Original Article

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Impact of Dietary Intervention on Nutritional Status of Rural School Children

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Abstract

A total of 60 children in the age group of 7-9 years, belonging to low income group of rural areas in Ludhiana district were screened for their haemoglobin and surveyed for their food intake before and after nutritional intervention. All the children were dewormed before feeding trial. Half of the subjects were taken as the control and the remaining half were fed with supplementary products namely *ladoo*, biscuits, *matri* and *seviyaan*, providing 400 kcal energy, 8.6 g of protein, 1269µg of beta carotene, 34 mg of vitamin C, 167 mg calcium and 7.7 mg of iron per day for 120 effective days. Supplementary feeding showed a significant increase in haemoglobin levels and weights of the experimental group children, thereby reducing prevalence of protein energy malnutrition among them.

Keywords: Rural Children; Haemoglobin; Supplementary Products; Intervention.

Introduction

Child malnutrition is the burning issue for developing India. Reports suggest that about 48 per cent of children below age of 9 are found to be malnourished. The malnutrition level in country seems to be increasing every year [12]. Malnutrition continues to be a primary cause of ill health and mortality among children in developing countries. It is a major public health problem and accounts for about half of all child deaths worldwide. About 150 million children in developing countries are still malnourished and more than half of underweight children live in South East Asia Region [6].

Childhood malnutrition diminishes adult intellectual ability and work capacity. Malnourished women tend to deliver premature or small babies who are more likely to die or suffer from suboptimal growth and development. Poor early nutrition leads to poor school readiness and performance, resulting in fewer years of schooling, reduced productivity, and earlier childbearing. Thus, poverty, under nutrition and ill-health are passed on from generation to generation. Worldwide more than 50 per cent of women of reproductive age are being affected. Under nutrition impedes economic progress in all developing countries [1].

The prevalence of anaemia in the pregnant women is the highest among the countries in South East Asia. Anaemia is causing red alert for Indian women and children [11]. India has shown remarkable progress and has a number of nutrition intervention programs, but malnutrition remains highly prevalent in the poor states of the country. Malnutrition results due to imbalance between the needs of the body and the intake of nutrients. In India, gender inequality in nutrition is present from infants to adulthood. Women and girls never reach their full growth potential due to nutritional deprivation. It may be due to poverty, lack of awareness, illiteracy and gender differences [8].

Material and Methods

A total of 120 malnourished school children in the age group of 7-9 years belonging to low income group were purposively selected for the study. A two stage sampling technique was used for the selection of subjects. First stage consisted of convenient sampling of the school in Phullawal village in the vicinity of Ludhiana city of Punjab. Second stage consisted of

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purposive selection of malnourished and anaemic school children. Sixty children in the age group 7-9 years studying in third and forth standards were selected by simple random sampling technique.

The selected children were divided into two groups namely Control (C) and Experimental (E) having 30 children each, comprising 50% each boys and girls. Supplementary feeding of value added products was given to the children under E group for 120 days.

A survey regarding food consumption of the school children using 24 hour recall method [4] for 3 consecutive days was conducted before and after supplementary feeding. For calculations of daily nutrient intake of each subject, "Diet Cal" Software [7] was used and the average nutrient intake of the subjects was obtained. The body weight and height of the subjects were recorded before and after supplementary feeding according to the standard methods by WHO [13].

To evaluate the nutritional status of the children, the data on height and weight were classified using standard deviation (z-score), (height for age, and weight for age and weight for height). The cut off point for malnourished children was taken as-2SD below the reference median as recommended by WHO, 2006. Children falling between -2SD and -3SD of standard were considered as moderately stunted, underweight or wasted and those below -3SD were classified as being severely malnourished. Measurement of height was taken with help of anthropometric rod to the nearest 0.5 cm while the body weight of the subjects was recorded using portable weighing machine.

Feeding of the children in the experimental group with iron and beta carotene rich value added products namely *laddu*, biscuits, *matri* and *sewiyaan* (prepared by incorporating Bengal gram and colocasia leaves powder and *amla* powder) was carried out for 120 effective days. The children of the control group did not receive any supplementation. Supplementary feeding provided 400 kcal energy, 8.6 g of protein, and 1269µg of beta carotene, 34 mg of vitamin C, 167 mg calcium and 7.7 mg of iron to the experimental group children. At the end of the study period, weights and heights of both the groups were measured again.

Blood was also analysed for haemoglobin level to see the impact of intervention. The results were analyzed statistically using paired't' test (Data analysis by using Statistical Package for Social Sciences (SPSS) Software.

Results and Discussion

The mean daily food intake of both the groups before supplementation for various food groups is given in Table 1. The children of E group were given nutritional intervention of iron and beta carotene rich food products. The additional food groups through supplementation provided cereals (66 g), pulses (9 g), green leafy vegetables (14.7 g), fruits (12.5 g), fats and edible oils (12.5 g) and sugar (7.5 g). The energy intake of the E group without supplementation was 622.4 ± 143.2 Kcal, protein 20.7 ± 4.7 g, fat 16.9 ± 6.4 g, calcium 180.7 ± 25.0 mg, iron 5.7 ± 1.4 mg, vitamin C 22.8 ± 13.6 mg and beta carotene 204.9 ± 205.7 µg per day (Table 2). The corresponding values for the C group were 601.4 ± 145.3 Kcal, 20.3 ± 4.3 g, 17.2 ± 9.2 g, 179.9 ± 24.5 mg, 4.6 ± 1.0 mg, 23.3 ± 12.1 mg and 204.3 ± 205.7 µg. The supplements provided additional nutrients as 400 kcal energy, 8.6 g of protein, 1269 µg of beta carotene, 34 mg of vitamin C, 167 mg calcium and 7.7 mg of iron to the experimental group children, thus showing significant increase in the intake of all the nutrients by the E group when compared to the C group (Table 2).

Nutritional intervention enhanced the per cent adequacy of energy, protein, fats, calcium, iron, vitamin C and beta carotene by 22.7, 29.9, 41.7, 27.7, 48.1 and 26.4 per cent, respectively in E group children, when compared with per cent adequacy of corresponding nutrients before supplementation.

Similarly, the shortbread-based biscuits (cookies) were designed to provide 50% of the recommended dietary allowances of iron (5 mg ferrous fumarate), iodine (60 ìg potassium iodate), and â-carotene (2.1 mg) for children aged 7–10 years. The sugar-based cold drink was to provide 90 mg vitamin C. The results showed that the percentage of children with low serum ferritin concentrations in the intervention group decreased from 27.8% to 13.9%. The prevalence of anaemia decreased from 29.6% to 15.6% in the intervention group and from 24.5% to 19.4% in the control group [3].

The results also revealed that the mean weight of the control girls before experimentation was 20.9 ± 3.0 kg while after experimentation it increased to 21.1 ± 2.8 kg, whereas the mean weight of control boys remained the same i.e. 21.7 ± 1.5 kg (before and after experimentation). The mean weight of experimental girls and boys, before experimentation was 21.9 ± 3.2 and 20.5 ± 2.4 kg, respectively while after experimentation it increased significantly ($p < 0.01$) to 23.5 ± 3.2 (girls) and 22.1 ± 2.2 kg (boys) respectively.

While the mean height of the children before experimentation in C group was 121.2 ± 4.3 (girls) and 122.6 ± 2.9 cm (boys) while in E group was 123.4 ± 5.8 (girls) and 122.3 ± 4.8 cm (boys), and after experimentation was 121.2 ± 4.3 (girls) and 122.6 ± 3.0 (boys) in C group and 123.4 ± 5.7 (girls) and 122.4 ± 4.7 (boys) in E group.

On similar basis, [10] conducted a study in rural Bangladesh among moderately-malnourished (weight-for-age between 61% and 75%) school children. Mothers of the first intervention group received intensive nutrition education (INE group) twice a week for three months. The second intervention group received the same nutrition education, and their children received additional supplementary feeding. After three months of interventions, a significantly higher proportion of children in the INE and INE+SF groups improved (37% and 47% respectively) from moderate to mild or normal nutrition compared to the comparison group (18%). At the end of six months of observation, the nutritional status of children in the intervention groups improved further from moderate to mild or normal nutrition compared to the comparison group (59% and 86% vs 30%).

The haemoglobin level of the respondents before experimentation in C group was 11.7 (girls) and 11.9 g / dl (boys) and 10.5 (girls) and 10.8 g / dl (boys) in E group, while after experimentation it was 11.8 (girls) and 12.0 g / dl (boys) in C group and 11.4 (girls) and 11.0 g / dl (boys) in E group.

A significant ($p < 0.05$) ($p< 0.01$) increase was observed in Hb level of respondents in E group, due to the consumption of value added products (supplemented with underutilized greens namely Bengal gram and colocasia leaves powder). However, the respondents in both the groups had Hb level less than normal level of 12.5 – 13.5 g / dl (WHO 2006).

These findings were in line with the study by (2) who studied the effect of probiotic (curd) and micronutrient rich leaf protein concentrate (LPC) and stated a significant rise in the haemoglobin level from 9.33 to 9.63 g / dl (before and after feeding probiotic curd) and 8.07 to 8.59 g / dl (before and after feeding LPC).

Similar results were given by [9] who conducted a nutrition intervention program on school children feeding them a local plant dish made of maize, beans and greens (185 g) along with meat (60 g) and found an increase in the average iron content of 1.51 mg. Micronutrient status of school children aged 6 – 11 years was assessed through consumption of fortified biscuits (rich in beta carotene, iron and iodine) and reported a decrease in the prevalence of anaemia from 29% to 15% [3]

To conclude, the data revealed that developed value added products rich in energy, protein, iron, vitamin C and beta carotene can be effectively used for the prevention and control of PEM and anaemia in children. Low income, illiteracy and inadequate food and nutrient intake were responsible for the under nourished state of health of these school children. The subjects before experimentation did not meet the basic food needs due to poverty, ignorance and lack of knowledge. However, supplementation increased food and nutrient intake, with an increase in anthropometry and biochemical parameters of the respondents of experimental group.

Table 1: Food intake (g) of rural school children (Mean±SE)

Food groups	SDI	Experimental group (E)			Control group (C)	t-value
		BS	Through supplements	AS	Total intake	
Cereals	180	121.5±26.3	66	183.8±27.3	116.5±26.3	6.28**
Pulses and legumes	60	32.0±13.0	9	41.5±10.4	32.0±13.0	3.22**
Green leafy vegetables	100	-	14.7	14.7±3.4	-	3.85**
Other vegetables	100	59.1±20.7	-	59.4±21.8	58.7±29.3	1.21^{NS}
Roots and tubers	100	37.8±19.0	-	39.9±15.4	38.3±15.5	1.20^{NS}
Fruit	100	12.9±2.3	12.5	25.4±7.9	12.6±6.6	2.41*
Milk and milk products	500	64.8±14.6	-	68.3±14.5	64.6±13.9	1.31^{NS}
Sugar	20	12.2±2.1	7.5	19.7±12.5	11.8±4.8	1.93*
Fats and oils	30	12.0±6.0	12.5	24.5±16.8	12.4±7.6	2.40*

SDI-Suggested Dietary Intake; BS-Before supplementation; NS-Non significant;
**-Significant at 1%

Table 2: Nutrient intake of rural school children (Mean±SE)

Nutrients	RDA	Experimental group (E) BS	Experimental group (E) Through supplements	Experimental group (E) AS	Control group (C)	t-value
Energy (Kcal)	1690	622.4±143.2 (36.8)	400	1006.4±140.5(59.5)	601.4±145.3	4.64**
Protein (g)	29.5	20.7±4.7 (70.1)	8.6	29.7±5.2 (100)	20.3±4.3	1.9*
Fat (g)	30	16.9±6.4 (56.3)	20.5	29.4±4.3 (98)	17.2±9.2	1.2*
Calcium (mg)	600	180.7±25.0 (30.1)	167	347.7±32.1 (57.8)	179.9±24.5	3.17**
Iron (mg)	16	5.7±1.4 (35.6)	7.7	13.4±1.9 (83.7)	4.6±1.0	2.58**
Vitamin C (mg)	40	22.8±13.6 (57.0)	34	36.8±15.0 (92.0)	23.3±12.1	6.69**
Beta-carotene (μg)	4800	204.9±205.7 (4.2)	1269	1473.6±220.5 (30.6)	204.3±205.7	2.50**

RDA-Recommended dietary allowances; BS-Before supplementation;
**-Significant at 1%; *Significant at 5%; Parentheses indicate % adequacy;

Table 3: Anthropometry and haemoglobin (Mean±SE) of rural school children

Parameters	Control group (C) BS Girls	Control group (C) BS Boys	Control group (C) AS Girls	Control group (C) AS Boys	t-value	Experimental group (E) BS Girls	Experimental group (E) BS Boys	Experimental group (E) AS Girls	Experimental group (E) AS Boys	t-value
Hb(g/dl)	9.2±0.4	9.7±0.6	9.3±0.4	9.8±0.6	0.6 NS	8.5±0.3	8.8±0.3	10.4±0.5	10.5 ±0.2	3.2**
Weight (Kg)	20.9±3.0	21.7±1.5	21.1±2.8	21.7±1.6	1.4 NS	21.9±3.2	20.5±2.4	23.5±3.2	22.1±2.2	2.1**
Height (cm)	121.2±4.3	122.6±2.9	121.2±4.3	122.6±3.0	1.6 NS	123.4±5.8	122.3±4.8	123.4±5.7	122.4±4.7	1.6 NS

BS-Before supplementation; AS-After supplementation; NS-Non significant;
**-Significant at 1%

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