

PREVALENCE OF ANAEMIA AMONGST RURAL ADOLESCENT GIRLS

***Sakshi Sharma¹ and Nikita Arya²**

¹Faculty, Institute of Hotel Management, Catering and Nutrition, Pusa, New Delhi

²Nutrition Coordinator, Centre for Health Research and Development, Society for Applied Studies, New Delhi
sakshish2008@yahoo.com

ABSTRACT

Background: Iron deficiency anaemia is a global problem of immense public health significance. Its prevalence is seen to be high amongst the adolescent girls. **Objective:** To find out the prevalence of iron deficiency anaemia amongst rural adolescent girls. **Methodology:** The study was conducted on rural adolescent girls (n=100) aged 15-17 years from Palsana, Sikar district, Rajasthan. Socio Demographic details of the subjects were collected. Clinical and biochemical assessment of haemoglobin estimation was done. **Results:** The mean age of all the subjects was found to be 15.92 years. Majority of girls were having yellowness in eyes (75%) and nails (70%). Mean haemoglobin of all subjects was 9.60 gm/dl. All subjects were found to be anaemic. **Conclusion:** Prevalence of anaemia was found to be high. Adolescent girls are vulnerable to iron deficiency anaemia especially in the rural settings. Timely and rapid assessments should be conducted for early identification.

Key Words: Adolescent girls, Anaemia, Clinical Assessment, Haemoglobin.

INTRODUCTION

Anaemia is a serious and widespread public health problem and a major contributor in high incidence of premature births, low birth weight and perinatal mortality. Iron deficiency anaemia is a serious public health concern in developing countries. It affects 20-50 percent of the world's population and is common in young children, adolescent girls and expectant and nursing mothers. Various studies from different regions of India have reported the prevalence of anaemia to be between 33 and 100 percent in children and adolescent girls, respectively (Agrawal et al, 1999). Anaemia is characterized by a low level of haemoglobin in the red blood cells. Anaemia usually results from a nutritional deficiency of iron, folate, vitamin B12, or some other nutrients. It is the most widespread form of malnutrition in the world, affecting more than 2 billion people (Stolzfus et al, 1998).

World Health Organization defined anaemia as, 'a condition in which the number of red blood cells (RBC) or their oxygen-carrying capacity is insufficient to meet physiologic needs, which vary by age, sex, altitude, smoking, and pregnancy'. A decreased amount of haemoglobin and RBCs in the blood stream is known as anaemia. As RBCs are needed to carry oxygen throughout the body, anaemia results in less oxygen reaching the cells and tissues, affecting their functions (Patel et al, 2009). Anaemia is characterized by reduction in total circulating haemoglobin. In iron deficiency, firstly the iron stores become depleted, later when iron level in blood remains low for long period of time, results in iron deficiency anaemia (Robinson, 2007). The cut off for normal haemoglobin levels has been given by WHO in 2001, according to that 12.0gm/dl is the normal level for adolescent girls with age 12-18 years.

The symptoms for anaemia are pale skin, lips, tongue and inner surface of conjunctiva, fatigue, irritability, weakness, shortness of breath on climbing stairs, low blood pressure with position change from lying or sitting to standing, koilonychias (spoon shaped nails), unusual food cravings (called pica), decreased appetite, hypermenoria (Tiwari, 2002).

Adolescence is a period of rapid growth, weight gain and blood volume expansion so the overall iron requirement of the body increases during this period. Anaemia is an indicator of both poor health and poor nutrition. The risk of iron deficiency anaemia among girls appears to be more due to growth spurt, and it remains same during their reproductive life (Gawarikar et al, 2002). Adolescent girls constitute a vulnerable group for iron deficiency anaemia, resulting in a reduced physical work capacity and cognitive function, behavioural disturbances, co- morbidity and delay in the onset of menarche which leads to cephalopelvic disproportions. The population of the Indian adolescent girls in 2011 was 109.4 million, out of that 67.8-98.5 million (56-90.1%) adolescent girls were found to be suffering from iron deficiency anaemia. The prevalence of iron deficiency anaemia in Bhopal was 58.4 percent, in Karnataka 45.2 percent and in Wardha city was 31.4 percent (WHO, 2011).

According to the National Family Health Survey, 2005-06, the prevalence of anaemia in Indian women aged 15-49 years was more than half of the population that is 55 percent. The highest prevalence of anaemia in women (more than 60 percent) was found in eight contiguous states along the east coast of India continuing north through Jharkhand and Bihar into Northeast. Severe anaemia was highest in Assam and Andhra Pradesh (3 percent). Anaemia prevalence was low in five states that were Punjab, Manipur, Mizoram, Goa, and Kerala with 30 percent prevalence. As per the NFHS findings, no improvement can be seen in anaemia prevalence from 2005 to 2011.

The state which had lowest prevalence of anaemia was Nagaland 44.3 percent, then Goa with 49.3 percent, followed by Mizoram 51.7 percent. Bihar had the highest prevalence that was 87.6 percent followed by Rajasthan 85.1 percent and Karnataka 82.7 percent (Sonkamble, 2006). The overall prevalence of anaemia was 52 percent in women, 35 percent of them were mildly anaemic, 15 percent were moderately anaemic and 2 percent were severely anaemic (NFHS-2, 1998-1999). The overall prevalence of anaemia has increased from 1998-1999 to 2005-2006 that is 74.2 percent to 79.2 percent. The prevalence of anaemia in adolescent girls is very high (72.6 percent) in India with prevalence of severe anaemia among them much higher (21.1 percent) than that in preschool children (2.1 percent). Thus it can be seen that overall prevalence of anaemia is found to be increasing for adolescent girls.

Measuring haemoglobin (Hb) concentration is relatively easy and inexpensive method, and this measurement is frequently used as a proxy indicator of iron deficiency anaemia and thus on the basis of this, interventions for anaemic girls can be helpful in raising their iron stores and sustain their haemoglobin at normal levels to the anaemic individuals. This will not only improve their physical and mental capacity, but also subsequently help in reducing the incidence of low birth weight of infants and maternal mortality rates.

The initiatives of Government play a very crucial role in the society. In tenth five year plan (2002-2007) the goals for overcoming prevalence of anaemia were decided, where the major goals were: Effective implementation of the provision for food and drug safety: strengthening the food and drug administration both at the centre and in the states and screening for common nutritional deficiencies especially in vulnerable groups and initiating appropriate remedial measures; evolving and effectively implementing programmes for improving nutritional status, including micronutrient status of the population.

Unfortunately despite scientific basis for the programme, iron-folic acid supplementation has failed to have an impact on the incidence or severity of anaemia, allegedly due to: lack of awareness regarding its importance and consequently poor compliance, poor outreach in all over the country, uniformly giving one tablet of iron and folic acid (which meant for preventing anaemia in non-anaemic women) regardless of the severity of anaemia, iron folic acid supplements are unappealing to people, in part due to unpleasant side effects. National programmes to control and prevent anaemia have not been successful. Experiences from other countries in controlling moderately-severe anaemia guide to adopt

long term measures i.e. fortification of food items like milk, cereal, sugar, salt with iron. Nutritional Anaemia Control Programme should be comprehensive and incorporate nutrition education through school health and ICDS infrastructure to promote regular intake of iron/ folic acid-rich foods, to promote intake of food which helps in absorption of iron and folic acid and adequate intake of food (NIHFW, 2009).

After many government efforts still the prevalence of anaemia is high in our country which may due to poor outreach, unavailability of supplements and self withdrawal. As iron deficiency anaemia is associated with impaired growth in children, poor pregnancy outcome, and decreased work capacity there is a dire need to regularly and quickly assess adolescent girls especially for iron deficiency anaemia since today's youth is the future of our country. Special focus need to be given to rural areas with regard to their timely health and nutrition assessment and intervention. If these people are provided with timely supplementation along with nutrition education, we may increase the compliance. Thus considering this the general objective of the study was to check the prevalence of anaemia amongst the rural adolescent girls and the specific objectives were:

- 1) To conduct clinical assessment of the adolescent girls
- 2) To conduct biochemical assessment of the adolescent girls

METHODOLOGY

The study was conducted on school going, unmarried rural adolescent girls of Sikar, Rajasthan. The locale was selected on the basis of convenience. Simple random sampling was done to select the samples from the Tambi Higher Secondary School, Palsana, Sikar, Rajasthan. The school comprised of 739 students out of which 391 were boys and 348 were girls. The strength of 15 to 17 years girls was 183, out of which 100 unmarried, physically fit girls were selected. Total 100 girls participated in the study.

Duration of investigation was from 6 November 2011 to 27 January 2012.

Tools and Techniques: In the initial phase of study permission was sought from the health authorities of Rajasthan, and then the school was selected as a part of work. After that rapport development was done with school authority and they were told for the purpose of the study. Due permission was taken through the consent form, from the parents of all the subjects and research objectives were explained to them. For rapport development with students, personal interaction was done and where they were informed about the research work.

General Performa comprised of set of general questions related to demographic, socio-economic and health profile of the subjects. Data regarding the demographic profile, socio economic profile, health status was collected using different variable like age, family income, education, number of family member, symptom of anaemia.

Clinical assessment is one of the common tools used to assess the clinical signs of various nutritional disorders. Clinical examination was done to identify clinical signs in subjects like yellowness of eyes, nails, tongue, breathlessness on climbing stairs, weakness and fatigue, koilonychias, hypermenoria and low appetite.

In biochemical assessment haemoglobin level was measured by Sahli's method. This particular method was used as it is less time consuming so it is suitable for a large sample size also for testing it requires only a single drop of blood due to which subjects were easily convinced for testing of haemoglobin.

RESULTS AND DISCUSSION

Demographic and Socio Economic details

Age: The age of the subjects ranged from 15 to 17 years. Out of 100 subjects 29 girls were of 15 years, 50 and 21 girls were of 16 years and 17 years of age respectively (Table 1). The mean age was 15.92 years.

Members in Family: Majority of subjects (58%) were living with 3 to 5 members, followed by 29 percent of subjects who were having more than eight members in their family and only 13 percent were having 6 to 8 members in family. Rawat et al (2001) observed that girls who were living in families having more than three family members were having increased prevalence of anaemia. In the present study no significant association was found between the number of family members and haemoglobin level of subjects (Table 2).

Siblings: 37 percent of the subjects were having 2 to 3 siblings, 35 percent subjects were having 4 to 5 siblings and 28 percent of subjects were having more than 5 siblings.

Type of Family: Majority of subjects (64%) were living in nuclear family and 36% of samples were living in joint family. As apparent from table 3, prevalence of moderate degree of anaemia among subjects of joint family was found to be higher i.e. 78 percent than the subjects living in nuclear family (63 percent) and a significant association was found at one percent level of significance between the haemoglobin of subjects and their family type. Similarly Rawat et al in 2001 also reported that the prevalence of anaemia was significantly higher (45.2 percent) among those girls living in joint families than girls (28.3 percent) living in nuclear families.

Father's Occupation : The data revealed that majority (68%) of the subject's fathers were engaged in agricultural work, 20 percent were doing services and only 12% were self employed. In relation to father's occupation Rawat et al (2008) also presented data in which girls whose fathers were labourers were more anaemic than those whose fathers working in agriculture.

Mother's Education : The data revealed that only 30 percent subject's mothers were literate out of

which 27 percent were qualified to 12th standard, 17 percent were to 10th standard, 23 percent were to 8th standard and 33 percent mothers were educated to 5th standard whereas 70 percent mothers were illiterate.

Table 1: Socio Demographic Profile

General Information	Number of Subjects (n=100)
1) Age	
15 years	29
16 years	50
17 years	21
2) Members in family	
3-5	58
6-8	13
More than 8	29
3) Siblings	
2-3	37
4-5	28
More than 5	35
4) Type of family	
Nuclear family	64
Joint family	36
5) Father's occupation	
Agriculture	60
Service	20
Business	12
6) Mother's education	
Literate:	30
Below 10th standard	8
Till 10th standard	5
Till 12th standard	17
Illiterate	90
7) Mother's occupation	
House wife	98
Teacher	2
8) Working after school	
Yes	5
No	95

Table 2 : Association between Prevalence of Anaemia and Number of Family Members

Members in Family	Mildly Anaemic	Moderately Anaemic	Total	x ² Value
3 to 5 members	16	42	58	0.024*
More than 5 members	11	31	42	
Total	27	73	100	

*Not significant.

Table 3: Association between Type of Family and Prevalence of Anaemia

Type of Family	Mildly Anaemic	Moderately Anaemic	Total	x ² Value
Joint	14	50	64	3.32*
Nuclear	13	23	36	
Total	27	73	100	

*(p<0.01)

Clinical Assessment: Various clinical symptoms of anaemia were assessed (Table 4) in subjects and it was found that majority of girls were having yellowness in eyes (75%) and nails (70%), revealed that girls were suffering from mild to moderate degree of anaemia. This followed by yellowness of tongue present in 49 percent of subjects then weakness and low appetite was found in 38 percent and 39 percent of the subjects respectively. Similar findings were obtained by Sajjan et al, 2008 in which clinical symptoms related to anaemia were found to be paleness 28 percent of adolescent girls, 6.66 and 3.33 percent had giddiness and breathlessness, while 34 percent were free of symptoms. In the present study anaemia was prevalent among all the subjects as there were none of the subjects who were free from clinical signs of anaemia. Swarnalatha et al, 2006 also reported that of pale conjunctiva was the symptom which was majorly prevalent in anaemic adolescent girls as compare to other symptoms like white patches, loss of appetite. Similarly in present endeavour paleness was found to be more prevalent among the subjects as paleness is the first symptom to be appear in the initial stage of anaemia due to increased level of bilirubin in the blood.

Breathlessness on climbing stairs was prevalent in 20 percent of girls and hypermenoria comparatively less prevalent, found to be in 15 percent of subjects. Koilonychia is one of the symptom of anaemia was not present in any of the subject. Kumari and Singh (2008) observed the various signs and symptoms of anaemia in adolescent girls which were breathlessness, tiredness and pale nails where most of the girls (95%) were found to have these symptoms. In present study prevalence of these clinical symptoms was found to be 100 percent as all the subjects were having various degree of anaemia.

Table 4: Clinical Signs and Symptoms Prevalent in Subjects

Symptoms	Total (n=100)
Breathlessness on climbing stairs	20
Weakness and Fatigue	38
Yellowness of Tongue	49
Yellowness of Nails	70
Yellowness of Eyes	75
Koilonychia	0
Hypermenoria	15
Low appetite	39

Biochemical Assessment: On the basis of the haemoglobin estimation done it is apparent in table 5 that the mean haemoglobin of all subjects was 9.60 gm/dl and the mean of haemoglobin for the various age group was found to be 9.73 gm/dl, 9.41 gm/dl and 9.87 gm/dl of subjects of 15 years, 16 years and 17 years respectively. Thus anaemia was found to be prevalent amongst all the subjects of various age groups included in present endeavour. (Table 6). Shobha and Sharda (2008) revealed that the prevalence of anaemia was found to be increased with age after 15 years to 78.57 percent. Abalkhal and Shwaky (2002) also found that prevalence of anaemia was significantly higher among older age group (12-14 and 15-21 years) than younger students (9-11 years).

Further on categorizing as per WHO classification of anaemia (Figure1) it was observed that 73 percent of girls were suffering from moderate anaemia and 27 percent of girls were having mild degree of anaemia and none of the subjects were found to be severely anaemic. Similarly Siddharam et al, 2011 did a cross sectional study to find the prevalence of anaemia amongst 142 adolescent girls of Hassan district of Karnataka wherein 57 percent had mild anaemia, 78 percent had moderate anaemia and 7 percent had severe anaemia. Prevalence of anaemia was found to be 100 percent.

Sidhu et al, 2005 studied the prevalence of anaemia among adolescent girls of government school of Chandigarh and they revealed that only 29.43 percent were normal and 70.57 percent were anaemic in which 30.57 percent were mildly anaemic, 20.17 percent moderately anaemic and 12.83 percent severely anaemic.

Table 5: Age wise Mean of Haemoglobin of Subjects

Age Group	Number of Subjects (n)	Mean \pm SE (gm/dl)
15 years	29	9.73 \pm 0.90
16 years	50	9.41 \pm 0.89
17 years	21	9.87 \pm 1.01
Total	100	9.60 \pm 0.94

Table 6 : Prevalence of Anaemia amongst Subjects

Age Group	Number of Subjects (n)	Anaemia (n%)
15 years	29	29 (100%)
16 years	50	50 (100%)
17 years	21	21 (100%)
Total	100	100 (100%)

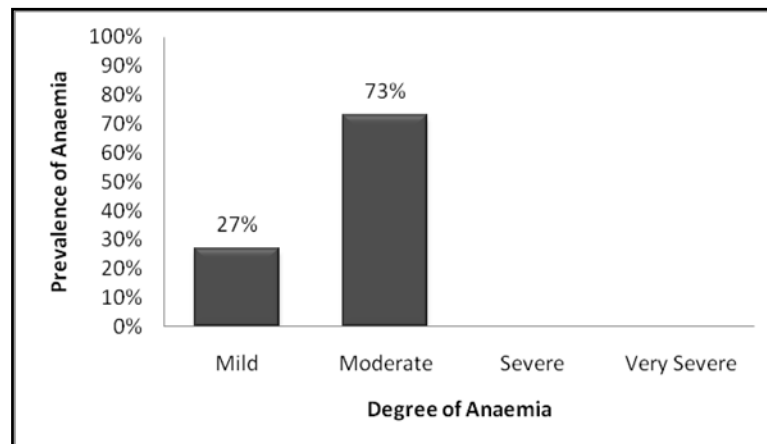


Figure 1: Severity of Anaemia among the Subjects

On the basis of NFHS 1998-1999 findings, where in 88 percent of Indian women were tested for estimation of haemoglobin levels and it was found that overall, 52 percent of women had some degree of anaemia out of which 35 percent were mildly anaemic, 15 percent were moderately and 2 percent were severely anaemic. The prevalence of anaemia increased from 1999 to 2005 as according to the findings of NFHS 2005-2006 when anaemia was measured among women aged 15-49 years it was concluded that more than half of women (55 percent) were anaemic. The state wise data revealed that highest prevalence of anaemia in women (more than 60 percent) was found in Jharkhand and Bihar into Northeast. Severe anaemia was highest in Assam and Andhra Pradesh (3 percent) and anaemia prevalence was low in five states that were Punjab, Manipur, Mizoram, Goa, and Kerala with 30 percent prevalence.

According to DLHS 2002-04 data on state wise prevalence of anaemia in adolescent girls, the state which had lowest prevalence of anaemia was Nagaland 44.3 percent, then Goa with 49.3 percent, followed by Mizoram 51.7 percent. Bihar had the highest prevalence that was 87.6 percent followed by Rajasthan 85.1 percent and Karnataka 82.7 percent.

Rawat et al, 2001 worked to study the socio-demographic characteristics in relation to anaemia among 504 adolescent girls of Meerut, Uttar Pradesh in which the prevalence of mild, moderate and severe anaemia among girls was 19 percent, 14.1 percent and 1.4 percent, respectively.

As per the survey of National Nutritional Monitoring Bureau (2002) it was reported that the overall prevalence of anaemia among adolescents was relatively higher in states of West Bengal (88-90%) Orissa (78-82%), Madhya Pradesh (72-76%) and Andhra Pradesh (73%). In 2002, Shah reported that the prevalence of anaemia among 209 school going adolescent girls resident in urban foothill town of Shimla was 68.8%. This shows that anaemia is more prevalent in hilly areas.

Basu et al (2004) conducted cross sectional study to assess the prevalence of anaemia among 1120 healthy adolescent girls aged 12-18 years wherein subjects from 11 city and 2 rural schools of Chandigarh were selected for the study. The prevalence of anaemia was observed to be 25.4 percent in rural girls where as 14.2 percent in urban girls. Estimation of haemoglobin was done for all of the subjects. In the results it was observed that 68 students were found have normal levels of haemoglobin, none of them were observed to be severely anaemic (Hb <7g/dl); 12.6 percent and 46 percent subjects were moderately and mildly anaemic, respectively.

Patel (2004) has done a study on to check the prevalence of anaemia in adolescent girls of Vadodara district wherein 2860 school going adolescent girls with age 12-19 years from rural, urban and tribal community were selected. The prevalence of anaemia (Hb <120mg/l) was recorded as 53.2 percent among all subjects.

Uppal et al, 2005 did a study to check the prevalence of anaemia among 265 adolescent girls of government schools of Amritsar, Punjab. Out of 265 girls, only 29.43 percent were found to have normal level of haemoglobin as per the standards and 70.50 percent were anaemic in which 30.57 percent were mildly anaemic, 27.17 percent moderately anaemic and 12.83 percent severely anaemic. Further it revealed that prevalence of anaemia increases with age and maximum (78.57 percent) in the age group more than 15 years.

In a cross-sectional descriptive study done by Singh et al (2006) to determine the prevalence of iron deficiency and iron deficiency anaemia among adolescent girls of slums of Lucknow wherein 400 girls belonging to 10-19 years age group were selected randomly. The mean haemoglobin was 10gm/dl and 56% of girls were found to be mildly anaemic (Hb level > 8-11 gm %). In a similar study conducted by Amani and Maryam, (2008) among school going adolescent girls of Lucknow where the prevalence of anemia (12 mg/dl) was observed to be 21.4 percent. Kowsalya et al conducted a study in 2008 to check prevalence of anaemia in adolescent girls (13-18 years) of Manipur wherein 100 girls were selected for work. The results revealed that of all the subjects, 30 percent were moderately anaemic, 25 percent were mildly anaemic and 10 percent girls were severely anaemic.

Kulkarni et al (2010) has done study to check the prevalence of anaemia among adolescent girls in an urban slum of Nagpur. Prevalence of anaemia was found to be high (90.1%) among adolescent girls. Majority of girls were found to have moderate to mild anaemia (88.6%). Akhter et al (2010) reported that in a project done by Helen Keller International's Nutritional surveillance in collaboration

with the Institute of Public Health Nutrition, 900 Indian unmarried adolescent girls were checked for prevalence of anaemia. It was found that overall 43.5% of the adolescent girls were anaemic. Aggarwal did a study in 2010 to check the effect of frequency and dosage of iron and folic acid supplementation on blood haemoglobin of 140 anaemic adolescent girls of Delhi in which girls were screened for the prevalence of anaemia. It was found that 52.8 percent of girls suffering from mild degree of anaemia, 8.57 percent and 2.1 percent girls were suffering from moderate and severe degree of anaemia respectively. It was stated that daily doses rapidly reduce the intestinal absorption of both dietary iron and subsequent supplementary doses because of the tiredness of the gastric mucosa.

On the basis of WHO findings of 2011, 1,50,700 school-going and nonschool going girls were selected from Lucknow, Uttar Pradesh to check the prevalence of anaemia wherein the prevalence of anaemia was 92.6 percent in school going and 73.3% in nonschool going girls.

In a cross sectional, descriptive study of rural area of Hassan district of Karnataka anaemia prevalence was checked in adolescent girls of 12 anganwadi centers. Haemoglobin estimation was done for 314 adolescent girls and in the results, 142 girls were found to be anaemic, of which 57 had mild anaemia, 78 had moderate anaemia and 7 had severe anaemia (Venketesh, 2011).

CONCLUSION

On the basis of results it can be concluded that adolescent girls of rural area in age group of 15 years to 17 years are vulnerable to iron deficiency anaemia. The prevalence of iron deficiency anaemia was found to be high and it was found to be significantly related with family type and education of mother. Timely and rapid health and nutritional assessment should be conducted for such age groups so as to overcome the barriers of impaired growth and development of such an essential segment of our nation.

REFERENCES

1. Abalkhal, B., & Shawky, S. (2002). Prevalence of daily breakfast intake, iron deficiency anaemia and awareness of being anaemic among Saudi school students. *Journal of Food Science and Nutrition*, 53, 519-528.
2. Aggarwal, D. (2010). Effect of frequency and doses of iron folic acid supplementation on blood haemoglobin of anaemic adolescent girls. *Nutrition in Disease Management*, 45, 7-12.
3. Agrawal, V., & Tejwani, S. (1999). Prevalence of Iron Deficiency Anaemia in Indian antenatal women especially in rural areas. *Indian Medical Gazette*, September, 300-3.
4. Akhter, N., & Haselow, N. (2010). Using data from a nationally representative nutrition surveillance system to assess trends and influence nutrition programs and policy. *The Journal of Field Actions*, 4.
5. Amani, R., & Maryam, S. (2006, September). Nutrition education alone improves dietary

- practices but not haematologic indices of adolescent girls in Iran. *Food and nutrition Bulletin*.
6. Basu, S., Basu, S., Hazarika, R., & Parmar, V. (2005). Prevalence of anaemia among school going adolescents of Chandigarh. *Indian Paediatrics*, 42, 593-597.
 7. District Level Health Surveys. (2002-2004). Ministry of Health and Family Welfare, Government of India. Retrieved from: rchiips.org/pdf/rch2/National_Report_RCH-II.pdf
 8. Gawarikar, R. S., Gawarikar, S. B., & Tripathi, B. C. (2002). Prevalence of Anaemia in Adolescent Girls of Ujjain in Western M.P. *Indian Journal of Nutrition and Dietetics*, 39, 493-499.
 9. Government of India, 10th Five Year Plan, Planning Commission, India, (2002). Retrieved from: Planningcommission.nic.in/plans/planrel/fivelyr/10th/10defaultchap.htm.
 10. Kowsalya, S. (2008). Impact of supplementation of lotus stem on the iron level of adolescent girls in Manipur. *Indian Journal of Nutrition and Dietetics*, 45, 47-53.
 11. Kulkarni, V. M., Durge, M. P., & Kasturwar, B. N. (2012). Prevalence of anaemia among adolescent girls in urban slum. *National Journal of Community Medicine*, 3(1), 108-111.
 12. Kumari, S., & Singh, S. (2003). Nutritional status of scheduled caste adolescents from deprived section of society. *Indian Journal of Nutrition and Dietetics*, 147-152.
 13. National Family Health Survey India. (1998-1999). International Institute of Population sciences, measures International, Demographic Health Survey (2000).
 14. National Family Health Survey-3. (2005-2006). September, 2007. International Institute for Population Sciences, Mumbai. India, 290.
 15. National Institute of Health and Family Welfare. (2009). Retrieved on: 2012, January.
 16. National Nutritional Monitoring Bureau Technical Report No. 22. Prevalence of Micronutrient deficiencies. ICMR 2003, 16.
 17. Patel, H. Z., & Shah, P. U. (2009). A study about anaemic condition of adolescent girls by haemoglobin estimation and dietary survey. *International Research Journal*, 3, 86-87.
 18. Rawat, C. M. S., Garg, S. K., Singh, J. V., & Bhatnagar, M. (2008). Socio Demographic correlated of anaemia among adolescent girls in rural areas of district Meerut (UP). *Studies on adolescent girls*. 49-50.
 19. Robinson, C. H., Lawler, M. R., Chenoweth, W. L., & Garwick, A. E. (2007). *Normal and Therapeutic Nutrition* (17th ed.): Macmilian Publishing Company, 127.
 20. Sajjan, J. T. (2008). Consumption pattern of green leafy vegetables and impact of nutrition education on haemoglobin levels of rural adolescent girls. University of Agricultural sciences, Dharwad.
 21. Shah, B. K., & Gupta, P. (2002). Weekly vs. daily iron and folic acid supplementation in adolescent Nepalese girls. *Archives of Paediatrics and Adolescent Medicine*, 156, 131-135.

22. Shobha, S., & Sharda, D. (2008). Efficacy of twice weekly iron supplementation in anaemia adolescent girls. *Studies on adolescent girls*, 57-58.
23. Siddharam, S. M., Venketesh, G. M., & Thejeshwari, H. L. (2011). A study of anaemia among adolescent girls in rural area of Hasan district Karnataka, South India. *International Journal of Biological and Medical Research*, 2(4), 922-924.
24. Sidhu, S., Kumari, K., & Uppal, M. (2005). Prevalence of anaemia among adolescent girls of scheduled caste community in Punjab. *Anthropologist*, 7(4), 265-267.
25. Singh, N., & Jain, R. (2008, September). Weekly iron and folic acid supplementation with counselling reduces anaemia in adolescent girls: a large-scale effectiveness study in Uttar Pradesh. *Food and Nutrition Bulletin*.
26. Sonkamble, U. J., Goswami, B., Sahu, A. B., & Prabhu P. (2006, December). 2002-2004. Nutritional status of children and prevalence of anaemia among children, adolescent girls and pregnant women, District Level Household Survey, 33-39.
27. Stoltzfus, R. J., & Dreyfuss, M. L. (1998). Guidelines for the use of iron supplements to prevent and treat iron deficiency anaemia, Geneva.
28. Swarnalath, A., & Yegammai, C. (2008). Impact of Iron, vitamin A and vitamin C supplementation on anaemic adolescent girls. *Studies on adolescent girls*, 59-60.
29. Tiwari, K. (2004). Prevention and Control of Nutritional Anaemia: A South Asia Priority. UNICEF, 4.
30. World Health Organization. (2011). Prevention of Iron Deficiency Anaemia in Adolescents: Role of weekly iron and folic acid supplementation. Regional office of South East Asia, 42.