



Full Length Research Article

IMPACT OF BREAKFAST BAR SUPPLEMENTATION ON NUTRITIONAL AND ACADEMIC PERFORMANCE OF ADOLESCENCE

Bhuvanewari, J. and *Nazni, P.

Department of Food Science, Periyar University, Salem-636 011, Tamilnadu, India

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ABSTRACT

The supplementary effect of breakfast bar on nutritional and academic performance was studied among adolescent under the age group of 13-15 years. About 500 adolescents were assessed for their demographic, dietary pattern, breakfast skipping patterns, nutritional status (weight, BMI and body fat percentage) and academic performance (scales such as arithmetic, concept and processes scale, reading and writing scales). About 120g of the developed breakfast bar contributing 1/3rd of the adolescent nutrient requirements was formulated and selected for supplementation. For experimentation study 50 breakfast consumers and 100 breakfast skippers were selected. Fifty breakfast consumers were taken as Control group (n=50) and 100 breakfast skippers were divided into two groups such as Experimental group I (n=50) with no intervention and Experimental group II (n=50) supplemented with 120g breakfast bars daily for the period of 90 days. Results about the nutritional status of the study revealed that there was a significant increase at 1% level in the weight, Body Mass Index (BMI), and body fat percentage levels of both Control and Experimental group II when compared to Experimental group I. Results of academic performance of the study showed a significant increase at 1% level in all the three groups, with less mean difference in Experimental Group I. Thus the present study concluded that consumption of breakfast on regular basis will improve both nutritional and academic performance of adolescents.

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INTRODUCTION

Breakfast is regarded by many nutritionists as the most important meal of the day. Breakfast provides a significant proportion of the day's total nutrient intake and offers the opportunity to eat foods fortified with nutrients such as foliate, iron, vitamins and fiber. Essential vitamins, minerals and other nutrients can only be gained from food¹. Regular meal pattern is an important factor in ensuring the physiological balance of the body for all age groups². Breakfast for academic achievement is reflected in the effects of breakfast on cognitive performance. Research suggests that skipping breakfast detrimentally affects problem solving, short-term memory, attention and episodic memory in children. Conversely, when children consume breakfast performance is enhanced on measures of vigilance attention, arithmetic, problem solving tasks, and logical reasoning³. Adolescents who skip breakfast are at increased risk for skipping other meals, snacking, being less physically active and being

overweight and obese. Breakfast skipping in adolescents has been associated with various health-compromising behaviors and unhealthy lifestyles, such as tobacco, alcohol, and substance use, and risk-taking in general⁴. Food is one of the basic necessities of life and there are different sources of food such as cereals, meat, vegetables, fruits, milk and milk products etc. In almost all over the world cereals are used as staple food. Cereal grains are cheapest source of energy and protein in human diet⁵. Breakfast cereals are defined as "Processed grain formulations suitable for human consumption without further cooking". One or more of the cereal grain or milled fractions thereof are indeed constituents of all breakfast cereals. The principle grains used in breakfast cereals are corn, wheat, rice, oats, and barley. The common breakfast cereals are cereal flakes and porridge⁶. Based on the above aspects, the main aim of this study is to find out the impact of breakfast bar and its impact on nutritional and academic performance of the adolescents.

MATERIALS AND METHODS

Development of breakfast bar: The breakfast bar development procedure reported by Fast and Caldwell (1990) was adopted

*Corresponding author: naznip@gmail.com

for producing the breakfast bar. It was developed with Mixture flakes (Corn flakes, wheat flakes, rice flakes and oat flakes in 1:1:1:1 ratio), groundnut, chocolate chips, butter, sugar, vanaspathi, essences, glycerin, sodium bi carbonate and sesame were purchased from local market of Salem. A nutritious breakfast bar formulated with mixture flakes, groundnut and chocolate chips with other necessary ingredients was developed and analyzed for its nutrients like energy (Kcal) was calculated by using calculation method, the protein (g) was calculated by Lowry's method, and the fat (g) was by soxhlet method and carbohydrate by Anthrone method. The developed breakfast bar was evaluated for sensory quality on the basis of appearance, colour, flavour, texture, taste and over all acceptability using a 9 point Hedonic rating scale card with scores ranging from 9 to 1 representing like extremely and dislike extremely respectively. About 120g of the developed breakfast bar contributing 1/3rd of the adolescent nutrient requirements was selected for supplementation.

Conduct of the study: The present study was carried out in Salem district of Tamilnadu and comprised of 500 adolescents of 13-15 years of age group. About 500 adolescents were assessed for their demographic status, dietary, life style and breakfast skipping pattern. The nutritional status of the subjects was studied through anthropometric assessment like height, weight, body mass index, and percentage of body fat. The academic performance was assessed by using four types of scale namely arithmetic scales, Concept and Processes scales, Reading and Writing scales. Each heading comprised of 11 questions. The subjects were encouraged to answer the academic performance questionnaire.

Supplementation of developed breakfast bar: From 500 adolescents, 50 breakfast consumers and 100 breakfast skippers were selected. Fifty breakfast consumers were taken as Control group (n=50) and 100 breakfast skippers were divided into two groups such as Experimental group I (n=50) with no intervention and Experimental group II (n=50) supplemented with 120g breakfast bars daily for the period of 90 days. The impact of supplementation was studied by assessing the initial and final status of nutritional and academic performance of the selected subjects. The collected data were statistically analyzed for results.

RESULTS AND DISCUSSION

Mean acceptability and nutritive value of the developed breakfast bar: The developed breakfast bar was standardized and evaluated for acceptability based on their 1/3rd nutrient requirements of the adolescents. Results of the sensory analysis revealed that the mean overall acceptability score (80.2%) was high 5 and the nutritive value of the bar was calorie 423.1kcal, protein 8.65g, fat 14.14g and carbohydrate is 51.4g, iron 8.7mg, calcium 148.6mg and phosphorus 124.3g. Table 1 gives the nutritive value of the developed breakfast bar.

Demographic Status of the selected subjects: Among the selected subjects 36.4 per cent of boys and 36.6 per cent of the girls belongs to 14 years and about 32.7 percent of boys and 32.3 per cent of the girls belongs to the age group of 15 years. More than 50 percent of selected subject's parents are educated upto higher secondary level.

Table 1. Nutrient composition of developed breakfast bar

Nutrient contents of the bar	Quantity
Energy (k.cal)	423.1
Protein (g)	8.65
Fat(g)	14.14
Carbohydrate (g)	51.4
Iron (mg)	8.7
Calcium (mg)	148.6
Phosphorus (g)	124.3
Vitamin A (mcg)	60
Vitamin C (mg)	1.5
Thiamine (mg)	0.03
Riboflavin (mg)	0.05

Dietary pattern of the selected subjects: Soft drink consumption of the selected subjects revealed that 70 per cent of the subjects regularly having coffee. Regarding consumption of tea 45 per cent of the subjects having it daily, 37 per cent, 10.4 per cent and 7.6 per cent were consuming it alternatively, weekly and occasionally. Results about carbonated drinks consumption revealed that 56 per cent of the subjects consuming coca-cola in alternative days and 47 per cent consuming fanta in alternate days.

Life style pattern of the selected subjects: Regarding the time management in various activities about 40 minutes were spent for their personal routine work, 82 – 95 minutes for reading, 30 minutes for writing home works at home. Exercise pattern of the selected subjects showed that 74.83 per cent and 45.07 per cent know about the exercise. About 61.77 per cent do their exercise in the morning time. Regarding smoking habits of the selected subjects 100 per cent of both boys and girls won't having the habits of smoking, drinking and dieting practices.

Breakfast pattern of the selected subjects: Regarding breakfast consumption of the selected subjects 30% (150 subjects) of the subjects won't having their breakfast regularly for the past one year. The main reason for not having breakfast was lack of time and not liking the food.

Impact of breakfast bar supplementation on Nutritional and Academic performance of the selected subjects

Impact of breakfast bar supplementation on Nutritional status: The mean weight of the control group was $36.42 \pm 1.74\text{Kg}$ and it was increased to $37.62 \pm 1.84\text{Kg}$ at the end of the study with a significant difference at ($p < 0.01$) level. In Experimental group I the initial mean weight was $37.15 \pm 1.82\text{Kg}$ and it has slightly increased to $37.88 \pm 1.83\text{Kg}$ after the study period with a significant difference of ($p < 0.05$) level. In Experimental group II the initial mean weight was $36.27 \pm 1.85\text{Kg}$ and it was increased to $39.54 \pm 1.39\text{Kg}$ with a significant difference at ($p < 0.01$) level. The mean difference between groups showed good increase in Control group and Experimental group II when compared to Experimental group I. The mean BMI of the control group was $19.10 \pm 0.941\text{Kg/m}^2$ and it was increased to $19.72 \pm 0.969\text{Kg/m}^2$ at the end of the study with a significant difference at ($p < 0.01$) level. In Experimental group I the initial mean BMI was

Table 2: Impact of breakfast bar supplementation on Nutritional status

Variables	Groups	Initial mean \pm SD	Final mean \pm SD	Mean difference between initial and final 't' value	Standard error deviation	't' value	Significance
Weight (kg)	Control Group	36.42 \pm 1.74	37.62 \pm 1.84	1.20	0.106	11.3	0.00**
	Experimental Group I	37.15 \pm 1.82	37.88 \pm 1.83	0.72	0.34	2.13	0.03*
	Experimental Group II	36.27 \pm 1.85	39.54 \pm 1.39	3.26	0.24	13.42	0.00**
BMI (kg/m ²)	Control Group	19.10 \pm 0.941	19.72 \pm 0.969	0.61	0.05	10.49	0.00**
	Experimental Group I	19.4 \pm 0.98	19.86 \pm 0.96	0.37	0.17	2.11	0.04*
	Experimental Group II	19.33 \pm 0.161	21.04 \pm 0.99	1.71	0.14	12.11	0.00**
Body fat (%)	Control Group	18.84 \pm 0.69	19.32 \pm 0.103	0.48	0.127	3.78	0.00**
	Experimental Group I	19.04 \pm 0.79	19.19 \pm 0.79	0.15	0.15	0.97	0.33 ^{NS}
	Experimental Group II	18.8 \pm 0.37	20.67 \pm 0.91	1.84	0.38	4.8	0.00**

** - Significant at 1% level; * - Significant at 5% level, NS - Not significant

Table 3: Impact of breakfast bar supplementation on Academic Performance of the selected subjects

Academic Performance scores	Groups	Initial mean \pm SD	Final mean \pm SD	Mean difference between initial and final 't' value	Standard Error Deviation	't' value	Significance
Arithmetic scores	Control Group	6.10 \pm 0.99	7.38 \pm 0.94	1.3	0.16	7.79	0.00**
	Experimental Group I	6.02 \pm 1.05	7.22 \pm 1.10	1.2	0.17	9.63	0.00**
	Experimental Group II	6.10 \pm 1.03	7.80 \pm 0.98	1.7	0.15	10.81	0.00**
Concepts and processes scores	Control Group	6.14 \pm 0.94	7.88 \pm 1.08	1.7	0.15	11.1	0.00**
	Experimental Group I	6.14 \pm 0.96	7.58 \pm 1.01	1.4	0.16	8.75	0.00**
	Experimental Group II	6.20 \pm 1.10	8.28 \pm 1.16	2.08	0.19	10.63	0.00**
Writing scores	Control Group	6.12 \pm 1.04	7.58 \pm 1.08	1.4	0.15	9.45	0.00**
	Experimental Group I	6.16 \pm 1.09	7.46 \pm 1.10	1.3	0.16	9.87	0.00**
	Experimental Group II	6.16 \pm 1.03	8.48 \pm 0.90	2.32	0.17	13.27	0.00**
Reading scores	Control Group	6.02 \pm 0.99	7.68 \pm 1.07	1.6	0.18	9.11	0.00**
	Experimental Group I	6.14 \pm 1.06	7.64 \pm 0.98	1.5	0.157	11.32	0.00**
	Experimental Group II	6.24 \pm 1.06	7.92 \pm 0.98	1.6	0.18	9.13	0.00**

** - Significant at 1% level; * - Significant at 5% level, NS - Not significant

19.4 \pm 0.98 Kg/m² and it has slightly increased to 19.86 \pm 0.96 Kg/m² after the study period with a significant difference of (p<0.05) level. In Experimental group II the initial mean BMI was 19.33 \pm 0.161 Kg/m² and it was increased to 21.04 \pm 0.99 Kg/m² with a significant difference at (p<0.01) level. The mean difference between groups showed good increase in both Control group and Experimental group II when compared to Experimental group I. The mean body fat of the control group was 18.84 \pm 0.69 % and it was increased to 19.32 \pm 0.103 % at the end of the study with a significant difference at (p<0.01) level. In Experimental group I the initial mean body fat was 19.04 \pm 0.79 % and it was very slightly increased to 19.19 \pm 0.79 % after the study period with no significant difference level. In Experimental group II the initial mean body fat was 18.8 \pm 0.37 % and it was increased to 20.67 \pm 0.91 % with a significant difference at (p<0.01) level after supplementation with breakfast bar. The mean difference between groups showed a high increase in both Control group and Experimental group II when compared to Experimental group I.

Impact of breakfast bar supplementation on Academic Performance of the selected subjects

The mean arithmetic scores of the Control group was 6.10 \pm 0.99 and it was increased to 7.38 \pm 0.94 at the end of the study with a significant difference at (p<0.01) level. In Experimental group I the initial mean arithmetic scores was 6.02 \pm 1.05 and it was increased to 7.22 \pm 1.10 after the study period significant difference at (p<0.01) level. In Experimental group II the initial mean score was 6.10 \pm 1.03 and it was increased

to 7.80 \pm 0.98 with a significant difference at (p<0.01) level. Increase in mean difference of arithmetic scores was found to be more in Experimental group II followed by Control group and Experimental group I. The mean Concepts and processes scores of the Control group was 6.14 \pm 0.94 and it was increased to 7.88 \pm 1.08 at the end of the study with a significant difference at (p<0.01) level. In Experimental group I the initial mean Concepts and processes scores was 6.14 \pm 0.96 and it was slightly increased to 7.58 \pm 1.01 after the study period significant difference at (p<0.01) level. In Experimental group II the initial mean score was 6.20 \pm 1.10 and it was increased to 8.28 \pm 1.16 with a significant difference at (p<0.01) level. Increase in mean difference of Concepts and processes scores was found to be more in Experimental group II followed by Control group and Experimental group I.

The mean writing scores of the Control group was 6.12 \pm 1.04 and it was increased to 7.58 \pm 1.08 at the end of the study with a significant difference at (p<0.01) level. In Experimental group I the initial mean writing scores was 6.16 \pm 1.09 and it was slightly increased to 7.46 \pm 1.10 after the study period with significant difference at (p<0.01) level. In Experimental group II the initial mean scores was 6.16 \pm 1.03 and it was increased to 8.48 \pm 0.90 with a significant difference at (p<0.01) level. Increase in mean difference of writing scores was found to be more in Experimental group II followed by Control group and Experimental group I. The mean reading scores of the control group was 6.02 \pm 0.99 and it was increased to 7.68 \pm 1.07 at the end of the study period with a significant difference at (p<0.01) level. In Experimental group I the initial mean reading scores was 6.14 \pm 1.06 and it was

increased to 7.64 ± 0.98 after the study period with significant difference at ($p < 0.01$) level. In Experimental group II the initial mean weight was 6.24 ± 1.06 and it was increased to 7.92 ± 0.98 with a significant difference at ($p < 0.01$) level. Increase in mean difference of reading scores was found to be more in Experimental group I (Wesnes *et al.*,⁷ and Simeon *et al.*,⁸ followed by Control group and Experimental group I.^{7,8} reported that areas of cognitive deficit include problem solving, attention, and memory. Pollitt *et al.*,⁶ showed that children at nutritional risk are likely to have even greater decreases in cognitive functioning following a fast. Berkey⁹ reported that a related factor that general academic performance has also been seen to suffer in breakfast skippers, and children who skip breakfast are less likely to report doing well with schoolwork.

Conclusion

Addition of breakfast bar leads to more beneficial changes in nutritional status and academic performance in 'breakfast skipping' adolescents. Taken together, the above findings suggest that the consumption of regular breakfast has a good impact in improving both nutritional status and academic performance among the adolescents who are the future healthy citizens.

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