IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

An education intervention based study on adolescent anaemic girls residing in rural area of Bellary district, Karnataka, India

Prabhavathi S.N*, Anitha C and Pampapathi B.V*****

*Guest lecturer, DOS in Food Science and Nutrition, University of Mysore, **Assistant professor, DOS in Food Science and Nutrition, Karnataka State Open University, Mukthagangothri, Mysore, ***Post Graduate student at DOS in Food Science and Nutrition, Karnataka State Open University, Mukthagangothri, Mysore.

Abstract

Anaemia is one of the most common nutritional problems prevailing worldwide and the commonest cause for it is iron deficiency. The prevalence of anaemia is disproportionately high in the developing countries particularly among pregnant and lactating women and adolescent girls when compared to developed countries. The present study was planned with an objective of assessing the haemoglobin status of adolescent girls and to impart nutrition education as a preventive therapy to reduce the prevalence of iron deficiency anaemia. A total of 50 adolescent girls (13-16 years) from government school residing in rural area of Bellary district were recruited. After baseline screening they were grouped as anaemic (n=25) and non-anaemic (n=25) subjects based on their Hb status. Nutrition education intervention was carried out for 3 months for all the anaemic subjects. The results projected that the majority of subjects in the age group of 15 years were shown to be anaemic (38%). Distribution of subjects according to demographic characteristics revealed that higher percentage of subjects belonging to nuclear families were anaemic (60%). The mean height and weight of subjects in anaemic group was reported to be lower than the non-anaemic group. Considerably higher percentage of subjects (39.3%) from anaemic group had BMI below 18.5 kg/m^2. The clinical symptoms of nutrient deficiency were found to be highly prevalent among the anaemic group subjects. The iron deficiency related co-morbidities such as breathlessness, tiredness and weakness were also higher among them. The mean nutrient intake of iron

for subjects in anaemic group and non-anaemic group was found to be in the range of 5.10 – 5.38 and 6.55-8.72 mg/day respectively. The post Hb assessment after nutrition education intervention of anemic subjects indicated significant improvement in haemoglobin from an initial 9.8g% to 12.2g%. Hence, it could be concluded that nutrition education could be used as a strategy for bringing changes in their dietary habits in particular to encourage them to have iron rich natural foods for maintaining normal Hb levels.

Key words: anaemia, Hb, Adolescent, nutrition education, dietary habits.

Introduction

Adolescence is considered as a significant period of human growth and maturation. This phase of growth is also characterized by uniquechanges and many adultpatterns are established (Jolly et al 2000). Increased nutritional needs in this phase of growthis related to the fact that adolescents gain up to 50% of their adult weight, more than 20% of their adult height, and 50% of their adult skeletal mass during this period and to support all these physiological changes and for maintaining normal growth velocity adequate supply of nutrients is recommended. The iron needs are high in adolescent girls because of the increased requirements for expansion of blood volume associated with the adolescent growth spurt and the onset of menstruation (Dallman, 1992, Beard, 2000). The overall iron requirements increase from a preadolescent level of ~0.7-0.9 mg Fe/d to as much as 2.2 mg Fe/d or perhaps more in heavily menstruating young women (Kulkarni et al 2012). The prevalence of anemia is disproportionately high in developing countries and several factors are known to aggravate the conditions especially poverty, inadequate diet, certain diseases, pregnancy/lactation and poor access to health services are the major causative factors (Kaur et al 2006). This phase of life is also considered to be very important due to the ever-increasing evidence which suggests that control of anemia in pregnant women may be more easily achieved if satisfactory iron status can be ensured during adolescence. Few programs for anemia control have targeted adolescent girls and health care of adolescent girls all over the world but, has not been givenmuch priority.

According to World Health Organization (WHO) iron deficiency is the most prevalent nutritional deficiency and its timely correction could help raise the national productivity by about 20% (Gupta et al 2013). It has been well documented that anaemia in girls has an enormous impact on their physical capacity particularly on their reproductive physiology (Sheshadri, 1997). It is believed that girl children are more prone to develop severe anaemia than their male counterpart (Swami et al 1998).

Available literature suggests that 60 percent and 70 percent of Indian adolescent girls are anemic and the hemoglobin levels were reported to be < 12 g/dl (IHMP, 2003). To address the high anaemia burden, the World Health Assembly has set a target of achieving a 50% reduction of anaemia cases

particularly in women of reproductive age by 2025 relative to 2010 level (WHO, 2014). Anemia during adolescence has been known to have negative implications since it is linked with limited growth and delayed onset of menarche, which is known to be highly associated withcephalopelvic disproportion (Shobha, 2003).

Adolescent girls are at a high risk for anaemia and malnutrition. Inadequate nutrition during adolescence can have serious consequences throughout the reproductive years of life and beyond. Very often, in India, the common scenario is that, girls get married and become pregnant even before the growth period is over, thus doubles the risk for anaemia (Biradar and Biradar 2012). In a study by Upadhye and Upadhye (2017) reported that, the prevalence of anemia was found to be 90%. A significant association of anemia was found with socio- economic status and literacy status of parents. Hence, the present investigation was planned with an objective to explore the prevalence of anaemia among the adolescent girls from rural area of bellary district and to impart nutrition education as a therapy to maintain the normal Hb status.

Methodology

It is a community based cross-sectional study. A total of 50 adolescent girls who were in the age group of 13-16 years studying in government schools were recruited. Approval from the Institutional Human Ethics committee was obtained for the study. A pretested interview schedule was used to collect information on socio demographic variables. All subjects included for the study were measured for their body dimensions. Anthropometric assessment schedule included useful measurements such as height, weight. Height was measured in cm, using a fiber glass tape (nearest to 0.1 cm). A battery operated digital balance precise to 0.1 kg was used to record weight of the selected subjects. The balance was calibrated with standard weights every time before use. Using height and weight data the BMI was calculated using the formula: Weight (kg)/Height (m2) (Rao et al, 2003). Through this interview schedule, the subject's food and nutrient intake was also assessed using 24hr recall method.Information about the foods, beverages, and snacks consumed in the preceding 24 h with the help of standard cups and spoons were recorded. Nutrient content of the foods were computed using food composition tables for Indian foods (Gopalan, 1996). The subjects' dietary habits were also evaluated to know the frequency of consumption of certain food group's such as green leafy vegetables, eggs, meat/chicken, fish, fruits, fruit juice and tea/coffee. Pre-testing was done on 10% of adolescent girls, to ensure the validity and feasibility of questionnaire before administering it on the entire population. On the basis of pre-testing necessary modifications were made.

Biochemical assessment

The biochemical assessment schedule included haemoglobin estimation (g %) of all the subjects at the baseline. Based on the baseline information subjects were categorized into two groups. Subjects with more than 12g%Hb were grouped as non-anaemic (n=25) and those with less than 10g% Hb were categorized as anemic (n=25).

Clinical assessment

Clinical examination is the most essential part of all nutrition surveys, essentially the method is based on examining the subject for changes that are believed to be related to various nutrient deficiencies that can be seen or felt in the superficial epithelial tissues especially on skin, eyes, hair, tongue, teeth etc. The clinical assessment schedule included an orderly examination of the obvious physical signs/symptoms for deficiency disorders on various body parts

Menstrual History and anemia related co-morbidities

The questions included in this section were age of menarche and duration of the blood flow and its severity. With respect to anemia related co-morbidities subjects were asked questions about whether they have frequent episodes of head ache, dyspnea, pallor and fatigue.

Nutrition education

Nutrition and health education can be defined as planned effort to improve nutritional and health status by bringing about changes in the behavior of the people. Nutrition and health education is a process by which people gain the knowledge and develop confidence.Skills are needed for establishing good dietary and health practices. However, changing behavior is not easy such changes require a vigorous and concerted effort through a variety of communication channels. Therefore in this present investigation Health and Nutrition Education was implemented in the form of a module.The methodology adopted for implementation of the programme was as follows: visual aids in the form of posters and charts and lecture method was used to impart knowledge regarding the importance of various nutrients. The objective of the intervention program was to make them know about various food groups and to encourage them to consume iron and vitamin C rich foods.

Post Test

All anaemic subjects underwent education intervention for 3 months. After 3 months of educational intervention Hb estimation was done to know the impact of education on their Hb levels.

Statistical Analysis

Data were analyzed and reported as mean ± SD for all measurements using a software on computer. Levels of significance between the groups were measured using t-test. The p-value less than 0.05 was considered significant. MS excel, SPSS version 16.0 were used for data analyses. The analysed data was presented with the help of tables.

Results and discussion

The age wise distribution of subjects is presented in table 1. Majority of the subjects were belonging to the age group of 15 years (40%) followed by 24% subjects in 16 years group. The age wise distribution of non-anaemic subjects also revealed a similar trend i.e. higher number were in the age group of 15 and 16 years.

Table 1: Age-wise distribution of children according to Hb status

Age (years)	Anaemic (n=25)		Non-anaemic (n=25)		p-value
	N	%	N	%	
13	03	12	04	16	0.49^{ns}
14	06	24	04	16	
15	10	40	09	36	
16	06	24	08	32	

The information pertaining to demographic characteristics of the study subjects is presented in table 2. As can be seen from the table, it was clear that the majority of children from anemic group were reported to be from nuclear families (68%) followed by 32% belonging to joint families. While, in the non-anaemic group the distribution of children according to type of family was shown to be equally distributed between nuclear and joint family (50%). Children belonging to nuclear families exhibited higher prevalence of anemia as against prevalence among the joint family residents. The differences were shown to be statistically significant (p=0.016).

Further, children from households with total family member of ≤5, showed lesser rates of anemia. Families with more than 8 members indicated considerably higher rates of anemia. This could be attributed to several socio economic factors like lack of resources to purchase and feed iron rich foods and deprived care during growing years and lack of attention by the adults towards the health and nutritional status of the adolescents. Socio economic status revealed that a considerably higher proportion of subjects from anemic group were reported a total family income ofRs. ≥5,000/month. Information on type of diet showed that, majority of the subjects from both the groups were reported to consume mixed diet (68 and 60%). In a study by Agrawal et al (2018), it was observed that the adolescents on vegetarian diet had higher proportions of anaemics (56.3%) (9 out of 16) compared to those who were following mixed type of diet (36.1%). The prevalence of anaemia among adolescents who consumed meat products everyday

was less (35%) compared to those consumed <3 times a week (38.7%), subjects who did not consume meat products the total prevalence was 56.2%, (P=0.20). Our study also revealed similar results where the prevalence of anaemia among vegetarian subjects was 62% as against 38% prevalence seen among the mixed diet followers. The proportion of adolescents who consumed Vitamin C rich food (like tomato and lemon) >3 times a week (36.1%) were less anaemic compared to those who consumed <3 times a week (50%).

Table 2: Demographic characteristics of the study subjects (%)

Type of family	Anaemic	Non-anaemic	p value
Type of family			
Nuclear	68	50	0.016*
joint	32	50	
Number of family members			
5	10.6	59.0	0.132^{ns}
6-8	21.4	21.0	
>8	68.0	20.0	
Monthly income of the family			
≥5000	89.3	87.5	0.695^{ns}
≥10000	10.7	12.5	
Type of diet			
Vegetarian	32	40	0.1^{ns}
Mixed	68	60	

Table 3, represents data related to mean height and weight of the study subjects. The mean height of subjects in the anemic group for 13 years, was shown to be slightly lower than those in the non-anaemic group (144±17.9 Vs 152. 63 ±6.9 cm). The recorded observations indicated that for other age groups also the scenario was reported to be same i.e. for subjects in anemic group it was lower and for those in the non-anaemic category showed slightly higher mean height. Our results are in confirmation with the investigation carried out by Upadhye and Upadhye (2017) on the assessment of anaemia in adolescent girls also has reported similar results where they found mean height and mean weight of subjects with anemia to be less as compared with that of subjects without anemia; the difference was statistically

significant. Study done in Dibrugarh district among adolescent girls in tea garden community which revealed 51.9% stunting and 41.3% thinness (Medhi et al, 2007). Another study among the rural adolescents in West Bengal revealed 53.57% stunting and 48.75% thinness (Pal et al, 2017). With regard to weight, except for anaemic subjects in 13 years age group other groups indicated almost similar pattern of weight status with no significant differences.

Table 3: Mean height and weight of the study subjects

Age (years)	Mean height (cm)			Mean weight (kg)		
	Anaemic	Non-anaemic	P-value	Anaemic	Non-anaemic	P-value
13	144.0+ 17.9	152.63+ 6.9	0.421^{ns}	38.50+ 7.05	42.25+ 6.54	0.414^{ns}
14	148.3+ 12.3	152.2+ 14.3	0.408^{ns}	44.24+ 5.53	44.36+ 5.54	0.951^{ns}
15	145.1+ 13.8	153.4+ 10.9	0.008**	45.13+ 7.14	43.22+ 5.61	0.214^{ns}
16	148.6+ 12.7	152.2+ 12.2	0.182^{ns}	46.58+ 5.19	47.76+ 5.89	0.445^{ns}

The classification of subjects according to BMI ranges is shown in table 4. As can be seen from the table, about 44% of the subjects in the anemic group and 24% subjects in non-anaemic group were shown to be underweight while, 56% and 44% of subject from both the groups were observed to be normal. While, among the non-anaemic group relatively highest percentage of subjects (32%) were seemed to be overweight. Statistically significant differences were noted.

Table 4: Distribution of subjects according to BMI

Body Mass Index	Anaemic		Non-anaemic		P Value
	n=25	%	n=25	%	
≤18.5 kg/m^2	11	44.0	06	24.0	0.015*
18.5- 22.5kg/m^2	14	56.0	11	44.0	
>23kg/m^2	-		08	32.0	

A perusal of table 5 provides information on the presence of clinical signs and symptoms of nutrient deficiency among the study subjects. With reference to body appearance, more than 40% of the subjects were found to have smaller body frame in both the groups. The appearance of the eye was reported as normal for majority of subjects from both the groups (50 and 63.6%). An examination of eye in anemic group revealed 36% prevalence of dryness. The presence of angular stomatitis was shown to be higher among subjects in the non-anaemic group (54.5%) in comparison to anemic group (42.8%).

Paleness (25% and 36.2%) and redness (14.3% and 18.2%) of tongue were also noticed to be higher for subjects in the non-anaemic group. Bleeding gums were present in 46.4% and 45.5% of the subjects from both the groups. Statistical analysis indicated no significant differences.

Table 5: Prevalence of clinical signs and symptoms (%)

Clinical Signs		Anaemic	Non-anaemic	p-value
Body appearance	Small	42.9	40.9	0.817^{ns}
	Average	46.4	50.0	
	Large	10.7	9.1	
Eyes	Normal	50.0	63.6	0.22^{ns}
	Watery	14.0	9.1	
	Dry	36.0	27.3	
Lips	Normal	57.2	45.5	0.232^{ns}
	Angular stomatitis	42.8	54.5	
Tongue	Normal	60.7	45.6	0.082^{ns}
	Pale	25.0	36.2	
	Red	14.3	18.2	
Skin	Normal	53.6	45.5	0.519^{ns}
	Pale	33.5	4.5	
	Dry and Rough	12.9	50.0	
Teeth	Normal	67.0	63.6	0.767^{ns}
	Discolored	33.0	36.4	
Gums	Normal	53.6	54.5	0.767^{ns}
	Bleeding	46.4	45.5	
Nails	Normal	64.3	63.6	0.619^{ns}
	Abnormal	35.7	36.4	

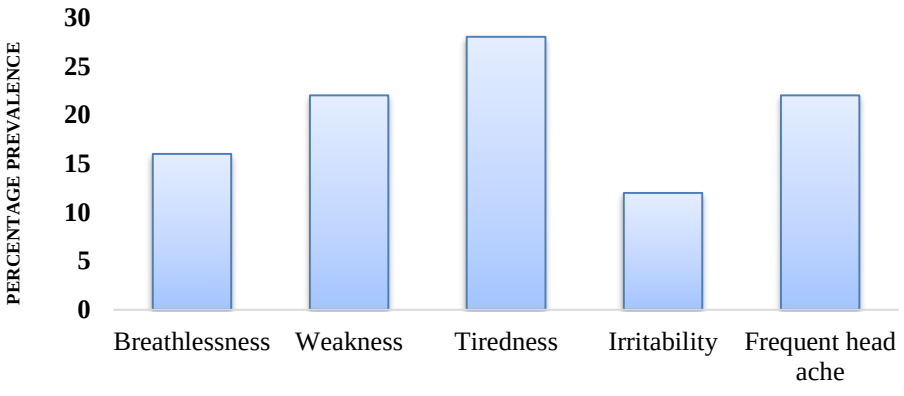
Data pertaining to menstrual history of study subjects is shown in table 6. Majority of the subjects from both the groups were reported to have attained menarche at ≤11 years and between 12-14 years. Information on duration of menstruation indicated that for 52% of subjects in non-anaemic group it was ≤4 days. A highest majority in anaemic group (40%) were reported a total duration of menstruation as between 5-7 days. This could aggravate the condition and may progress towards developing severe iron deficiency anaemia. With respect to severity of menstrual bleeding vast majority of subjects reported as mild (52%) in non-anaemic group. Moderate (40%) to heavy (48%) bleeding incidences were reported as higher among anaemic group subjects.

Table 6: Menstrual history of the subjects

Variables	Categories	Anaemic	Non-anaemic
Age at Menarche	≤11	48	32
	12-14 years	32	40
	≥ 15 years	20	28
Duration of menstruation	≤ 4 days	24	52
	≥4 days	36	32
	5-7 days	40	16
Duration of menstrual cycle	<21 days	56	32
	21-35 days	24	40
	>35 days	20	28
Severity of menstrual bleeding	Mild	12	52
	Moderate	40	36
	Heavy	48	12

Information on the occurrence of type of anemia related co-morbidities is given in fig 1. The data revealed that, tiredness was the most common problem reported in relatively higher number of subjects (28%). Followed byfrequentepisodes of head ache in 22% of subjects. Breathlessness (16%) and weakness (22%) were also themost common types of co-morbidities which were recorded to be highly prevalent subjects.

Fig 1: Anaemia related co-morbidities among anaemic subjects



The information on the dietary habits of subjects is presented in table 7. From the compiled data it could be said that a higher percentage of non-anaemic subjects had frequent consumption of leafy vegetable (28%). Whereas for anaemic subjects it was reported as 16%. Tea and coffee consumption was reported to be much higher for subjects in anaemic group (40%) while, for non-anaemics only 14% had the habit of drinking tea/coffee. A very small percentage of subjects from anaemic group (8%) reported frequent consumption of fresh fruit juice. While among the non-aanemic group it was slightly higher (12%). The frequency of consumption of non-vegetarian foods such as meat, fish and chicken were shown

to be high for subjects in the non-anaemic group (30%). In a study by Chaturvedi et al (2017) it was reported that32% had the habits of consuming tea/coffee postmeal frequently, 36% consumed fruits / fruit juices frequently, 39% had green leafy vegetables frequently and surprisingly 78% had the habit of taking junkfoods frequently. Literature studies have indicated that consumption of tea/ coffee post meal is known to impair the bioavailability of vital nutrients particularly iron and calcium.

Table 7: Dietary habits of the subjects (%)

Food group	Anaemic	Non-anaemic
Leafy vegetables frequently	16	28
Tea/coffee	40	14
Fruit juice	8	12
Meat/fish/chicken	12	30
Eggs	8	11
Junk foods	16	5

The Hb status of the subjects at baseline and after 3 months of educational intervention has been reported in table 8. At baseline all the subjects in anaemic group had a mean Hb of 9.8 ±1.7 g%. All the subjects were known to be moderately anaemic according to WHO classification. Any therapy which is initiated early is considered to have positive benefit which also prevents the subjects from becoming severely anaemic. In the present investigation educational intervention was carried out for 3 months using display charts and lecture method. As can be observed from the table it could be said that there was a significant improvement in the Hb status of all the anaemic subjects, where the levels were shown to have improved to 12.2 g% from the baseline level of 9.8g%. An investigation was carried out in 2006 to estimate the prevalence of anaemia in 16 districts of India. The investigators found the total prevalence of anaemia among adolescent girls to be 90.1%. In the states of Dehradun and Srinagar the prevalence was observed to be 58% and 99% respectively. Various studies done all over the country have reported a wide range of prevalence of anaemia cases. The prevalence of anaemia among adolescent girls was reported as 21.4% in Shimla, 90.1% in Nagpur, 41.1% in Belgaum, 52.8% in Meerut, 92.5% in Darjeeling(Gupta, et al 2013, Biradar et al 2012, Zou et al 2006, Toteja et al 2006)

Table 8: Hemoglobin status of the respondents.

Hemoglobin status (g %)	Mean ± S.D	P value
Anaemic subjects (Baseline)	9.8±1.7	p<0.001**
Non-anaemic subjects (baseline)	12.7±1.8	
Hb status after 3 motnths	12.2±1.4	

The mean intake of macro nutrients and minerals is given in table 9. It was very evident from the table that anaemic subjects in the age group of 13 years showed slightly higher intake of protein (44.84± 6.6 g/day). While other age groups indicated lower intake. Lowest consumption was reported for subjects in the age groups of 14 years (37.6 ±13). For non-anaemic group the protein intake was shown to be similar for all the age groups. Fat intake for both the groups of all age groups was observed to be below the recommended dietary allowances (RDA). Energy intake was also found to be below the RDA for all the age groups of both anaemic and non-anaemic subjects. Calcium intake was shown to be in the range of 313 – 395mg/day for anaemic subjects. Iron intake for all the age groups in anaemic and non-anaemic group was noticed to be significantly lower. A study done in rural areas of Bhopal found that 70% of adolescents had a low intake of calorie (Joshi et al, 2014). Another study done among rural adolescents in Karnal district, Haryana reported that more than half of the girls, i.e., 54.3%, had inadequate energy intake (Kaur and Kaur, 2015).

Table 9: Mean nutrient intake of the subjects

Nutrients	Age (years)								p-value
	Anaemic				Non-anaemic				
	13	14	15	16	13	14	15	16	
Protein (g)	44.84+ 6.6	37.6+ 13	42.46+ 7.4	40.32+ 8.3	43.3+ 18.3	44.76+ 5.27	44.90+ 7.7	42.20+ 8.9	0.091^{ns}
Fat (g)	10.40+ 8.7	10.77+ 4.2	11.95+ 4.6	11.97+ 5.7	14.68+ 3.6	12.29+ 2.3	12.98+ 3.4	12.52+ 4.9	0.286^{ns}
Energy (Kcal)	1523+ 479	1465+ 325	1576+ 253	1576+ 253	1649+ 192	1636+ 158	1651+ 292	1606+ 244	0.646^{ns}
Calcium (mg)	313+ 108	324.8+ 66.9	369.2+ 73.9	352.0+ 148	395.0+ 11	370.6+ 85.9	378.0+ 112	372.0+ 102	0.101^{ns}
Iron (mg)	5.10+ 1.93	5.38+ 1.64	5.11+ 1.93	5.21+ 4.29	8.72+ 4.52	7.03+ 2.84	7.14+ 3.32	6.55+ 5.11	0.010*

Conclusion

Iron deficiency anaemia is the major nutritional disorder seen among adolescent girls in rural area. Documented literature has indicated the benefits of community based activities as a strategy to improve the nutritional status. Promoting female education has been shown to play significant role in motivating the females to undergo regular health checkups. Our study also focuses on the importance of Health education along with behavioral change communication since the education intervention indicated to have significant impact on subjects Hb status. Thus health education would definitely help them to achieve maximum growth and it also enables them to become healthy adults. The study also revealed higher prevalence of anaemic among vegetarians. Thus, dietary modification strategies should mainly focus on imparting knowledge about factors that could impair absorption of iron as well as those which would help increase bioavailability of iron. Health infrastructure and programs targeted to improve the health and

nutritional status of adolescent girls should be strengthened in order to ensure smooth delivery of health care services to the targeted population.

References

1. Agarwal A, Shetty A, Jacob GP. Anaemia among adolescents in a costal district of India. National J Com Med. 2018; 9(6):396-401.

2. Beard JL. Iron requirements in adolescent females. The J nutri. 2000; 130(2):440S-2S

3. Biradar SS, Biradar SP, Alatagi AC, Wantamutte AS, Malur PR. Prevalence of anaemia among adolescent girls: a one year cross-sectional study. Journal of clinical and Diagnostic Research. 2012; 6 (3):372-7.

4. Chaturvedi D, Kumar P, Chaudhuri P, Chaudhary A.). Study of correlation between dietary habits and anemia among adolescent girls in Ranchi and its surrounding area. Int J ContemPediatr, 2017; 4(4):1165-1168.

5. Dallman PR. Changing iron needs from birth through adolescence. In: Fomon SJ, Zlotkin S, eds. Nutritional anemias. Nestle nutrition workshop series. Nestec. Ltd. New York, NY: Vevey/ Raven Press. 1992; 30:29- 38

6. Gopalan C, Rama Sastri BV, Balasubramanian SC, Narasinga Rao BS, Deosthale YG and Pant KC. Nutritive value of Indian Foods. Hyderabad: National Institute of Nutrition, Indian Council of Medical Research; 1996.

7. Gupta D, Pant B, Kumari R, Gupta M. Screen Out anaemia among Adolescent Boys as Well. Natl J Community Med. 2013; 4 (1):20-5.

8. Institute for Health Management, Pachod (IHMP) and International Center for Research on Women (ICRW) project study: Reducing Iron-Deficiency Anemia and Changing Dietary Behaviors among Adolescent Girls in Maharashtra, India (2000-2003).

9. Jolly R, Rajaratnam A, Asokan JS, and Jonathan P. Prevalence of anemia among adolescent girls of rural Tamilnadu. Indian Ped. 2000; 37(5):532-6. 4

10. Joshi SM, Swarna L, Agarwal SS, Mishra MK, Umashankar S. Astudy of nutritional status of adolescent girls in rural area of Bhopal district. Natl J Community Med. 2014; 5:191-4.

11. 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.

12. Kaur T, Kaur M. Anaemia a health burden among rural adolescent girls in district Karnal: Prevalence and correlates. Int Res J Biol Sci. 2015; 4:34-41.

13. Kulkarni MV, Durge PM, Kasturwar NB. Prevalence of anemia among adolescent girls in an urban slum. National J Comm Med. 2012; 3(1):108-11

14. Medhi GK, Hazarika NC, Mahanta J. Nutritional status of adolescents among tea garden workers. Indian J Pediatr. 2007; 74:343-7.

15. Pal A, Pari AK, Sinha A, Dhara PC. Prevalence of undernutrition and associated factors: A cross-sectional study among rural adolescents in West Bengal, India. Int J PediatrAdolesc Med 2017; 4:9-18

16. Rao HK, Raghavan V and Rao M (2003) Anthropometry in the assessment of nutritional status. Human Nutrition, (3rd edition), Oxford and IBH publishing company

17. Seshadri S. Nutritional anaemia in South Asia. Malnutrition in South Asia: a regional profile. ROSA Publication No. 5. 1997 Nov. [4], 189.

18. Shobha S, Sharada D. Efficacy of twice weekly iron supplementation in anemic adolescent girls. Indian Ped. 2003; 15; 40(12):1186-90.

19. Swami HM, Thakur SS, Bhatia SPS. Prevalence of anaemia in a rural area in Chandigarh. Indian J Maternal and Child Health. 1998; 9 (3 and 4): 62-64

20. Toteja GS, Singh P, Dhillon BS, Saxena BN, Ahmed FU, Singh RP, Prakash B, Vijayaraghavan K, Singh Y, Rauf A, Sarma UC. Prevalence of anemia among pregnant women and adolescent girls in 16 districts of India. Food and Nutrition Bulletin. 2006; 27 (4):311-5.

21. Upadhye J and Upadhye J. Assessment of anaemia in adolescent girls. Int J Repro, Contra, Obstd and Gyne. 2017; 6(7):3113-3117

22. WHO. Global nutrition targets 2025: anaemia policy brief (WHO/ NMH/NHD/14.4). Geneva: World Health Organization, 2014.

23. Zou Y, Zhang RH, Xia SC, Huang LC, Fang YQ, Meng J, Chen J, Zhang HX, Zhou B, Ding GQ. The Rural-Urban Difference in BMI and Anemia among Children and Adolescents. Int J Envt Res and Public Health. 2016 Oct 18; 13 (10):1020.