Effects of Nutrition Education Alone and in Combination with Homestead Food Production on Nutritional Status and School Performance among Rural Students of Kishoreganj

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Abstract

The research critically evaluated the sequence of homestead food production (HFP) inputs along with nutrition education program and also the effect of only the latter on nutritional status and school performance in chosen rural secondary school pupils of Kishoreganj district of Bangladesh. In this research, a total of 1214 pupils were distributed among study group 1, study group 2 and the control group. The number of students in study group 1, study group 2 and the control group was 406, 400 and 408 respectively. The study group 1 took part in the nutrition education program. The second study group received HFP inputs besides nutrition education. Anthropometric, blood samples and school performance-related data were gathered at the beginning and also after an intervention of six months. In the control group, severe and moderate malnutrition increased at the end of the research period of half a year (from 2.0 to 2.5% and 8.9 to 10.5% respectively). On the other hand, severe and moderate malnutrition reduced in study group 1 (from 8.5 to 6.4% and 13.5 to 11.3% respectively) and study group 2 (from 4.5 to 4.2% and 10.1 to 8.3% respectively) after the intervention. The prevalence of anemia was 48.5%, 43.8% and 48.5% at the baseline in the control, first and second study groups respectively. After half-year, the frequency of anemia escalated in the control group (54.9%) while it reduced in the study group 1 (35.5%) and study group 2 (44%). The serum ferritin level reduced from baseline in the control group. Noteworthy differences in the examination marks were noted in the three groups after the duration of six months, especially among the pupils in study groups 1 and 2. Advancement in curricular achievement of study group 2 was noticeably better than study group 1 ($p<0.05$) and control group ($p<0.05$). Findings from this study suggest nutrition intervention programs can positively affect the nutritional status and the academic performance of the students.

Key words: Nutrition education, Homestead food production, Nutritional status, School performance

Introduction

Malnutrition is a devastating problem in the developing countries among secondary school children lying under the age group of 10-19 years. This adolescence (10-19 years) is a notable period of development and maturation in human beings; special changes occur at this time and many adult patterns are introduced. Malnutrition among the poor citizens settled in rural regions of Bangladesh is possibly the highest in the globe[1]. Rural adolescents of Bangladesh suffer from high rates of malnutrition. According to Nurul Alam et al. prevalence of adolescent stunting in Bangladesh is 36%, about 30% have iron deficiency anemia and 25-27% have less hemoglobin level (hemoglobin < 12 g/dl)[2]. In the southern part of Asia, a high frequence of malnutrition (50% or more with BMI <5th percentile WHO/NCHS references) amongst juveniles living in villages has been demonstrated[3]. At present, an increase in global food prices has substantially increased poverty and has pushed many people into undernutrition[4]. Other than genetic factors, inconvenient environmental factors such as poor socioeconomic status (SES) and miserable quality diets describe the dis-satisfactory growth of juveniles[5]. Inadequate dietary intake could have long-lasting bad consequences on an adolescent's decreased learning capability leading to impaired school performance. During school age, children are more free, and begin to make choices on what to eat on their own. Food habits they develop during puberty are more likely to persist in their adulthood. So, it is crucial for children to learn about the benefits of proper nutrition. For school-going kids, education regarding nutrition has not only been proved to enrich erudition and masterfulness but also in taking foods and physical activity behaviours as well as health condition.[6-9]

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Many adverse results of malnutrition, including morbidities and mortalities in unguarded populations, could be avoided through nutrition interventions on time and have shown to be highly beneficial to the millions of population. These nutrition interventions were provided mainly to vulnerable population, including children and women.[10] But nutritional interventions to target particularly the rural adolescents of low socioeconomic status of Bangladesh are urgently required to reduce undernutrition of this group. However, no prior intervention study was found where nutrition education and homestead food production inputs were provided to the school students in Bangladesh. This study aimed at investigating the influence of nutrition education given singly and alongside homestead food production inputs on nutritional status and school performance of selected rural secondary school students.

Materials and Methods

Study design and settings

An intervention (quasi-experimental) study was conducted among 1214 secondary school students (class six to ten) from six selected high schools of Kishoreganj district in Bangladesh during August 2014 to May 2015 to investigate their nutritional status, school performance and to execute a nutrition education and homestead food production program to evaluate the changes in these variables. The schools were selected purposively.

Study subjects

In this interventional study, a total of 1214 pupils were distributed among 3 groups: study group 1 (n=406), study group 2 (n=400) and control group (n =408). Study group 1 participated in the nutrition education program, whereas the study group 2 received nutrition education together with homestead food production inputs. The third group was the control group which did not receive any intervention. Each group consisted of participants from two schools out of six schools. They were followed up for 6 months.

Collection of data

Socio-demographic data

Socio-demographic data were collected through direct interview and from completed forms by the guardians. The exact age of the students was obtained from school registers.

Assessment of nutritional status

Anthropometric data (height and weight) were gathered based on standard methods[11].

Body Mass Index (BMI) was determined by the standard anthropometric method. BMI- for age Z-scores was calculated according to 2007 WHO reference for 5 - 19 years old children using Anthro Plus[12]. We calculated delta changes for each individual in each group (Mean delta change of a group = Mean total percentage of marks of end line - Mean total percentage of marks of baseline). Mean delta changes for the total percentage of marks were +2.88 in study group 1, +12.29 in study group 2, and +2.22 in the control group.

Blood collection and biochemical analysis

For analysis of biochemical indices, 5ml of venous blood was collected from each of the participants. Analyses of hemoglobin and serum ferritin were done on the same day of blood collection. Hemoglobin concentration was determined by cyanmethemoglobin method[13] using a commercial kit (Boehringer Mannheim, Germany), and serum ferritin level was estimated by enzyme-linked immunosorbent assay (ELISA) method[14,15] using a commercial kit (Bio check, Inc).

School performance

Total marks obtained in the examination, number of hours studying at home, completion of homework in time, and class - attendance were collected to evaluate the effect of the intervention on the school performance of the participants. Marks and class-attendance were obtained from the records of the school's administration.

Nutrition education intervention

A lesson plan of nutrition education was constructed to detect the educational content of each session. The goal of this lesson plan was to provide targeted and systematic nutrition education to enrich education quality. Students in the intervention groups received twelve 45-minutes sessions during six months. Around 50 students (25 boys and 25 girls) were in each group.

Statistical analysis

The delta changes among the groups were subjected to one-way analysis of variance (ANOVA) test, including Bonferroni correction, to adjust the multiple comparisons. 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.

Lesson plan of nutrition education

Session	Title	Nutrition Education Materials
1.	Definition of food and its general function in the body	Booklets (Md. Aminul Haque Bhuyan, Pushti Porichay)
2.	Easily available common nutritious foods	Posters and booklets (INFS and Pushti Porichay)
3.	Basic food groups	Practical food demonstration
4.	Balanced diet	Practical food demonstration
5.	Malnutrition related diseases and their preventive foods	Posters and practical food demonstration (FAO and Agriculture Department, Government of Bangladesh)
6.	Extra need for adolescents	Posters and leaflets (INFS and Ministry of Health and Family Welfare, Bangladesh)
7.	Iodized salt (importance and testing)	Posters (BSCIC, IPHN, UNICEF and USAID)
8.	Personal hygiene and sanitation	Booklets and leaflets (Ministry of Health and Family Welfare, Bangladesh)
9.	Homestead food production	Posters (Ministry of Agriculture, Bangladesh and FAO)
10.	Safe food	Booklets and leaflets (FAO, Improving Food Safety in Bangladesh, IPHN and Ministry of Health and Family Welfare, Bangladesh)
11.	Rememberable information on nutrition	Posters
12.	Review (the materials presented in the past sessions were recounted and summarized)	A question -answer session

Inputs given for Homestead Food Production (HFP)

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

Inputs	Sample given
Seeds	Lalshak, Puishak, Misti Kumra, Dheros, Begun, Lau (1+1+1+1+1+1=6 packets)
Seedlings	Peyara, Papaya (1 + 1 = 2)
Fertilizer	Organic fertilizer (2 packets)
Chicks	One to one and a half months old chicks (2)
Fry	Grass carp, Gonia, Carfu (50+50+50=150)

Implementation history

After the collection of baseline data and providing HFP inputs, the participants of study group 2 were followed up by visiting their households fortnightly for 6 months. These participants were from Shahbag, Vatgaon, Jalalpur, and Chowdhuryhati villages of Kishoreganj district, Bangladesh. During the follow-up period, the parents of the participants were asked about the effectiveness of homestead food production inputs, such as whether their children ate those foods or not and whether they earned some money from those products or not. Additionally, their homestead gardens were monitored during the implementation period.

Results

The study was conducted among six schools in Kishoreganj district, Bangladesh. Each of the groups comprised of participants from two schools. Table 1 shows the socio-demographic traits of the participants. An almost equal number of boys and girls were recruited in each group. Most of the participants in the three groups were Muslim (above 90%). Also, most of the families in three groups were found nuclear rather than the joint type. Most of the respondents belonged to the income group of less than Tk. 3000 (53.2% in study group 1, 48.7% in study group 2 and 47.8% in control group).

Table 2 shows the BMI category changes in different groups across the study. Comparing with the World Health Organization's body mass index reference for children and adolescents, the study participants were classified accordingly as severe, moderate malnourished, and normal groups. In the control group, 89.1% of partakers' BMI was normal at the baseline, which declined to 87% at the end of the research. Percentage of the study partakers having normal BMI escalated slightly in study group 1 and 2 after the intervention.

Table 1: Socio-demographic characteristics of the participants of different groups

Characteristics		Study Group 1 n(%)	Study Group 2 n(%)	Control Group n(%)
Gender	Boy	205(50.5%)	199 (49.7%)	204 (50%)
	Girl	201 (49.5%)	201 (50.3%)	204 (50%)
Religion	Muslim	390 (96.1%)	390 (97.5%)	380 (93.1%)
	Hindu	16 (3.9%)	10 (2.5%)	28 (6.9%)
Family type	Nuclear	306 (75.4%)	308 (77%)	300 (73.5%)
	Joint	100 (24.6%)	92 (23%)	108 (26.5%)
Family Size	<4	49 (12.1%)	56 (14%)	73 (17.9%)
	4-6	321 (79.1%)	304 (76%)	302 (74%)
	>6	36 (8.8%)	40 (10%)	33 (8.1%)
Monthly	<3000	214 (53.2%)	186 (48.7%)	194 (47.8%)
Family	3000 -6000	90 (22.4%)	78 (20.4%)	68 (16.7%)
Income (taka)	6001 -9000	46 (11.4%)	26 (6.8%)	48 (11.8%)
	>9000	52 (12.9%)	92 (24.1%)	96 (23.6%)

Table 2: The changes of BMI category in different groups across the study

Group	Baseline			After 6 months		
	Severe Malnutrition	Moderate Malnutrition	Normal	Severe Malnutrition	Moderate Malnutrition	Normal
Study Group 1	8.5%	13.5%	78%	6.4%	11.3%	82.3%
Study Group 2	4.5%	10.1%	85.4%	4.2%	8.3%	87.5%
Control Group	2.0%	8.9%	89.1%	2.5%	10.5%	87.0%

Table 3 depicts the hematopoietic indices of the participants of different groups. The prevalence of anemia (measured by hemoglobin)was 43.8%, 48.5%, and 48.5% in baseline in the study group 1, study group 2, and control group, respectively. After half of a year, the frequency of anemia escalated in the control group. On the other hand, declined anemia frequency was observed in study group 1 and 2. Serum ferritin level shows the number of iron store depleted participants increased from baseline to after 6 months (from 1% to 3.4%) in the control group.

Table 3: Anemia prevalence (measured by hemoglobin) and serum ferritin level in different groups

Group	Anemia Prevalence				Serum Ferritin Level			
	Baseline		After 6 months		Baseline		After 6 months	
	Normal n (%)	Anemic n (%)	Normal n (%)	Anemic n (%)	Normal n (%)	Iron depleted n (%)	Normal n (%)	Iron depleted n (%)
Study Group 1	228 (56.2%)	178 (43.8%)	262 (64.5%)	144 (35.5%)	390 (96.1%)	16 (3.9%)	394 (97%)	12 (3%)
Study Group 2	206 (51.5%)	194 (48.5%)	224 (56%)	176 (44%)	384 (96%)	16 (4%)	386 (96.5%)	14 (3.5%)
Control Group	210 (51.5%)	198 (48.5%)	184 (45.1%)	224 (54.9%)	404 (99%)	4 (1%)	394 (96.6%)	14 (3.4%)

Normal *Hb* level = Children (10-11 yrs) > 11.5 *g/dl*, children (12 - 14 yrs) > 12 *g/dl*, girls (15-18 yrs) > 12 *g/dl*, boys (15-18 yrs) > 13*g/dl*. Normal serum ferritin level = Both boys and girls (more than 10 yrs) > 15*ng/ml*. Normal range of *Hb* and serum ferritin was categorized by WHO (World Health Organization).

The types of anemia in different groups across the study are shown in Figure-1. Among the anemic participants, 9%, 8%, and 2% were iron deficient in study group 1, study group 2, and control group, respectively, at the baseline. An increasing trend of iron deficiency (6%) was noted in the control group after half-year.

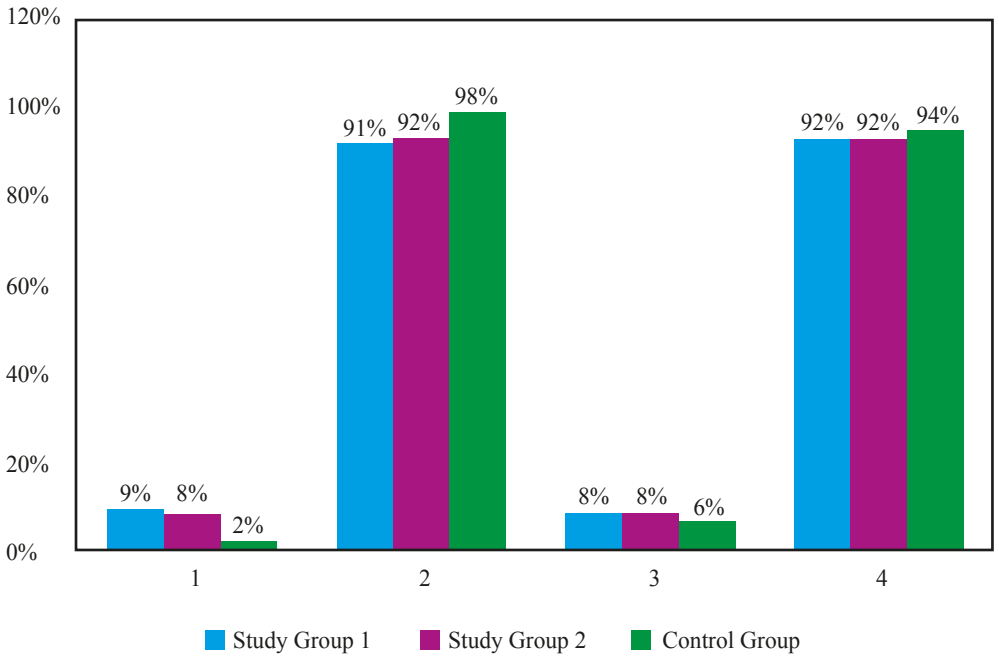

Figure 1: Type of anemia in different groups

The mean percentage of marks obtained in the examination was found to be improved in all the groups after the intervention (Table 4). Among the participants, the performance of study group 2 was comparatively better. The changes were highly significant in study groups 1 and 2 (p<= 0.001 and 0.001, respectively).

Table 4: The changes in the total percentage of marks obtained in the examination across the study

Group	Baseline Mean ± SD	After 6 months Mean ± SD	*P* value[T]
Study Group 1	53.42 ± 8.09	56.30 ± 11.38	0.00*
Study Group 2	52.91 ± 11.79	65.20 ± 11.87	0.00*
Control Group	52.21 ± 11.18	54.43 ± 11.80	0.01*

* p<0.05

*T*p value is based on paired t-tests for differences

The study found the improvement in study group 2 was noteworthily more analogized to study group 1 (p< 0.05) and control group (p< 0.05) (Table 5).

Table 5: Comparison of the changes in academic performance between different groups

Multiple Comparisons (Bonferroni) Dependent Variable: Delta of % of total marks						
Type of respondent (I)	Type of respondent (J)	Mean Difference (I – J)	Std Error	*P* value	95% CI	
					Lower Bound	Upper Bound
Study Group 1	Study Group 2	-9.410	3.066	0.007*	-16.770	-2.046
	Control Group	0.660	3.050	1.000	-6.673	7.973
Study Group 2	Study Group 1	9.410	3.066	0.007*	2.046	16.770
	Control Group	10.070	3.081	0.003*	2.659	17.456
Control Group	Study Group 1	-0.660	3.050	1.000	-7.973	6.673
	Study Group 2	-10.070	3.081	0.003*	-17.456	-2.659

*p<0.05

Class - attendance of the participants of study group 2 increased after the intervention (Figure 2), and the change was highly significant (p< 0.001).

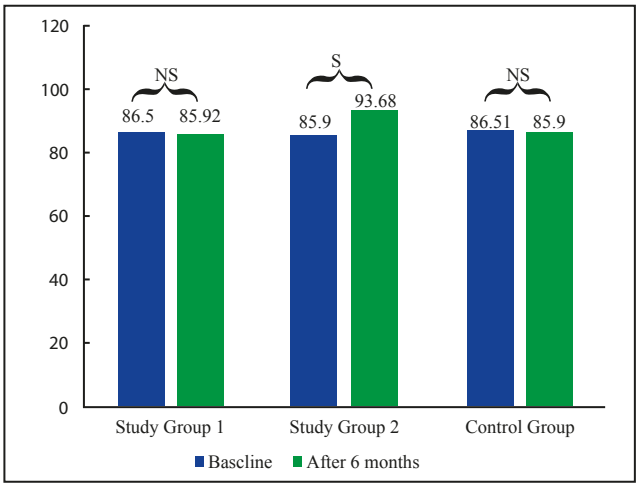

Figure 2: The changes in class - attendance across the study (study group 1 = NS, study group 2,p< 0.001, control group = NS)

NS - Not Significant S - Significant

Number of hours spent in studying at home by different groups is shown in Table 6. It was found that after 6 months more hours were spent studying at home by all the groups, but the percentage was higher in study group 2.

Table 6: Comparison of no. of hours spent in study by different groups

Parameters		Study group 1		Study group 2		Control group	
		Baseline n (%)	After 6 months n (%)	Baseline n(%)	After 6 months n (%)	Baseline n (%)	After 6 months n(%)
No. of hours studying at home	>3	46 (11.3%)	49 (12.1%)	39 (9.8%)	52 (13%)	37 (9.1%)	45 (11%)
	3-2	231 (56.9%)	249 (61.3%)	252 (63%)	287 (71.8%)	212 (52%)	238 (58.3%)
	2-1	129 (31.8%)	108 (26.6%)	109 (27.2%)	61 (15.2%)	159 (38.9%)	125 (30.7%)

Table 7 shows the comparison of the percentage of homework completion by different groups. The rate of homework completion in time is comparatively better after 6 months in study group 2.

Table 7: Comparison of the percentage of homework completion by different groups

Parameters		Study group 1		Study group 2		Control group	
		Baseline n(%)	After 6 months n (%)	Baseline n(%)	After 6 months n (%)	Baseline n(%)	After 6 months n(%)
Completed homework in time	Always	25 (6.2%)	28 (6.9%)	19 (4.8%)	30 (7.5%)	23 (5.6%)	29 (7.1%)
	Mostly	174 (42.8%)	191 (47.0%)	167 (41.7%)	200 (50.0%)	159 (39.0%)	155 (38.0%)
	Sometimes	198 (48.8%)	179 (44.1%)	212 (53.0%)	163 (40.7%)	213 (52.2%)	217 (53.2%)
	Rarely	9 (2.2%)	8 (2%)	2 (0.5%)	7 (1.8%)	13 (3.2%)	7 (1.7%)

Discussion

The goal of the research was to evaluate the impacts of two types of interventions on nutritional status and curricular achievement of selected rural secondary school students. Malnutrition increased in the control group after intervention. After the intervention of half-year, the frequency of anemia escalated in the control group, while decreased anemia prevalence was found in both intervention groups. The advancement in curricular achievement in study group 2 was noticeably better as analogized to the study group 1 and control group.

As revealed in the present study, the percentage of the research partakers having normal BMI escalated slightly in study group 1 and 2 after interventions for 6 months. Also, the prevalence of anemia decreased in these groups after intervention. The findings were totally opposite for the participants of the control group, where 89.1% of partakers' BMI was normal at the baseline, which declined to 87% in the end of the research. The prevalence of anemia also increased in this group after 6 months. In a study in Bangladesh, the nutritional status of intervention groups was found improved after three months of interventions, compared to the comparison group[16]. In another study in India, both anthropometric and biochemical improvement was found after nutrition counselling for

four months in the experimental group of school girls[17]. Among the anemic participants, 2% were iron-deficient at baseline in the control group, which increased to 6% at the endline. The picture of iron deficiency was different in study groups 1 and 2. In study group 1, a 1% decrease in iron deficiency was noted at the endline. The percentage of iron-deficient was the same at beginning and ending in study group 2. Helen Keller International has been accomplishing homestead food production programs, coupled with nutrition education among ~ 30,000 households in four countries. Anemia frequency among kids in program households declined in all the states.[4]

The mean percentage of the marks in the examination was found improved in all three groups after intervention. Amongst them, the performance of study group 2 was comparatively better (52.91% at baseline to 65.20% at the endline). The changes were highly significant in study groups 1 and 2. It was also noted that the advancement in curricular achievement in study group 2 was noticeably more analogized to study group 1 and control group. However, no significant change was found among the study group 1 and the control group. Class - attendance of the participants of study group 2 increased after intervention and the change was highly significant. More hours were spent studying at home by all the groups as was found after 6 months of intervention, but the percentage was relatively higher in study group 2 (13%). The rate of homework completion in time is comparatively better after intervention in study group 2. Shore et al[18] stressed the need for healthy lifestyle intervention and preventive measures to help students work to their full potential. Another study showed that the nutritional status of a student has a definite relationship with his/her academic achievement[19].

Strengths and limitations

Keeping nutrition education constant, two approaches have been used, such as only nutrition education versus nutrition education with homestead food production inputs in this research, which is the tested strength. The cooperation of secondary school authorities without seeking financial incentives is another noted strength of this research. Furthermore, having time spent on implementation of research in the field level for six months is a limitation, which could be overcome when the time would be around three years for better execution at the field level, which needs significant funding.

Conclusion

Nutrition education and HFP program had an optimistic effect on the nutritional status and school performance of the secondary school students. The findings support the vital link between nutrition and learning potential. Nutrition education, along with homestead food production, played a significant part in the improvement of nutritional status and academic performance of secondary school students.

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