Original Article

Effectiveness of Nutrition Education, Iron Supplementation or both on Iron Status in Children

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Objectives: *A community-based, randomized trial was designed to compare the effect of nutrition education and/or iron supplementation (weekly) on iron status of children in an urban slum in Delhi.* ***Methods:*** *Four hundred and fifty one children, 9-36 months of age and their caretakers (mothers), assigned to one of the following groups were included in the cohort. Group 1, nutrition education. Group 2, supplementation (with 20 mg elemental iron). Group 3, nutrition education with supplementation (with 20 mg elemental iron) and Group 4, control given placebo. The intervention program was of four months duration, with a treatment phase of 8 wk followed by 8 wk of no treatment.* ***Results:*** *Post intervention, at 8 wk and at 16 wk, the hemoglobin change in the nutrition education, supplementation, nutrition education with supplementation and control groups was 2.9, 1.9, 3.8 and –5.9%, respectively and 2.1, –1.9, 0 and –9.3%, respectively (as compared to initial values). There was no significant effect of any of the intervention at 8 weeks. At 16 wk, there was significant positive effect of nutrition education group ($p < 0.05$). The percent change in serum ferritin value at 16 wk in the nutrition education, supplementation, nutrition education with supplementation and control groups was 5.7, –2.3, -3.4 and –40%, respectively. Serum ferritin values were significantly higher for the nutrition education group ($p<0.001$) as compared to the control. At 16 wk, the nutrition education group mothers showed significantly higher nutrition knowledge and the dietary iron intake of children was significantly higher than their control group counterparts ($p < 0.0001$).* ***Conclusions:*** *The study suggests that nutrition education did have a positive effect on the iron status possibly by improving the dietary iron intake.*

Key words: *Dietary iron, Iron deficiency anemia, Nutrition education, Supplementation.*

IRON deficiency anemia is the most common form of malnutrition in the world, being most prevalent and severe in young children (6-24 months) and women of reproductive age(1). Evidences(2,3) suggest high prevalence of iron deficiency anemia among children, less than three years of age in India. Iron deficiency anemia is associated with developmental delays, behavioral disorders and poor scholastic performance in children(4). In animal model intrauterine and early life latent iron deficiency induced irreversible neurotransmitter alterations(5) which are related to developmental behavioral changes.

Several studies(6,7) have suggested that

supplementation with iron may increase hematological indicators of iron status. Some researchers(8) have documented a significant relationship between nutrition knowledge and nutrition behavior, specific to iron. It is presumed that detailed guidance on such topics as food purchasing, food preparation and serving sizes(9), nutrient value of foods and balanced diets(10) will provide individuals with enough information and motivation to make wise decision about selections for good health. However, there is lack of studies on evaluation of the true impact of nutrition education intervention on dietary intake, specially the intake of iron and on the iron status.

In this context, the present study is an effort in designing and implementing a nutrition intervention program aimed at both increasing knowledge about and promoting positive attitudes and behavior change towards child feeding practices, specific to iron intake. The paper reports on a community-based nutrition education intervention trial to improve the iron status and dietary iron intake of children 9-36 months of age. The intervention was conducted through the Integrated Child Development Services (ICDS) program involving the anganwadi workers.

Materials and Methodology

A community-based nutrition education intervention trial was designed based on the hypotheses that focused nutrition education may reduce the risk of iron deficiency anemia in young children. The study was designed as an intervention program of nutrition education based on a multi-media approach using print/ audio-visual media, discussions etc. targeted at mothers. At the same time and at the same site, an intervention to improve iron status through supplementation alone and nutrition education and supplementation together was also implemented.

A complete record of all children (9-36 months of age) - beneficiaries of the 41 anganwadis (AWs) from the Nand Nagri ICDS project in North-East Delhi - was obtained from the respective anganwadi workers. A total of 2629 children qualified to be registered in these 41 AWs. Based on these data, using the random number Tables, 545 children aged 9-36 months of age and their caretakers (mothers) were invited to participate in the study. Sample size was calculated according to the statistical formula (11) as indicated:

$$n > \frac{(u+v)^2 (s_1^2 + s_2^2)}{(\mu_1 - \mu_2)^2}$$

where $u = 1.28$ (90% power), $v = 1.96$ (2 sided significance level at 5%), s_1, s_2 (standard deviation) = 1.9 (based on a pilot study), $\mu_1 - \mu_2 = 1$ (difference between the mean hemoglobin). Therefore, a sample size of 75 children in each group with a total sample size of 300 was calculated. A 50-60% safety margin was added to allow for a maximum estimated non-response, giving a sample size $n \geq 500$ subjects.

Ethical approval for the study was obtained from the institutional ethics committee and the ICDS authorities. Following their advice, informed consent was obtained from the parents participating in the study.

The 545 children along with their mothers were allotted to one of the following four study groups: (*a*) Nutrition education group, wherein, education was imparted at informal meetings with mothers (once a week for 8 wk). (*b*) The supplementation group, provided a weekly oral dose of 20 mg of elemental iron (Ferium, M/S Emcure Pharm. Ltd, Poona,

India; VIFOR International Inc, Switzerland). (*c*) The nutrition education with supplementation group (mothers provided nutrition education and children oral supplementation *i.e.*, 20 mg of elemental iron/wk). (*d*) The control group, given sugar syrup, administered weekly.

Of the 545 children enrolled in different groups, parents of 451 children – nutrition education (98), supplementation (129), nutrition education with supplementation (105) and control (119) – consented to have their children's blood samples taken and were thus included in the cohort.

The intervention program was of four months (16 wk) duration, with a treatment (*i.e.*, nutrition education and/or supplementation) phase of 8 wk followed by 8 wk of no treatment. The anganwadi workers administered the intervention continuously for 8 wk, once a week. Prior to the intervention, the anganwadi workers were oriented and trained to use the education package prepared for the purpose and/or to administer the iron syrup. At the end of the intervention (16 wk), all the children were given necessary treatment, if required for anemia.

At entry, the hemoglobin (Hb) and growth and dietary measures were carried out in all children. Every fifth child had serum ferritin (SF) measured. The mother's nutrition knowledge, attitude towards improving child feeding practices was assessed. After 8 wk of intervention (treatment), hemoglobin levels were reassessed for all children in the four groups. Subsequently, there was eight wk interval (when no treatment was given) and at the end of the intervention (*i.e.*, 16 wk stage) all children were reassessed for Hb, SF, growth and their diet intake. Mothers were re-surveyed regarding their attitude and nutrition knowledge.

Hematological analysis

Twenty μl blood by finger prick in 5ml Drabkin's solution was transported (protected from light) within 2 hours to the laboratory where hemoglobin measurements were undertaken immediately. Hemoglobin levels were assessed using the cyanmethemoglobin method(12). The blood for serum ferritin was taken by venipuncture (from every fifth child). Ferritin levels were determined by a commercially available immunoassay (Spectro Ferritin kit, Ramco Lab, Inc, Houston, TX). For all the subjects included for the serum ferritin estimation, the detection of C-Reactive Protein (CRP) was undertaken using AVITEX-CRP Latex Test (Omega Diagnostic Limited, Scotland, UK).

Diagnostic Criteria

Anemia was classified based on the WHO recommended cut-off value of <11.0g/dL for children 5 months to 5 years of age(13). Hb concentrations less than 7.0g/dL were considered severe anemia, 7.0 to 9.9g/dL as moderate anemia and 10.0 to 10.9g/dL as mild anemia. A cut-off value of 10 µg/L for serum ferritin was chosen based on the recommendations of WHO for diagnosis of iron deficiency(13).

Growth parameters

Height, weight and mid upper arm circumference (MUAC) were measured using standard techniques and those <90% of height and weight as compared to 50th centile of Indian children(14) were taken as stunted and undernourished, respectively.

Nutrition Education Package

A series of studies were conducted which aimed to survey the nutrient intake, food selection, nutrition knowledge and attitudes of mother's regarding child feeding and iron nutrition. These studies, a part of the formative research, formed the bases for the

development of the nutrition education package which included: A *Flip Chart:* A simple, well illustrated set of cards (chart) presenting 8-9 concepts related to healthy child feeding practices; *An Information Leaflet:* A visually (pictorial/graphic) enriched leaflet providing specific advice for improving iron status and information regarding feeding schedule for children; *A Calendar:* A useful reference and hand-out material highlighting the consequences of anemia and presenting simple messages related to improving iron status by consuming iron-rich foods and iron enhancers; *A Video Program* specific to preventing iron deficiency anemia.

The areas/messages identified for intervention/reinforcement included.

Under Child feeding practices: Exclusive breast feeding for 6 months; introducing complementary foods by 6 months; providing appropriate foods (in term of consistency, quality and quantity) during the infancy and early childhood period; encouraging small, but frequent feedings; initiating the child to the family food by one year of age; emphasizing the importance of solid food rather than milk-based diet for children; reinforcing the importance of hygiene and cleanliness with respect to child feeding.

*Under improving iron status:*Iron deficiency anemia – causes, symptoms and prevention; ensuring adequate inclusion of iron-rich foods; encouraging the consumption of vitamin C-rich foods along with the meals; cooking food in iron vessels; avoiding iron absorption inhibitors such as tea; preventing worm infestations by maintaining good personal and environmental hygiene practices(15).

Food and Nutrient Intake

The food and nutrient intake of children was assessed using a 10-item food frequency and amount questionnaire (FAQ). The FAQ was designed with the intention to estimate the usual frequency and/or amount of consumption of specific items of food and drinks, including dietary supplements such as minerals, vitamin drops *etc*. by children. The questionnaire consisted of two components - a food list and a frequency response section for subjects to report how often each food was eaten.

Food models and series of photographs were used to help mother's quantify the amount of food consumed. The weight of the food portions consumed was derived from the known weights of the portions portrayed in the photographs and/or from weighing duplicate portions of the items consumed.

The reliability of the dietary intake data was assessed by correlating the mean intake of the major nutrients derived from the FAQ record with the mean nutrient intake derived from the 3 day diet record method for approximately one-fifth of the total sample. There was a significant positive association between the two methods for all nutrients, except vitamin C. The difference between mean nutrient intakes of paired samples was calculated and assessed using t-test. Overall, the results for the 2-3 day dietary record method appeared to be marginally lower than the food frequency and amount method although the difference was only significant for vitamin C ($p < 0.001$).

Validity of the dietary intake data was assessed by correlating dietary iron intake of 30 subjects with an independent measure of hemoglobin(16). The correlation ($r = 0.494$, $p = 0.006$) was significant ($p < 0.001$).

The mean food intake was assessed for adequacy by comparing with the balanced diet for children as per the Dietary Guidelines for

Indians(17). The nutrient intake of children was computed as per the Indian Council of Medical Research's (ICMR) "Food Composition Tables". For few specific local foods/items *e.g.*, Rusk, 'phan' (puffed patty) (for which data were not available in the Food Composition Table) nutritive value estimation was undertaken in the Food Analysis and Research Center (FARC), New Delhi, India. For breast fed infants, the quantity of breast milk consumed was estimated based on data specific to Indian children(18).

Maternal Nutrition Knowledge

The maternal nutrition knowledge score was assessed using an 18-item multiple-choice visual format questionnaire, specially designed for use with illiterate subjects. The questionnaire focused on assessing the knowledge of mother regarding the following aspects, specific to child feeding and iron deficiency anemia.

- Familiarity with nutrition terms and disease sign/symptoms
- Knowledge about present recommendations for child feeding practices
- Understanding practical applications of the recommendations, in terms of food and eating

Four questions assessed knowledge about nutrient term, symptoms and disease condition. Seven items assessed the knowledge about present recommendations for child feeding. Seven questions assessed the practical application of nutrition principles. These questions were defined as those items relating to specific foods. The final questionnaire was developed following a series of pilot studies. A logical analysis survey was undertaken, involving 3 experts, to rate possible topics for inclusion in the questionnaire. Wording and comprehen-sion were assessed using visual analogue scale with experts and 20 subjects. The discriminating power was calculated by administering the questionnaire to 20 graduate nutrition students.

The multiple-choice questionnaire was presented to each subject and each question was read in full, the visuals shown in a one-to-one interview. The interviewer on a precoded answer sheet recorded responses. During analysis, items were scored as 1 for a correct response and 0 for an incorrect response. The possible score range was from 0-18. Results were expressed as a total score out of 18 and as percentage correct answer out of a possible 18 (100%).

Attitude Questionnaire

The attitude questionnaire was developed based on the Expectancy Value Model described by Fishbein and Ajzen(19). The questions comprised 22 statements, which covered the four components of the Expectancy Value Model, which are attitude (behavior belief × outcome evaluation) and subjective norm (normative belief × motivation to comply). To measure these components, questions (and responses) were designed as follows:

Attitude - This was assessed by constructing eight pairs (one each for behavior belief and outcome evaluation) of statements on the relationship between 'improving child feeding practices' and exclusive breast feeding for 4-6 months, frequency of meals, reducing the milk intake and increasing the solid food intake, putting the child on family food by one year of age, introducing variety in meals, control of mother over child eating habits and maintaining iron status and reducing the risk of iron deficiency anemia. The belief statements were assessed on the scale 'strongly agree' to 'strongly disagree' and

corresponding evaluation statement on the scale 'very desirable' to 'very undesirable'. The belief statements were identified from the beliefs assessed during the group discussion sessions with mothers.

Subjective Norm – This was assessed by three pairs of statements (one each for normative belief and motivation to comply) which queried whether the respondent thought her mother-in-law/mother, husband, doctor/ anganwadi worker would like her to improve the child feeding habit and the respondents motivation to comply with these referents. The statements on normative belief were assessed on the scale 'strongly agree' to 'strongly disagree' and corresponding motivation to comply items on the scale 'wishing to do' or 'not to do' what referents thought they ought to. The normative belief items were identified from group discussion work.

The questionnaire contained 22 questions in the form of statements with seven category Likert response scales(20) labeled only at extreme ends. For all questions the center of the response scale was taken as zero, and hence responses were rated as -3 to +3 other than the motivation to comply questions, which were rated 0 to 6(21).

Statistical Analysis

The impact of intervention, on the hematological indices, was determined by using the factorial design analysis. Analysis of Variance (ANOVA) was used to determine group differences in dietary intake data, anthropometry, and maternal nutrition knowledge and attitude scores. All the observations on serum ferritin were taken on natural log scales and then compared. Geometric mean was computed using the log transformed (natural logarithm) serum ferritin observations. Significant difference was defined as $p < 0.05$

Results

Three hundred and sixty four of the 451 children included in the cohort (at baseline) completed the study protocol for a follow up rate of 81% (nutrition education 74.4%, supplementation 84.5%, nutrition education plus supplementation group 81.9%, control 79.8%) at 16 wk. Complete serial data at the three point of time, initial, 8 and 16 wk, were obtained from 232 subjects for hemoglobin. The reason for the moderately high dropout rate over the study period could be attributed to population mobility and/or families not cooperating for repeated hematological measurements, after initial recruitment. *Table I* shows the characteristics of the children and families (232 subjects).

No significant differences were found in the baseline data between groups. In all the four groups, large number of families were disadvantaged by maternal education and family income. Mothers were predominantly housewives and majority of them had 2-3 children.

The compliance with the attendance at the nutrition education sessions and/or treatment with iron by mouth were high (more than 75% of the subjects completed the 8 wk course) as noted from the attendance sheet maintained by the anganwadi workers. Children receiving iron supplementation were given a total of 8 doses. The preparation was found to be palatable and no untoward side effect was noted.

Response of Hemoglobin and serum ferritin

The baseline prevalence of anemia was 57.3%. Mean Hb was 105 ± 16.0 g/L for the total study group. There was no significant difference in the mean Hb values between the control and intervention group children at baseline. The change in hemoglobin at

TABLE I–*Characteristics of Children and Their Families in the Four Study Groups*

Characteristics	Control (n = 58)	Supplementation (n = 58)	Nutrition Education (n = 58)	Nut Education + Supplementation (n = 58)	Significance p value
Child-related age[1] (mo)	20.6 (8.9)	21.1 (8.0)	20.0 (7.6)	21.1 (8.5)	0.878
Sex[2] M	56.9	44.8	43.1	41.4	0.325
F	43.1	55.2	56.9	58.6	
Height[1] (cm)	73.0 (6.8)	75.0 (4.6)	73.7 (5.6)	74.5 (5.5)	0.243
Weight[1] (kg)	8.6 (1.9)	8.3 (1.2)	8.1 (1.4)	8.3 (1.4)	0.267
MUAC[1] (cm)	12.6 (1.1)	12.7 (0.9)	12.7 (0.9)	12.7 (0.9)	0.967
Mother's Education[2]					
• Illiterate	62.1	58.2	52.6	41.1	0.08
• Primary	24.1	14.5	17.5	22.4	
• Secondary	13.8	24.6	24.6	36.2	
• Others	—	3.4	5.2	—	
Mother's Occupation[2]					
• Housewife	96.5	90.1	82.8	89.5	0.26
• Unskilled	—	1.8	—	—	
• Skilled	1.7	7.3	15.5	8.8	
• Others	1.7	—	1.7	1.8	
Family Income in Rupees[2] (annual)					
No Income	—	1.8	3.4	3.4	0.295
0 - 20,000	62.5	70.9	55.2	65.5	
20,001 - 40,000	37.5	21.8	39.7	29.3	
40,001 - 60,000	—	5.2	1.7	1.7	
Birth interval[2]					
• One year	6.5	7.9	11.6	11.9	
• Two years	47.8	28.9	23.3	21.4	0.405
• Three years	28.3	28.9	34.9	33.3	
• Four years	8.7	15.8	18.6	9.5	
• Five years	4.3	7.9	2.3	9.5	
• > Five years	4.3	10.5	9.3	14.3	

M = male; F = female; 1. Values are mean, values in parentheses are SD; 2. Values are percentages.

8 wk was 2.9, 1.9, 3.8 and –5.9% for the nutrition education, supplementation, nutrition education with supplementation and control group, respectively. The corresponding change at 16 wk was 1.9, –1.9, 0 and –9.3%, respectively with a significant main effect of nutrition education ($p < 0.05$) and supplementation ($p < 0.05$) (*Table II*).

One hundred and six children were assessed for serum ferritin along with C-Reactive Protein (CRP) at baseline. Geometric mean serum ferritin concentration was 5.3 μg/1 (with 95% confidence interval of 4.00-6.99) for the total study group. Sub-clinical infection as evident by positive CRP was found in 16 (15%) children. Ninety (85%) were C-reactive negative. At 16 wk, 91 children (86%) could be followed up. Ninety three per cent were C-reactive negative. Sub-clinical infection as evident by positive CRP was found in 6 (6.6%) children. Complete serial data at two points of time, initial and 16 wk, could however, be obtained from 60 subjects (15 subjects in each of the study groups) for serum ferritin (*Table II*). Data indicated a fall of 50%, 17% and 13% in the serum ferritin value in the control, supplementation and nutrition

TABLE II–*Hematological Measurements and Impact of the Intervention at 8 and 16 wk in the Study Groups*

Variable	Initial	8 weeks	16 weeks	Significance	p value
Hemoglobin (g/l)[1]				At 8 wk	
Nutrition Education	103	106	105	Main effect	
(n = 58)	(15)	(15)	(15)	Nutrition education	0.776
				Supplementation	0.402
Supplementation	105	107	103		
(n = 58)	(14)	(12)	(16)	Nutrition education*	
Nut. Education + Supplmentation	104	108	104	Supplementation	0.209
(n = 58)	(20)	(19)	(21)	At 16 wk	
				Main effect	
Control	107	101	97	Nutrition education	0.042*
(n = 58)	(15)	(14)	(14)	Supplementation	0.013*
				Nutrition education* Supplementation	0.853
Serum Ferritin (µg/L)[2]					
Nutrition Education	5.3	—	5.6	Main effect	
(n = 15)	(4.0-6.99)		(4.77-6.64)	Nutrition education	<0.00*
Supplementation	4.3	—	3.3	Supplementation	0.493
(n = 15)	(3.34-5.58)		(2.51-4.41)		
Nutrition Education	5.8	—	5.6	Nutrition education*	
+ Supplementation (n = 15)	(5.22-6.49)		(4.42-6.48)	Suplementation	0.610
Control	5.7		3.4		
(n = 15)	(4.79-6.88)	–	(2.21-3.35)		

* Significantly different; 1. Values are mean, values in parenthesis are SD; 2. Values are percentages.

education with supplementation group, respectively. The main effect of nutrition education was a rise in ferritin value by 14% ($p < 0.001$).

Impact of Intervention on Maternal Nutrition Knowledge

The mean baseline nutrition knowledge score was 5.7 ± 2.15 (Total score 18, Median 6, Range 1-12). In terms of percentage, the mean score was 31.6 ± 11.96%. The mean nutrition knowledge score of subjects in each of the four study groups at 16 wk is presented in *Table III*. Data suggest that at the end of the intervention mothers in the nutrition education and the nutrition education cum supplementation group scored significantly higher ($p < 0.001$).

Individual item analysis data revealed lowest scores, in all the four groups, for the component on practical applications *i.e.*, questions related to nutrient-rich food sources and food combinations.

Impact of Intervention on Maternal Attitude Towards Improving Child Feeding Practices

Table IV presents the total mean score for the attitude and subjective norm component for each of the four groups. Nutrition education and nutrition education plus supplementation group recorded significantly higher values ($p<0.001$) for attitude component. As for the subjective norm component, high values were recorded in all four groups suggesting that overall this group of women felt a lot of social pressure to improve child feeding practices.

The scoring for individual questions in the attitude component indicated that the questions relating to improving feeding practices to reducing the risk of anemia scored much higher than the other belief items. No significant difference for this variable was recorded among the study groups. Overall significant positive feelings related to exclusive breast feeding for 4-6 months ($p < 0.001$), feeding children 4-5 times a day ($p < 0.001$), providing variety of foods in the child's diet ($p < 0.001$), putting the child on to the family food by one year ($p < 0.001$) and reducing the milk intake and giving more solid food ($p < 0.001$) was recorded in the nutrition education group. Mother's attitude towards control over child's feeding habits did not seem to improve as a result of intervention as negative feelings were recorded in each of the four study groups (for this component), with the difference not being significant.

Impact of Intervention on Nutrient Intake and Dietary Adequacy

The mean daily nutrient intake for children

TABLE III–*Nutrition Knowledge Score of Mothers at Baseline and at 16 Weeks**

Nutrition knowledge score	Baseline	At 16 weeks				Significance
		Control	Supplementation	Nutrition Education	Nutrition Education + Supplementation	
Total score	5.7 (2.2)	5.5 (2.2)	5.4 (2.2)	11.6 (2.7)	11.4 (2.7)	<0.001
%Score	31.6 (12.0)	30.6 (12.4)	30.3 (12.4)	64.6 (15.1)	63.3 (14.9)	

*Values are mean, values in parentheses are SD.

TABLE IV–*Scoring for the Components of the Attitude model in the Four Study Groups**

Component	Control	Supplementation	Nutrition Education	Nutrition Education plus Supplementation	Possible Score	p value
Attitude	–2.1 (1.2)	–13.3 (3.0)	34.8 (17.3)	10.1 (25.4)	–72 to +72	<0.0001
Subjective norms	46.8 (13.7)	41.5 (21.5)	53.7 (2.4)	51.1 (1.7)	–54 to 54	<0.0001

*Values are mean, values in parenthesis are SD;

was derived from the food frequency questionnaire (FAQ) and the data are presented in *Table V*. Baseline data suggest that nutrient intake of children ranged from 45% (iron) to 233% (protein) of RDA, with energy and iron falling much below the current requirements for this population. Inter-group comparison of the mean daily dietary intake (for energy, protein, iron and vitamin C) in the four study groups at 16 wk and in relation to the baseline nutrient intake, revealed that children in the nutrition education group had significantly higher intakes of energy, protein and iron ($p < 0.001$). No significant difference in the vitamin C intake was recorded within the groups. The energy/iron adequacy of the diet (at 16 wk) did not change much as compared to the adequacy at the initial stage in control children, but it increased significantly in the nutrition education group ($p < 0.05$). Nutrient intake at the end of the intervention ranged from 47% (iron) to 295 % (protein) of RDA's, with energy (deficit ranging from 34% to 44%) and iron (deficit ranging from 38% for nutrition education group to 53% for supplementation group) still falling below the current RDA's for this population(17).

Growth Data

Baseline data indicated that underweight (90.4%) and stunting (44.8%) was widely prevalent among the children. There was no difference in mean weight, height or mid; upper arm circumference at 16 wk between the control and intervention groups.

Discussion

In this population group, wherein, the iron and nutritional status was highly compromised, evidence suggests that nutrition education intervention was effective, as it improved the dietary iron intake and prevented the children from suffering the sharp decline in iron status, noted in the control.

Evaluation of the impact of intervention on maternal nutrition knowledge indicated an overall improvement in the nutrition score. The attitude data showed that the education intervention was associated with higher scores, implying a change in beliefs.

The nutrition education intervention, focusing on food-based strategies promoting consumption of iron-rich foods and foods that increase absorption of iron (vitamin C rich foods) brought about significant changes in intake (improved energy, protein, iron (by 37%) and vitamin C intake). The adequacy of cereals, pulses, other vegetables, fruits, oil/fats intake was high in groups where nutrition education was a component as compared to control and supplementation group. Although

TABLE V–*Daily Nutrient Intake and Percent Adequacy of the Diet as Compared to the Recommended Dietary Allowance at Baseline and at 16 Weeks*(1–3).

Nutrition	Baseline	At 16 weeks				Significance
		Control	Supplementation	Nutrition Education	Nutrition Education + Supplementation	
Energy Kcal	694 (56)	692 (56)	704 (57)	821 (66)	719 (58)	<0.0001
Protein g	49 (223)	36 (165)	39 (177)	66 (295)	39 (186)	<0.0001
Iron mg	5.4 (45)	5.9 (48)	5.6 (47)	7.4 (62)	6.1 (51)	<0.0001
Vitamin C mg	57 (143)	50 (125)	57 (143)	70 (175)	65 (163)	0.1135

1. Values are mean, n = 277 (nutrition education 81, supplementation 63, nutrition education with supplementation 69, control 64).
2. Values in parenthesis are percentage adequacy of the diet as compared to the Indian recommended dietary allowances (ICMR 1998).
3. The Indian recommended dietary allowances (RDA) is 1240 KCal for energy, 22 g for protein, 12 mg for iron and 40 mg for vitamin C for children aged 1-3 years.

the intake of green leafy vegetables was low among children in all the four groups, perhaps cereals and pulses may have been the main contributory food for iron, the intake of which was certainly higher in groups where nutrition education was a component. Further, the high vitamin C intake attributed to the high intakes of fruits and other vegetables recorded in the food intake data specific to nutrition education group may have also contributed in terms of better absorption of iron from the diet.

However, inspite of the improved nutrient intake, the overall adequacy of the diet (in terms of energy and iron) as compared to the Indian Recommended Allowances for Children remained low in all the groups. A deficit of 34% for energy and 38% for iron was recorded for the nutrition education group (as compared to 44% deficit for energy and 52% deficit for iron in the control). Latest WHO recommendations(22) on dietary requirements in young children are considerably lower than early ones. It is being recommended that dietary energy intakes should remain at 100 kcal/kg after three months of age and through out infancy, with the estimate energy requirement for boys and girls aged 12-35 months ranging from 844-1184 kcal/d and 768-1139 kcal/d, respectively. From these data, it may seem reasonable to suggest that perhaps the present ICMR recommended energy intakes for young children (1240 kcal/d for children 1-3 years of age) may require reconsideration.

Further, the limited effect of nutrition education intervention on improving the overall diet adequacy may possibly be due to the fact that moderate to severe malnutrition was prevalent in the study group. Only 9.6% children were well nourished. Under such circumstances, wherein, the children's diet (before the intervention) was highly

Key Messages

- Nutrition education had a positive effect on the iron status possibly by improving the dietary iron intake.
- Weekly supplementation (20 mg elemental iron) not efficacious in conditions where baseline anemia is high.
- Dietary diversification through nutrition education on long term basis may possibly reduce the risk of anemia.

compromised, perhaps a long term systematically sequenced communication effort, providing repeated exposure to the messages (much beyond the 8 wk period), advocating good weaning practices of initiating supplementary food by six months, giving small but frequent feeds to children etc. may have been more beneficial. Moreover, we recognize that many other factors influence the food intake of children. The high scoring for the items in the attitude scale relating to referents influence(23) speculate that it might be more successful to focus on "group" nutrition health education using community groups and more involvement from families (particularly mothers-in-law, husbands *etc*.) themselves.

It is strongly being proposed(24) and few studies(25) have indicated that in controlled situations, intermittent iron supplementation can effectively reduce the prevalence of iron deficiency in several groups, particularly young children. In the present study, a weekly supplement of 20 mg Fe only marginally improved the iron status as compared to the control. Weekly supplementation was not efficacious, perhaps due to the facts that baseline anemia was high (57.3%), as well as the dose and duration of supplementation may have been insufficient (26) for this group of children with a highly compromised iron status.

The present study suggests that nutrition education did have a positive effect on the iron status possibly by improving the dietary iron intake. Long-term community-based approaches involving dietary education emphasizing optimum feeding schedules and adequate diets for children may possibly reduce the risk of anemia and raise iron status. Short-term low level (weekly) elemental iron administration did not have much protective effect. These findings suggest that dietary diversification through nutrition education as well as dietary iron availability through fortification on long term basis will possibly control prevalent moderate to severe degree of anemia in growing children.

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