

Gender differences and a school-based obesity prevention program in Argentina: a randomized trial

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ABSTRACT

Objective. To evaluate the impact of a school-based obesity prevention program that seeks to change food intake among students at schools in Rosario, Argentina.

Methods. This was a prospective study involving 405 children 9–11 years of age at six schools in the poor areas of Rosario, Argentina, in May–October 2008. After matching for socioeconomic status, schools were selected by simple randomization; participants were assessed at baseline (T1) and again 6 months later, after completion of the intervention (T2). The program focused on increasing the children's knowledge of healthy nutrition and exercise through four workshops; educating the parents/caregivers; and offering healthy options at the school snack bar. The main outcome measures were the children's intake of healthy and unhealthy foods (assessed with a weekly food frequency questionnaire) and their body mass index (BMI).

Results. Of the 387 children assessed at T1, 369 were reassessed at T2 (205 intervention; 164 control). Girls at the schools where the intervention occurred increased their intake of three of the five healthy food items promoted by the program (fruits, vegetables, low-sugar cereals). Statistical significance was reached for skim milk ($P = 0.03$) and for pure orange juice ($P = 0.05$). Boys of both the intervention and control groups failed to improve their intake of healthy foods, but those of the intervention arm significantly reduced their intake of hamburgers and hot dogs ($P = 0.001$).

Conclusions. Girls were more amenable to improving their dietary intake. Overall, the program was more likely to increase consumption of healthy food than to decrease intake of unhealthy foods. Gender differences should be taken into account when designing preventive interventions.

Key words

Obesity; primary prevention; child health; child nutrition; food; Argentina.

During the past 30 years, childhood obesity rates have increased sharply, not only in developed, but also in developing countries (1). Long-term follow-up

studies suggest that overweight children and adolescents may be at increased risk of becoming obese adults. This is of great concern because obesity and its related comorbidities (e.g., type 2 diabetes, hypertension, heart disease, some types of cancer) are one of the main preventable causes of death. In fact, the Pan American Health Organization (PAHO) has recognized that currently, the prevention of

this multifactorial condition is one of the most important public health challenges (2). There is evidence that a high intake of sweetened beverages and high-fat/high-sugar foods, coupled with a low intake of fruits and vegetables and increased sedentary behavior, is associated with obesity (3–8). Shifts in diet and physical activity patterns have affected the low- and moderate-income

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developing countries over the last two decades (9). Childhood obesity in Argentina is a major public health problem as documented by a recent study in which 27.9% of middle- and low-income children 10–11 years of age were overweight (10). Sedentary behavior and an excess of calories seem to be part of this multifactorial problem. Therefore, educating families and school environments to promote healthier food choices is critical (11). In fact, schools are a pivotal component of the social milieu that shapes children's eating and physical activity patterns, and there is evidence that school-based programs may affect how youngsters perceive the influence of dietary practices on overall health (12).

Preventive programs aimed at reducing the risk of obesity in developed and developing countries are current public health priorities. Educating school children in healthy nutrition has been signaled as one of the most effective strategies for overcoming malnutrition and diet-related diseases (13). Reviews of population-based interventions carried out in both school and family settings with children from kindergarten to high school mostly in the United States and the United Kingdom indicate that school-based interventions often result in some improvement of health knowledge and health-related behaviors; additionally, the short-term effect on nutritional state seems to be more pronounced among girls than boys (14, 15). There is evidence that families of middle- and upper-socioeconomic status, as well as intact original families (not divorced, separated, or blended) benefit more from these programs, and that prevention among obese children is most successful when they are treated together with their parents (14). To date, interventions aimed at improving food intake among middle school children have had limited success in attaining dietary changes (16, 17). Variations across these studies in relation to strategy (environmental, plus policy changes), setting (the United States), duration (2 years), focus, and other methodological issues, hinder the possibility of drawing general conclusions about the value of preventive measures.

Nonetheless, the best way to assess the impact of a program and consider future directions for allocating resources is by evaluating the program under controlled conditions. To date, relatively few con-

trolled studies have been published on the prevention of overweight and obesity in children and adolescents worldwide. Worth mentioning is the scarcity of controlled studies on obesity prevention programs in developing countries (18). Partly because assessments of interventions are too expensive for local research organizations, there has been no data published (to the authors' knowledge) on this topic regarding Argentina, despite the increased prevalence of overweight and obesity in this country during recent years (19).

In the city of Rosario, Argentina, the Ministry of Public Health developed and implemented an obesity prevention intervention called, "Cantinas Saludables" (Healthy Snack Bars; HSB). This school-based program focuses on increasing the number of healthy options available at the school snack bars, improving the students' knowledge of healthy eating, and promoting physical activity during school hours. Additionally, it aims to improve parents' knowledge of healthy habits. In spite of being put into action more than six years ago, the program has never been evaluated.

The goal of this study was to evaluate changes in body mass index (BMI) and food intake among children at schools that received the HSB intervention. A full report of the HSB evaluation is presented elsewhere (20). It was hypothesized that children at the schools receiving the intervention would show an increased intake of healthy foods and beverages, and a modest decrease in body weight, compared to children in the control arm.

MATERIALS AND METHODS

Study design and sample

This was a prospective study targeting boys and girls 9–11 years of age in the 5th and 6th grades and their families during a 6-month school period from 5 May–31 October 2008. The sample was pooled from six schools that had been waitlisted and randomized for receiving the HSB. Four of these six received the intervention; the remaining two schools served as controls. This allocation was assigned by simple randomization. Experimental and control schools had been matched according to social condition. The school districts that participated in this study comprised neighborhoods of

vulnerable social sectors in which macroeconomic conditions are compatible with very-low, low, and lower-middle income standards.

After obtaining parental consent, all children from the participating grades were invited to take part in the study; only those over the age of 11.9 years (decimal age) and/or any child that presented a chronic or acute illness that would impact normal eating behavior were excluded. A total of six schools were evaluated at baseline (T1) in May 2008 and at post-intervention (T2) in October 2008 (Figure 1).

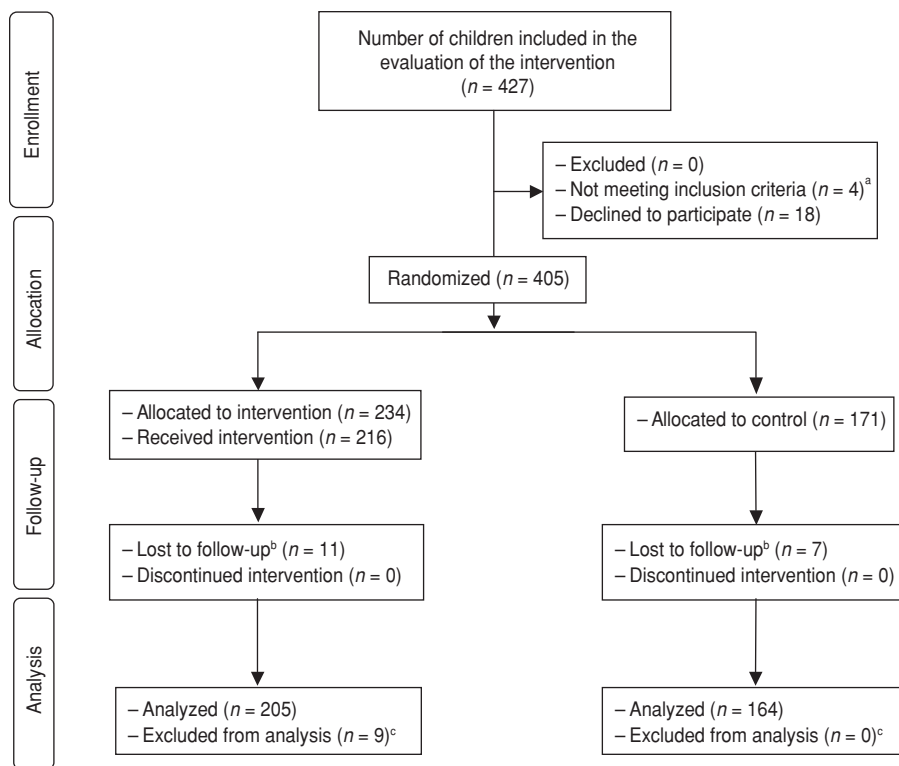
The intervention

For the intervention arm, the participating grades took part in four workshops: three for the children (Healthy Eating, Body in Motion, and Healthy Body); and one for their parents/caregivers. Workshops lasted 40 minutes, were conducted monthly by an interdisciplinary team, and had an interactive modality. Because the children's workshops took place during school hours, attendance was the same it would be for a normal school day and was not considered exclusion criteria. Parents' and/or caregivers' attendance was 53% and was not considered exclusion criteria. The intervention consisted of five parts: the four workshops, plus modifications to the school cafeteria menu.

Workshop 1: Healthy Eating. The first workshop aimed to help children identify healthy foods, understand why healthy foods improve health, and contemplate the disadvantages of including competitive options in their diet (e.g., pros and cons of fat and sodium consumption). This workshop specifically encouraged the intake of five healthy food items targeted by the program: orange juice (100% orange, no sugar added), whole fruits, low-sugar cereal, skim milk, and vegetables (fresh, canned, or cooked).

Workshop 2: Body in Motion. The second workshop aimed to get children motivated about physical activity, and to understand the health-related benefits of regular exercise.

Workshop 3: Healthy Body. The third workshop sought to help children establish the connection between good eating habits, regular physical activity, and a

FIGURE 1. Flowchart of participants in an evaluation of a school-based obesity prevention intervention in Rosario, Argentina, 2008

^a Children more than 11.9 years of age and/or children with an illness that affects normal eating behavior.

^b Children absent from school on test-day.

^c Incomplete questionnaire.

healthy body. An additional goal was to enable children to identify a healthy menu based on nutritional components.

Workshop 4: Parent/Caregiver. The fourth workshop aimed to provide dietary education to the children's parents/caregivers and emphasized the importance of physical activity.

School Snack Bar. At the start of the study, the school snack bar options were modified to include three of the aforementioned five healthy food items stimulated by the program (orange juice, fruit, and low-sugar cereal).

Outcome measures

Body weight. All participating children were weighed and measured following international standards at T1 (baseline) and T2 (post-intervention). Weight was taken in kilograms (kg) with a digital, portable beam scale (Seca Onda Model 843; Seca Corporation, Hamburg, Germany); height was taken in meters (m)

with a wall-mounted body-meter (Seca Stadiometer 208, Seca Corporation, Hamburg, Germany). BMI (weight/height²) was calculated and standard criteria were used to classify the status of each boy and girl. The Z-score (normal or standardized distribution) of weight and height was used for each age. References used were all based on BMI cut-off points that were gender- and age-specific in keeping with the United States Centers for Disease Control and Prevention (CDC) growth charts (21). The BMI cut-off points were 85th and 95th percentiles for age and gender for overweight and obesity, respectively.

Weekly Food Frequency Questionnaire (WFFQ). This instrument was designed to collect information related to the children's daily diet (22). It was based on a listing of foods and beverages consistent with local patterns of intake. Included were both the healthy items targeted by the program, as well as others of high caloric density categorized as competitive or unhealthy (e.g., hamburgers and hot

dogs, salted packed snacks, chocolate candy bars and sweets, and sodas and sweetened beverages).

Additionally, categories were set in order to determine the number of times those foods or beverage items were ingested weekly. Trained dietitians interviewed the children for an average of 40 minutes each. For each item, responses were on a scale of: never = 0; once per week = 1; 2 – 4 times per week = 2; and daily = 3, and later analyzed according to the expected intake (1 or more daily for some; and 2 or more times/week for others). The expected intake standard derives from the Food Intake Guidelines for the Argentine Population, which recommends a daily intake of five fruits and/or vegetables (23).

Statistical analysis

One-way repeated measures timed at two levels (baseline and post-intervention) were conducted with intervention and control groups, and controlled for gender to determine differences over time between the intervention and control groups. Independent sample t-test evaluated anthropometric mean values and comparisons between genders. Independent sample t-test for proportions evaluated frequency of overweight, obesity, and under-weight. The difference in the measures over time was evaluated comparing both subgroups (intervention and control) with a one-way ANOVA (analysis of variance). McNemar chi-square test was used for the analysis of weekly intake of healthy or competitive foods. The children's ages were collapsed for the analysis of the data. Data were analyzed using IBM SPSS Statistics software, version 10 (SPSS Inc., an IBM company, Chicago, Illinois, United States) with $\alpha = 0.05$.

RESULTS

Of the 405 students randomized at baseline, 387 returned the informed consent (216 intervention and 171 controls); a total of 369 (91%) were reassessed at T2. There was no difference between the representations of both groups (intervention and control) at T2 (51% and 49%, respectively). The resulting number of cases from each school was determined by the rate of acceptance of the informed consent and by the number of children in each school grade. Of the participat-

TABLE 1. Baseline demographic and anthropometric data of participants in an evaluation of a school-based obesity prevention intervention, by group, Rosario, Argentina, 2008

Variable	Intervention group (n = 216)	Control group (n = 171)	P value
Girls (%)	53	47	0.376 ^a
Age in years (mean ± SD)	9.64 ± (0.77)	9.76 ± (0.68)	0.2 ^a
Weight status, n (%)			
Underweight	2.8	3.5	0.946 ^b
Normal weight	73.6	63.2	0.071 ^b
Overweight	15.7	15.2	0.957 ^b
Obese	7.9	18.1	0.341 ^b
Mean BMI ± SD	21.0 ± 5.1	20.7 ± 5.0	0.014 ^a
Mean BMI Z-score ± SD	0.71 ± 1.1	0.65 ± 1.1	0.021 ^a

BMI: body mass index.

^a Two sample t-test.^b T-test for proportions.**TABLE 2. Baseline demographic and anthropometric data of participants in an evaluation of a school-based obesity prevention intervention, by group and gender, Rosario, Argentina, 2008**

Variable	Intervention group (n = 216)		Control group (n = 171)	
	Boys (n = 105)	Girls (n = 115)	Boys (n = 91)	Girls (n = 80)
Weight status/gender n (%)				
Underweight	0 (0.0)	6 (5.2)	3 (3.3)	3 (3.8)
Normal weight	74 (73.3)	85 (73.9)	52 (57.1)	56 (70.0)
Overweight	18 (17.8)	16 (13.9)	14 (15.4)	12 (15.0)
Obese	9 (8.9)	8 (7.0)	22 (24.2)	9 (11.3)

ing girls, 89% were pre-menarcheal. The rate of menarcheal girls was 13.8% in the experimental group and 11.5% among the controls.

Table 1 describes the demographic and anthropometric status of the sample at baseline. Table 2 describes the demographic and anthropometric status by study group and by gender at baseline. Overall, boys were more overweight and obese than girls (31% vs. 24.3%), and for the former, a statistically significant difference was found in their BMI Z scores, with boys in the control group being slightly heavier than boys in the intervention group.

BMI changes

Differences in anthropometric measures at baseline and at post-intervention by study group and by gender can be seen in Table 3. No statistically significant difference was found between the experimental and control groups.

WFFQ: Healthy food items and beverages

The five foods promoted by the program (orange juice, whole fruits, low-sugar cereal, skim milk, and vegetables) were analyzed according to frequency

of intake (Figure 2). Analyses were performed for boys and girls separately, comparing outcome of the control to intervention groups at T2. When applying McNemar's chi-square test, boys in the experimental group failed to increase their intake of the healthy foods targeted by the program, and they did not differ from the control group on the remaining variables. Contrarily, when compared to their controls, girls in the experimental group tended to increase their intake of the five foods targeted by the program; this attained statistical significance for skim milk ($P = 0.03$) and orange juice ($P = 0.05$). Girls of the control group showed a decrease (albeit non-significant) in their intake of skim milk and of low-sugar cereals.

WFFQ: Competitive food items and beverages

Figure 3 shows the changes in the intake of competitive foods. Sweets, chocolate candy bars, salted packed snacks, and sodas and sweetened beverages were categorized as 1/day; hotdogs/hamburgers as more than 2–4 times/week. Girls in the intervention group showed an overall trend to decrease intake of competitive foods; this attained statistical significance for hamburgers and hot dogs ($P > 0.001$). Girls in the control group presented an irregular pattern of change regarding intake of competitive food items, and showed a significant decrease in their intake of hamburgers and hotdogs ($P = 0.008$). Of the five competitive food items measured, boys in the intervention group attained a statistically significant reduction in the consumption of hamburgers and hot dogs ($P = 0.01$); no statistically significant change was observed for boys

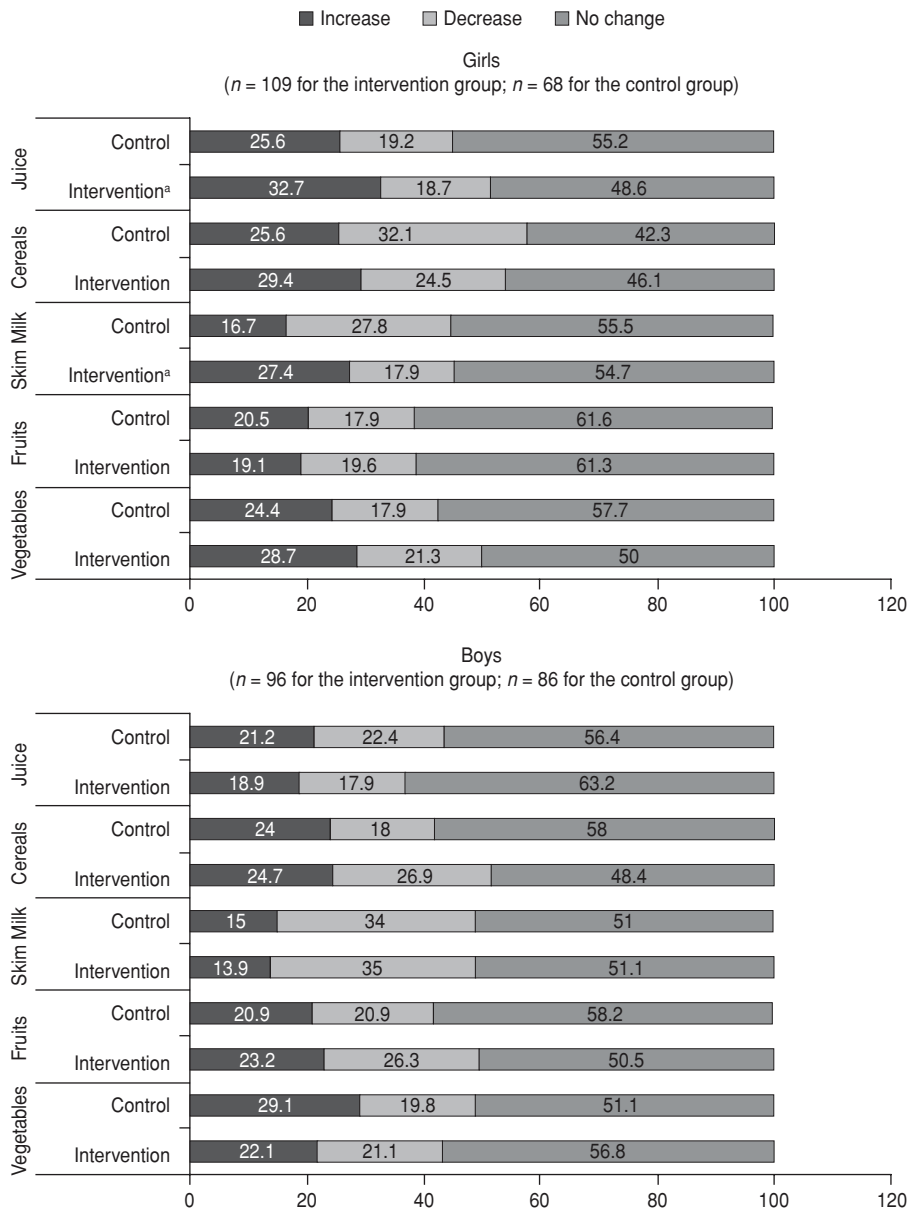
TABLE 3. Differences (Dif) in anthropometric data at baseline (T1) and at post-intervention (T2) of a school based obesity prevention intervention, by study group and by gender, Rosario, Argentina, 2008

Measure	Girls (n = 187)					Boys (n = 182)				
	T1	T2	Dif ^a %	Dif ^b (95% CI)	P ^c	T1	T2	Dif ^a %	Dif ^b (95% CI)	P ^c
BMI										
Control group	18.3	18.9	0.56	0.02	0.9	19.5	20.1	0.6	-0.15	0.19
Intervention group	17.8	18.3	0.58	(-0.27; 0.30)		18.3	18.7	0.4	(-0.37; 0.07)	
BMI Z score										
Control group	0.2	0.4	0.12	0.02	0.69	0.65	0.73	0.09	-0.03	0.53
Intervention group	0.1	0.2	0.10	(-0.12; 0.08)		0.33	0.39	0.06	(-0.11; 0.06)	

BMI: body mass index.

^a Difference between baseline (T1) and post-intervention (T2).^b Differences between intervention and control groups.^c One-way ANOVA (analysis of variance).

FIGURE 2. Comparison of percentage of children (n = 369) that showed positive (increase) versus negative (decrease) change in healthy food intake before and after a obesity prevention intervention, analyzed by group and by gender, Argentina, 2008



^a McNemar's chi-squared test $P \geq 0.01$.

in the control group for any of the competitive food items.

DISCUSSION

Previous findings have indicated that for prevention of overweight, the focus should be on pre-menarcheal girls, before their mean body fat mass tends to increase (24, 25). In this study, girls at the schools receiving HSB increased their intake of the healthy foods promoted by the program, and decreased their intake

of all the competitive foods itemized on the questionnaire. Moreover, regarding the latter, girls of both the control and the experimental groups reported a significant decrease in consumption of hamburgers and hot dogs. Boys at the schools where the intervention was carried out decreased intake of one type of competitive food (hamburgers and hot dogs). These results, which suggest that girls are more amenable to accepting changes in their dietary intake, are probably related to the characteristic con-

cern with physical appearance and body weight that affects this gender early on. Another potential explanation is in line with a related study (26), which suggests that programs grounded in social learning may be more appropriate for girls, while structural and environmental programs involving physical activity may be more effective for boys (26).

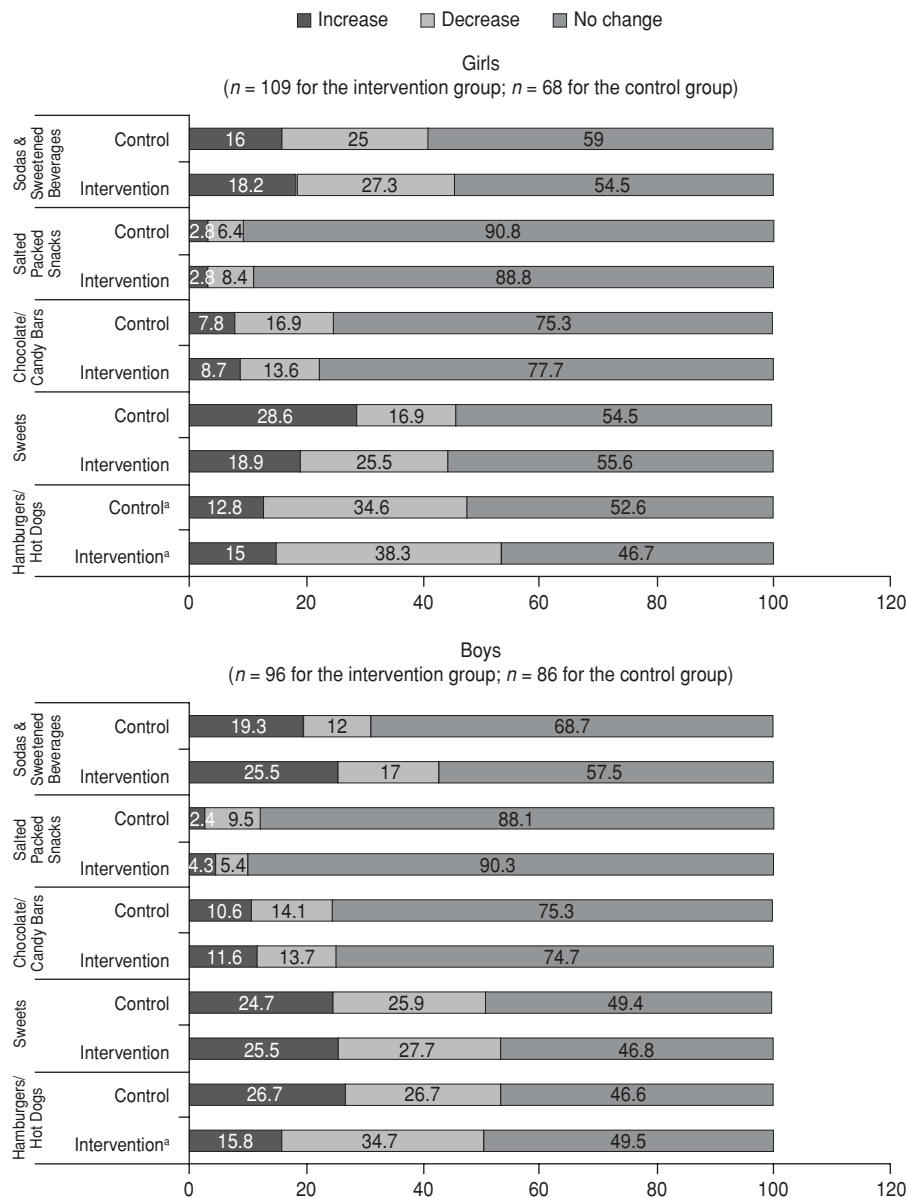
The HSB program evaluated in this study did not tackle physical activity specifically, but rather focused principally on social learning aspects derived from the workshops, in addition to modifying the food items offered by the school snack bar.

The reduction in intake of hamburgers and hotdogs in three of the subgroups is hard to explain, but is perhaps related to a political crisis in the country involving the agricultural sector. This crisis, which started in March 2008, precipitated a rise in the consumer price index for meat, from 157.39 in February to 205.33 in December of that year (23, 27).

Both groups of boys increased their intake of sweetened beverages. That this increase was greater in the control group points to a favorable outcome for the intervention. Because a higher consumption of the latter has been associated with a greater magnitude of weight gain (7), the importance of affecting this variable is relevant when addressing obesity prevention interventions. Previous studies have shown that curbing intake of sweetened beverages is not an easy task. An earlier, targeted, school-based, 12-month educational program produced only a modest reduction in the number of carbonated drinks consumed, albeit associated with a reduction in the number of overweight and obese children (28). Moreover, the importance of an increase in orange juice intake must be underscored by recent findings showing that moderate consumption of fresh orange juice should be encouraged as a component of a healthy diet, and that it is not associated with higher weight or BMI (29).

The absence of a significant change in weight among participants at the post-intervention is to be expected given the short duration of the study. Previous studies show that most school-based intervention programs increase knowledge about nutrition, but rarely produce significant changes in either behavior or short- to intermediate-term health outcomes (30, 31). Additionally, current literature has indicated limited success

FIGURE 3. Comparison of percentage of children (n = 369) that showed positive (increase) versus negative (decrease) change in competitive food intake before and after a obesity prevention intervention, analyzed by group and by gender, Argentina, 2008



^a McNemar's chi-squared test $P \geq 0.01$.

rates in obesity prevention school-based programs for boys and children of lower income levels (32–35).

Overall, this intervention program's results are comparable to those of similar programs of similar duration and goals. A recent meta-analysis showed that even though school-based interventions were effective, longer-running programs were more successful than their shorter counterparts (34, 36). A 4-year study that assessed nutritional knowledge before, and 3 months after an

intervention, showed that school-based health promotion had sustainable effects on nutritional knowledge with remission of overweight being most pronounced in girls (37). Current results underscore those previous findings.

Study limitations

The major limitation of this study was its duration, considering that a 6-month period will likely fail to reflect anthropometric changes. Another pos-

sible limitation is the well-documented problem of obtaining accurate food records from anyone, adult or child. An extensive study evaluating the validity of children's food records concluded that precise records are difficult to obtain, require intensive training, and often have low test-retest correlations (38). Nonetheless, a recent study comparing "self-reported" to "observed" lunch fruit and vegetable intake among 4th graders found that condition assignment did not bias recalled intake (39). In the present study, care was taken to minimize any potential bias by having trained dieticians individually interview each child and help them retrieve information with the aid of food pictures. Furthermore, this study did not calculate daily energy intake in kcals/day. Although daily energy intake goes beyond the aims of the current study, it is important for future studies given that almost 30% of the children in this sample were overweight.

Conclusions

Even though the HSB program succeeded in increasing the intake of healthy food items among girls in the intervention group, it failed to significantly reduce their intake of competitive foods. The positive change in the girls' intake underscores the gender differences among children this age, which appears to impinge upon the response to a social learning obesity prevention school-based program. The overweight evidenced by the children in this study attests to the importance of addressing obesity prevention strategies among this vulnerable population. The schools evaluated by the study belong to a community of lower-middle and low social class. Despite increasing obesity rates among mostly low-income populations, to the authors' knowledge this is one of the few intervention studies that has focused on this segment of the population, and one of the few randomly-controlled evaluations of obesity prevention programs in Latin America, and certainly, in Argentina. A clear suggestion arising from this study is to consider gender differences when planning obesity prevention interventions for school-aged children.

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Conflicts of interest. None.

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RESUMEN**Diferencias entre los sexos en un programa de prevención de la obesidad en medio escolar en la Argentina: un ensayo aleatorizado**

Objetivo. Evaluar la repercusión de un programa de prevención de la obesidad en medio escolar, que busca modificar la ingesta de los alumnos de las escuelas de Rosario, Argentina.

Métodos. Estudio prospectivo en el cual participaron 405 niños de 9 a 11 años de edad, realizado en seis escuelas de las zonas pobres de Rosario, Argentina, de mayo a octubre del 2008. Tras emparejamiento en función de la situación socioeconómica, se escogieron las escuelas mediante una aleatorización sencilla; se evaluaron los participantes al inicio del estudio (T1) y 6 meses más tarde, después de haber completado la intervención (T2). El programa consistió en cuatro talleres encaminados a mejorar los conocimientos de los niños sobre la nutrición y el ejercicio saludables; educar a los padres y los cuidadores; y ofrecer opciones sanas en la cafetería escolar. Los principales criterios de valoración fueron la ingestión de alimentos sanos o malsanos por parte de los niños (evaluada mediante un cuestionario sobre la frecuencia semanal de consumo de alimentos) y el índice de masa corporal de los niños.

Resultados. Se evaluaron 387 niños en T1 y de ellos 369 contaron con una nueva evaluación en T2 (205 del grupo de intervención y 164 del grupo testigo). Las niñas de las escuelas donde tuvo lugar la intervención aumentaron la ingesta de tres de los cinco alimentos sanos propuestos por el programa (las frutas, las verduras y los cereales con bajo contenido de azúcar). Se alcanzó una significación estadística con la leche desnatada ($P = 0,03$) y el jugo de naranja puro ($P = 0,05$). Los niños de los grupos de intervención y de los grupos de referencia no lograron mejorar su ingesta de alimentos sanos, pero los que pertenecían al grupo de intervención disminuyeron significativamente el consumo de hamburguesas y perros calientes ($P = 0,001$).

Conclusiones. Las niñas estaban más dispuestas a mejorar su alimentación. En términos generales, con el programa, la probabilidad de aumentar el consumo de alimentos saludables fue mayor que la probabilidad de disminuir el consumo de alimentos malsanos. Es necesario tener en cuenta las diferencias entre los sexos cuando se diseñan intervenciones preventivas.

Palabras clave

Obesidad; prevención primaria; salud del niño; nutrición del niño; alimentos; Argentina.