Effects of an intervention strategy for school children aimed at reducing overweight and obesity within the State of Mexico

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Abstract

Objective. This study explored the intervention effect of the "Nutrition on the Go" strategy on the prevalence of overweight and obesity (OW+O), according to the role played by different patterns. **Materials and methods.** Pattern Groups (PG) were determined based on schools' food availability and other variables at individual level: nutrition knowledge, physical activity, socioeconomic level and self-efficacy, using an ecological approach. The PG classification was achieved using Ward's cluster method. **Results.** The prevalence of OW+O was higher in PG1 (intermediate food availability and high socioeconomic index [SEI]) compared to PG 2 (high availability of food and lower SEI) and PG 3 (low availability of food and medium SEI) with a lower prevalence (p<0.001). The PG-intervention interaction showed differences for PG 3 (p=0.066), the stage-PG interaction showed differences between PGs 1 and 3 (p=0.014) and between PGs 2 and 3 (p=0.055). **Conclusions.** Differences between PGs have important implications for the prevalence of OW+O.

Key words: intervention studies; physical activity; health promotion; schools; Mexico

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Resumen

Objetivo. Explorar el efecto de la intervención "Nutrición en movimiento" en el sobrepeso y obesidad (SO+O) en escolares, de acuerdo con diferentes patrones. **Material y métodos.** Los grupos de patrones (GP) fueron determinados con base en alimentos disponibles en la escuela y variables de conocimientos, actividad física, nivel socioeconómico y autoeficacia a nivel individual, usando un enfoque ecológico. La clasificación en GP se construyó por conglomerados con el método de Ward. **Resultados.** La prevalencia de SO+O fue mayor en el GP 1 (mediana disponibilidad de alimentos e índice socioeconómico [ISE] alto), más baja en los GP 2 (alta disponibilidad de alimentos e ISE bajo) y 3 (baja disponibilidad de alimentos e ISE medio) (p<0.001). La interacción entre GP e intervención muestra diferencias para GP 3 (p=0.066), la interacción GP con etapa mostró diferencias entre GP 1 contra 3 (p=0.014) y 2 contra 3 (p=0.055). **Conclusiones.** Diferencias en GP tienen implicaciones importantes en la prevalencia de SO+O.

Palabras clave: estudios de intervención; actividad física; promoción de la salud; escuelas; México

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In recent years, the rate of overweight and obesity (OW+O) in school-age children has increased alarmingly. The increase in overweight is particularly significant among African-American and Latin American children[1], especially among Mexican school-age children, in whom the prevalence has increased over recent years and now affects approximately one out of every three school-age children.[2]

The influence of the environment and its correlation with obesity and unhealthy lifestyles in diverse populations has been described previously.[3] It has been documented that the availability of energy-dense foods and drinks and few opportunities for physical activity are elements that are directly related to the increase in OW+O.[3]

The term "obesogenic environment" refers to "an environment that promotes gaining weight and one that is not conducive to weight loss" within the home or workplace.[4] In other words, the obesogenic environment refers to an environment that contributes to obesity.[4]

In Mexico the "obesogenic environment" is also a prevalent characteristic of schools. Some studies conducted in elementary schools indicate that school-age children have opportunities for food consumption as many as five times within a 4.5-hour period during school hours,[5] which may be equivalent to 50% of the total daily requirements (840–1259 kcal). Also, while there is a high availability of energy-dense products, access to performing both systematic and recreational physical activity is limited.[6]

The objective of the present study was to explore the effect of the "Nutrition on the Go"[7] strategy on the prevalence of overweight and obesity among school children with different environment-individual patterns.

Materials and methods

A randomized cluster design was used to study an intervention effect on the prevalence of overweight and obesity in Mexican children. A simple random sample of 60 schools was selected from a total of 2 969 public elementary schools receiving breakfasts, which represent 125 municipalities in the State of Mexico. The experimental group was created with 30 schools randomly assigned to the intervention, and other 30 were used as controls.

The present study included 5th grade children from each selected school. Body mass index (BMI) was used as the main variable to determine a sample size. From a previous study in the same population, the estimated BMI standard deviation was 2.79 and the design effect was 1.68. The expected statistical difference in BMI between intervention and control groups was fixed at 0.45; with 95% confidence and a sample power of 80%, a sample size of 1 000 children was obtained.[8] We selected a random sample of 17 children from each school to collect statistical data, adding up to a total of 510 children for the intervention group and 510 for the control, in order to have a sufficient sample size at follow-up. The non-response rate expected in this study was ≤ 5%.

Two stage transversal measurements –baseline and final– were conducted during the study. The baseline assessment was conducted in early November 2010; the intervention strategy was implemented between November 2010 and the first half of May 2011, and the final evaluation was conducted between late May and early June 2011.

Intervention

The "Nutrition on the Go" strategy is described elsewhere,[9] including the analysis of its effectiveness. The intervention was conducted during a 6-month period in the schools and included the following activities:

- Nutrition and physical activity workshops—these were divided into six sessions that included participatory recreational activities for children to gain knowledge and skills to properly select healthful foods and to promote physical activity.
- *Puppet theater:* A puppet theater was developed, based on the peer learning theory, in which fifth grade students presented the play "Saving Sanopolis" to younger children at school. The script for the play was previously developed and validated by those in charge of the project. Didactic resources provided to each school included the play's script, the puppets and the curtain. Performances took place once a week.
- *Physical activity:* Organized activities involving motion were conducted and performed each day prior to the start of classes and included warm-ups, physical activity and relaxation.
- *Physical activation:* To provide incentives to perform physical activity in the school environment, the campaign planned an exercise routine, beginning gradually with two days per week for 15 minutes before the beginning of classes, in order to create a habit of daily exercise. Didactic resources used included a manual of routines and a music CD.
- *Organized games during break time (twice a week):* Active and safe participation of teachers and children was promoted during the break with educational materials provided for these activities.
- *Organized games:* These were held so that the school children might participate, according to their

interests, in games and activities that involve movement during the 30-minute recess twice a week. In addition, the participation of the entire school community was encouraged, with the intention of promoting active and safe recesses. A manual was used with suggestions for games and dynamics according to age-group.

- *Banners:* Placing banners at the entrance of the school: In order to position the campaign in the school community, a 2-meter high banner was hung which read: "This school promotes healthy recess."
- *Recipe calendars:* Calendars for the school year were distributed to the parents, which included recipes to prepare snacks (including fruits and vegetables). The recipe-calendar also included messages related to the importance of performing physical activity and of hydration with plain water.
- *Activities for teachers and school cooperative:* Two-day awareness raising workshops were held in each school about healthy eating and physical activity. The workshops were aimed at highlighting the importance of the availability of fruits and vegetables as well as a pure water supply inside the school and of the benefits of a healthy lifestyle.
- *Broadcasting of audio spots on the schools' public address systems three times per week during the break:* messages were in regard to consumption of fruits, vegetables, pure water and physical activity during break time.
- *Sale of fruits, vegetables and pure water at the school food cooperative:* a session (~1 hour) was held with the store personnel to convey information and to make suggestions about healthful eating.

Instruments

A set of measuring instruments were created and applied in each stage in order to collect all information considered in this study. This included:

Body mass index. Weight was determined using a Tanita electronic scale with a precision of 100 grams. Height was measured using Dynatop stadiometers with a 2-m capacity and a precision of 1 mm. Measurements were made at the beginning and at the end of the 2010–2011 school periods. Body mass index (BMI = kg/m^2) was calculated for all students in order to determine classifications of OW+O, considering the distribution and cut-off points proposed by the International Obesity Task Force (IOTF).[10]

Food. A semiquantitative food frequency questionnaire was used to record diets for the children using the same instrument used in Health and Nutrition Survey (Ensanut-2006), whose methodology has been published previously.[11]

The socioeconomic level was determined based on information related to housing characteristics and possession of goods. A principal component analysis[12] was used to obtain the socioeconomic index using the first component, which had seven variables and accounted for 40.2% of the total variance. This index was categorized into tertiles to obtain a three-tiered socioeconomic classification defined as low, medium and high.

Physical activity. In order to record the physical activity performed by school-age children, a semiquantitative questionnaire, developed and validated by Hernández and colleagues and based on the Youth Activity Questionnaire,[13] was used to measure physical activity and inactivity.[13] School-age children were classified according to the time spent performing vigorous and moderate activities, using the following criteria: school-age children who reported performing at least *seven hours per week of moderate and/or vigorous activity* were classified as *active*;[14] those reporting *less than seven hours and at least four hours* were classified as *moderately active*, and those performing *less than four hours a week of vigorous and/or moderate activity* were classified as *inactive*.[15]

Time spent watching television. Time spent in front of the television or computer screen was classified according to time in hours spent watching television shows and movies, as well as playing video games at home. *Adequate time class* was considered to be 12 hours/week on average (~80 minutes/day). More than 12 hours and <21 hours per week (an average of 135 minutes a day) was classified as *less than adequate*, and >21 hours was considered *inadequate* (average of 3 hours or more per day). The American Academy of Pediatrics (2001) recommends no more than 1 to 2 hours per day.[16]

Knowledge. Topic identification was carried out through formative research: discussion groups, meetings with experts (psychologists, teachers, nutritionists and physical education teachers) and review of specialized literature. 20 questions were structured with the collected information. Evaluation criteria were writing style, comprehension and content of items. The final questionnaire consisted of 13 items (seven in the food section and six in the physical activity section). Both sections were designed with closed multiple choice questions, and two questions used graphics as answers. A pilot study was carried out with the participation of 30 children to facilitate error detection. These were corrected for the final version.

The results were analyzed and compared considering the average notes obtained by the children in every test –using a scale of 1 to 10– for both food intake and physical activity and according to the group to which they

belonged. Finally, a comparison was performed in order to establish the approval percentage among the students for the two topics (≥ 6 = approved; <6 = failed).

Self-efficacy. To evaluate the self-efficacy of children with respect to physical activity, a 12-item dichotomous scale was used, which was designed and validated for Mexican school-age children by Aedo and Avila (2009).[17] The scale consists of three dimensions for self-efficacy: search for positive alternatives, ability to face potential barriers and expectations related to skill or competence.

To assess self-efficacy on the topic of healthy eating, specific questionnaires validated for the population of children were used as a reference, and the items were adapted to be consistent with the physical activity scale. This resulted in a dichotomous choice (yes or no) questionnaire consisting of 13 items with a Cronbach alpha of 0.478. Both scales were previously validated for children of similar ages and characteristics.[18,19]

The results were obtained from the sum of positive responses (value 1). The minimum value obtained was "0" and the maximum was "12" or "13", according to the number of items in each scale. The percentages of positive responses were then estimated for each evaluation.

Based on the percentage obtained in the previous scores described, the self-efficacy level was categorized for each child according to three groups:

1. *Low self-efficacy*, classified between 0 and 33.3% when the child had little confidence in him/herself in terms of modifying behavior related to food intake or physical activity.
2. *Medium self-efficacy*, classified between 33.4 and 66.6% when the child believed he/she could perform various activities (related to his/her eating or physical activity) but was not sure about his/her ability to successfully complete them.
3. *High self-efficacy*, rated between 66.7 and 100% when the child was convinced he/she would succeed in performing a certain behavior and was willing to modify his/her actions and behaviors.

The above classification was based on the results obtained by the efficacy study regarding this strategy, which does not establish scales for the self-efficacy questionnaire but treats this as a continuous variable in order to avoid loss of sensitivity and predictive information.[20] The Eating Self-Efficacy Scale was also included as a way to measure self-efficacy and was adapted for the Spanish language.[21]

School variables

For school evaluation, observations of the cooperative were conducted, the purpose of these observations was to document the products sold in the school, as well as the access and availability of food, and to record the recipes and their ingredients.

As part of the observation, food preparations –including tacos, sandwiches, and crisp-tortilla preparations- were weighted. The gathered information was recorded in three observation forms:

a) School co-operative stock: This consists of eight sections, each one including a list of food items commonly offered and spaces for recording presence/absence.
b) Food availability: A list including product name, brand and portion size, and spaces for recording presence/absence.
c) Recipe breakdown: A form with blank spaces for recording the ingredients of each recipe as well as thier weight.

For information about the school environment, variables related to the availability of foods in the school were used and classified into four groups. Variables indicating the presence or absence in school were built as follows: the first group covered the availability of dairy and yogurt products; the second group consisted of juices and nectars; the third group included snacks, cookies and crackers, cakes and desserts, and the fourth group, oilseeds and dry pulses (edible seeds).

Schoolyards

In order to evaluate the availability of spaces for physical activity, measures were taken of the schoolyards; the data gathered included not only the width and height data but also the shape (rectangular, square or other), the activity or games performed in it (soccer, basketball, volleyball, multiple uses, floor games etc.), and, finally, whether the schoolyard is covered or not.

Water

In order to to evaluate the availability of water for human consumption, the number and conditions of the drinking fountains existing in the school was recorded in a form, as well as the presence and the potability of water.

Data analysis

A descriptive analysis was conducted using frequencies and means with respective confidence intervals for each variable. In order to verify comparability among groups, χ^2 tests were performed for independence between the intervention and control groups for the baseline measurements by categorical variables. A student t-test was used for numerical variables when applicable.

Environmental-individual group pattern classifications were built using Ward's hierarchical clustering method with multivariate Euclidian distances.[22] Four variables for food availability at school level and average number of children per school using an ecological approach for the socioeconomic index, physical activity, time in front of the television, and scores for knowledge and self-efficacy regarding food intake and physical activity were used. A scheme with patterns grouped into three clusters was chosen based on the shortest distances between groups and an on appropriate environment-individual characterization.

A longitudinal panel data model using Generalized Estimating Equations (GEE) with exchangeable correlation matrix[23] was utilized to study the association between the prevalence of overweight and obesity in children and intervention, pattern groups and follow-up stage. Gender and age were used as adjusting variables. A confidence intervals graph was utilized to show factor interactions. All analyses were conducted using Stata 11 package, with the "xtgee" command with an individual ID as panel indicator and stage as time variable. A significance level of 0.05 was used for main effects, and 0.2 was used for interactions.[24]

Ethical aspects of the study

Written authorization was requested from school principals for school participation in the study and from teachers of the study groups for their inclusion. The purpose and procedure of the study, freedom from risks, and time required to administer the questionnaire along with the process to measure weight and height were explained to the mothers of the participating children. After this explanation, written authorization (informed consent) was requested. This procedure was repeated with the children selected to participate in the study, with a letter of agreement.

The protocol for this study was submitted to and approved by the ethics, biosafety and research committees from the National Institute of Public Health of Mexico.

Results

The baseline characteristics of the children are shown in Table I, where few statistically significant differences between intervention and control groups were found. *T*- and χ^2 tests, respectively, found differences in consumption of nutrients, physical activity and time spent watching television, which are likely to be associated with the lifestyles of the children. Nevertheless, we found no differences in BMI by gender or by prevalence of OW+O.

The study groups showed no significant differences in distribution by gender, age, socioeconomic level, knowledge and self-efficacy related to food intake and physical activity.

Figure 1 shows the pattern group classifications into the three groups obtained from the cluster analysis. These pattern groups were defined as follows:

Group 1: With an intermediate availability of food, high socioeconomic index, high mean scores for physical activity performance and for time spent watching television, and high scores for knowledge and self-efficacy related to food intake and physical activity.

Group 2: With a high availability of foods, a low socioeconomic level and low scores for knowledge, self-efficacy, time spent watching television and physical activity performance.

Group 3: With a low availability of all food groups, low scores for knowledge and self-efficacy regarding food intake and physical activity, medium socioeconomic index, and a score slightly above the average for time performing physical activity and watching television.

Table II shows the population averaged model representing the effect of the pattern groups, stage and the intervention on the probability of overweight and obesity in children. It can be observed that the intervention alone has a protective effect (p=0.007).

The interaction between the intervention and group pattern (overall p=0.18), shows significant differences in the prevalence of OW+O between groups 1 and 3 (p=0.066); on the other hand, a small non-significant difference in group 2 was shown (p=0.43). A significant interaction between the stage and the group patterns was found (overall p=0.04); there were differences between groups 1 and 3 (p=0.014) and between groups 2 and 3 (p=0.055), while there were no differences in prevalence (p=0.44) between groups 1 and 2. There are no significant effects for the intervention-stage or intervention-stage-pattern group interactions.

Table I

Baseline characteristics of 5th grade children of public schools in the State of Mexico. Mexico 2010-2011

	Intervention n = 510	*Control n = 509*	*p*
Sex (%)			
Female	51.6 (47.2-55.9)	49.7 (45.4-54.1)	0.55
Male	48.4 (44.1-52.8)	50.3 (45.9-54.6)	
Age (%)			
<10	7.5 (5.2-9.7)	10.5 (7.8-13.1)	0.49
10	78.6 (75.1-82.2)	75.3 (71.3-78.8)	
11	10.4 (7.7-13.0)	10.3 (7.6-12.9)	
12	2.2 (0.9-3.4)	2.8 (1.3-4.2)	
≥13	1.4 (0.4-2.4)	1.2 (0.4-2.7)	
SEL Index (%)			
Low	34.9 (30.8-39.0)	34.1 (30.1-38.3)	0.12
Medium	33.7 (29.6-37.8)	39.3 (35.0-43.5)	
High	31.4 (27.3-35.4)	26.5 (22.7-30.4)	
Overweight (%)			
Female	20.2 (15.3-25.0)	23.3 (18.0-28.6)	0.39
Male	19.0 (14.1-23.9)	25.9 (20.5-31.3)	
Obesity (%)			
Female	11.4 (7.6-15.3)	9.6 (6.0-13.3)	0.78
Male	17.4 (12.7-22.2)	15.1 (10.7-19.6)	
BMI (X)			
Female	18.6 (18.1-19.9)	18.7 (18.3-19.1)	0.6
Male	18.8 (18.3-19.2)	18.8 (18.4-19.3)	0.85
Diet (X)			
Energy (Kcal)	1731.0 (1656.5-1805.5)	1509.2 (1437.6-1580.8)	0.0001
Carbohydrates (g)	339.7 (324.0-355.4)	299.0 (284.2-313.8)	0.0002
Fats (g)	28.9 (27.5-30.4)	24.3 (23.0-25.6)	0.0001
Physical activity (%)			
Inactive	21.9 (18.3-25.4)	47 (42.7-51.4)	0.0001
Moderately active	14.4 (11.3-17.4)	14.6 (11.5-17.6)	
Active	63.8 (59.6-68.0)	38.4 (34.2-42.6)	
Time watching television			
Adequate	68.5 (63.5-73.5)	80.3 (76.9-83.8)	0.0001
Less than adequate	26.8 (22.3-31.2)	17.7 (14.6-20.8)	
Inadequate	4.7 (3.0-6.4)	2.0 (0.4-3.5)	
Knowledge (X)			
Food intake	7.5 (7.3-7.6)	7.3 (7.2-7.4)	0.04
Physical activity	7.2 (7.1-7.3)	7.2 (7.0-7.3)	0.40
Food Intake (%)			
Approved >6	82.1 (78.8-85.5)	77.2 (73.6-80.9)	
Failed <6	17.9 (14.5-21.2)	22.8 (19.1-26.4)	0.05

(Continue…)

(Continuation)

Physical activity (%)			
Approved >6	85.7 (82.6-88.7)	84.3 (81.1-87.4)	0.5
Failed <6	14.3 (11.3-17.4)	15.7 (12.6-18.9)	
Self-efficacy (X)			
Eating	8.6 (8.5-8.7)	8.5 (8.4-8.6)	0.2
Physical activity	6.8 (6.6-6.9)	6.7 (6.6-6.9)	0.7
Food intake			
High	94.9 (93.0-96.8)	91.9 (89.6-94.3)	
Medium	5.1 (3.2-7.0)	7.9 (5.5-10.2)	0.1
Low	-	0.2 (0.0-0.6)	
Physical activity			
High	43.6 (39.3-47.9)	42.4 (38.1-46.7)	
Medium	53.4 (49.1-57.8)	53.0 (48.7-57.4)	0.4
Low	3.0 (1.5-4.4)	4.5 (2.7-6.3)	

Note: Variable scales are (X) for numerical and % for categorical
Results are estimate (95% interval)
Statistical significance for comparisons is at the right end (t test for numerical and chi square for categorical)
BMI: body mass index; SEI: Socioeconomic index

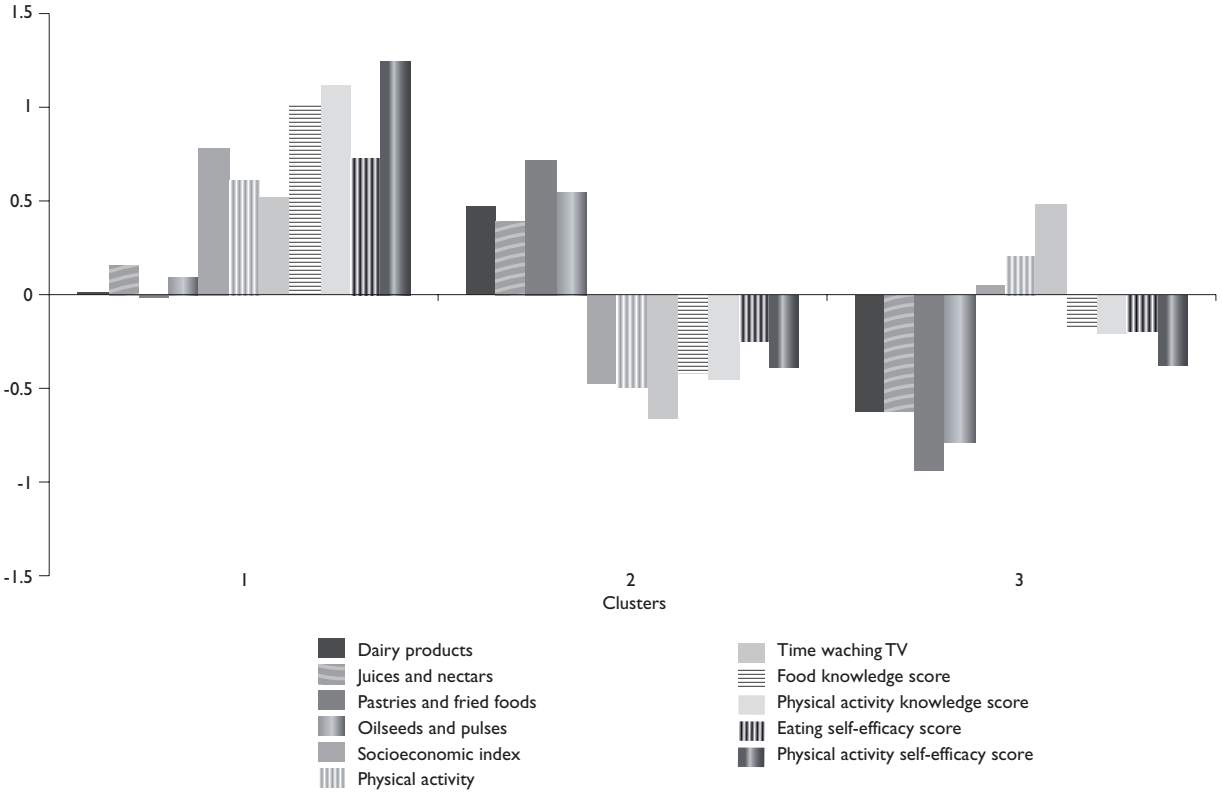

Figure 1. Variable averages according to environment classification (standardized units). State of Mexico, México, November 2010 - June 2011

Table II
Population-Averaged model by pattern group, intervention and stage-related effects on overweight and obesity in 5th grade children of public schools in the State of Mexico. Mexico 2010-2011

Overweight and obesity	*OR*	*95%CI*	*Significance (p)*
Pattern group 2	0.323	(0.191-0.545)	<0.001*
Pattern group 3	0.356	(0.186-0.680)	0.002*
Intervention(tx)	0.463	(0.266-0.806)	0.007*
Interaction between Tx and Pattern group 2	1.365	(0.632-2.950)	0.428
Interaction between Tx and Pattern group 3	2.022	(0.953-4.288)	0.066*
Stage (final)	1.030	(0.833-1.200)	0.708
Interaction between Stage and Pattern group 2	0.930	(0.773-1.118)	0.440
Interaction between Stage and Pattern group 3	0.785	(0.646-0.952)	0.014*
Age	0.966	(0.855-1.091)	0.575
Sex (female)	0.789	(0.618-1.029)	0.082

Reference categories are baseline, control group, pattern group 1 and sex (male)

* Significant differences

Figure 2 shows the interaction effect of the intervention, stage and pattern groups. It is clear that groups 2 and 3 are associated with a lower prevalence of overweight and obesity (p <0.001 in both cases); in group 1, with a high prevalence of overweight and obesity, the intervention shows group differences. In the pattern group 2, the prevalence was lower, but the intervention effect was not significant, whereas in group 3 there was a small prevalence but a significant reduction on follow up.

Discussion

In the present study, intervention effects were not significant; however, pattern groups showed important differences and implications regarding the prevalence of OW+O. Thus, the implementation of an intervention strategy like "Nutrition on the Go" should take into account the potential effect of different patterns with more obesogenic factors, including high availability of foods, to improve intervention effectiveness.[25]

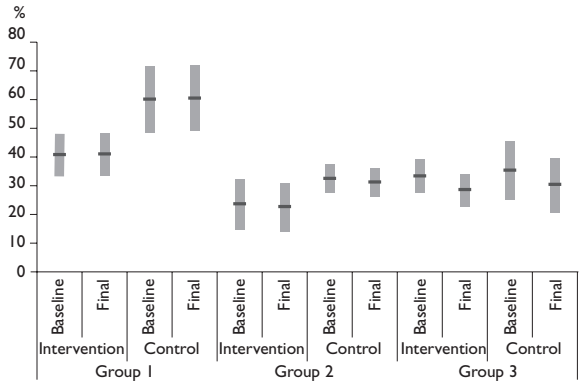

Figure 2. Interaction effects on the estimated prevalence of overweight and obesity. State of Mexico, México, November 2010 - June 2011

Several pervasive environmental factors have been documented to promote energy intake and to limit energy expenditure in children, undermining individual efforts to maintain a healthy bodyweight.[26] Different types of environmental influences may also operate across these multiple domains, affecting not only physical characteristics but also those associated with social, cultural and political environments.[27]

Schools are a natural setting for influencing the food and physical activity environments of children.[28] It has been documented that school-age children with higher socioeconomic levels and greater availability of food are more prone to being OW+O;[29] the present study produced similar results. This may be due to easy access to energy-rich, low-nutrient foods, as well as access to transportation and the lack of access to healthier alternatives and recreational opportunities.

A study conducted in Brazil found that children who consumed food sold in school stores had a greater likelihood of being overweight or obese (OR=1.56; 95%CI:1.19-2.16). In addition, children from higher socioeconomic backgrounds (OR=1.93, 95%CI:1.32-2.85) also were at increased risk of obesity.[30]

Another study conducted in the U.S.[31] concluded that the differences in BMI by school suggest that some characteristic of the school and/or community environ-

ment –perhaps cultural factors or differences in school food, beverage, or physical education policies– facilitate obesity in schools with a high concentration of students with a lower socioeconomic status, beyond individual-level factors.

A small favorable effect of the "Nutrition on the Go" strategy to prevent OW+O[9] can be observed. Various articles have documented the effect of strategies to promote healthful eating and physical activity on the prevention and control of OW+O.[32-34]

An important result is that the differences between pattern groups showed differential possibilities for intervention strategies and also different responses. These are important issues for the design and implementation of effective intervention strategies appropriate to each specific group pattern.

A national survey of schools in Mexico[35] documented a high prevalence of OW+O in children of the same age as the children represented in this study (30.3%) with a tortilla-based diet, a low or nonexistent consumption of fruits and vegetables, and a high and frequent consumption of sodas. As to the performance of physical activity, ~50% were inactive.

The availability of food in school stores showed high access to energy-dense foods, foods high in fats and sugars and low in micronutrients and fiber (sweets, commercial snacks, sandwiches, hot dogs, hamburgers and sodas), and fried foods such as *sopes*, *quesadillas*, French fries and *molletes* (bread topped with beans and melted cheese). This situation strengthens an environment that favors the onset of obesity when there are no comprehensive action strategies.

One original aspect of the present study is the cluster analysis, a technique that has been highly employed to construct typographies or classifications useful for the analysis of multivariate data and recently used in an efficient way to solve multiple boundary problems between explanatory variables when building statistical models.

The results of the present study are useful to identify elements of school and individual characteristics that significantly influence the development of obesity and that can be modified for prevention and control in intervention strategies, taking into account that children spend one-half of their days in school.

For the 13 reagent questions included in this self-efficacy scale, Cronbach alpha was 0.478, which indicates that an association may be intermediate, i.e., the estimated efficacy rate has an internal mean consistency. Future studies should validate the self-efficacy scale for food in children.

Study limitations

An important study limitation is the use of indirect instruments to measure children's diet and physical activity; however, the questionnaires used were adapted and pre-tested with representative populations in Mexico,[11,13] which contributes to the validity of the presented information. Using the questionnaire of Hernández and colleagues, we evaluated routine physical activity; while we recognize that this is a reporting method that cannot be verified, it is an approach to what happens outside of the school.

Conclusions

In the present study, the effects of the intervention were not significant; however, pattern groups showed important implications for the prevalence of OW+O, and therefore the implementation of an intervention strategy should take into account the potential effect of different patterns to improve effectiveness.

Efforts to tackle obesity should focus on prevention rather than treatment. The challenge that lies ahead is to identify obesogenic group patterns and to influence them so that healthier choices are more available, accessible, and widely promoted to a large proportion of the school community.[28] The results obtained in this study will be used as a basis for future studies to explore the impact of pattern groups on intervention strategies in order to improve their efficiency.

Therefore existing school policies should be strengthened to ensure the availability of healthy food as well as limit the energy-dense food supply. In addition, the frequency, intensity and duration of physical activity at school should be increased. Thus, a systematic and coordinated response by the society and an increased political will are required to prioritize the health and well-being of children.

Implications for school health/school health professionals

This study provides evidence of the need for further investigation of the environmental-individual interactions in school. It is necessary to identify the factors that contribute to obesogenic patterns, as well as to implement new strategies for obesity prevention in school-age children. Communities may be able to improve child nutrition through school-based nutritional programs and policies that address the sale of healthy foods.

Declaration of conflict of interests. The authors declare that they have no conflict of interests.

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