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Dietary intake and meal frequency of Brazilian girls attending a school-based randomized controlled trial

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Abstract

Purpose – This paper aims to evaluate the effects of a school-based obesity prevention program targeting Brazilian adolescent girls on dietary intake and meal frequency.

Design/methodology/approach – It was a six-month school-based group randomized controlled trial with female adolescents. The intervention was based on the Social Cognitive Theory and focused on ten nutrition and physical activity key messages. Diet intake was measured using a validated food frequency questionnaire, and the food items were aggregate into the eight food groups of the Brazilian Food Guide Pyramid. The meals frequency assessed were breakfast, lunch, dinner and snack-in-between-meals, the frequency ranged from never to everyday. Linear mixed models were used to examine the dietary effects and chi-squared test to identify proportional differences among groups in meal frequency. All analyses followed intention-to-treat principles and alpha levels of $p \leq 0.05$ were set.

Findings – After six months from baseline, changes in the fruits (mean [SE] 12.48 kcal [7.86], $p = 0.005$), vegetables (8.80 kcal [7.11], $p = 0.006$) and sugar (−55.98 kcal [50.70], $p = 0.036$) groups were demonstrated. Proportional difference was shown for snack-in-between-meals ($p = 0.001$), and the frequency most cited was for "five to six days" per week.

Originality/value – The "Healthy Habits, Healthy Girls-Brazil" showed promise in the adolescents' dietary intake and could be used as framework for future interventions. Also, the methods used for dietary intake can be enhanced and implemented for future studies.

Keywords Adolescents, Diet, Obesity prevention, Meals, Randomized controlled trials

Paper type Research paper

Introduction

The promotion of healthy eating is important to prevent unhealthy weight gain and other diet-related diseases (WHO, 2012). Also, there is a high likelihood of the dietary habits to be developed during childhood and adolescence and consolidated in adulthood (Spengler *et al.*, 2014; Shi *et al.*, 2014; Hoare *et al.*, 2014). Therefore, changing the youth dietary behaviors is important for obesity and other non-communicable diseases (Zurriaga *et al.*, 2011; Leme *et al.*, 2011; Moreno, 2013). International evidence shows that children and adolescents generally do not meet the dietary guidelines recommendations, with a reduction in the intake of fruits and vegetables, milk and dairy products and whole grains and an increase in food items rich in saturated fat and sugar (Hoare *et al.*, 2014; Guenther *et al.*, 2014).

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A population-based crosssectional study with data used from a subsample (n = 1.661) of the food intake module of the 2008 Health Survey in the city of São Paulo, Brazil, (ISA-Capital 2008) aimed to analyze the adherence of the Brazilian population's diet to the Food Guide. It was demonstrated that intake of fruits and natural juices was below the recommendation in 98 per cent of the population, whereas the recommended intake level of vegetables was not reached in 90 per cent of the population. Also, intake of oils and fats (66 per cent) and sugar and sweets (93 per cent) above the recommendation was observed (Verly Junior *et al.*, 2013). Moreover, data from a school-based representative study with adolescents demonstrated that among the healthy diet markers, regular intake of beans (69.9 per cent) and milk (51.5 per cent) exhibited the highest proportions, whereas regular intake of cooked vegetables the lowest one (13.5 per cent). Among the unhealthy diet markers, regular intake of sweets (41.3 per cent), soft drinks (33.3 per cent) and sweet biscuits (32.5 per cent) were most prominent. A higher proportion of girls than boys reported regular intake for baked snacks (14.97 vs 10.93 per cent), fried salty snacks (17.34 vs 14.17 per cent), processed meat (15.51 vs 13.72 per cent), sweet biscuits (35.04 vs 28.72 per cent) and sweets (48.14 vs 33.79 per cent). The only exception was for soft drinks (32.89 vs 33.59 per cent). Also, adolescents from the southeast regions reported the intake of more unhealthy diet markers (Azeredo *et al.*, 2014). In this sense, sex appears to be an additional risk factor, as the proportion of unhealthy diet among Brazilian adolescent girls is higher than among males. Consequently, female youth living in the southeast region can be considered a particularly vulnerable group for having an unhealthy diet intake.

Schools have been identified as a critical institutional settings for obesity prevention, as they establish a safe and supportive environment with policies and practices that support healthy behaviors, providing opportunities for students to learn about and practice healthy eating (CDC, 2011). Outside of the home, school-based settings are the only institutions that have a continuous and intensive connection with children and adolescents during the first two decades of life and are a socialization agent that can favorably influence the health of children (Robinson *et al.*, 2014). Although school-based obesity prevention programs with Brazilian adolescents are limited (Guerra *et al.*, 2014), methodologically rigorous trials have demonstrated that these interventions can improve diet in youth (Collins *et al.*, 2014; Neumark-Sztainer *et al.*, 2010; Smith *et al.*, 2014b; Singh *et al.*, 2009). Therefore, the aim of this study was to evaluate the effects of a school-based obesity prevention program targeting Brazilian adolescent girls on dietary intake and meal frequency.

Methods

The "Healthy Habits, Healthy Girls – Brazil (H3G – Brazil)" obesity prevention intervention was evaluated using a randomized controlled trial. The trial was registered in the ClinicalTrials.gov (NCT02228447) and reported according to the CONSORT checklist (Moher *et al.*, 2010).

Study design and participants

The study design, protocol and baseline results are reported in detail elsewhere (Leme and Philippi, 2015). In summary, it was a six-month school-based group randomized controlled trial named "Healthy Habits, Healthy Girls – Brazil (H3G – -Brazil)". The intervention included ten technical governmental high schools located in low-income

communities in São Paulo, Brazil. The study participants were adolescent girls attending first and second grades. Data were collected at baseline and post-intervention (i.e. immediately after the intervention) (Figure 1). Ethics approval for the study was obtained from the School of Public Health, University of São Paulo, Brazil. School principals and parents/caregivers provided written informed consent and the girls the assent form.

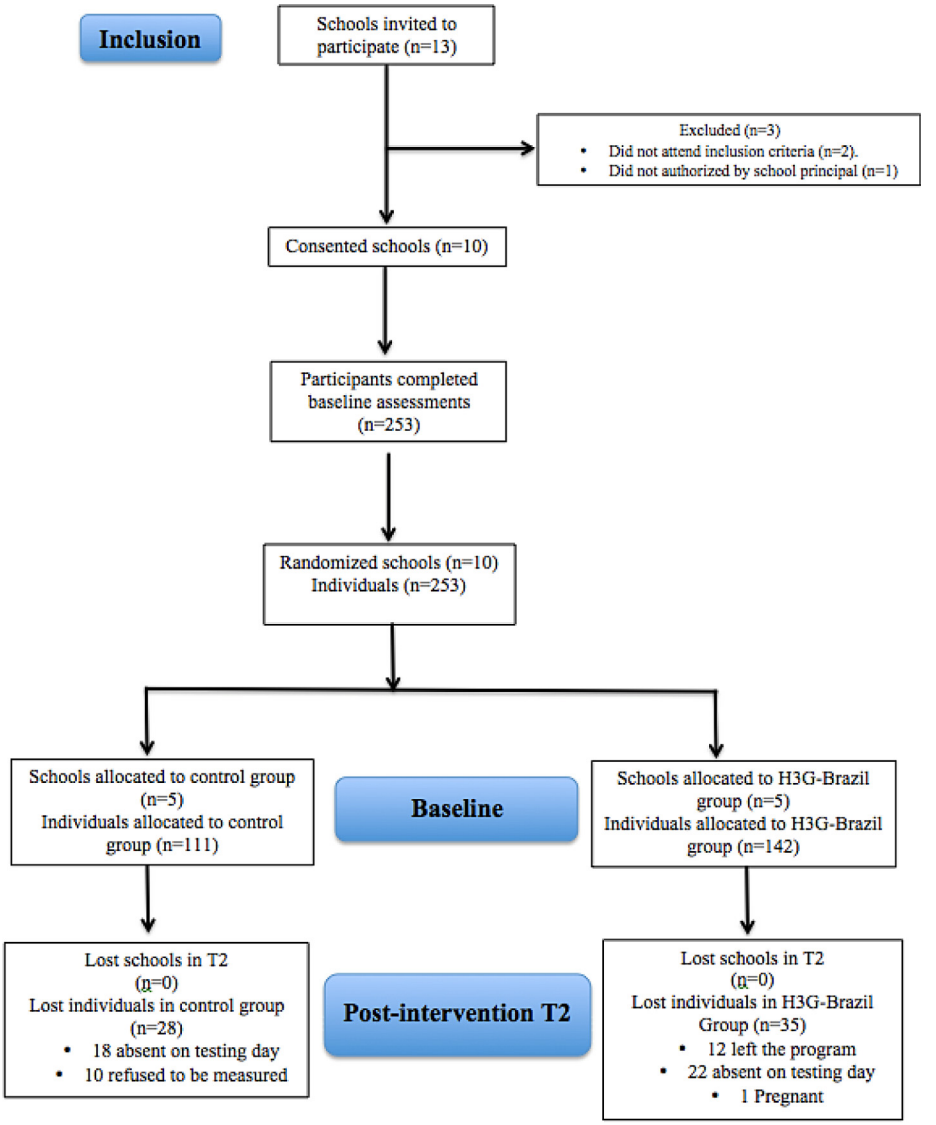

Figure 1.
Flowchart of the adolescent girls attending the study, São Paulo, 2015

Notes: Participant's retention and dropout rates and reasons for leaving the study

The sample size was calculated to determine the necessary detectable post-intervention changes in the primary outcome (Body Mass Index (BMI)) (Smith *et al.*, 2014a; Lubans *et al.*, 2010). The power calculation was based on power of 80 per cent, significance level of 5 per cent ($p \leq 0.05$) and proportion of non-exposed and exposed to the outcome. Considering potential dropout of 20 per cent after six-month of intervention, 266 participants were necessary to detect a between-group difference in BMI of 0.4 kg/m^2.

Intervention

The intervention was adapted from the Nutrition and Enjoyable Activity for Teen (NEAT) girls study (Lubans *et al.*, 2010; Dewar *et al.*, 2013; Lubans *et al.*, 2012). "Healthy Habits, Healthy Girls – Brazil (H3G-Brazil)" was based on the Social Cognitive Theory (Bandura, 1986) and focused the following mediators of nutrition and physical activity (PA) behavior change: self-efficacy, intentions, social support (family and friends), behavioral strategies, situations, outcome expectations and expectancies. The intervention included multiple components: Physical Education classes, PA sessions during school-break, nutrition workshops, interactive seminars, handbooks, PA and food diaries, parents' newsletters and WhatsApp® group text messages. H3G – Brazil aimed to promote PA and healthy eating and decrease time spent on the screens focusing on lifetime, lifestyle and low-cost activities and healthy eating. The intervention was delivery at no financial cost to the students or school. The school-based program was based on ten Nutrition and Physical Activity key messages (Leme and Philippi, 2015), reinforced by the intervention components.

Each girl received a handbook that presented the ten-week nutrition and PA information and home challenges to be conducted on their own and with their parents/caregivers to promote healthy behaviors and social support. The ten key messages are in line with the Brazilian Food Guide Pyramid and smart food choices concept (Philippi, 2014) and with the recommendations of the World Health Organization for PA (WHO, 2010). Moreover, food and PA diaries were presented at back of the handbook to provide daily self-monitoring on their behaviors (e.g. increase consumption of fruits and vegetables according to recommendations of the adolescents' food pyramid (Philippi *et al.*, 2009). In regard to the nutrition messages, it targeted: fruit and vegetable intake, daily breakfast, control the portion size, eat meals at tables, junk foods during meals and snacks, munch less, drink water, reduce sugar sweetened beverages and make family meals.

Each school have a coordinator teacher who organized and developed the intervention at the school. As the schools have Nutrition and Dietetic technical courses, the coordinators were teachers from those courses to facilitate the development of the intervention. However, the participants were not enrolled in this course and on other courses related to food/health sciences. Thus, these teachers were trained to deliver a ten-week mini-classes to reinforce the concepts provided in the student handbook. Also, they were trained along with a Physical Education teacher to deliver the PA sessions during school-break to motivate the students for practicing PA.

Three nutrition workshops were delivered in the school food labs by two accredited dietitians and were assisted by the nutrition teachers. The workshops reinforced the nutrition messages of the student handbook, providing dietary information and

strategies designed to develop lifetime nutrition skills to maintain a healthy weight. The topics targeted were:

- reading and comprehension of food label;
- energy balance and kilocalories;
- diet and light concept;
- sugar and fat in food;
- adequacy and distortion of portion size; and
- preparation of inexpensive healthy snacks and meals (e.g. fruit *smoothies*, sandwiches, pasta and salads).

Parents' newsletters and Whatsapp® text messages were other components used. Four newsletters were sent to parents describing the program content, information and strategies for healthy eating and PA in the family environment. The range of topics covered in the newsletters aimed to promote parents to increase their knowledge and encourages support their children's healthy eating and PA. For example: suggestions to increase the fruits and vegetables intake and tips to encourage family food pattern. WhatsApp® text message encouraged participants to implement targeted healthy eating and PA (e.g. Are you still drinking a lot of sugar sweet beverages? The Coca-Cola® has a lot of sugar and empty calories, without important nutrients for our body. Coconut water has important vitamins and minerals for adequate body functions. (Also have fewer calories and sugar.) At the end of the intervention, girls were provided with a cooking book with all the recipes delivered during the workshops, WhatsApp® messages and parents' newsletters. The aim of this strategy was to encourage and support long-term healthy eating behaviors.

To prevent resentful demoralization or compensatory rivalry (Murray, 1998), the control group was provided with the instructional materials (i.e. books and parents newsletters) and a condensed version of the intervention after the completion of the six-month follow-up assessments (i.e. 12-month from baseline).

Outcomes

Dietary intake. Dietary outcomes were the energy contributed from the eight food groups and the total energy intake. Dietary intake was assessed using the Food Frequency Questionnaire based on the Food Pyramid (FFQ-FP), which was previously validated and evaluated for reliability in adolescents from public schools of São Paulo, Brazil (mean [standard deviation] 16 [0.99] years) (Martinez *et al.*, 2013).

The FFQ-FP is semi-quantitative and evaluates usual intake of 50 food items over the previous 12 months by self-report. Portion size data were obtained from the Brazilian Food Guide Pyramid for the adolescent population (Philippi *et al.*, 2009) and "usual" serving sizes for items such as fruit unit, glass of milk, steak and unit of bread rolls. The frequency consumption options ranged from "never" to "2 or more times per day" for all the food items. The students reported the quantity of each food item consumed, and this quantity was transformed in daily serving using the codes (i.e. codes represent an estimate of the daily servings):

- 2 or more x/day (code is 2);
- 1x/day (code is 1);

- 2-4x/day (code is 0.14);
- 1x/day (code is 0.43);
- 1-3x/month (code is 0.07);
- less than 1x/month (code is 0.02); and
- never (code is 0) (Collucci *et al.*, 2004).

Then, different foods items in each pyramid group were added. Nevertheless, some foods needed to be aggregated in more than one group (for example: pizza), and so the proportion of macronutrients presented in the food items was calculated and then distributed among the pyramid groups (e.g. oils [oil group], cheese [milk, cheese and yoghurt group] and bread [rice, bread, pasta, potato and manioc group]. Having an estimate of the servings of the food groups, each group was multiplied by the equivalent amount of calories from the eight groups (Philippi, 2014), and, finally, the groups were added and the total energy intake was calculated. Energy intake < 500 kcal and > 5.000 kcal were removed from database (57 from baseline and 29 post-intervention) (Collins *et al.*, 2014; Leal *et al.*, 2010).

The eight food pyramid groups were divided into four levels according to their main nutrient composition:

(1) rice group, highlighting the presence of carbohydrates;

(2) vegetables and fruits groups that in addition to carbohydrates (fructose) highlight a great amount of vitamins and minerals;

(3) milk (whose main source is calcium), meats and beans groups, animal and vegetable proteins; and

(4) oil and sugars (table sugar), which should be consumed moderately (Philippi, 2014).

Meal frequency. Self-reported questions related to meal frequency were adapted and pre-tested from a study with adolescents attending technical schools in São Paulo, Brazil (Araki *et al.*, 2011). The meals assessed were breakfast, lunch, dinner and snacks. The frequency reported ranged from never to everyday.

Statistical analysis

Differences between groups at baseline were assessed using independent *t*-tests. Data were checked for normality and those that were not normally distributed were square root transformed. The intervention effects for dietary intake were examined using the linear mixed model adjusted for the nature of the data (i.e. school). In addition, the proportional difference between groups among those improving their meal frequency (e.g. five-six days to everyday) or regressing to a decrease in meal frequency (e.g. four-five days to three-two days) was explored by using Pearson's x^2 test. All analyses followed the intention-to-treat principles and were conducted in SPSS software for Macintosh 21.0 version (IBM SPSS Statistics, IBM Corporation, Armonk, NY, 2010) with significance levels set at $p < 0.05$.

Results

The study sample included 253 (mean [standard deviation] 16.05 [0.053] years) adolescent girls, and at baseline, 18.6 and 8.3 per cent of the sample were overweight or

obese, respectively. Of the seven participants who improved their weight status, six (86 per cent) were in the intervention group, four improved from obesity/overweight to normal weight and two from thinness to normal weight. In regards to control group, two participants improved from thinness to normal weight and from obesity to overweight. Thus, the Pearson's x^2 test indicated a significant difference in the favor of intervention girls ($x^2 = 8.934$, $p = 0.03$) (data not shown). Assessments were conducted six months from baseline (i.e. immediate after intervention), 107 (75.3 per cent) and 83 (74.7 per cent) girls were retained in the intervention and control groups (Figure 1).

Outcomes are reported in Table I. Changes in dietary intake were in the favor of the intervention group, with exception for the milk group where there is a trend for reducing the energy intake (mean [SE] −69.78 kcal [26.88], $p = 0.053$) in H3G – Brazil group. The fruits (12.48 kcal [7.86], $p = 0.005$), vegetables (8.80 kcal [7.11], $p = 0.006$) and sugar and sweets (−55.98 kcal [50.70], $p = 0.036$) groups demonstrated statistically significant group-by-time effects. There were no other between-group differences after six-months from baseline.

Pearson's x^2 test indicated a significant difference for snacks-in-between-meals in the favor of intervention girls ($p = 0.001$). The most reported category for the in-between-meals snacks frequency by the adolescents in both groups at baseline is "five to six days in the week". Intervention vs control girls reported an improvement for this frequency (33.1-50.7 vs 29.7-27.0 per cent). There were no other differences after six months from baseline, but H3G – Brazil vs control girls demonstrated an increase in "five to six days in the week" (i.e. most reported category) for all the other meals: breakfast (28.2-41.5 vs 18.0-36.0 per cent), lunch (47.2-56.3 vs 38.7-53.2 per cent) and dinner (26.8-40.1 vs 18.0-33.3 per cent) (Tables II and III).

Discussion

This is the first Brazilian study to examine whether a multiple component school-based group randomized controlled trial is effective at changing dietary behaviors and improving nutritional status in female youth. At baseline, the percentage of adolescents who were overweight/obese is similar to a Brazilian representative study where the prevalence among girls of overweight was 22 per cent and obesity was 6 per cent (Araújo *et al.*, 2010). The proportional shift in nutritional status between study groups provides additional support for the efficacy of the intervention (Smith *et al.*, 2014b) and also suggesting that the intensity of the intervention might have been efficacious on changing behaviors and as consequence to the weight status. However, those findings are related to immediate post-test analysis implicating that follow-up is required.

However, results are promising for the fruits, the vegetables and for the sugars and sweets groups, with girls from intervention group consuming 8.80 and 12.48 more daily calories from the fruits and the vegetables groups, respectively, and 53.98 fewer daily calories for the sweets groups than the control group. Improvements on dietary intake are similar to or higher than those found in school-based interventions in high-income countries (Collins *et al.*, 2014; Neumark-Sztainer *et al.*, 2010; Klesges *et al.*, 2010) and are especially relevant considering the large-scale reach and dissemination of obesity prevention interventions targeting youth (Waters *et al.*, 2011; Brown and Summerbell, 2009).

Corroborating the NEAT girls study (Collins *et al.*, 2014), the majority of teenage girls at baseline from schools in low-income communities consumes almost half of their

Table I. Changes in diet intake and between group changes "Healthy habits, healthy girls–Brazil", São Paulo, 2015

		Baseline		Six months from baseline				
Dietary outcomes	ICC values	H3G –Brazil (n = 142)	Control (n = 111)	H3G –Brazil (n = 107)	Control (n = 83)	Adjusted mean differences (SE) [a]	Time p-value [c]	Group-by-time p-value [c]
Total energy intake (kcal) [b]	0.047	3,278 (2826-3849)	3,279 (2797-3625)	2,522 (2237-3178)	2,674 (2236.66-3349.69)	−43 (181)	< 0.001	0.22
Rice group (kcal)[b]	0.027	1,442 (1071-1744)	1,442 (1105-1515)	1,268 (1155-1367)	1,258 (917.23-1430.21)	86 (85)	< 0.001	0.66
Vegetables group (kcal)[b]	0.000	68 (26-76)	75 (32-90)	60 (48-81)	58 (32-75)	12 (7)	0.87	**0.005**
Fruits group (kcal)[b]	0.011	30 (26-70)	53 (30-70)	70 (30.10-75.05)	70 (30-75)	8 (7)	< 0.001	**0.006**
Milk group (kcal)[b]	0.000	257 (143-295)	257 (178-293)	141.83 (122-242)	217 (160-280)	−70 (27)	0.015	0.05
Meat group (kcal)[b]	0.044	408 (253-510)	409 (267-408)	267 (227-337)	342 (223-427)	−17 (50)	0.003	0.32
Beans group (kcal)[b]	0.030	98 (55-110)	98 (55-110)	83 (55-110)	83 (55-110)	8 (12)	0.84	0.64
Oils group (kcal)[b]	0.022	347 (211-438)	347.31 (236-350)	250 (204-336)	209 (204-356)	−21 (22)	< 0.001	0.19
Sugar group (kcal)[b]	0.016	599 (420-730)	599.10 (427-698)	368 (206-487)	406 (231-528)	−54 (51)	< 0.001	**0.036**

Notes: SE: Standard error, ICC: intra-cluster correlation coefficient; [a] Adjusted mean difference and standard error between H3G – Brazil and control groups after six-month interventions (intervention minus control) using squared root transformed data; [b] Data transformed, median interquartile range provided; [c] Significance values using the transformed data; significance of bold ($p < 0.05$) for the variables: vegetables group, fruit group and sweet group. Those valuables are expressed in Kcalories

Table II.
Breakfast and lunch frequency, "Healthy habits, healthy girls–Brazil", São Paulo, 2015

	Baseline			Six months from baseline			Baseline			Six months from baseline		
	Breakfast, *n*(%)						Lunch, *n*(%)					
Frequency	H3G – Brazil (*n* = 142)	Control (*n* = 111)	*P*-value	H3G – Brazil (*n* = 107)	Control (*n* = 83)	*P*-value	H3G – Brazil (*n* = 142)	Control (*n* = 111)	*P*-value	H3G – Brazil (*n* = 107)	Control (*n* = 83)	*P*-value
Never	4 (2.8)	2 (1.8)	0.265	2 (1.4)	0 (0.0)	0.334	1 (0.7)	0 (0.0)	0.334	–	–	0.846
1-2 days	20 (14.1)	19 (17.1)		15 (10.6)	12 (10.8)		9 (6.3)	8 (7.2)		5 (3.5)	5 (4.5)	
3-4 days	19 (13.4)	12 (10.8)		14 (9.9)	19 (17.1)		12 (8.5)	6 (5.4)		7 (4.9)	8 (7.2)	
5-6 days	40 (28.2)	20 (18.0)		59 (41.5)	40 (36.0)		67 (47.2)	43 (38.7)		80 (56.3)	59 (53.2)	
Everyday	59 (41.5)	58 (52.3)		52 (36.6)	40 (36.0)		57 (37.3)	54 (48.6)		50 (35.2)	39 (35.1)	

Note: Chi-squared for proportional differences between groups

Table III. Dinner and snack-in-between-meals frequency, "Healthy habits, healthy girls–Brazil", São Paulo, 2015

	Dinner, n(%)						Snacks-in-between meals, n(%)					
	Baseline			Six months from baseline			Baseline			Six months from baseline		
Frequency	H3G – Brazil (n = 142)	Control (n = 111)	P-value	H3G – Brazil (n = 107)	Control (n = 83)	P-value	H3G – Brazil (n = 142)	Control (n = 111)	P-value	H3G – Brazil (n = 107)	Control (n = 83)	P-value
Never	1 (0.7)	2 (1.8)	0.313	1 (0.7)	0 (0.0)	0.416	0 (0.0)	3 (2.7)	0.278	–	–	0.001
1-2 days	15 (10.6)	9 (8.1)		14 (9.9)	7 (6.3)		21 (14.8)	21 (18.9)		11 (7.7)	15 (13.5)	
3-4 days	15 (10.6)	10 (9.0)		8 (5.6)	8 (7.2)		43 (30.3)	29 (26.1)		33 (23.2)	42 (37.8)	
5-6 days	38 (26.8)	20 (18.0)		57 (40.1)	37 (33.3)		47 (33.1)	33 (29.7)		72 (50.7)	30 (27.0)	
Everyday	73 (51.4)	70 (63.1)		62 (43.7)	59 (53.2)		31 (21.8)	25 (22.5)		26 (18.3)	24 (21.6)	

Note: Chi-squared for proportional differences between groups

energy intake from the sugars and sweets and the oils and fats groups. This goes against the recommended consumption of up to 1 portion of 110 and 73 kcal of the sweets and the fats groups, respectively, based on the Brazilian Food Guide Pyramid for adolescents (Philippi *et al.*, 2009). Furthermore, girls at baseline consume fewer than the recommendations of the fruits groups just like reported in other randomized controlled trials targeting adolescent girls (Neumark-Sztainer *et al.*, 2010; Klesges *et al.*, 2010; Rosenkranz *et al.*, 2010). The Food Guide (Philippi *et al.*, 2009) recommends 5 portions of 70 kcal of fruits and 4 portions of 15 kcal of vegetables (i.e. 350 kcal of fruits and 60 kcal of vegetables). This contrast increases the likelihood of excessive energy intake and decreases long-term sub-optimal nutrient intake. Also, it may lead to the development of unhealthy weight gain and diet-related chronic conditions such as cardiovascular diseases, type two diabetes and osteoporosis (Zhang *et al.*, 2015; Moore *et al.*, 2015; Larson *et al.*, 2006).

Findings from this study suggest that there was a shift in the consumption of items from the sweets to the fruits and vegetables groups. Also, the proportional differences for in-between-meals snacks might be explained by the increase in the consumption of the fruits. Similarly to the Girls Scouts study (Rosenkranz *et al.*, 2010), a major finding of this study was that the intervention components were implemented with good fidelity in real-world situations and resulted in the promotion of behaviors and environmental opportunities for healthful eating. Nevertheless, the current study did not assess the impact on the behavioral influences of obesity for female youth or family and friends in settings beyond the school environment. The intervention group was offered several opportunities to increase FV and decrease fats and sugars (i.e. workshops, seminars, text-messages, diaries and handbooks), while the control group did not have those opportunities. It appears that H3G – Brazil was fully engaged in the intervention situations, which promoted fruits and vegetables and discouraged the intake of food rich in sugars, such as soft-drinks, artificial juices, candies, sandwich cookies, chocolate, popsicles, ice-cream and sugar-coated cereals.

There might be some effects that were not measured in the H3G – Brazil study, as self-efficacy, intentions, goal settings, situations (i.e. environment), social support (i.e. family and friends) and outcome expectations and expectancies have profound implications for current and future health (Lubans *et al.*, 2012; Rosenkranz *et al.*, 2010). The New Moves study, a randomized controlled trial with teenage girls, (Neumark-Sztainer *et al.*, 2010) which focuses on goal setting demonstrated an improvement in the eating behaviors, especially for regular meal frequency. This is important because regular meals have been associated with healthy weight (Hallstrom *et al.*, 2013; Zurriaga *et al.*, 2011; Westerberg-Jacobson *et al.*, 2010). In this sense, assessing mediators that might be related to the situation of meal frequency is important. Although studies suggest the test of mediators (Rosenkranz *et al.*, 2010), this was not the scope of the current study, in view of the lack of randomized controlled trials with the Brazilian population. Examining the intervention effects in the Brazilian context is important to have a clearer idea of the effectiveness of an adaptation of a study conducted in developed countries. However, this does not exclude future works with the Brazilian population to test the effects of those mediators on obesity and health behaviors.

The strengths of this study include the group randomized controlled trial design, the unique study population and the level of participant retention. Nevertheless, there are

some limitations that should be noted. Although the FFQ-FP used was previously validated and tested for reliability, self-reported measurements should be interpreted with caution due to misreporting. To reduce this impact, a protocol manual with information on how to fill out the questionnaire was provided and when the girls delivered the FFQ-FP, it was carefully reviewed by a research member to check if there was any over and under reporting of the food items. Nonetheless, previous studies suggest that the dietary data should be expressed as the percentage contribution of food group to total energy intake to reduce the impact of misreporting (Collins *et al.*, 2014, 2010).

Conclusion

The "Healthy Habits, Healthy Girls – Brazil" intervention resulted in a significant changes in the intake of fruits and vegetables in food items rich in sugar. Significant differences on in-between-meals snacks were also a positive change. Nevertheless, no significance was demonstrated for the other food groups and meal frequency. Future obesity prevention trials with Brazilian adolescents should be adequately powered to detect dietary intake, and with varying intensities of nutrition intervention components, directed at nutrition either through other curriculum components or through school policies.

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