;31(4):287-8.
18. Bentley ME, Griffiths PL. The burden of anemia among women in India. Eur J Clin Nutr. 2003;57:52-60.
19. Hanan S, Gilani AH, Haq IU. Anemia in adolescent college girls: effect of age, nutritional status and nutrient intake. Pak J Sci. 2010;62(4):207-9.
20. Iron absorption and its implications on strategies to control iron deficiency anemia. ICMR Bulletin India. 2000;30:2.
21. Bhalwar R. Nutrition in public Health In: Rajul K Gupta eds. AFMC Textbook of Public Health and Community Medicine, 1st ed. Pune. Published by Department of Community Medicine, AFMC, Pune in Collaboration with WHO, India office, New Delhi; 2009.
22. Nutrient requirement and recommended dietary allowance for Indians. NIN, ICMR Hyderabad, India. 2010:162.
23. Mittal S. Overview of 12 by 12 Initiatives (Hb 12 by 12 years). GOI, UNICEF and FOGSI collaboration, 2007. Available at: http://www.whoindia.org/ Link Files/ FCH_ News_ &_ Workshop_12_ by_12_Initiative_Booklet.pdf. Accessed on 15th December 2013.
24. Maliya CH, Deshmuskh PR, Gupta SS, Kaur S, Mehendale AM, Garg BS. Nutrient intake amongst rural adolescent girls of Wardha. Ind J Comm Med. 2010;35(3):399-402.
25. Alaofè H, Zee J, Turgeon O'Brien H. Dietary iron and iron deficiency anemia among adolescent girls from Benin. Rev Epidemiol Sante Publique. 2007;55(3):187-96.
26. Verma A, Rawal VS, Kedia G, Kumar D, Chauhan J. Factors influencing anemia among girls of school going age (6-18 years) from the slum of Ahmedabad city. IJCM. 2004;XXIX(1):25-6.
27. Goel S, Gupta BP. Low anemia prevalence among adolescents of an urban hilly community. Ind J Comm Med. 2007;32:67-8.

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