Impact of nutritional supplementation of quality protein maize based supplementary foods on nutritional status of adolescent girls

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Abstract
Adolescent girls are the most vulnerable section of population that constitute about one-tenth total population. Under-nutrition among adolescents is a serious public health problem, especially in India. In this context, the present study was taken up among early adolescent girls residing in the urban area of Muzaffarpur District, Bihar, India. The objective of the study is to assess the Nutritional status of the early adolescent and to study the Morbidity pattern among these adolescent girls in Muzaffarpur District of Bihar. Cross-sectional study was carried out over a period of four months. 600 girls of age 13-17 years were examined during that period. Data was collected by interviewing the girls using predesigned, pre tested, semi-structured schedule. Anthropometric measurements were recorded using standardized methodology as recommended by World Health Organization (WHO). Body Mass Index (BMI) was calculated using the formula Weight in kg/height in m². The subjects were categorized into various grade based on BMI according to WHO International Standard. Data were analyzed by using SPSS 16.0 version. A total 600 girls were studied. 37.4% were in the age group 13 years. According to WHO reference standards 56.4 % girls were under-nourished (BMI 23.5 kg/m²). 32.4% were showed clinical anaemia, 27.1% were having dental caries, 18.8 were having reproductive problem (Dysmenorrhea), 16% were skin problem, 4% Eye problem (defective vision). It is concluded that there is a high prevalence of under nutrition, dental caries and clinical anaemia among adolescent girls in Muzaffarpur District of Bihar. The present study calls for Health education and nutrition interventions to reduce the serious health problem on priority basis.

Keywords: BMI, Thinness, under nutrition, Adolescent girls, Morbidity Pattern, dental caries, anaemia

Introduction
Adolescent girls form an important vulnerable sector of population that constitute about one-tenth of Indian population. Under-nutrition among adolescents is a serious public health problem, especially in developing countries (FAO, 1993) Early adolescence is the critical period of rapid physical growth and changes in body composition, physiology and endocrine in the life cycle after the first year. Nutritional adequacy is one of the key elements for support of growth and maintenance of adolescents (Awasthi and Kumar, 1999) [1] Due to inadequate intake of nutrient in diet like energy, protein, vitamin iron and calcium etc. various deficiency disorders occur [3] India holds 87 %of anaemic Adolescents. Prevention and control of iron deficiency required the combined approach of dietary improvement, fortification of a common staple food when feasible and appropriate iron supplements of Adolescent girls. Indians mainly depend on the staple food for their livelihood. Therefore the staple food must be balanced in nutrient content. Maize is one of the staple cereal food in the country which has been improved for quality protein. Keeping in view the nutritional requirement of Adolescent girls, an impact study of Quality Protein Maize based food on their nutritional status has been carried out.

Material and Methods
To carry out the study, the product was developed for supplementation. The stages involved...
for development of food were:

Selection of food materials
Cereals—Quality Protein Maize recently developed with balanced amino acid composition has been chosen for the development of supplementary food. Ragi one of the most common millet in the state has been taken as a rich source of calcium, thus, Quality Protein Maize and Ragi were selected for the development of supplementary food for Adolescent girls.
Pulses—Green gram, hereby most commonly consumed pulse in the state was selected to increase the Protein content of food for Adolescent girls.
Oil seeds—Gingelly seeds were selected to further enrich the food with nutrients including essential fatty acids. Green Leafy Vegetables—Amaranthus was selected to enrich the iron content. Sugars—Jaggery was included for taste.

Processing of food materials
Processing methods applied for food materials were soaking, alkali processing, germination and roasting. The different processing methods were applied to different food materials.

Maize: Quality Protein Maize was procured from the Department of Plant Breeding, Rajendra Agricultural University, Pusa. After cleaning the maize grains were soaked for 5 minutes in double the amount of water per cent—Lime water. Heat treatment was given to it for 30 minutes. Then it was kept overnight. Next morning the grains were washed four times and sun dried. After drying the grains were roasted till the desired flavor was obtained.

Ragi: Ragi grains were collected from the farmers. These were first cleaned to remove dust particles and then they were subjected to roasting process. Malting has been done by soaking the Ragi in double the amount of water for 24 hours. Then the soaked Ragi grain were kept on gunny bag and covered with another gunny bag for 24 hours. Water was sprinkled over it and again were covered with gunny bag for 72 hours. After sprouting it was sundried. After drying it was roasted till desirable flavor was obtained.

Gingelly seeds: Gingelly seeds were washed, dried and roasted to improve digestibility and palatability.

Amaranthus—Amaranthus was cleaned, washed, blanched and dried in the sunlight.

Preparation of food for Adolescent girls
Ingredients used for evolving the supplementary food for the Adolescent girls were: Quality Protein Maize; 60g; Green gram; 22.5g; Ragi; 10.5g; Gingelly seeds; 10g; Amaranthus; 5g and Jaggery; 60g.
All the processed ingredients were powdered in a dry grinder and mixed thoroughly. Jaggery syrup was prepared. The powdered mix was added with continuous stirring and then removed from oven. When it was warm it was made into specific shapes.

Impact of supplementation of Quality Protein Maize based food was carried out in Muzaffarpur District, Bihar. A total of six hundred Adolescent girls were selected among whom 300 served as control and 300 as experimental group in whom supplementation was done.

Result and Discussion
The Adolescent girls selected for the supplementation study aged between 10-18 years.

Health and nutritional status of Adolescent girls of control and experimental group
Health and nutritional status of Adolescent girls of control and experimental group were determined by the body weight, clinical examination and other problems associated to Adolescents. The difference in the body weight of Adolescent girls compared to the standard has been presented in Table 1.

Table 1: The Mean Body Weight of the Selected Adolescent Girls

<table>
<thead>
<tr>
<th>Percentage of lowered body weight compared to the standard</th>
<th>Control group (n=300)</th>
<th>Experimental group (n=300)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>0 - 5</td>
<td>20</td>
<td>6.6</td>
</tr>
<tr>
<td>5.1 - 10</td>
<td>40</td>
<td>13.3</td>
</tr>
<tr>
<td>10.1 - 15</td>
<td>60</td>
<td>20.0</td>
</tr>
<tr>
<td>15.1 - 20</td>
<td>80</td>
<td>26.6</td>
</tr>
<tr>
<td>20.1 - 25</td>
<td>50</td>
<td>16.6</td>
</tr>
<tr>
<td>25.1 - 30</td>
<td>50</td>
<td>16.6</td>
</tr>
</tbody>
</table>

It is discouraging to note that the selected Adolescent girls were showing lesser body weights than the standards. In control group 26.6 percent of Adolescent girls were lower in their body weight by 15.1 to 20 per cent than the standard. Among the experimental group, 33 per cent Adolescent girls were the lower body weight by 15.1 to 20 per cent than the standard.

The poor nutritional status definitely affects their health inviting many problems. Some problems can be known by interviewing the Adolescent girls and some by examining them clinically.

Table 2: Problems encountered by the selected Adolescent girls

<table>
<thead>
<tr>
<th>Problems</th>
<th>Initial Present (n = 300)</th>
<th>Final Absent (n = 300)</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constipation</td>
<td>130</td>
<td>43.3</td>
<td>170</td>
</tr>
<tr>
<td>Diarrhoea</td>
<td>50</td>
<td>10.0</td>
<td>250</td>
</tr>
<tr>
<td>Dysentery</td>
<td>10</td>
<td>3.3</td>
<td>290</td>
</tr>
<tr>
<td>Fever</td>
<td>40</td>
<td>13.3</td>
<td>260</td>
</tr>
</tbody>
</table>

Table 3: Anthropometric measurements of the Adolescent Girls

<table>
<thead>
<tr>
<th>Variables</th>
<th>Initial</th>
<th>Final</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (kg)</td>
<td>49.97</td>
<td>55.39</td>
<td>7.14*</td>
</tr>
<tr>
<td>MUAC (cm)</td>
<td>24.61</td>
<td>25.27</td>
<td>11.67*</td>
</tr>
</tbody>
</table>

*Significant at 5% level
**Significant at 1% level

The various problems and diseases encountered during the period of Adolescence by the control and experimental group are presented in Table III.

Constipation, diarrhoea, dysentery and fever were the common problems of the Adolescent girls. Majority of them (from both the control groups) were suffering from constipation (43.3 per cent). Diarrhoea was also found in 16.6 per cent and 13.3 per cent in control and experimental group respectively. Dysentery was observed among 3.3 per cent and 16.6 per cent in control and experimental group respectively.
Impact of Supplementation on Nutritional Status of Adolescent Girls

Impact of supplementation on the nutritional status of Adolescent girls was studied in terms of anthropometric measurements, haemoglobin level and prevalence of anaemia (Barbera and Clemente, 2005)[2]

Antropometric measurements of Adolescent girls

The anthropometric measurements i.e. weight and mid upper arm circumference of the selected subjects of both the groups after intervention trial are presented in Table IV. The mean weight of Adolescent girls after supplementation was 42.39kg whereas initial was 39.27kg. The result was statistically significant at 1 per cent level.

Mid upper arm circumference (MUAC) was also increased during the course of supplementation.

Mean haemoglobin level

Mean haemoglobin level of Adolescent girls of both the groups are presented in Table IV. The mean difference in haemoglobin level before and after supplementation of food among Adolescent girls of experimental group as found to be 1.4g/dl while only 0.23g/dl increment was observed among the Adolescent girls of control group.

A change in haemoglobin level has been seen after intervention with supplementary food to adolescent girls. Around 13.3 per cent of severe anaemic adolescents and 80 per cent moderate anaemic adolescent girls shifted to mild anaemic and normal. There was no case of severe anaemia found after supplementation. A shifting trend in the level of haemoglobin was found after supplementation. A change in haemoglobin level has been seen after intervention with supplementary food to adolescent girls. Around 13.3 per cent of severe anaemic adolescents and 80 per cent moderate anaemic adolescent girls shifted to mild anaemic and normal. There was no case of severe anaemia found after supplementation. A shifting trend in the level of haemoglobin was found after supplementation.

If such supplementation trial with locally available nutritious foods be continued to adolescent girls, the health status of adolescent girls can be improved to a great extent.

Acknowledgement

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References