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Nutrition education and homestead food production in the context of dietary intake in Bangladeshi school-going children

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Abstract

Nutrition education and inputs of some homestead food production in school-going children can improve the household food security. Thus, an intervention study was conducted to compare the effectiveness of nutrition education alone and nutrition education supported with homestead food production interventions on dietary pattern and nutrient intake among selected rural secondary school students in Bangladesh. A total number of 1214 students were divided into three groups. Group-1 (n=406) was received only nutrition education, group-2 (n=400) was received both nutrition education and some inputs of homestead production. These two groups were compared with other control group (n=408) who doesn't receive any intervention. Dietary data were collected by 24-hours recall method and seven days' food frequency questionnaire at both baseline and after six months. At baseline survey, individual dietary diversity score of group 1, 2 and 3 were 5.29±0.87, 4.97±0.97 and 5.38±0.95 respectively. After six months' intervention, study group 2 were found to have better dietary diversity score 5.65±0.94 (p = 0.000) compared to others. In group 2, dietary consumption of fruits and vegetables, egg and milk & milk products were increased significantly (p = 0.000) compared to others. Most of the participants of all groups were inadequate in terms of macro and micronutrients intakes compared to their dietary requirements. There was a significant improvement in dietary diversity score and dietary intake of students in study group 2, which implies that nutrition education along with homestead food production can be a sustainable and affordable strategy to improve dietary diversity.

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Introduction

The nutritional demand and dietary habit is increased in school age children due to their rapid growth (Chang and Kim, 2006). Research has shown that eating habits developed during childhood continue into adulthood (Raby Powers *et al.,* 2005). As a result, health promotion targeting school children is considered as an effective social vaccine to current health problems as well as the health challenges in the generation to come (Tamiru *et al.,* 2016). In order to improving dietary intake patterns in school age children nutritional knowledge may be a key link (Oosthuizen *et al.,* 2011). Nutrition education is widely used for a range of population groups as a medium to deliver healthy diet and nutrition information.

In Bangladesh, nutritional problems, a consequence of poor dietary intake, are widespread and persistent (Ahmed *et al.,* 1998). Secondary school children lying under the age group of 10 – 19 come under the category of adolescent. A fast growth rate joined with a borderline nutrient intake increases the risk of nutritional insufficiencies in this population (Kabir *et al.,* 2010). Sixty million people in Bangladesh still do not have sufficient food to eat and the usual diet lacks micronutrients and diversity due to low access and limited availability of both plant and animal sources foods to meet nutritional requirements (Hasan and Sultana, 2011). Increasing availability and consumption of micronutrient – rich foods through a household's own production is considered a sustainable approach (Talukder *et al.,* 2010). Homestead food production provides important nutrients that may not be readily available or within their economic reach.

Different types of interventions are employed to improve micronutrient status of different population groups. But, nutrition education along with homestead food production inputs intervention was not implemented for school students in Bangladesh before. This study thus, intends to compare the effect of two types of interventions on dietary pattern and nutrient intake of selected rural secondary school students.

Materials and methods

Study design

This interventional study was conducted among 1214 secondary school students of six selected high schools of Kishoreganj district in Bangladesh during August 2014 to May 2015 to investigate their food intake pattern and to execute a nutrition education and homestead food production program to evaluate the change in this variable. The experimental locations were designated purposively.

Two groups of school students were selected for the intervention with nutrition education as well as nutrition education and inputs of homestead food production. The group who received only nutrition education, was named as study group 1 (n = 406); whereas the group who received nutrition education along with homestead food production inputs, was named as study group 2 (n = 400). They were followed up to 6 months along with a control group (n = 408). Each group consisted of participants of two schools out of six schools.

Collection of data

Dietary data were collected by a 24–hour dietary recall along with a seven days' food consumption frequency.

Dietary assessment

Dietary intake of the participants was assessed using 24- hour recall method and details of all foods and drinks consumed by the participants were recorded. The participants were informed the day before data collection for the memorization of their dietary intake of that day. The participants were shown various standards of utensils, such as measuring cups, spoons, glasses, plates and models of different foods to get nearest possible serving sizes of the food consumed. From this information the serving weight of different food items were calculated. A conversion table for Bangladeshi foods formulated in the Institute of Nutrition and Food Science was used for calculating equivalent raw food weight (Ali and

Pramanik, 1991). Food Composition Table for Bangladesh (Shaheen *et al.,* 2013) was used to calculate the intake of nutrients from foods on the basis of raw weight. The adequacy of the intake of nutrients was assessed by comparing with recommended dietary allowances (WHO, 2007 and Burlingame *et al.,* 2009).

A food frequency questionnaire (FFQ) was used to collect information on the weekly consumption of 8 food groups (cereals, pulse, fruits and vegetables, green leafy vegetables, fats and oils, meat and fish, egg and milk & milk products) that consist of the most commonly consumed foods in Bangladesh. The usual consumption frequency of each participant was required to report as the number of time per week. It was used to obtain information about the dietary diversity score of each participant (Swindale and Bilinsky, 2006).

Contents and procedure of nutrition education

A lesson plan of nutrition education was structured to determine the educational content of each session (Table 1). An effort was made to provide a targeted and efficient nutrition education to improve the quality of education. Students in the intervention groups received twelve 45-minutes sessions during a six-month period. Around 50 students (25 boys and 25 girls) were in each group.

Inputs given for homestead food production (HFP)

To implement HFP program, families of study group 2 received some selected inputs (seeds, seedlings, fertilizer, chicks and fry) along with nutrition messages.

Follow up history

After the collection of baseline data and HFP input giving, the participants of study group 2 were followed up by visiting households of them fortnightly for 6 months.

These participants were from Shahbag, Vatgaon, Jalalpur and Chawdhuryhati villages of Kishoreganj district. During the follow up period the parents of the participants were asked about the effectiveness of homestead food production inputs, whether their children ate those or not and whether they earned some money from those and also their homestead gardens were monitored.

Statistical analysis

All of the statistical analyses and all other data processing were done by using IBM SPSS 20 version windows program. Comparative analysis between data from baseline and after six months was done by paired *t*-test. In all statistical tests, *p* values of ≤0.05 were considered significant.

Results and discussion

Background information

Table 3 shows the age distribution of the participants according to gender in different groups. Almost equal number of boys and girls were recruited from each of the age categories in three groups.

Table 1. Lesson plan of nutrition education with education materials.

Session Title	Nutrition Education Materials
Definition of food and its general function in the body	Booklets
Easily available common nutritious foods	Posters and booklets
Basic food groups	Practical food demonstration
Balanced diet	Practical food demonstration
Malnutrition related diseases and their preventive foods	Posters and practical food demonstration
Extra need for adolescents	Posters and leaflets
Iodized salt (importance & testing)	Posters
Personal hygiene and sanitation	Booklets and leaflets
Homestead food production	Posters
Safe food	Booklets and leaflets
Rememberable information on nutrition	Posters
Review (the materials presented in the past sessions were recounted and summarized)	A question – answer session

Individual dietary diversity score (IDDS)

Individual dietary diversity score has been used very popularly in nutritional sciences to report the variety of food items consumed by individuals which ultimately provide a perception about the macro and micronutrient adequacy of an individual diet. Table 4 represents the IDDS among the participants of different groups through the study period. At baseline survey, individual dietary diversity score of group 1, 2 and 3 were 5.29±0.87, 4.97±0.97 and 5.38±0.95 respectively. After six months' intervention, study group 1, 2 and 3 were found 5.16±0.93, 5.65±0.94 and 5.33±0.98 respectively.

Table 2. Various **i**nputs given for homestead food production for group-2.

Inputs	Sample given
Seeds	Lalshak (*Anaranthus olraceus*), Puishak (*Basella alba*), Mistikumra (*Cucurbita moschata*), Dheros (*Abelmoschus esculentus*), Begun (*Solanam melongena*), Lau (*Lagenaria siceraria*) (1+1+1+1+1+1= 6 Packets)
Seedlings	Peyara (*Psidium guajava*), Papaya (*Carica papaya*) (1+1= 2)
Fertilizer	Organic fertilizer (2 packets)
Chicks	One to one and half months old chicks (2)
Fry	Grass carp (*Ctenopharyngodon idella*), Gonia (*Xenentodon cancilla*), Carfu (*Cyprinus carpio*) (50 + 50 + 50 = 150)

Table 3. Distribution of the respondents' age by gender in different groups**.**

Age category	Gender	Study Group 1		Study Group 2		Control Group	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
10 to 13 years	Boys	103	25.4	100	25.0	105	25.7
	Girls	99	24.4	102	25.5	99	24.3
14 to 18 years	Boys	102	25.1	99	24.75	99	24.3
	Girls	102	25.1	99	24.75	105	25.7
	Total	406	100.0	400	100.0	408	100.0

It was observed that IDDS of the participants of study group 2 increased significantly (p = 0.000). On the other hand, IDDS of the participants of study group 1 and control group decreased significantly. Significant improvement of dietary diversity among intervention group was found from baseline to end line in another study (Tamiru *et al.,* 2016).

Table 4. Individual dietary diversity score (IDDS) in different groups.

Type of respondent	Baseline (Mean±SD)	After 6 months (Mean±SD)	p-value
Study Group 1	5.29±0.87	5.16±0.93	0.004
Study Group 2	4.97±0.97	5.65±0.94	0.000
Control Group	5.38±0.95	5.33±0.98	0.006

Consumption of different food groups

Fig. 1, 2, 3 shows the mean food group consumption in different groups in baseline and after intervention. In study group 2, significant increase in the dietary consumption of pulse (p = 0.037), fruits and vegetables (p = 0.000), green leafy vegetables (p = 0.000), fats and oils (p = 0.039), meat and fish (p = 0.057), egg (p = 0.000) and milk & milk products (p = 0.000) were reported.

Though significant increase was not found in both study group 1 and control group, significant decrease was found in case of meat and fish (p = 0.000) and fruits & vegetables (p = 0.010) respectively in these groups.

Dietary nutrient intake

Table 5, 6 and 7 describe the changes in the intake of different nutrients from the baseline in all the groups. In terms of macro and micronutrients intakes of the participants of study group 2 showed significant changes after intervention except zinc.

Table 5. Changes in the intake of different nutrients in study group 1 (n=406).

Nutrients			Baseline (Mean±SD)	After 6 months (Mean±SD)	p value
Macronutrients		Energy (Kcal)	1604.96±341.03	1645.67±398.87	0.040*
		Protein (g)	55.84±14.60	56.78±17.23	0.338
		Fat (g)	29.11±11.73	29.76±13.77	0.334
Micronutrients	Vitamins	Vitamin A (µg RE)	275.99±225.86	287.73±353.53	0.296
		Vitamin C (mg)	26.01±17.58	24.99±16.51	0.241
		Vitamin E (mg)	2.85±0.61	2.94±1.09	0.200
		Thiamine (mg)	0.66±0.20	0.68±0.24	0.208
		Riboflavin (mg)	0.78±0.32	0.80±0.42	0.340
		Vitamin B6 (mg)	1.06±0.29	1.06±0.27	0.969
		Niacin (mg)	17.48±6.34	17.60±6.63	0.665
		Folate (µg)	91.67±30.39	95.64±47.64	0.235
	Minerals	Calcium (mg)	298.22±185.56	294.56±193.19	0.512
		Magnesium (mg)	235.24±52.08	238.80±57.23	0.216
		Iron (mg)	7.91±2.57	8.10±2.84	0.137
		Zinc (mg)	10.18±3.06	10.26±3.35	0.594

In study group 1, significant change was found only in energy intake whereas significant decrease in vitamin C intake was noted in control group. The increase in consumption of food group and nutrient intake after intervention was also found in other studies (Naghashpour *et al.,* 2014 and Kumari, 2016). In developing countries, nutrition education interventions aim at improving children's nutrition and learning capability (Shermen and Muehlhoff, 2007).

Table 6. Changes in the intake of different nutrients in study group.

Nutrients			Baseline (Mean±SD)	After 6 months (Mean±SD)	p value
Macronutrients		Energy (Kcal)	1635.01±416.71	1681.17±359.72	0.005*
		Protein (g)	58.43±18.36	65.95±16.47	0.001*
		Fat (g)	30.74±12.70	34.60±12.45	0.000*
Micronutrients	Vitamins	Vitamin A (µg RE)	215.84±231.13	312.03±248.77	0.000*
		Vitamin C (mg)	20.31±12.04	25.80±12.28	0.000*
		Vitamin E (mg)	2.82±0.90	4.10±0.86	0.000*
		Thiamine (mg)	0.62±0.20	0.80±0.21	0.000*
		Riboflavin (mg)	0.75±0.39	0.96±0.34	0.000*
		Vitamin B6 (mg)	1.01±0.32	1.17±0.29	0.000*
		Niacin (mg)	19.65±7.36	20.20±7.08	0.018*
		Folate (µg)	84.81±29.67	103.34±29.67	0.000*
	Minerals	Calcium (mg)	294.20±271.38	362.71±227.70	0.000*
		Magnesium (mg)	232.52±62.06	282.58±53.66	0.000*
		Iron (mg)	8.22±3.17	8.91±3.04	0.000*
		Zinc (mg)	11.13±3.86	11.35±3.60	0.092

2 (n=400).

Table 8 shows different nutrients adequacy among the groups in the baseline and after the intervention. Nutrient adequacy was measured by comparing the nutrient intake with the recommended dietary allowances (RDA) of each individual participants of the study.

Table 7. Changes in the intake of different nutrients in control group (n=408).

Nutrients			Baseline	After 6 months	*p* value
Macronutrients		Energy (Kcal)	1670.08±377.53	1670.55±338.81	0.977
		Protein (g)	60.64±20.90	60.95±18.58	0.803
		Fat (g)	31.24±15.17	30.44±14.52	0.283
Micronutrients	Vitamins	Vitamin A (µg RE)	312.05±309.91	301.10±307.88	0.348
		Vitamin C (mg)	29.73±41.74	23.03±16.16	0.031*
		Vitamin E (mg)	2.99±1.35	2.87±0.80	0.139
		Thiamine (mg)	0.72±0.39	0.72±0.28	0.880
		Riboflavin (mg)	0.80±0.37	0.81±0.46	0.833
		Vitamin B6 (mg)	1.13±0.33	1.12±0.29	0.550
		Niacin (mg)	19.61±8.34	19.48±7.58	0.733
		Folate (µg)	97.30±38.93	95.02±35.26	0.188
	Minerals	Calcium (mg)	318.15±171.04	323.79±263.38	0.715
		Magnesium (mg)	249.65±65.78	249.92±59.60	0.933
		Iron (mg)	8.77±3.63	8.74±3.04	0.896
		Zinc (mg)	11.05±4.19	11.00±3.68	0.785

Table 8. Nutrient adequacy in different groups.

Nutrients			Study group 1		Study group 2		Control	
			Baseline	After 6 months	Baseline	After 6 months	Baseline	After 6 months
Macronutrients		Energy (Kcal)	12.0%	16.5%	9.8%	11.6%	8.1%	9.3%
		Protein (g)	73.7%	71.4%	69.2%	71.9%	72.7%	77.9%
		Fat (g)	13.5%	14.3%	7.1%	12.3%	15.7%	13.4%
Micronutrients	Vitamins	Vitamin A (µg RE)	12.0%	13.5%	11.0%	17.4%	18.0%	16.3%
		Vitamin C (mg)	16.5%	14.3%	9.0%	11.6%	16.3%	11.0%
		Vitamin E (mg)	0.0%	0.0%	0.0%	0.0%	1.2%	0.0%
		Thiamine (mg)	2.3%	2.3%	1.9%	1.9%	2.9%	2.9%
		Riboflavin (mg)	19.5%	22.6%	14.8%	29.0%	21.5%	21.5%
		Vitamin B6 (mg)	21.1%	22.6%	27.7%	34.8%	27.9%	27.9%
		Niacin (mg)	52.6%	50.4%	67.7%	69.0%	58.7%	59.9%
		Folate (µg)	0.0%	0.8%	0.0%	0.0%	0.0%	0.0%
	Minerals	Calcium (mg)	0.0%	0.0%	0.6%	0.0%	0.0%	0.6%
		Magnesium (mg)	57.1%	56.4%	52.3%	64.5%	62.8%	63.4%
		Iron (mg)	0.8%	0.8%	3.9%	4.8%	3.5%	0.6%
		Zinc (mg)	70.7%	64.7%	73.2%	74.7%	65.7%	60.5%

Most of the participants of all groups were inadequate in terms of macro and micronutrients intakes except protein, niacin, magnesium and zinc. These results were also in agreement with the findings of (Kumari, 2016). In developing countries, nutrition interventions aim at improving children's nutrition and learning ability (Sherman and Muehlhoff, 2007

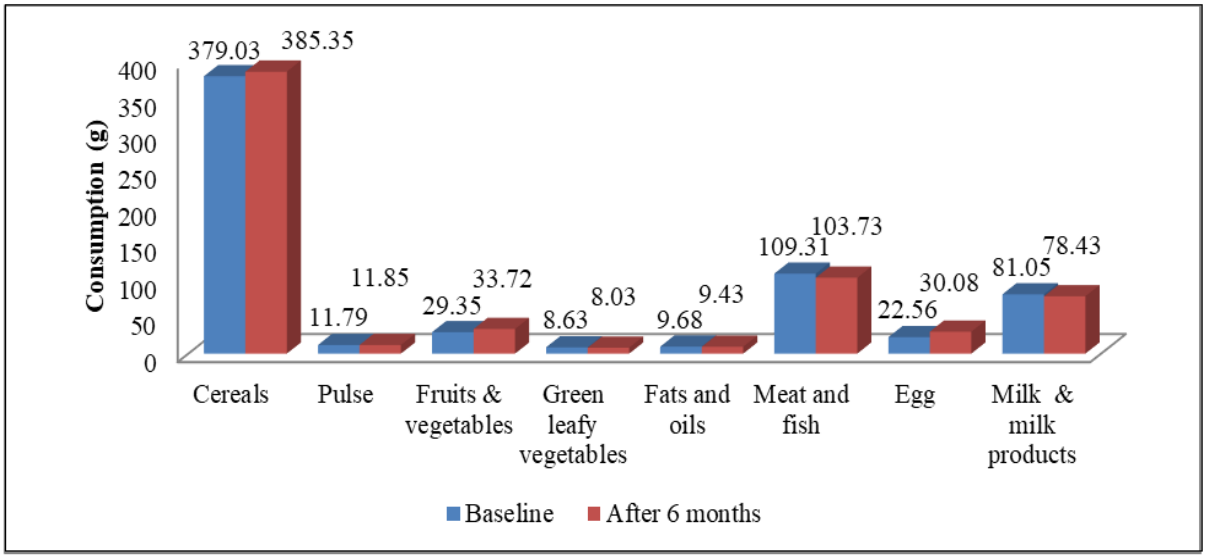

Fig. 1. Changes in the consumption of different food groups in study group 1 (n=406).

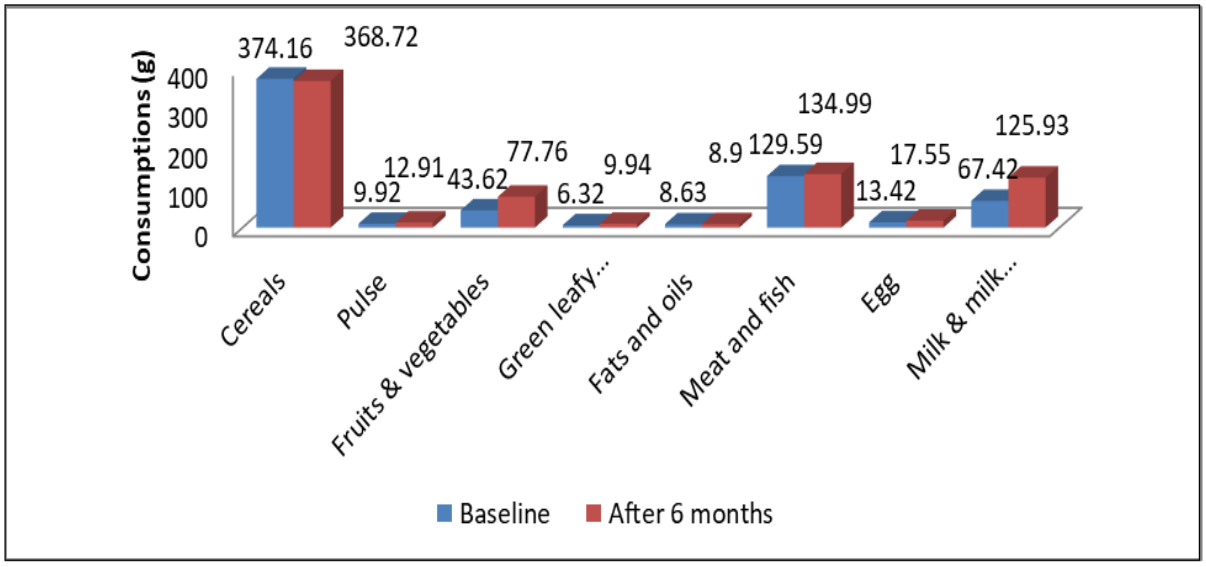

Fig. 2. Changes in the consumption of different food groups in study group 2 (n=400).

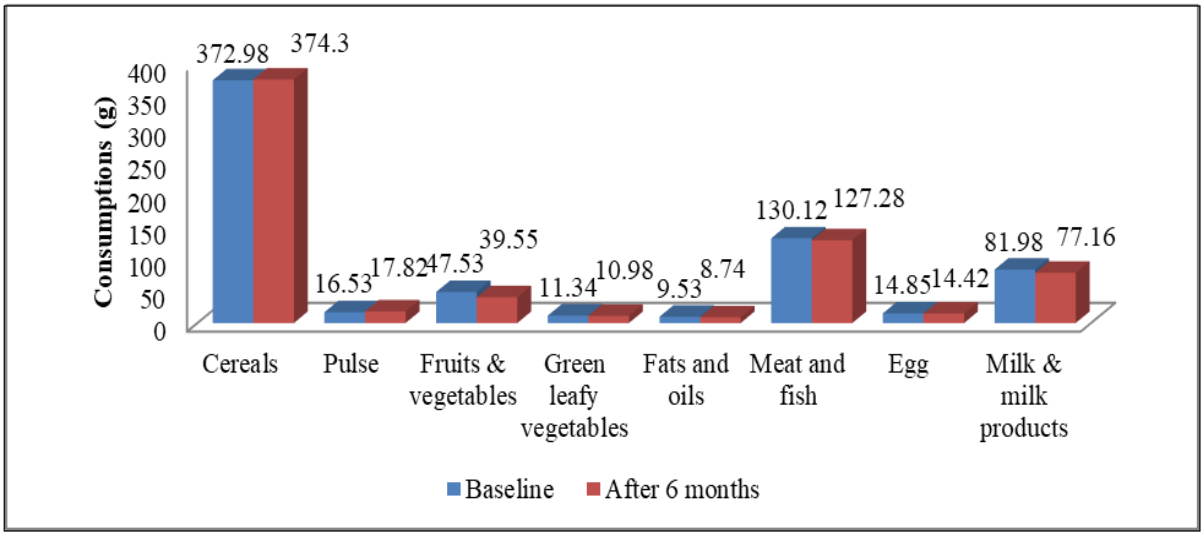

Fig. 3. Changes in the consumption of different food groups in control group (n=408).

Conclusion

Individual dietary diversity score of study group 2 was higher than other two groups. Again, in group 2, dietary consumption of pulses, fruits and vegetables, green leafy vegetable, egg and milk & milk products were increased more compared to other groups. Most of the participants of all groups were inadequate in terms of macro and micronutrients intakes except protein, niacin, magnesium and zinc. Individual's energy levels, physical activity, attitude, memory, mental clearness and emotional and mental wellbeing were seriously affected by nutritional intake level. To overcome this complexity nutrition education is an effective beginning to facilitate dietary behavior changes. Nutrition education along with homestead food production can be a sustainable and affordable strategy to improve dietary diversity as well as nutrient intake of the population, particularly the poor.

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