An assessment of interventional strategies for control of anemia among adolescent girls in an urban slum of Karad, Dist. Satara, Maharashtra

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Abstract: *Objectives:* To find the prevalence of anemia among adolescent girls and to assess the impact of nutritional education, therapeutic intervention and supplementary intervention for the control of anemia amongst these girls. *Materials & Methods:* A longitudinal study was carried out in an urban field practice area of Department of Community Medicine in a teaching institute in Western Maharashtra. All the adolescent girls in the age group of 11-18 years were contacted by a house-to-house survey during which data regarding social and personal factors was collected along with hemoglobin (Hb) estimation. Out of the total 103 adolescent girls 88 (85.4%) were anemic of which 52 (50.48%) had mild anemia, 34 (33%) moderate anemia and 2 (1.9%) had severe anemia. Age match distribution was done of the 52 mildly anemic girls in Group 1, Group 2 and Group 3 in the size of 17, 17 and 18 respectively. Interventions of nutritional education, distribution of iron and folic acid tablets and supplementary nutrition by giving iron rich preparations was done in the above three groups for a period of one month and Hb was rechecked. *Statistical Analysis:* was done by applying one way ANOVA, Chi-square test and logistic regression analysis. *Results:* One way ANOVA revealed homogeneity in age matched distribution of girls in 3 groups. There was significant rise in the Hb level in group 2 who received iron and folic acid tablets. No change in Hb level was seen in group 1 and 3. But in some girls there was improvement in Hb levels however in some there was reduction in Hb level belonging to group 1 and 3. By applying backward logistic regression model it was found that increasing age, mixed diet and supplementation of iron and folic acid were associated with improved Hb level irrespective of intervention in group 1 and 3.
Keywords: anemia; adolescent girls; interventions; prevalence; ANOVA; Chi-square test; logistic regression test.

Introduction

Iron deficiency anemia is widely prevalent all over the world affecting about 700 to 800 million people in less developed countries and 60 to 70 million in developed countries [1]. The women of reproductive age in the developing countries are more affected the reason being poverty, inadequate diet, certain diseases, repeated pregnancies and lactation and poor access to health services. Adolescent age group is more susceptible because of their rapid growth and associated higher iron requirement. On account of practice of early marriages and potential exposure to a greater risk of morbidity and mortality adolescent girls constitute a vulnerable group [2]. A review of Indian studies on anemia in adolescent girls revealed that more than 70 % of adolescent girls in low income communities had levels less than 110 gm/L [3].

Anemia in this group attributes to high Maternal Mortality Rate, high incidence of low birth –weight babies, high perinatal mortality and fetal wastage and consequent high fertility rates. This phase of life is important because if we control anemia at this stage we can prevent its occurrence in pregnancy. Strategies for reducing anemia include supplementation, fortification and improving the diet by nutritional education. Though supplementation of iron and folic acid remains the cornerstone in the treatment of anemia, nutritional education and dietary supplementation are long term measures to prevent its recurrence.

The less availability of various facilities like water supply and sanitation, food grains at subsidized rate, health care and education are

always observed in an urban slum area. Because of this the adolescent girls who are already a vulnerable group is unaware about the importance of nutrition and anemia. Thus the present study was carried out to find out the magnitude of anemia in adolescent girls and to assess the impact of nutritional education, therapeutic intervention and supplementary nutrition on the hemoglobin level of anemic adolescent girls.

Material and Methods

After preparing the protocol and getting it approved by the Institute Ethical Committee the present longitudinal as well as experimental and observational study was carried out in an urban field practice area of Community Medicine Department of Krishna Institute of Medical Sciences, Karad, Dist. Satara in Western Maharashtra. All the adolescent girls irrespective of school going or not in the age group of 11 to 18 years residing in the slum adopted by urban health training centre (UHTC) area were included in the study and contacted by a house-to-house survey. All families were registered under UHTC and belonged to socio-economic class lll and lV according to Kuppuswami's method of classification.

They were informed about the project and consent was taken from each participant and data was collected. Hemoglobin (Hb) estimation was done by Sahli's Hemoglobinometer. Data regarding social factors (education, occupation, family type, parent education) and personal factors (menstrual cycle, diet, history of passing worms, nail hygiene) was collected by a pre-tested proforma. Nail hygiene was assessed by presence of dirt in nails. Clinical examination for anemia was carried out. Girls with moderate and severe grades of anemia (Hb <10 gm %) were excluded and referred to Tertiary Care Hospital for further treatment while girls with normal Hb ((≥12gm %) were also excluded from the study. Only mildly anemic girls (Hb 10-12 gm %) were included in the intervention. To assess the usefulness of three different interventions as described below the mildly anemic girls were distributed in three groups. As all girls belonged to poor socio-economic class, age matched allocation to various groups was done. The interventions applied for a period of one month were as follows:

- *Group 1:* were given weekly education regarding role of nutrition to overcome anemia with the aid of printed material, lectures and discussion by the researcher four times a week for an hour in the UHTC.
- *Group 2:* were provided Ferrous Sulphate and Folic Acid tablets containing 100 mg elemental iron and 0.5 mg folic acid to consume daily in the presence of researcher at UHTC.
- *Group 3:* were made to consume a preparation of iron-rich food in the form of Laddus. This preparation was given to consume for a period of one month. Twenty-five laddus were prepared from garden cress seeds (locally called as '*haliva*') 250 gms, dry coconut 500 gms and jaggery 750 gms which contained a total of 349 mg of iron [4]. A laddu of 60 gms were prepared by trained women from above mentioned locally available cheap items. One laddu contained 14 mg of iron. Girls were made to consume two laddus at a time considering the iron absorption among adolescent girls to be 2.4 mg/day and the recommended daily allowance of iron should be 28 mg/day [5]. The interventions of iron and folic acid tablets and specially prepared food i.e. laddus were given in the same month to two groups followed by nutrition education in the next month to the third group along with post-intervention Hb estimation,so there was no contamination in the three groups though the interventions were done in the same area.

In a community based pilot study it was observed that daily consumption of laddus of cress seeds improved Hb level within a period of one month. Thus it was planned to assess and confirm scientifically the effectiveness of various interventions for a period of one month on improving Hb level. After a period of one month Hb level was rechecked using same method of all the girls in the three study groups and data was analyzed.

Statistical Analysis: Homogeneity in ages of girls distributed in three groups by using age matching concept was confirmed by applying one-way ANOVA. Comparison of baseline

variables in study groups was done by Chi-Square test and one way ANOVA. Post intervention Hb level in three groups was compared by applying one-way ANOVA. Initial and Post intervention Hb level in each of the study group was assessed by applying paired 't' test. Results were said to be significant if probability was less than 0.05. Backward logistic regression analysis was carried out to find the model that gives higher sensitivity (proportion of adolescents predicted/detected to be improved Hb level amongst actually observed improved) and higher specificity (proportion of adolescent predicted/detected to be not improved Hb level amongst actually observed not improved).

Results

There were total 103 adolescent girls out of which 15(14.6%) were non anemic and 88 (85.4%) were anemic having the prevalence of anemia to be 88.4%. Amongst these, 52(50.5%) were having mild anemia, 34(33%) were having moderate anemia and 2(1.9%) were having severe anemia. As per study design only mild anemic girls were included in the present study for the assessment of different interventions while moderate and severe anemic girls were referred to tertiary care hospital for necessary treatment and care. Age matched distribution of these 52 girls was done in group 1, group 2, and group 3 in the size of 17, 17, and 18 respectively as shown in Table-1.

Table-1: Age and initial Hb of girls allocated different interventions

Group	No. of Girls (n)	Age	Hb in gm%
1	17	14.18±2.58	10.52±0.48
2	17	14.35±2.71	10.72±0.60
3	18	14.28±2.65	10.43±0.38
ANOVA value(F) p value		0.019 0.981	1.527 0.227

One way ANOVA revealed homogeneity in age matched distribution of adolescent girls in Group 1, Group2 and Group 3($F_{2,49}$=0.019,p=0.981). Assessment of other baseline variables viz.demographic, social and personal hygiene related factors; for their responses also revealed proportionately similar distribution of girls in all study groups.

Table-2: Hb level before and at the end of one month

Hb	Group 1	Group 2	Group 3
Before	10.52 ± 0.48	10.72 ± 0.60	10.43 ± 0.38
After	10.41 ± 0.55	11.26 ± 0.75	10.44 ± 0.45
t value	0.872	2.7	0.858
p value	0.393	0.015	0.412
$F_{2,49}$=11.259,p<0.001			

As shown in Table-2 comparison of mean Hb level, before application of planned interventions, of girls belonging to Group 1, Group 2 and Group 3 also revealed no significant difference ($F_{2,49}$=1.527, p=0.227).At the end of one month of intervention it was observed that there was significant rise in the mean Hb level of girls in Group 2 that received Iron and Folic Acid tablets in comparison to the mean Hb level of girls in Group 1 and Group 3 that received nutritional education and supplementary food respectively ($F_{2,49}$=11.259,p<0.001).Group wise comparison of Hb between initial and after one month intervention also revealed significant rise in Group 2 (t=2.7,p=0.015).

Though Group 2 revealed significant improvement there was improvement as well as reduction in Hb level of girls belonging to Group 1 and Group 3 which balanced the average Hb level. To find the variables responsible to improvement in the Hb level logistic regression was executed (Table-3). For application of logistic regression, girls from all groups were taken together and a new variable 'Intervention' was created for the intervention which they received. Further girls with increased Hb levels after one month of intervention, were coded with value '1' while those with not increased Hb level were coded with value '0'.Thus a new variable 'Hb increase' indicating increase'1' and not-increase '0' was created. Taking this variable as dependent and 'Intervention' and other baseline variables (demographic, social and personal hygiene) as independent, the backward logistic regression was carried out. Logistic regression analysis revealed that increasing age, mixed diet, and supplementation of iron and folic acid tablets

were associated with improved Hb level. Presence of menstrual cycle was not significantly associated with increase Hb level. Odds Ratio

(0.011) indicates that there is only 1.1% chance of increasing Hb in adolescent girls even though menstrual cycle is present.

Variable	Regression coefficient (β)	Probability (p)	Odds ratio (OR)	Lower limit	upper limit
Table-3: Logistic Regression Model to determine factors associated with increased Hb level				95% CI of OR	
Interventions					
Nutr.Edu. (Gp 1)	-	-	-	-	-
Iron Tabs (Gp 2)	3.4	0.001	29.3	3.7	233.9
Supplem. Nutr. (Gp 3)	-0.2	0.871	0.8	0.1	6.7
Type of Family					
Nuclear family	-	-	-	-	-
Joint family	1.3	0.243	3.5	0.43	28.9
3 Gen	1.60	0.235	5.0	0.35	71.5
Menstrual Cycle					
Present	4.5	0.47	0.011	0.00	0.94
Absent	-	-	-	-	-
Diet					
Vegetarian diet	-	-	-	-	-
Mixed Diet	2.2	0.031	0.112	0.015	0.816
H/o Passing Hookworm					
Present	1.8	0.102	0.167	0.02	1.42
Absent	-	-	-	-	-
Nail Hygiene					
Clean	1.6	0.105	0.195	0.03	1.4
Unclean	-	-	-	-	-
Age in yrs					
11-14	-	-	-	-	-
14-16	3.4	0.079	30.9	0.671	1424.7
16-18	6.8	0.019	652.6	2.939	144920.4
Constant	0.168	0.901	1.183		

Discussion

In the present study the prevalence of anemia among adolescent girls was found to be 85.4%.The very high prevalence may be due to the low educational status of parents and therefore less awareness of anemia and its causes, poor sanitation and health care facilities available in urban slum. A very high prevalence reported was 98.87 % [6], while it was as low as 13.1% in an urban hilly community [7]. Some studies reported a prevalence of 35.1 % [8] 44.8 % [9] 59.8% [10] and 68.3% [11]. The difference in the

prevalence of anemia may be due to difference in the study area and other socio-demographic factors. WHO/UNICEF has suggested that the problem of anemia is of very high magnitude in a community when the prevalence rate exceeds 40 % [12]. Anemia development is a consequence which occurs at a later stage of iron deficiency; the problem in these girls with a prevalence of 85.4% should be considered serious and calls for an action. There was considerable improvement in the Hb status of the girls in group 2 who received

iron and folic acid tablets than group 1 and group 3 after a period of one month. Various interventions are carried out by different workers to overcome anemia. In many studies iron and folic acid supplementation was used and Hb level showed a rise [3,11,13-14]. Some researchers have used Vitamin C to enhance iron absorption [6,15]. After the start of iron treatment, a reticulocyte response may be seen in about 8 days. The patient begins to feel better and an improvement in clinical status and the Hb level is usually noted by the third week. The Hb rises by an average of 10 gm/litre per week until normal levels are reached [16].

Nutritional education was given to girls in group 1. But there was no improvement in Hb level after 1 month. However in a study by Kanani S. there was significant increase in awareness of anemia, its symptoms and importance in diet in preventing it. These girls were also encouraged to take iron tablets. Their Hb levels after three months showed a significant increase [17]. In the present study, education was given without active participation of these girls. Information and education of the girls, especially through social mobilization campaigns are essential because iron deficiency induces few visible symptoms, not easily recognizable by individuals. These girls did not modify their diet. In group 3 laddus were given to consume containing 14 mg of iron in 60 mg each. Considering the iron absorption among adolescent girls to be 2.4 mg/day, the recommended daily allowance of iron should be 28 mg/day. Two laddus were distributed to each girl daily to be consumed in front of the investigator. This provided their daily iron requirement. But this group did not show any change in Hb level. This may be because a higher iron content food then their daily requirement must have been given as these girls had mild anemia. There was no dietary modification in these girls involving increased iron intake, increasing total food intake, consumption of locally available iron-rich foods and dietary

practices favouring iron absorption. In a study in Peru, girls were first given education for 9 months and for next 5 months iron-rich menus were developed. Total daily iron intake increased significantly in the intervention group after the campaign [18].

Conclusion

In the present study, the prevalence of anemia among adolescent girls was 85.4% which is significantly higher than reported by WHO/UNICEF. Amongst the various interventional measures to overcome anemia, iron supplementation proved to be the most effective and prompt measure because of better absorption and bioavailability of iron then dietary intervention. Iron and folic acid is an immediate medical measure to control anemia. The preparation we tried though rich in iron did not showed any rise in the Hb level but the level remained the same. This may be because of less bioavailability of iron in the Laddus which should be tested and which may be the limitation of our study.

As the bioavailability of iron in Indian foods is comparatively less, long term effective approaches like nutritional education along with dietary interventions will be an effective strategy to combat anemia in this highly vulnerable group of adolescent girls. In future after marriage they will practise the same in their family which will be an added advantage. Logistic regression model revealed that elder girls, mixed diet and supplementation of iron and folic acid tablets showed improve Hb level. Therefore the intervention measures are more effective when they are integrated with other approaches such as improvement of nutritional practices, fortification, dietary modification, infection control, public health measures and income generation programmes. Nutrition education must be an integral part to all the strategies.

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