Prevalence of Anaemia and Nutrition intervention on Nutritional Status of Adolescent Girls in Rural Coimbatore

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ABSTRACT

The risk of developing anaemia and malnutrition is highest among adolescent girls. Nutrition inadequacy during crucial period of adolescence may have serious health related consequences during adolescence as well as throughout life. Anaemia in adolescent girls contributes to maternal and foetal mortality and morbidity in future. Adolescent girls are considered as the backbone of not only healthy but also progressive family and thus future builders of healthy community. A cross sectional community based study was conducted to estimate prevalence of anaemia among adolescent girls in rural areas and to assess the iron nutritional status of 920 adolescent girls in the age group of 13-18 years studying in Government Higher Secondary Schools hailing from different rural areas of Karamadai of Coimbatore District. The study design is multistage sampling design. Relevant data on, anthropometric measurements, biochemical investigations, clinical examination, and morbidity was recorded in pre-designed, pre-tested proforma. Hemoglobin estimation (Cyanmethaemoglobin method) revealed the prevalence of anaemia among adolescent girls (N =920) and it was reported that 59.5 per cent of the girls had moderate level of anaemia and 39.5 percent of them were reported with mild level of anaemia. A subsample of 165 moderate anaemic subjects are categorized in to Group 1 (Nutrition Education Food supplement intervention), Group 2 (Nutrition Education+Kitchen garden intervention) and Group 3 (Nutrition Education intervention) and subjected to respective intervention for about four months. Analysis of blood haemoglobin exhibited significant increase in haemoglobin level among the subjects belonging to Group 1(t = 14.56**), Group 2 (t = 8.73**) and Group 3 (t = 10.45**) after intervention. In general the intervention has brought about reduction of anaemia from moderate level to mild anaemia (83.7 per cent) and from mild anaemia to normal level (16 per cent). Continuous nutrition education, kitchen garden activity and adequate intake of micronutrients are recommended as long term strategy. Disseminating knowledge and awareness through participatory approach and social actions proved to be the best strategy for combating anaemia.

Keywords: Prevalence of anemia, anaemic status of adolescent girls, rural areas.

INTRODUCTION

WHO (2011)\(^1\) estimates suggest that anaemia affects around 800 million children and women globally. Nearly 1.2 billion individuals aged 10-19 years comprise the world population. India has the largest population of adolescents (243 million) followed by China (207 million) and United States (44 million)\(^2\). Among adolescents, girls constitute a vulnerable group, particularly in developing countries where they are traditionally married at an early age and exposed to a greater risk of reproductive morbidity and mortality\(^3\). Globally, anaemia is a public health problem and hampers the health thus
adversely affecting the social as well as economic development of the country. WHO (2016) defines anaemia as a condition in which the number and size of red blood cells, or the haemoglobin concentration, falls below an established cut-off value, consequently impairing the capacity of the blood to transport oxygen around the body. Anaemia is an indicator of both poor nutrition and poor health. Mean blood haemoglobin concentrations and prevalence of anaemia varied substantially across regions and countries.

Anemia is still one of India’s major public health problems, despite more than 37 years of iron and folic acid supplementation by the Government of India through the National Nutritional Anaemia Prophylaxis Programme (NNAP) launched in 1970. Some modifications of NNAP have been done to make it more effective and efficient, but the basic problem still remains. This may be due to the fact that supplementation during pregnancy may be too late for desirable birth outcomes. NFHS-4 (2015-16) also reported prevalence of anaemia among 53.9 % urban women (15-49 years) and 56.9 % of rural women comprising a total women population of 55.4 per cent.

Iron deficiency anaemia should ideally be addressed through dietary diversification and improved access to foods that have high levels of bioavailable iron, including animal products. Anaemia among adolescent girls is an important health issue since the reproductive age follows adolescence period soon after menarche. However, supplementation programmes need to address challenges that have limited their effectiveness, such as poor attendance at antenatal clinics, insufficient doses for supplementation, or insufficient emphasis on behavioural aspects of using supplements on a regular basis.

Intake of nutritionally adequate diet should be ensured to boost the immune system and maintain optimum health. The major intervention strategies envisaged for prevention and management of anaemia are health and nutrition education that would improve iron intake. Food fortification is being increasingly recognized as the most effective, long term approach for nutritional value addition and eradication of micronutrient deficiencies. Supplementation could be an effective preventive and curative strategy, in contrast to dietary intervention and food fortification.

In developing countries, fortified food may not be beneficial enough for all the population, since few households ever consume commercial foods. Therefore,
fortification through public distribution programme will be more beneficial. Further home gardening can be encouraged that focuses on provitamin A rich vegetables, iron rich green leafy vegetables to combat nutritional deficiencies which are of public health significance in developing countries.

Hence the need arises for effective intervention of creating nutrition awareness among the population. With this background, this community based study was undertaken to find out the prevalence of anaemia and assess the iron nutritional status and study the impact of interventions on anaemic status of adolescent girls from rural areas of Karamadai Block, Coimbatore district.

**MATERIALS AND METHODS**

**Selection of Subjects**

Karamadai block consisting of 12 villages and a total of 12,446 households was selected as the study area. 1330 adolescents girls belonging to the age group of 13-18 yrs volunteered to participate in the study were screened for the prevalence of anaemia by conducting blood haemoglobin analysis. Finally 920 Adolescent girls (13-18 years) enrolled in Government schools hailing from different rural areas of Karamadai, forming a homogeneous group, representing a true sample of population who were screened to be anaemic were selected for the initial study.

Initial rapport was created with the subjects and family members about the project and its objectives. Written consent from the subjects was obtained for participation in the study. The study proposal was presented to Institutional Human Ethical Committee (IHEC) of Avinashilingam Institute for Home Science and Higher Education for Women and Ethical clearance was obtained (HEC.2010:16).

**Nutritional assessment**

Assessment of the nutritional status of subjects (n = 920) was done through anthropometric measurements such as height, weight, body mass index using standardized procedures and Clinical examination with the help of a physician for detecting signs of anaemia using clinical assessment schedule.

Biochemical tests help to diagnose deficiencies/diseases at the sub clinical stage and confirm the disease state. Haemoglobin is a useful index of the overall nutritional status irrespective of its significant role in anaemia. The selected 920 anaemic adolescents girls in the age group of 13-18 years were subjected to estimation of Haemoglobin using cyanmethoglobin (CMG) method, a standard method for estimation of Hemoglobin recommended by the International Committee for Standardization in Hematology (ICSH) and suggested by
NIN. All the subjects were dewormed using Albendazole tablet (Bendex-400mg) as prescribed by the physician after initial haemoglobin estimation.

**Intervention Phase**

A subsample of 165 moderate anaemic subjects (mild anaemic) willing to participate in the intervention phase was selected for further study. The anaemic subjects were categorized into three groups namely Group 1 (Food Supplement+Nutrition Education), Group 2 (Kitchen garden+Nutrition Education) and Group 3 (Nutrition Education) based on the intervention given during the experimental period.

Nutrition education was provided to all the three groups using demonstration, informal meetings, focus group discussions and modules through posters, charts, pamphlets and booklets.

**Group 1**

Group 1 subjects were supplemented with 50g of the iron rich food supplement along with nutrition education. The amount of the food supplement was determined based on the dietary intake of iron in order to meet the adequacy of dietary iron per day.

The food supplement, Micronutrient iron rich laddoo was prepared using:

i) Roasted and “powdered rice flakes (25gm), gingelly seeds (5gm) and flax seeds (10gm)” and “roasted wheat flour (10gm) and bengal gram flour (20gm)”

ii) Cleaned, washed, dried (shade drying followed by oven drying) and powdered green leafy vegetables namely *Amaranthus tritis* (5gm), *Solanum nigrum* (5gm) and *Amaranthus gangeticus* (5gm).

Jaggery (20gm) syrup was prepared and mixed well with all the powdered ingredients and made into laddoos.

Sensory qualities of the food supplement were assessed by 9 point hedonic rating scale for sensory attributes namely colour, flavor, texture, taste, mouth feel and overall acceptability by trained panel of 25 judges.

**Group 2**

Group 2 subjects were motivated to develop kitchen garden based on the space in their home or willingness to develop rooftop garden and encouraged to consume vegetables and fruits grown in their kitchen gardens and nutrition education was provided to the subjects.

**Group 3**

Group 3 subjects were given only nutrition education using demonstration, informal meetings, focus group discussions.
and modules through posters, charts, pamphlets and booklets.

The moderate anaemic subjects underwent intervention were assessed for their nutritional status especially anthropometric profile, clinical profile and estimation of haemoglobin before and after the intervention period of 4 months.

**RESULTS AND DISCUSSION**

The present study has been conducted to assess the nutritional profile and prevalence of anaemia among rural adolescent girls.

**Nutritional Assessment of Adolescent Girls**

The adolescent subjects (N = 920) were assessed for their nutritional status through anthropometric profile, clinical profile and estimation of blood haemoglobin level.

**Anthropometric Profile of Adolescent Girls**

Anthropometric profile was assessed through Height, weight and BMI of all the 920 respondents; mean and standard deviations for different age groups were calculated and the same is presented in Table 1.

The results of anthropometric measurements of the study revealed that the average height of female subjects (12-14 yrs) was 151.0 ± 5.30cm; whereas the subjects with 15-18 years were reported with the mean values of 153.4 ± 5.0cm height.

Mean weight of 12-14 yrs female subjects was found to be 38.34 ± 7.38 kg and the 15-18 yrs subjects were reported with mean value of 40.4 ± 6.1 kg. Mean Body Mass Index (BMI) of adolescent girls in the age group of 12-14 years and 15-18 years were found to be 16.8 and 17.7 respectively. Mean height, weight and BMI of all the adolescent girls were below the standard reference value\(^{10}\). The findings of Sachan *et al.,* (2012) revealed that the mean height and weight of the subjects from urban as well as rural schools were below the expected measures for their age group\(^ {11}\).

<table>
<thead>
<tr>
<th>Profile</th>
<th>Age (years)</th>
<th>Standards (WHO, 2007)</th>
<th>Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height (cm)</td>
<td>12-14</td>
<td>155.8</td>
<td>151±5.30</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td></td>
<td>43.5</td>
<td>38.34±7.38</td>
</tr>
<tr>
<td>BMI (kg/m2)</td>
<td></td>
<td>18.8</td>
<td>16.8±0.71</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>15-18</td>
<td>162.5</td>
<td>153.4±5.00</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td></td>
<td>53.2</td>
<td>40.4±6.1</td>
</tr>
<tr>
<td>BMI (kg/m2)</td>
<td></td>
<td>20.8</td>
<td>17.2±0.76</td>
</tr>
</tbody>
</table>

**Clinical Picture of Adolescent Girls**

Table 2 exhibits the presence of clinical signs and symptoms of anaemia among the selected adolescent girls.
Table 2
Clinical Signs and Symptoms of Anaemia (N = 920)

<table>
<thead>
<tr>
<th>Symptoms *</th>
<th>Number</th>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pale skin</td>
<td>148</td>
<td>16.0</td>
</tr>
<tr>
<td>Pigmentation of nails</td>
<td>54</td>
<td>5.7</td>
</tr>
<tr>
<td>Fatigue and weakness</td>
<td>264</td>
<td>28.6</td>
</tr>
<tr>
<td>Dizziness and giddiness</td>
<td>110</td>
<td>11.9</td>
</tr>
<tr>
<td>Frequent headache</td>
<td>132</td>
<td>14.3</td>
</tr>
<tr>
<td>Shortness of breath</td>
<td>141</td>
<td>15.3</td>
</tr>
<tr>
<td>Poor appetite</td>
<td>179</td>
<td>19.4</td>
</tr>
</tbody>
</table>

*Multiple responses

TABLE 3
Distribution of Adolescent Girls as Per Anaemic Status (N=920)

<table>
<thead>
<tr>
<th>Hb Levels g/dl</th>
<th>Grades of Anaemia*</th>
<th>No</th>
<th>Per cent</th>
<th>Mean Hb g/dl</th>
<th>F value</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 8</td>
<td>Severe</td>
<td>7</td>
<td>1.0</td>
<td>7.4 ± 0.22</td>
<td></td>
</tr>
<tr>
<td>8-10.9</td>
<td>Moderate</td>
<td>547</td>
<td>59.5</td>
<td>9.7 ± 0.12</td>
<td>123.67**</td>
</tr>
<tr>
<td>11-11.9</td>
<td>Mild</td>
<td>366</td>
<td>39.5</td>
<td>10.80 ± 0.16</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>920</td>
<td>100</td>
<td>9.65 ± 1.25</td>
<td></td>
</tr>
</tbody>
</table>

*WHO (2011) ** Significant at 1% level

Distribution of subjects according to clinical signs and symptoms of anaemia showed that 16.0 per cent of the subjects depicted pale skin followed by 5.7 per cent with pigmentation of nails. Whereas 28.6 per cent of subjects were suffering from fatigue and feeling of weakness, while dizziness and giddiness was reported by 11.9 per cent of adolescent subjects. Frequent headache was reported by 14.3 per cent of subjects while shortness of breath was reported by 15.3 per cent of the subjects, and remaining 19.4 per cent of the subjects reported poor appetite. Kaur (2011) reported that 68 per cent of the subjects depicted pallor skin. Respondents were more familiar with signs like pale palm and conjunctiva, all constituting 70 per cent of the signs enumerated\textsuperscript{12}.

Prevalence of Anaemia among Adolescent Girls

Table 3 gives the distribution of adolescent girls as per anaemic status. The subjects were categorized according to the grades of anaemia specified by WHO (2011) as severe, moderate and mild anaemia. The mean haemoglobin levels of the subjects were found to be 9.65 g/dl. The findings of the present study were in accordance with the study conducted by Hemlatta \textit{et al.}, (2009)\textsuperscript{13}. About 59.5 per cent of the subjects had blood
haemoglobin levels between 8-10.9 g/dl and was categorized as moderately anaemic; while haemoglobin level of 39.5 per cent of subjects were found to be 11 to 11.9g/dl and were categorized as mildly anaemic. Only one per cent of the subjects had severe anaemia and was referred to rural health services for medical attention. There existed one per cent significant difference between moderate and severe anaemic groups on haemoglobin level when compared between moderate and mild anaemic group statistically using Post-Hoc test. However, there is no significant difference between moderate and severe anemic subjects.

Trivedi (2007) reported that the prevalence of anaemia amongst the adolescent girls were found to be 82 per cent and may be attributed due to poor diet, ongoing blood loss during menstruation and inadequate intake of dietary iron.

Impact of Interventions on Nutritional Status of Adolescent Girls

Anthropometric Profile

The anthropometric profile of the moderate anaemic subjects (N= 165) were assessed through weight, height and Body Mass index (BMI). The mean weight, height and BMI of the subjects before and after the intervention period of 4 months are presented in Table 4.

Group 1 (t = 2.56*) and Group II from the age group of 12-14 years showed significant weight gain (t = 2.67*) due to intervention; however significant difference was observed only on mean BMI among the participants of Group I.

Significant mean gain in weight was also recorded in Group1 (t = 3.47*) and Group III (t = 1.96*) subjects belonging to the age group of 15-18 years after the intervention.

Similar results were shown in the study conducted by Kalhan et al., (2010) and Chatterjee (1990) reported that major consequence of girls’ nutritional deprivation in early childhood and adolescence is their failure to achieve full growth potential.
TABLE 4

Anthropometric Profile of Adolescent Girls Before and After Intervention (N = 165)

<table>
<thead>
<tr>
<th>Profile</th>
<th>Age (years)</th>
<th>Group I (N=56)</th>
<th>Group II (N=54)</th>
<th>Group III (N=55)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before</td>
<td>After</td>
<td>t value</td>
<td>Before</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>12-14</td>
<td>144.0±6.2</td>
<td>144.4±6.0</td>
<td>0.53</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>15.0±4.1</td>
<td>33.1±6.5</td>
<td>34.9±6.6</td>
<td>2.56*</td>
</tr>
<tr>
<td>BMI (kg/m)</td>
<td>16.0±0.59</td>
<td>16.7±0.77</td>
<td>3.15*</td>
<td>16.54</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>15-18</td>
<td>149.6±4.1</td>
<td>150.2±4.3</td>
<td>1.046</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>38.0±4.3</td>
<td>39.1±4.4</td>
<td>3.47*</td>
<td>35.6±6.07</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>17.0±0.56</td>
<td>17.3±0.58</td>
<td>0.843</td>
<td>16.52±0.62</td>
</tr>
</tbody>
</table>

** Significant at 1% level  *Significant at 5% level, NS – Non Significant

TABLE 5

Blood Haemoglobin Status of Adolescent Girls Before and After intervention

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Blood Hemoglobin Levels (g/ dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Standard (g/ dl)</td>
</tr>
<tr>
<td>Group 1 (n=56)</td>
<td>≥12</td>
</tr>
<tr>
<td>Group 2 (n=54)</td>
<td>≥12</td>
</tr>
<tr>
<td>Group 3 (n=55)</td>
<td>≥12</td>
</tr>
</tbody>
</table>

** Significant at 1% level
Group 1 Nutrition education +Food supplement
Group 2 Nutrition education +Kitchen garden
Group 3 Nutrition Education

Biochemical Profile

Table 5 exposes the mean haemoglobin levels of adolescent girls belonging to the three groups before and after intervention period. Analysis of the blood haemoglobin status of the children revealed that the majority of the children in all the 3 groups had moderate degree of anaemia with their mean haemoglobin levels which ranged between 9.1 to 9.14g/dl during the baseline period, It is evident that these level fall under deficiency category according to WHO (2007). A Similar status of mean haemoglobin levels between 7 to 10 g/dl have
been reported among school girls in India by Batra and Groves (2011)\textsuperscript{17}.

The mean values of hemoglobin concentration in anaemic adolescent girls group I before intervention was 9.14 ± 0.68 g/dl and after intervention the normal mean hemoglobin levels were 12.2 ±0.92 g/dl. Whereas the mean values of group II before intervention were 9.0 ± 0.41 and after intervention was 11.8 ± 0.73 g/dl, while in group III before intervention was 9.1 ±0.53 g/dl and after intervention was 11.7±0.62 g/dl respectively.

The mean hemoglobin levels of adolescent girls before intervention showed moderate degree of anaemia with haemoglobin levels of 9.14 g/dl, while at the terminal end of intervention the mean haemoglobin levels were found to be 12.2 g/dl which indicates that there was a substantial improvement in their hemoglobin levels. This finding shows that the majority of them were found to improve from moderate to mild level and from mild level to normal level of hemoglobin. The reason for the improvement can therefore be attributed to the effectiveness of intervention.

These findings are endorsed by the findings of Kakkar (2011)\textsuperscript{18} who revealed that the mean hemoglobin of 11.2g/dl was increased to 12.6g/dl after the intervention of iron and folic acid supplementation and health education. One per cent significant difference between the initial and final level of blood haemoglobin level of Group I (control), II (Iron and Folic acid supplementation and Health education) and III (Vitamin C supplementation + Health education) were found. The study results are in par with the findings of Trivedi (2007)\textsuperscript{14} too.

**CONCLUSION**

Majority of the subjects showed moderate anaemia than mild and severe anaemia. Continuous nutrition education, kitchen garden activity and adequate intake of micronutrients can be recommended as long term strategy. Disseminating the knowledge and awareness through participatory approach and social actions proved to be the best strategy for combating anemia. Involving women in the participatory action research was the key factor for enhancing iron security for the community. It may be concluded that supplementation of locally available foods rich in micronutrient along with nutrition education can be an effective strategy in combating micronutrient deficiency.

The anaemic adolescent girls were also taught the various methods of incorporation of greens in a simple form to
be used in their daily diet. Through this awareness programme, it was very interesting to note that the subjects both children and rural women readily accepted the new recipes which is simple to be adopted and different in taste unlike their daily routine and would like to go for a change when exposed to the intervention programmes. It is indeed a challenging task to make the beneficiaries to consume greens and to inculcate this practice to include greens in their daily diet. This kind of community based approach towards dietary modification is very much appreciated by the rural masses and adolescent community.

It may be concluded that supplementation of locally available foods rich in micronutrient along with nutrition education can be an effective strategy in combating micronutrient deficiency. Hence, it is recommended that dietary diversification coupled with education would be a sustainable strategy to combat anaemia among the masses.

Above marked studies showed that the efforts were put in the right direction which included the global burden of anemia, causes of anemia, etiology, seriousness of anemia and intervention strategies to combat anemia viz. supplementation, fortification and improving bioavailability of iron in the diet. Nutrition education and supplementation of indigenous food like Garden cress seeds helps in prevention of anemia. Supplementations of locally available foods helps reduce the prevalence of anemia at lower cost and useful to the community for combating anemia.

REFERENCES

8. Faber M, Oelofse A., Van Jaarsveld, P.J. Wenhold, FAM., and Jansen van Rensburg


