Rev Saúde Pública 2013;47(4):1-8

Original Articles

DOI: 10.1590/S0034-8910.2013047002988

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Reducing the use of sugar in public schools: a randomized cluster trial

ABSTRACT

OBJECTIVE: To test the efficacy of nutritional guidelines for school lunch cooks aiming to reduce added sugar in school meals and their own sugar intake.

METHODS: A controlled randomized cluster trial was carried out in twenty public schools in the municipality of Niteroi in Rio de Janeiro, Southeastern Brazil, from March to December 2007. A nutrition educational program was implemented in the schools in question through messages, activities and printed educational materials encouraging reduced levels of added sugar in school meals and in the school lunch cooks' own intake. The reduced availability of added sugar in schools was evaluated using spreadsheets including data on the monthly use of food item supplies. The cooks' individual food intake was evaluated by a Food Frequency Questionnaire. Anthropometric measurements were taken according to standardized techniques and variation in weight was measured throughout the duration of the study.

RESULTS: There was a more marked reduction in the intervention schools compared to the control schools (-6.0 kg *versus* 0.34 kg), but no statistically significant difference (p = 0.21), although the study power was low. Both groups of school lunch cooks showed a reduction in the consumption of sweets and sweetened beverages, but the difference in sugar intake was not statistically significant. Weight loss and a reduction in total energy consumption occurred in both groups, but the difference between them was not statistically significant, and there was no alteration in the percentages of adequacy of macronutrients in relation to energy consumption.

CONCLUSIONS: The strategy of reducing the use and consumption of sugar by school lunch cooks from public schools could not be proved to be effective.

DESCRIPTORS: School Feeding. Dietary Sucrose. Intervention Studies. Food and Nutrition Education.

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Received: 1/11/2011
Approved: 10/7/2012

Article available from: www.scielo.br/rsp

INTRODUCTION

Obesity is viewed as a global epidemic. It reflects the complex interaction of genetic, metabolic, cultural, environmental, socio-economic and behavioral factors, although it's most basic explanation lies in energy intake.[19] Consumption of carbohydrates, principally in the form of simple sugars, has increased over the last 20 years, as have rates of obesity and being overweight.[9]

The share of energy coming from consuming sugar increased from 13.1% to 16.0% between 1977 and 1996, and, between 1994 and 1996 in the United States,[10] over 30% of carbohydrates consumed came from sugar. In Brazil, the world's largest producer of sugar, its relative share of total energy, as determined in the *Pesquisas de Orçamento Familiar* (POF – Household Budget Surveys), was around 13%. However, the main sources of sugar have changed: soft drinks, which represented 0.8% of sugar intake in 1988, increased to 1.3% in 1996, 1.5% in 2003[5] and 1.8% in 2008.[a]

Although there is no consensus on the impact of sugar intake in isolation on obesity and other health conditions,[13] its increase has meant that, in Brazil and the United States,[b] the public are advised to choose food and drink which will decrease their added sugar intake. In 2003, the World Health Organization (WHO), suggested that added sugars should provide no more than 10% of energy intake in the diet.[22] This recommendation appears in the Brazilian food guide developed and distributed by the Ministry of Health.[c]

Although there are no known effective strategies to prevent or treat excessive weight gain,[7] a strategy to prevent this would be more viable than the entire population losing weight. Small, cumulative changes in diet and physical activity may have greater impact if developed with children who are not at risk of being overweight.[12]

Children and adolescents are the focus of efforts to prevent obesity,[1] thus schools are the ideal situation in which to set up interventions. They provide the opportunity for continued, intense contact with children throughout their formative years and have infrastructure, offering the greatest potential to positively influence infant-juvenile health.[21]

In Niterói, RJ, Southeastern Brazil, intervention studies with schoolchildren aiming at reducing consumption of soft drinks showed that a small decrease in their consumption was replaced by the consumption of juices with high levels of added sugar[16] and that the school lunch cooks participated very little in reducing added sugar.

This study aimed to analyze the effectiveness of nutritional education activities with school lunch cooks in reducing added sugar in school lunches and in their own consumption.

METHODS

A controlled randomized cluster trial carried out in 20 municipal schools in the municipality of Niterói between March and December 2007. The 36 municipal schools were distributed among five areas; 20 were selected from three areas (one, two and five) which had similar demographic and socio-economic characteristics.

One of the three areas was randomly selected to receive intervention (seven schools) and another to be the control (seven schools), aiming thus to reduce contamination between the groups. Of the seven schools in the third area, three were randomly allocated to the intervention group and three to the control group (one school was undergoing building work). This area was the most distant from the center of Niterói and had a lower population density, meaning the schools were not close together and there was less chance of contamination.

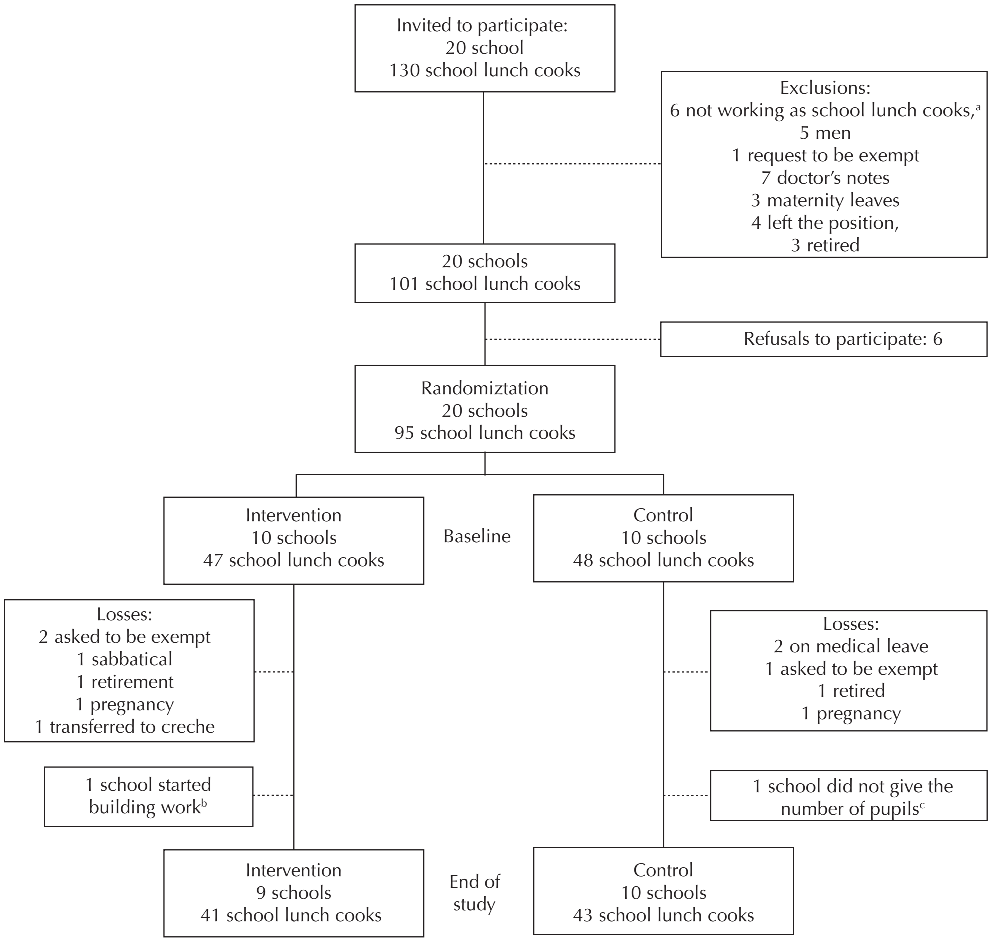
Five male workers were excluded and those considered eligible to take part were non-pregnant females working as school lunch cooks in participating schools, regardless of shift. Six (6.3%) refused to participate in the study; the intervention groups was made up of 47 individuals and the control group of 48 (Figure).

Data on consumption for children in public schools in Niterói (34.5 g; standard deviation (SD): 26.0 g) from a 2005 cross-sectional study[16] was used in order to estimate the necessary sample size for evaluating changes in the intake and availability of sugar. There would be 36 individuals needed in each group for a 10% decrease in intake (3.4 g), supposing 80% of power and a 0.05 level of significance. A suitable sample would be made up of 80 school lunch cooks, taking into consideration that the schools were randomly selected and the participation rate was 80%[14] (Figure).

A Nutritional Education Program was established in the intervention schools for a period of seven months in the 2007 academic year, using messages and activities which encouraged reducing the sugar added to school meals and in the cooks' own intake.

The school lunch cooks taking part in the intervention took part in five activities. The first two included

[a] Instituto Brasileiro de Geografia e Estatística. Pesquisa de orçamentos familiares 2008-2009: avaliação nutricional da disponibilidade domiciliar de alimentos no Brasil. Rio de Janeiro; 2010.
[b] United States Department of Agriculture, Center for Nutrition Policy and Promotion. Report of the Dietary Guidelines Advisory Committee on the Dietary Guidelines for Americans. Washington (DC); 2010.
[c] Ministério da Saúde. Secretaria de Atenção à Saúde. Coordenação Geral da Política de Alimentação e Nutrição. Guia Alimentar para a População Brasileira – Promovendo a alimentação saudável. Brasília (DF); 2006.



[a] School lunch cooks who, for health reasons, have other positions in the school.
[b] It was not possible to evaluate the food items stored, but the school lunch cooks in this school continued to participate in the study.
[c] It was not possible to calculate the food items stored *per capita*, but the school lunch cooks in this school continued to participate in the study.

Figure. Schematic representation of selection and monitoring of participants in the research, Niterói, RJ, Southeastern Brazil, 2007.

two sections on sugar intake (approaching topics such as obesity and sugar intake and foods which are sources of sugars in Brazil, dietary recommendations and encouragement to reduce sugar in food). The third activity was to substitute sugar in coffee with powdered milk. To accomplish this, a tin of powdered milk was provided to encourage this substitution and an information card promoting this change was placed where the coffee was made. The fourth activity included a section on food labelling; the fifth was a competition involving reduced sugar recipes. The activities took place monthly in the school and lasted around 20 minutes. Three research assistants were trained to carry out these activities.

Participants received educational material encouraging them to reduce sugar and products branded with the project logo such as mugs, bags and magnets. The schools were provided with banners and fridge magnets.

Demographic and socio-economic data, and information about health, physical activity and sugar intake for both groups were collected through interviews and the beginning of the academic year.

The school lunch cooks in the control group and the intervention group took part in three discussion segments on encouraging healthy eating, promoted by the municipal Education Department, in one of the participant schools, at the beginning of the academic year. These meetings aimed to enable the team and the participant to get to know each other.

The assessment of the availability of sugar and foods which are sources of sugar (donuts, milky coffee, banana cereal, chocolate cereal, chocolate milk, lacteal flour powdered drink mix, cake mix) in schools took place fortnightly. In this study, there was a baseline assessment (mean of two fortnights in March) and another carried out at the end of the study (mean of two fortnights in September). Spreadsheets containing data on the availability of the items were used. At these times, the number of pupils receiving school meals and the number of days on which they were served were recorded. The *per capita* availability of sugar, in grams, in the schools, was obtained by dividing the availability of sugar, in grams, by the mean monthly number of days on which school meals were served and by the number of pupils in the school.

The school lunch cooks' individual intake was assessed using a Food Frequency Questionnaire (FFQ).[15] The questionnaire included an item on adding refined table sugar to coffee, sugar and other foods. The items considered to be sweets were: ice-cream, candies, chocolate, chocolate milk, milk pudding and cookies. Sugary drinks were: soft drinks, juice and mate tea. Responses to frequency of consumption included eight options: three or more times/day, 2-3 times/day, once/day, 5-6 times/week, 2-4 times/week, 1 once/week, 1-3/month and never/almost never, which were transformed into daily frequency. Once/day, e.g, corresponded to 0.14 (1/7). The food items in question had three response options for the portion, with the exception of milk pudding, which had two response options. The FFQ was applied at the baseline and at the end of the study.

Weight was measured at the baseline, in the fifth month and at the end of the study, using light clothing and the same digital scale (Tanita, model BC 533 Inner Scan), calibrated to 0.1 kg and with a maximum capacity of 150 kg. The individuals had to stand straight, arms beside the body, looking straight ahead, according to the technique recommended in the equipment manual and utilized by Lohman et al[6] (1988). Height was measured at the baseline (mean of two measurements) in the position described above, although with feet together and with claves, shoulders and buttocks touching the wall. A portable stadiometer (Seca, model Body Metter 208) was used. Height and weight were used to calculate body mass index (BMI = weight (kg)/ height (meters)^2) and nutritional state was classified,

Table 1. Characteristics of the school lunch cooks at the baseline. Niterói, RJ, Southeastern Brazil, 2007.

Variable	Intervention (n = 47)		Control (n = 48)		p[a]
	Mean	SD	Mean	SD	
Age (years)	45.8	8.9	45.8	10.1	0,98
Per capita income (reais)	621.7	426.1	569.0	343.7	0,51
Nutritional state (%)					0,59
Normal weight (BMI 18.5-24.9 kg/m^2)	29.8		37.5		
Overweight (BMI 25.0-29.9 kg/m^2)	42.5		31.2		
Obese (BMI ≥ 30.0 kg/m^2)	23.4		29.2		
Skin color (%)					0.60
White	55.3		56.2		
Mixed	34.0		27.1		
Black	10.7		16.7		
Marital status (%)					0.25
Live with partner	57.4		68.8		
Not living with partner	42.6		31.2		
Number of children (%)					0.62
None	17.0		14.6		
Up to two	59.6		68.7		
Three or more	23.4		16.7		
Schooling (%)					0.98
Primary	27.6		29.1		
Secondary	68.1		66.7		
Further education	4.3		4.2		
Smoker (%)					0.37
Yes	19.1		12.5		
No	80.9		87.5		

SD: standard deviation; BMI: Body Mass Index
[a] Student t-test or Chi-squared test

Table 2. Mean and standard deviation (SD) for availability of sugar and foods which are sources of sugar, in school in both groups at the baseline and at the end of the study. Niterói, RJ, Southeastern Brazil, 2007.

Food	Baseline (*per capita* in grams)				Changes in the baseline (kg)				p[a]
	Intervention (n = 10)		Control (n = 10)		Intervention (n = 9)		Control (n = 10)		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Sugar	5.0	2.4	4.6	2.3	-6.0	15.7	3.4	15.6	0.21
Donuts	1.0	0.3	1.5	1.0	3.7	7.5	11.6	14.6	0.15
Milky coffee	2.2	1.8	3.6	2.6	-4.2	11.8	-7.9	14.3	0.55
Banana cereal	1.7	1.3	2.6	2.3	-1.8	8.0	-9.7	12.3	0.11
Chocolate cereal	1.5	1.2	1.4	1.3	-0.8	5.2	-1.8	9.2	0.77
Chocolate milk	0.6	0.6	1.0	0.9	0.2	3.4	-1.1	3.8	0.43
Farinha láctea	0.9	0.7	0.8	0.8	-3.1	6.4	-2.1	4.4	0.69
Cake mix	0.3	0.4	0.5	0.6	-0.03	2.9	-1.6	3.0	0.28

[a] Paired t-test

according to the WHO[23] into normal weight (BMI: 18.5 to 24.9 kg/m^2), overweight (BMI: 25.0 to 29.9 kg/m^2) and obese (BMI $\geq$ 30.0 kg/m^2).

The characteristics of the two groups were compared at the baseline using the Student's t-test for continuous variables and the chi-squared test for categorical variables, and were similar for both groups (Table 1). Mean age was approximately 46 years old, and income *per capita* around 600 reais. The majority of the women were overweight (BMI $\geq$ 25.0 kg/m^2), white and lived with a partner, had up to two children, had finished high school and were non-smokers.

Changes in the availability of sugar in the schools and in individual consumption were assessed using the paired t-test. Fluctuations in weight were evaluated using regression analysis of mixed effects for repeated measures, equivalent to intention-to-treat analysis and take into consideration the conglomerate effect. Weight underwent a logarithmic transformation as it did not have normal distribution. The analyses were carried out using Statistical Analyses System software, version 9.1. (SAS Institute Inc., Cary, NC, USA). The level of significance adopted was 5%.

This study was carried out following the standards required by the Helsinki Declaration and was approved by the Research Ethics Committee of the Institute of Social Medicine, *Universidade do Estado do Rio de Janeiro* (Process No. 26/2006, approved 12/14/2006). The aims of the study and the confidentiality of its results were explained to the participants. All participants read and signed a consent form.

RESULTS

In the intervention group, there was a loss of 12.8% during the study, and of 10.4% in the control group (Figure), none of which were related to the intervention. The follow up time was practically identical for both groups (8.8 months for the intervention group and 8.9 months for the control group). One school in the intervention group started building work in the middle of the study and it was therefore impossible to evaluate the food items stored. One school in the control group did not provide the number of pupils and it was therefore impossible to assess the *per capita* availability of sugar and foods which are sources of sugar, although the school lunch cooks continued to participate in

Table 3. Mean and standard deviation (SD) of the daily portions[a] of sugar, sweets and drinks at the baseline and at the end of the study between the groups. Niterói, RJ, Southeastern Brazil, 2007.

Food or food group	Intervention				Control				Change in the baseline				p[e]
	Baseline (n = 45)		End of study (n = 40)		Baseline (n = 43)		End of study (n = 39)		Intervention (n = 40)		Control (n = 39)		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Sugar[b]	1.7	1.9	2.0	1.8	1.8	2.0	1.5	1.7	0.3	1.7	-0.4	2.3	0.10
Sweets[c]	1.4	1.7	0.8	0.8	1.1	1.3	0.9	1.1	-0.6	1.5	-0.2	1.2	0.18
Sugary drinks[d]	2.3	2.1	1.9	2.7	3.0	3.6	1.4	1.3	-0.5	2.3	-1.8	3.6	0.07

[a] Daily portion = daily frequency x number of portions
[b] Added sugar
[c] Ice-cream, candies, chocolate, chocolate milk, milk pudding, cookies
[d] Soft drinks, mate tea, juice
[e] Paired t-test

Table 4. Mean and standard deviation (SD) for energy intake, mean percentage share of macronutrients[a] and energy from added sugar, from sweets and from sugary drinks between the groups at the baseline and at the end of the study and changes in weight throughout the study. Niterói, RJ, Southeastern Brazil, 2007.

Variable	Baseline					End of study				Changes at the baseline				
	Intervention (n = 45)		Control (n = 43)		p	Intervention (n = 40)		Control (n = 39)		Intervention		Control		p^b
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Energy (kcal)	3,791	2,385	3,888	2,390	0.85	2,839	1,904	2,906	2,064	-1,056	2,475	-1,149	2,737	0.88
Carbohydrate (%)	60.6	5.2	59.5	9.8	0.50	59.4	5.8	58.1	6.3	-1.1	6.9	-1.6	10.7	0.81
Protein (%)	12.2	2.5	12.4	2.8	0.67	13.0	2.5	13.1	2.8	0.9	2.9	0.8	3.5	0.90
Lipid (%)	27.2	3.7	28.1	7.5	0.49	27.5	4.3	28.8	4.5	0.2	5.1	0.8	8.0	0.70
Energy from added sugar (%)	2.1	2.4	2.9	4.9	0.34	3.7	3.7	4.0	5.0	1.6	3.7	1.1	5.2	0.62
Energy from sweets (%)	2.6	3.5	2.5	2.8	0.87	2.1	2.3	2.9	3.1	-0.28	3.7	0.28	2.8	0.46
Energy from sugary drinks (%)	4.2	3.4	5.8	7.0	0.19	4.0	4.5	4.1	3.5	-0.25	4.6	-2.1	7.0	0.18
Total energy for the items in question (%)	8.9	6.8	11.2	9.4	0.20	9.8	8.3	11.0	8.7	1.11	8.0	-0.65	9.0	0.36

Weight (kg)

	Baseline	5^{th} month	End of study	p^c
Intervention	68.7	68.7	67.3	0.74
Control	69.1	68.5	68.9	

[a] Mean percentage share in relation to energy intake
[b] Paired t-test
[c] Regression analysis of mixed effects for repeated measures

the study. Six women, (two in the intervention group and four in the control group) who had daily energy intakes of above ten thousand calories, and one in the control group who did not complete the FFQ were not included in analyses related to food intake.

The *per capital* available sugar was higher at the baseline, and there was a reduction in availability in the intervention group, compared with the control group, by the end of the study (-6.4 kg *versus* 3.4 kg). The items analyzed showed a reduction in the availability in both groups at the end of the study, with the exception of donuts in both groups, and chocolate milk in the intervention group. However, the differences were not statistically significant (Table 2).

Consumption of sweets and sugary drinks underwent a reduction in both groups. Sugar intake increased in the intervention group and fell in the control group, although the differences were not statistically significant (Table 3).

Although there was a significant decline in total energy intake (on average, 1,100 calories), there was no change in the percentage share of macronutrients in relation to energy intake, nor was there a significant change only in items in the intervention. Sugary drinks were those which made the highest contribution to the total percentage of energy. The school lunch cooks in the intervention group managed to maintain weight loss until the end of the study, although the difference was not statistically significant ($p = 0.74$); 15 school lunch cooks (15.8%) (nine in the intervention group and six in the control group) lost at least 5% of their initial weight (Table 4).

DISCUSSION

The strategy of small changes in behavior to negatively offset the energy balance has been proposed as a way to reduce the obesity epidemic,[4] although there is no consensus on this.[18] The data of this study suggest it is possible to reduce the availability of sugar and foods which are sources of sugar in schools. Although there was no reduction in the intake of sugar, sweets and sugary drinks in the intervention group compared with the control group, there was a reduction in the total calorie intake of the two groups and there was weight loss, although neither of these reductions were statistically significant.

A recent systematic review[13] concluded that sugar intake is not related to adverse health effects, such as obesity and metabolic syndrome, and some authors believe that sugar intake has no direct causal link to obesity. In spite of this, sugar contributes to high caloric density of the diet,[2,11] which can lead to weigh gain.[8] A meta-analysis, including the financing of the project as a variable, showed that studies financed by the food industry are those which show preferably negative results.[20] Moreover, it is believed that a high sugar diet may also contain lower levels of micronutrients (dilution effect)[3] and may be nutritionally deficient.[13]

There was no decrease in the school lunch cooks' carbohydrate intake, an aim of the study, nor was there a decrease in protein or lipid intake. Studies show that the adoption of multiple dietary strategies, aiming to improve dietary quality, may be more effective than focusing on one single strategy.[1,17] Reducing added sugar and solid fats is encouraged as they account for 355 of calories in the North American diet.

Measures regarding the production of foods with high sugar content may be more satisfactory than focusing on the consumer. Our focus on the school lunch cooks was justified by their importance in the schools' health eating process. The difficulty in making them reduce their sugar intake may indicate difficulties in implementing these changes in school meals due to the school lunch cooks themselves. However, it is possible, as shown in this study, to reduce sugar content based on policies which combine reducing availability and nutrition education activities.

The power of the study was compromised as the municipal Department of Education had taken measures to develop healthy eating strategies, leading to reductions in the availability of sugar in schools, in the same year in which the study was carried out. This explains the figures found, which were lower than those used in calculating the sample size.

The focus on sugar intake and availability based on one single message was not completely satisfactory regarding reduced intake by the school lunch cooks in both groups. Reduced availability of sugar should include reduced availability of foods in school meals which are sources of sugar.

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The authors declare that there are no conflicts of interest.