



Original/*Pediatría*

Evaluation of the effects of a programme promoting adequate and healthy eating on adolescent health markers: an interventional study

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Abstract

Aim: to evaluate the effects of a protocol promoting adequate and healthy eating on adolescent health parameters.

Methods: this controlled intervention study was conducted for 9 months, with the participation of adolescents enrolled in two schools (intervention/control) located in a poor neighbourhood in the city of Salvador (Bahia), Brazil. For the intervention school, activities promoting adequate and healthy eating were designed based on the *Food Guide for the Brazilian Population (Guia Alimentar para a População Brasileira)*. Students underwent biochemical, sexual maturation and anthropometric tests at baseline and at the end of the 9-month period. In addition, students answered a questionnaire on food consumption, physical activity and sedentary behaviour. Information on the socioeconomic status of their family was also obtained. Generalized Estimating Equation (GEE) analysis was chosen to evaluate the associations of interest.

Results: students under intervention presented decreases of 7.64 mg/dL in mean total cholesterol (TC) ($p = 0.009$) and 7.77 mg/dL in mean *low-density lipoprotein cholesterol* (LDLc) ($p = 0.003$) and increases of 18% in legume consumption (odds ratio [OR] = 1.18; 95% confidence interval [CI] 1.03-1.37) and 17% in vegetable consumption (OR = 1.17; 95% CI 1.01-1.35) compared with students who did not undergo intervention. No differences were observed in the anthropometric parameters analysed.

Conclusion: the results showed a positive effect of activities promoting adequate and healthy eating on reducing TC and LDLc and on increasing the consumption of vegetables and legumes, evidencing that the intervention

EVALUACIÓN DE LOS EFECTOS DE UN PROGRAMA DE PROMOCIÓN DE UNA ALIMENTACIÓN ADECUADA Y SALUDABLE EN LOS MARCADORES DE SALUD PARA ADOLESCENTES: UN ESTUDIO DE INTERVENCIÓN

Resumen

Objetivo: evaluar las repercusiones de un protocolo de promoción de una alimentación adecuada y saludable en los parámetros de salud de adolescentes.

Métodos: se trata de un estudio de intervención, controlado, con una duración de nueve meses, en el cual participaron estudiantes, con una edad entre 10 y 17 años, matriculados en dos escuelas (intervención/control) situadas en un barrio pobre del municipio de Salvador (Bahia), Brasil. Fueron previstas para la escuela bajo intervención acciones de promoción de una alimentación adecuada y saludable, con base en el *Guía Alimentar para a População Brasileira* (Guía Alimentaria para la Población Brasileña). Con el propósito de evaluar el efecto de tales acciones, todos los alumnos fueron sometidos a los exámenes bioquímicos, de maduración y antropométricos al principio y al final de los nueve meses. Además, contestaron a un cuestionario sobre consumo alimentario, actividad física y comportamiento sedentario. También se consiguió información sobre las condiciones socioeconómicas de la familia. La opción fue el análisis de Ecuaciones de Estimaciones Generalizadas (GEE) para evaluar las asociaciones de interés.

Resultados: se verificó que los estudiantes bajo intervención presentaron una disminución de 7,64 mg/dL en la media del colesterol total ($p = 0,009$), de 7,77 mg/dL en la media del LDLc ($p = 0,003$), un incremento del 18% en el consumo de legumbres (OR = 1,18; 95%IC 1,03-1,37) y del 17% en el consumo de verduras (OR = 1,17; 95%IC 1,01-1,35), comparados con aquellos que no fueron sometidos a la intervención. No hubo diferencias en los parámetros antropométricos estudiados.

Conclusión: los resultados apuntaron un efecto positivo de las acciones de promoción de la alimentación adecuada y saludable en la reducción del colesterol total, LDL-c, en el aumento del consumo de vegetales y legumbres, evidenciando una vez más que el modelo de inter-

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Recibido: 24-VI-2015.
Aceptado: 26-VII-2015.

model was able to prevent and/or treat cardiovascular risk factors in adolescents.

(*Nutr Hosp.* 2015;32:1582-1590)

DOI:10.3305/nh.2015.32.4.9512

Key words: *Intervention study. Lipid profile. Anthropometric parameters. Food consumption. Food and nutrition education program.*

Abbreviations

TC: total cholesterol.

LDLc: low-density lipoprotein cholesterol.

CNCDs: chronic non-communicable diseases.

WHO: World Health Organization.

GE: Global Strategy.

MOH: Brazilian Ministry of Health.

PNAN: National Policy for Food and Nutrition.

HDLc: high-density lipoprotein.

TG: triglycerides.

BMI: body mass index.

WC: waist circumference.

H: height.

Introduction

In Brazil, the occurrence of chronic non-communicable diseases (CNCDs) has been increasing in adolescence and is already a major cause of morbidity in this life stage, with high prevalence of overweight/obesity, hypertension, dyslipidemia and diabetes Type 2 observed among adolescents^{1,2}. There is consensus in the Brazilian and international literature that the epidemiological profile of morbidity in this life stage may be affected by several environmental factors associated with lifestyle, including negative changes in food consumption patterns associated with physical inactivity and sedentary behaviour³. These changes may be reflected in an increased consumption of processed foods, eating away from home and the replacement of traditional meals with snacks, which leads to the consumption of high-energy-density foods, such as those high in fat and simple carbohydrates, at the expense of food that serves as fibre sources, such as fruits and vegetables, which contain fewer calories and better quality nutrients⁴.

The concern with the morbidity profile in populations throughout the world led international and Brazilian organisations to strategically include this issue on the health agenda. The World Health Organization (WHO) launched the Global Strategy (GE) on Diet, Physical Activity and Health in 2004³. The general aim of this proposal, also adopted by the Brazilian Ministry of Health, is to promote and protect health by implementing sustainable actions that support healthy lifestyles, relying on the participation of health professionals and pertinent sectors. In 2008, the Brazilian

versión fue capaz de prever y/o tratar factores de riesgo cardiovascular en los adolescentes.

(*Nutr Hosp.* 2015;32:1582-1590)

DOI:10.3305/nh.2015.32.4.9512

Palabras clave: *Estudio de intervención. Perfil lipídico. Parámetros antropométricos. Consumo alimentario. Programa de educación alimentaria y nutricional.*

Ministry of Health (MOH) launched the *Food Guide for the Brazilian Population (Guia Alimentar para a População Brasileira)* as a tool of the National Policy for Food and Nutrition (PNAN)⁵. Considering the importance of the school as a proper forum to aid the formation of healthy eating habits, Inter-Ministerial Decree No.1,010 was published to establish guidelines for the promotion of healthy eating in schools, including strategies to promote adequate and healthy eating in the school environment⁶. Thus, the construction and assessment of intervention models made for schools meet the Brazilian Ministry of Health's expectation and are based on the evidence promulgated by the WHO that positive behavioral changes result in strategies capable of reducing the rates of NCD-related morbidity and mortality³.

A few studies in the Brazilian and international literature reported the effectiveness of educational programmes aimed at promoting adequate and healthy eating habits for reducing/maintaining healthy body weight^{7,8}, positive changes in the eating habits⁹ and lipid profiles⁹ in young people in the school environment. Considering the small number of methodologically well-designed studies in this field and the importance to stop the growing prevalences of NCD in Brazil, the aim of this study was to evaluate the impact of a protocol designed to promote adequate and healthy eating habits, developed based on the *Food Guide for the Brazilian Population*⁵, on the health parameters of adolescents enrolled in public schools.

Methods

Study design, study population and sample collection

This community controlled trial was conducted for 9 months, with the participation of adolescents, of both genders, 10 to 17 years old, enrolled in two schools (intervention/control) located in a poor neighbourhood of the Health District in the Salvador, capital of the Bahia, Brazil. This District is one of the most populous in the city and represents a typical example of the complexity of the social and sanitary problem that characterizes some city areas. This area is mostly occupied by people from low socioeconomic classes who suffer with the lack of appropriate infrastructure and government services. Two schools were selected from

a total of 6 state schools located in this District where the prevalence of overweight was among the highest detected in a previous study performed in this city². The school that underwent intervention and control were randomly selected and all students that accepted were enrolled in the study.

The sample size was calculated as follows: an intervention subject-to-control subject ratio of one¹, a statistical power of 0.80, a 95% Confidence Interval (95%CI), and a mean Total Cholesterol (TC) difference of 0.2 mmol/L¹⁰, which resulted in a sample size of 336 students. An extra 10% was added to account for losses due to student's refusal to participate in the study, relocation to other cities, and transfer to other schools. Therefore, the initial sample should consist of 372 students, 186 from the intervention school and 186 from the control school. The recruitment to the initial study took place between October and November 2013 and the follow-on intervention commenced in December 2013 and ended in August 2014.

Eligibility criteria

All students who met the eligibility criteria, adolescents, of both genders, 10 to 17 years old from secondary schools, and gave informed consent were enrolled. Pregnant adolescents were excluded from study.

Procedures

To evaluate the activities promoting healthy eating on health markers, all students from both schools were subjected to biochemical, sexual maturation and anthropometric tests at baseline and at the end of the 9-month intervention period. In addition, students answered a self-administered questionnaire on food consumption, physical activity and sedentary behaviour. To assess all questionnaires and field work, a pilot study was conducted in three classroom of approximately 10 students each (these students were not included in the study). Anthropometric evaluations consisted of waist circumference, weight and height measures. Moreover, blood was collected to determine the lipid profile (TC, LDLc and high-density lipoprotein [HDLc]), and triglycerides (TG). Another questionnaire was sent to parents and/or guardians to obtain information on the socioeconomic status of the family.

The intervention protocol covered two major axes

1. *The student*: This axis regarded actions to keep students within a healthy weight range. Eight meetings lasting fifty minutes each were provided to promote healthy eating and physical activity over nine-month intervention: The topics covered during each mee-

ting were: 1) Healthy eating; 2) Physical activity and sports; 3) Fats, sugars and salt: effects of a poor diet; 4) Nutritional evaluation: the basics; 5) Use of supplements in physical activity: a critical approach; 6) Food labelling: food and nutritional safety; 7) Role of nutrients in health promotion: functional foods with a focus on fruits, vegetables and legumes; 8) Good food handling practices. To take into account the diversity of age groups, adapted language was required. In addition to this, short videos taken from the internet were shown to the students, to improve knowledge of the topics covered during each class. Most of all students, about 95% participated of all meetings/classes over the period.

Workshops were planned to reinforce knowledge about healthy eating and physical activity. Topics covered in this workshops were: a) food groups, their nutrients, and their respective functions in the body, in addition to their representations in the food pyramid; and b) the ten steps for promoting a healthy diet at school according to Food Guide for the Brazilian Population (Guia Alimentar para a População Brasileira in 2008)⁵.

Moreover, a webpage was created in a social network used by the adolescents, in which videos, trivia and general guidelines on healthy eating were posted. Adolescents were encouraged to participate of the discussion group.

2. *The family*: For parents and/or guardians, didactic-educational materials were sent through adolescents to encourage them to maintain a healthy lifestyle. Material sent was developed by research of this study using *Food Guide for the Brazilian Population* as guidelines⁵.

All activities (lectures and workshops) planned for the intervention protocol were performed by nutritionists.

Data collection

Anthropometric data

Each participant's weight was obtained using a Master[®] portable digital scale, and height was measured using a Leicester Height Measure[®] portable stadiometer (Seca, Hamburg, Germany). The measurements were performed in duplicate using the techniques of Lohman, Roche, and Martorell (1988)¹¹. To assess anthropometric status, tables from the WHO (2007)¹² with percentile values of body mass index [BMI = weight (kg) / height (m²)] according to age and sex were used as reference. We classified the anthropometric state of each adolescent in: underweight (<3rd percentile); normal weight (\geq 3rd percentile and <85th percentile, reference category); overweight (\geq 85th percentile and <97th percentile) and obese (\geq 97th percentile).

Biochemical data

Approximately 5ml of blood was collected from each student after a minimum of 12 h of fasting with no physical activity performed on the previous day. The blood was centrifuged at 3,600 rpm for 10min, stored in dry tubes for biochemical tests, properly stored, and transported to the Central Laboratory where the samples were analysed. Serum levels of TC, HDLc and TG were determined by enzymatic methods and LDLc by the Friedewald formula when TG levels were lower than 400 mg/dL. The following values were considered adequate: TC < 150 mg/dL, LDLc < 100 mg/dL, HDLc \geq 45 mg/dL, and TG < 100 mg/dL¹³.

Consumption frequency

Food consumption was assessed during the seven days preceding the survey using a self-administered questionnaire on the frequency of consumption of foods, food groups, or food preparations: beans; rice; vegetables; legumes; fresh fruits; milk; soft drinks; candies; fast foods and processed meats¹⁴. It is important to highlight that this questionnaire was not validated. However, this instrument was used in National Enquiry on Students' Health, conducted in 2012 by the Ministry of Health, Brazil¹⁴.

In this questionnaire, the first six categories were considered as healthy eating markers and the last four as unhealthy eating markers. This classification was based on nutritional recommendations for the prevention of chronic non-transmissible diseases⁹. Consumption was expressed by an indicator able to reveal the proportion of adolescents consuming each of the selected foods either more frequently (regularly: on at least five out of the seven days preceding the study) or less frequently (between zero and four days out of the seven days preceding the study). This indicator is used in risk factor surveillance systems in other Brazilian states¹⁴.

Potential adjustment variables

Sexual maturation

The evaluation was performed by self-description of breast characteristics, age of menarche and age of pubic hair appearance in girls, and genitals characteristics and age of pubic hair appearance in boys using pictures that represent the different pubertal stages^{15,16}. In girls, the onset of pubescence is classified based on stage II of breast development, and the end (post-pubescence) of the growth spurt is characterised by age of menarche. In boys, the beginning of the growth spurt (pubescence) is indicated by Tanner stage III, and the end of the growth spurt (post-pubescence) by stage IV of genital development^{15,16}. Thus, students were grouped into two categories: pre-pubescent and pubescent.

Level of physical activity and sedentary behavior

To assess the frequency of physical activity, a questionnaire proposed and validated by Florindo et al.¹⁷ was used. This instrument was standardised to yield scores of physical activity in minutes (weekly and yearly). For the present study, the score obtained was dichotomised, using a cut-off of 300 minutes/week of moderate or vigorous physical activity, where those who performed \geq 300 minutes per week were considered active and those with <300 minutes per week were considered insufficiently active¹⁸.

Sociodemographic variables

Data on the educational level of the head of the family and on household consumer goods were obtained. The economic status was defined using the "Brazilian Economic Classification Criteria (Critério de Classificação Econômica Brasil)"¹⁹, which includes the possession of household goods and the educational level of the head of the family, using a scoring scale that classifies individuals into categories A to E, starting with the highest purchasing power. The adolescents were stratified into categories B, C, D and E, being grouped into better economic status (categories B, C and D) and worse economic status (category E).

Other variables were collected during the study: gender and age (by consulting each individual's identification card, birth certificate or school registration record).

Data entry

For processing and building the database, the software EpiInfo version 6.04 (Centers for Disease Control and Prevention in Atlanta, GA, USA) was used.

Statistical analysis

Descriptive analyses were performed to characterise the study population, using frequencies for categorical data and means (standard deviations) for continuous variables. To identify possible differences between the intervention and control group in the baseline, Chi square and student's t-test were used.

To evaluate the effect of the programme promoting adequate and healthy eating on changing lipid, anthropometric and food consumption profiles over the period, the generalized estimating equations (GEE) method, an extension of the quasi-likelihood approach, was used to analyze correlated data²⁰. This technique is appropriate to take into account the correlation of observation within the cluster once participants within the same cluster maybe more similar than those from different clusters²⁰. The GEE method does not explicit-

ly model between-cluster variation; instead it focuses on and estimates its counterpart, the within-cluster similarity of the residuals, and then uses this estimated correlation to re-estimate the regression parameters and to calculate standard errors. Several multivariate regression models were applied for each outcome variable (i.e., weight, BMI, WC, TG, TC, HDLc, LDLc). In addition to these parameters, other outcomes associated with food consumption were specified (beans; rice; vegetables; legumes; fresh fruits; milk; soft drinks; candies; fast food and processed meats). The models were adjusted by age, gender, level of physical activity, economic criteria and BMI (the latter variable was used to adjust models associated with lipid profile measures) at baseline. The confounding variables were explored using the data available in the literature^{21,9}. Two-tailed tests and 5% significance level were used. Data were analysed using Stata statistical package version 9.0 (Stata Corp.,College Station, United States).

Ethical issues

The study protocol was submitted to and approved by the Ethics Committee of the UFBA School of Nutrition (Protocol No. 18/09). The study was undertaken in accordance with the Declaration of Helsinki (World Medical Association, 2008) and the trial was registe-

red et Brazilian Clinical Trials Registry-ReBec (provisory req:3270), <http://www.ensaioclinicos.gov.br>.

Results

Characteristics of the study population (baseline)

Eight hundred thirty-three students (387 intervention, 446 control) were involved in the study (baseline) (Fig. 1). It is important to highlight that the number of students analyzed in this study was higher than sample size previously designed; we decided to keep in our analysis once there was ethical question. Of the students who started the study, 57.6% were female, and most were in pubertal stage (95.4%). In terms of weight, 5.9% of the participants were malnourished, 69.1% had normal weight and 25% were overweight (with 11.6% obesity). The data also showed that 64.6% of students had increased TC, 44.9% increased LDLc, 47.3% reduced HDLc and 17.8% an increased TG. Additional information is shown in Table I. Statistically significant differences were noted for a few of the characteristics of the adolescents from the comparison groups at baseline: [age ($p = 0.002$)], [economic index ($p = 0.003$)] [cholesterol levels ($p < 0.001$)], [LDL levels ($p < 0.001$)], [fruit consumption (0.004)]. For the

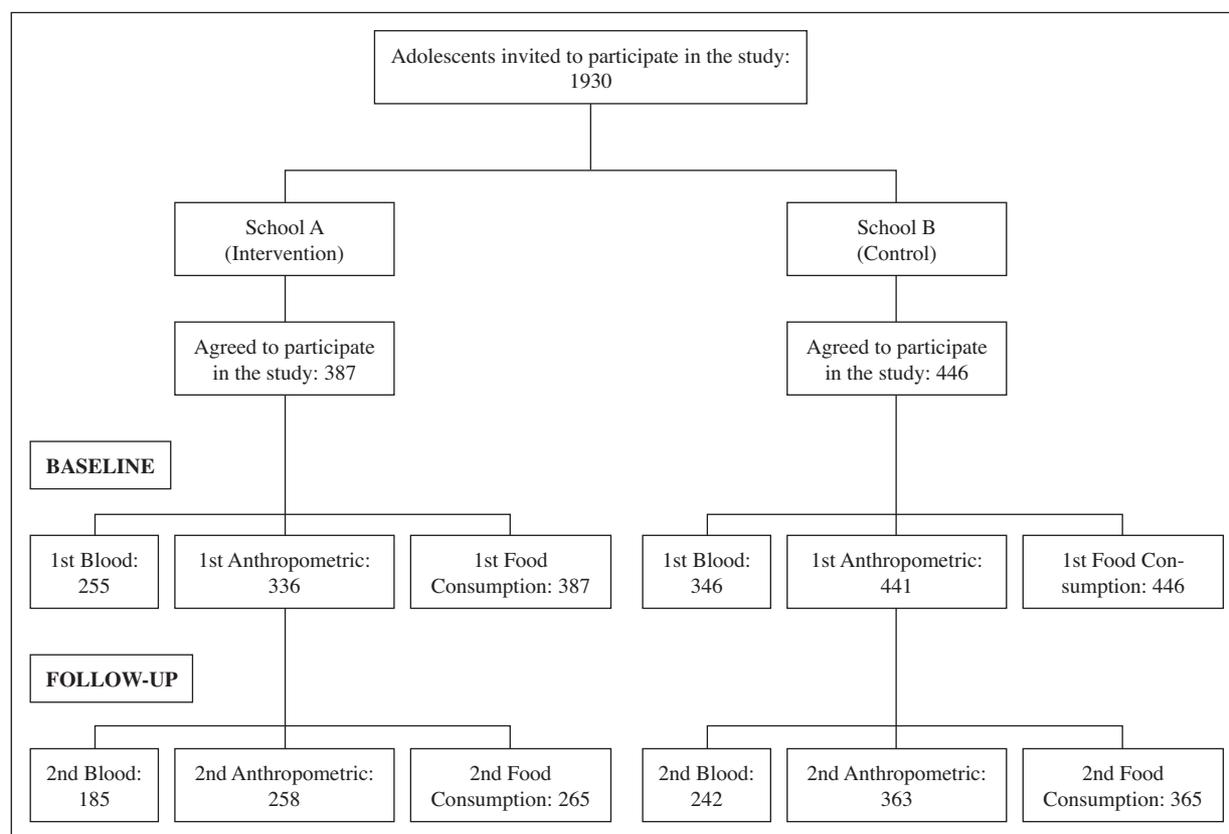


Fig. 1.—Flowchart of adolescent recruitment and participation in the study.

Table I
Characterisation of the study groups at baseline. Salvador -BA, 2014

Variables	Baseline				p
	Intervention n (%)		Control n (%)		
Age (in years) -mean (SD)	387	13.34 (1.46)	446	13.18 (1.32)	0.002
Gender (%)					
Male	169	43.7	182	40.8	0.406
Female	218	56.3	264	59.2	
Pubertal development					
Pre pubescent	18	5.3	18	4.1	
pubescent	318	94.7	428	95.9	0.430
Economic indicator					
Class: E	249	64.3	235	52.7	0.003
Classes: B2+C1+C2+D	138	35.7	211	47.3	
Anthropometric status					
Malnourished	19	5.7	27	6.1	0.724
Normal weight	227	67.6	310	70.3	
Overweight	50	14.9	54	12.2	
Obese	40	11.9	50	11.3	
Lipid profile					
Increased triglycerides	49	19.2	58	16.8	0.437
Increased total cholesterol	189	74.3	198	57.2	<0.001
Increased LDLc	138	54.1	132	38.2	<0.001
Decreased HDLc	124	48.6	160	46.2	0.563
Physical activity					
Physically inactive	261	67.4	296	66.4	0.753
Physically active	126	32.6	150	33.6	

Boldface numbers are statistically significant.

other variables, these differences were not observed (Table I).

To evaluate the effect of activities promoting adequate and healthy eating, the number of adolescents retained in the intervention and control groups were, respectively, 185 (72.5%) and 242 (70.0%) to evaluate the lipid profile; 258 (76.7%) and 363 (82.3%) for the anthropometric parameters; and 265 (68.4%) and 365 (81.8%) to assess food consumption (Fig. 1). The losses occurred mostly due to truancy and refusal to participate in the second stage of the study. There were no significant differences between the adolescents who completed and those who did not complete the second stage of the study (9 months of follow up) in regard to the baseline parameters, indicating the random character of follow-up losses (data not shown).

When considering the longitudinal relationship between the response variables and the corresponding predictor variables, students under intervention exhibited decreases of 7.64 mg/dL (2.94 mg/dL) in mean TC ($p = 0.009$) and 7.77 mg/dL (2.60 mg/dL) in mean LDLc ($p = 0.003$) and increases of 18% in legume consumption (OR = 1.18; 95% CI 1.03-1.37) and 17% in vegetable consumption (OR = 1.17, 95% CI 1.01-1.35) compared with those who did not undergo intervention at the end of the 9-month follow-up. No differences were noted in the anthropometric parameters studied.

In all models, the results were adjusted by age, gender, level of physical activity, economic criteria and BMI (the latter variable was used to adjust models associated with lipid profile measures) at baseline (Table II and III). Models including pubertal stage as a variable indicating "sexual maturation" were tested. However, as there was no change in the regression parameters, the parsimonious model was kept.

Discussion

This study was designed to evaluate the effects of activities promoting adequate and healthy eating on health markers of adolescents enrolled in public schools in the city of Salvador-BA. The study was conducted in an epidemiological scenario characterised by a high prevalence of dyslipidemia (64.6% increased TC, 44.9% increased LDLc, 47.3% of reduced HDLc and 17.8% increased TG). Moreover, a high percentage of overweight was also observed (25% overweight; 11.6% obesity). These data clearly show the urgency for impact interventions aimed at motivating adolescents to adopt recommendations for healthy eating and physical activity practice.

Results of this study corroborate with those indicating that healthy eating habits and/or regular physical activity

have a positive impact on normalising the lipid profiles in adolescents^{22,9}. Undoubtedly, a strong ally for the results obtained here is the biological plausibility of the associations identified. Hypercholesterolemia may result from physical inactivity and inadequate eating habits²³ik. At the end of the 9-month follow-up, students under intervention exhibited increased vegetable and legume consumption compared to those in the control group. There

is a consensus in the literature that the fibre content of food is positively correlated with the consumption of whole grains, fruits and vegetables²³. Among other benefits, fibre reduces appetite, increases satiety, decreases total TC synthesis and decreases the LDLc fraction²⁴. However, baseline differences in TC and LDLc levels between the intervention and control groups should not be over looked; higher values were detected in students selected for intervention. It is known, however, that the degree of the effects of such programmes depends upon the magnitude of the exposure²⁴.

This study also corroborates with those showing no effects of the intervention on anthropometric parameters^{8,25}. The educational activities promoted in the intervention group may not have been convincing enough to affect anthropometric estimates and to increase the differences between the values observed. Additionally, the intervention period may not have been adequate to promote such differences, as it was shorter than the school year. Moreover, the possibility that the control group school developed its own health promotion initiatives, even though it was part of a broader study, may not be ruled out; for ethical reasons, there was no attempt to prevent such a development. The lack of overall intervention effects may also be due to the limited changing potential, as most of the study participants had normal weight at the beginning of the study.

These findings revealed increases of 18% in legume consumption (OR=1.18; 95%CI 1.03-1.37) and 17% in vegetable consumption (OR=1.17; 95% CI 1.01-1.35) in adolescents under intervention compared with those who did not undergo intervention at the end of

Table II

Estimates (β) and standard errors to assess the effects of a programme on food and nutrition education on the lipid profiles of adolescents. Salvador -BA, 2014

Models	Estimate ^{&}	Standard error	p
Triglycerides			
Intercept	57.88	18.19	0.001
Intervention	-4.22	4.36	0.333
TC			
Intercept	175.56	12.58	<0.001
Intervention	-7.64	2.94	0.009
HDLc			
Intercept	41.35	4.1	0.000
Intervention	0.78	0.90	0.383
LDLc			
Intercept	127.72	11.14	0.000
Intervention	-7.77	2.60	0.003

[&]Adjusted by gender, age, economic status, time of physical activity and body mass index at baseline. Boldface numbers are statistically significant.

Table III

Odds ratios (ORs) and corresponding confidence intervals(95% CIs) to assess the effect of a programme on food and nutrition education on food consumption among adolescents. Salvador - BA, 2014

Groups	Foodgroups							
	Model 1 ^{&} Bean		Model 2 ^{&} Rice		Model 3 ^{&} Legumes		Model 4 ^{&} Vegetables	
	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI
Intervention	1.09	0.87-1.36	1.11	0.89-1.39	1.18	1.03-1.37	1.17	1.01-1.35
Control	1	-	1	-	1	-	1	-
	Model 5 ^{&} Fruits		Model 6 ^{&} Milk		Model 7 ^{&} Candies		Model 8 ^{&} Snacks	
	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI
Intervention	1.13	0.93-1.37	1.14	0.91-1.44	1.15	0.92-1.44	0.95	0.73-1.23
Control	1	-	1	-	1	-	1	-
	Model 9 ^{&} Processed meats		Model 10 ^{&} Soft drinks					
	OR	95%CI	OR	95%CI				
Intervention	1.16	0.88-1.52	1.10	0.88-1.37				
Control	1	-	1	-				

[&]models adjusted by gender, age, economic status and time of physical activity.

the 9-month follow-up. However, it is noteworthy that despite the increased consumption of vegetables/legumes observed, no significant reduction in the consumption of typical western-style foods among individuals under intervention was observed, reflecting the overall low appreciation of healthy eating. In fact, these results corroborate with data from several studies indicating that the promotion of healthy eating only may not completely displace the most obesogenic foods²⁵. The difficulties found in promoting behavioural changes directed at discouraging the consumption of unhealthy foods may be attributed to factors such as the strong influence of person food consumption habits. Additionally, data from the 2008-2009 Survey of Family Budgets (Pesquisa de Orçamentos Familiares – POF) in Brazil showed that families with greater access to healthy foods also have greater access to sugar and other unhealthy items in their homes²⁶.

It is important to highlight the adherence of students and educators to the proposed protocol, which focused on food and nutrition education as a strategy to prevent and control contemporary eating problems through a problem-solving active approach and educational resources that favoured dialogue with the student and the school community. It is a consensus in the literature that greater success is obtained when the programme allows interactions among the individual, health and education professionals, and the parents²⁷. Furthermore, when the programme is applied in person, it is adapted to individual and behavioural needs and enables the active participation of the individual in the learning process and the choices made²⁸. According to experts in this field, such an approach is the only way health education can be considered a critical component in the promotion of a healthy lifestyle²⁹ in adolescence and other life stages.

A few points should be considered when interpreting the results of this study. As some of the characteristics were not homogeneous between the groups, this issue was treated statistically through appropriate adjustments in the models studied to minimise the confounding biases, as indicated³⁰. Although follow-up loss occurred – considered high for a 9-month intervention, compared with losses in studies with similar methods³¹ – and may have influenced the decreased power and precision of the study, losses were not unbalanced; thus, they did not introduce changes in the composition of the participating groups (data not shown). The short period of the study is also an important limitation; this period was chosen because of the need to complete all activities within one school year, as student moves and follow-up losses could occur during the vacation period. Sustained long-term programmes are critical to promote changes in eating habits and, consequently, in the frequency of obesity and comorbidities³². Despite the limited time, benefits of the intervention were observed in a few risk markers for CNCs. Moreover, a wide range of programme components was used in this intervention protocol; thus, it is not possible to

distinguish which of these components contributed the most to the beneficial effects observed here. Given that the assessment of changes in food consumption was performed based on self-administered questionnaires in two study time points (pre- and post-intervention) and not through direct observation, it is possible that in the post-intervention period, students may have given more consistent answers based on what they learned during the activities conducted as part of the programme rather than their personal practices. However, the impact caused by the video classes and workshop on the benefits of fruits/vegetables/legumes leads us to assume that there actually was a favourable behavioural change in eating habits. Despite these limitations, the rigour of the analytical techniques adopted aimed at controlling potential confounders is assuring, which reinforces the findings and the body of knowledge on the positive influence of nutritional advice on a few of the health markers studied in adolescents.

The results showed a positive effect of activities promoting healthy eating in reducing TC and LDLc, and in increasing of legume and vegetable consumption, evidencing again that the intervention model based on the *Food Guide for the Brazilian Population*/MOH is able to modify cardiovascular risk factors in adolescents living in deprived areas.

Contributions of authors

Karine Brito Beck da Silva, Rosemeire Leovigildo Fiaccone and Rita de Cássia Ribeiro-Silva participated in the study design, data collection, interpretation of results and writing of the manuscript.

Conflicts of interest

The authors declare no conflicts of interest.

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