



Boletín Médico del Hospital Infantil de México (English Edition)

www.elsevier.es/bmhim



RESEARCH ARTICLE

Effect of an intervention based on child-care centers to reduce risk behaviors for obesity in preschool children[☆]

Hortensia Reyes-Morales^{a,*}, Marco A. González-Unzaga^b, Alejandra Jiménez-Aguilar^c,
Rebeca Uribe-Carvajal^c

^a Hospital Infantil de México Federico Gómez, Mexico City, Mexico

^b Unidad de Investigación Epidemiológica y en Servicios de Salud, Centro Médico Nacional Siglo XXI, Instituto Mexicano del Seguro Social, Mexico City, Mexico

^c Instituto Nacional de Salud Pública, Cuernavaca, Morelos, Mexico

Received 10 November 2015; accepted 18 November 2015

Available online 19 March 2016

KEYWORDS

Prevention;
Overweight;
Obesity;
Preschool children;
Child-care centers

Abstract

Background: Preschool age is a critical stage for health promotion and prevention of obesity, which is an emerging public health problem in children. The aim of this study was to design and evaluate the effect of a multifaceted intervention based on child-care centers to reduce risk behaviors for obesity among preschool children.

Methods: A 12-month cluster-randomized community trial was conducted in 16 Mexican Institute of Social Security child-care centers in Mexico City. Children between 2 and 4 years of age enrolled in the selected child-care centers participated in the study. Intervention comprised 12 weekly curriculum sessions for the children, and six family workshops. Changes in children's dietary and physical activity, food availability at home, and maternal feeding styles were determined after 6 and 12 months. Changes within groups among stages, and between groups by stage were analyzed through X^2 test.

Results: The intervention showed a decrease of home availability for some non-recommended foods and an increase in physical activity in the intervention group compared to the control group.

[☆] Please cite this article as: Reyes-Morales H, et al. Efecto de una intervención basada en guarderías para reducir conductas de riesgo de obesidad en niños preescolares. Bol Med Hosp Infant Mex. 2016;73:75-83.

* Corresponding author.

E-mail: hortensiareyes0406@gmail.com (H. Reyes-Morales)

PALABRAS CLAVE

Prevención;
Sobrepeso;
Obesidad;
Preescolares;
Guarderías

Conclusions: Improvement in physical activity can be effective in the long term; innovative strategies aimed to modify family dietary risk behaviors are required.

© 2016 Hospital Infantil de México Federico Gómez. Published by Masson Doyma México S.A. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Efecto de una intervención basada en guarderías para reducir conductas de riesgo de obesidad en niños preescolares

Resumen

Introducción. La edad preescolar es una etapa crítica para la promoción de la salud y la prevención de la obesidad, que es un problema emergente de salud pública en la niñez. El objetivo de este trabajo fue diseñar y evaluar el efecto de una intervención multifacética basada en la atención en guarderías para reducir conductas de riesgo de obesidad en niños preescolares.

Métodos. Se realizó un ensayo comunitario, aleatorizado por conglomerados, en 16 guarderías del Instituto Mexicano del Seguro Social de la Ciudad de México. El estudio duró 12 meses. Participaron niños entre 2 y 4 años de edad que asistían a las guarderías. La intervención consistió en 12 sesiones educativas semanales interactivas para los niños y seis talleres familiares. Se determinaron cambios de alimentación y actividad física, disponibilidad en el hogar por tipo de alimentos y estilos maternos de alimentación a 6 y 12 meses. Se comparó el cambio por etapa en cada grupo y entre ambos grupos en cada etapa con la prueba X^2 .

Resultados. Se observó reducción de disponibilidad en el hogar de algunos alimentos no recomendados y mayor actividad física en el grupo de intervención.

Conclusiones. La mejora en actividad física puede tener efecto en el largo plazo; se requieren estrategias innovadoras que modifiquen las conductas alimentarias de riesgo para obesidad en las familias.

© 2016 Hospital Infantil de México Federico Gómez. Publicado por Masson Doyma México S.A. Este es un artículo Open Access bajo la licencia CC BY-NC-ND (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

1. Introduction

Preschool age is currently recognized as a critical stage to obtain the maximum benefits in health promotion and prevention of diseases. Due to the growing problem of overweight that affects the population around the world, including children,¹ the early childhood is considered as a priority stage to establish actions to promote their healthy development, where an adequate physical activity² and a good nutrition³ are key features.

There is growing evidence of interventions directed to promote healthy preferences in children from an early age because it is widely believed that the incorporation of this habits at this stage will favor permanent lifestyles.^{4,5} Also, the inclusion of care providers, educators, parents and caregivers of children in obesity prevention strategies⁶ has been recommended, since young children are more susceptible to interventions focused on environmental and behavior factors of members of their own family environment, childcare centers and schools.⁷ However, to date, there are few interventions aimed at the prevention of overweight, particularly in children under 6 years.⁸⁻¹¹ Most studies have focused on school age, with varying results in behavior modification and decreasing the proportion of overweight.^{12,13}

The recognition of preschool age as an area of opportunity for the prevention of overweight, with advantages over older children, has led to the identification of childcare centers as

favorable spaces for the implementation of strategies to improve nutrition programs and physical activities. Childcare centers are places where many children spend most of the day, and therefore, where they consume a high proportion of calories and perform daily physical activity, so they are ideal for setting actions to promote healthy behaviors.¹⁴

However, it is also necessary to establish relevant strategies at home, in order to achieve and maintain an adequate nutritional status. The success of the actions in daycare centers requires the involvement of parents and caregivers, as they have the potential to positively influence the young child's healthy preferences, mainly by offering a favorable environment that facilitates healthy eating, and preferring an active life, becoming role models for their children.^{15,16}

In Mexico, the nutritional status of the population has changed substantially in the last two decades. In children, this change has manifested itself in the reduction of the prevalence of malnutrition and the emergence of obesity as a public health problem.^{17,18} In the Mexican Social Security Institute (IMSS), which is the largest public health institution in Mexico, the prevalence of overweight has increased dramatically in recent years, even among children; in 2012, 38.1% of overweight in insured schoolchildren has been reported.¹⁷

In 2009, approximately 30,000 children were enrolled in 142 childcare centers of direct provision of IMSS (childcare centers run by the IMSS own and attended by institutional

staff). Children, sons of IMSS cardholder working mothers, remain under the care of educators and childcare officers during the working hours of their mothers, receive their food at the childcare center and carry out activities in accordance with institutional programs. These areas represent a major opportunity to perform interventions for obesity prevention, focused on promoting physical activity and healthy eating behaviors that, if successful, have the potential to extend to similar contexts. Therefore, the main objective of this study was to design and evaluate the effect of a multifaceted intervention based in the attention at IMSS's daycare centers to reduce obesity risk behaviors in children 2 to 4 years old.

2. Patients and methods

A community assay was performed, randomized by conglomerates in sixteen IMSS's daycare centers in the city of Mexico, with duration of 12 months; eight daycare centers from intervention and eight from non-intervention with usual care were assigned randomly.

2.1. Selection criteria

The childcare centers that were selected have registered at least 40 children between the ages of 2 and 4 years and the respective directors agreed to participate in the study. To ensure a one year later follow-up, all children of 2 and 3 years of age, regardless of their nutritional status, and attending the selected childcare centers were deemed eligible. We included children whose participation was accepted by their parents by way of written informed consent. Children with chronic conditions that interfere with their growth and which would prevent performing physical activity and consequently limit anthropometric measurements, or children with special food requirements, were excluded. The 16 childcare centers were paired and classified according to their size. Each pair was randomized using a computerized procedure in order to assign a childcare center to intervention and non-intervention groups. The following criteria were established in order to identify differences in the proportion of risk behaviors with obesity as the main variable: minimum rate of detectable change being 10%; α error of 0.05 in unilateral test; β error of 0.20 corresponding to 80% of power.¹⁹ The required sample size was 614 children (307 in 8 childcare center interventions and 307 in the usual care setting).

2.2. Intervention

The intervention had three components:

- 1) Training of childcare center staff. Before the start of the intervention, a 3-day workshop was held (24 h in total) for the benefit of educators and childcare officers of the childcare centers. Teaching was undertaken by two researchers (AJ, HR), with the aim of facilitating the knowledge and skills required for the delivery of educational sessions for children and the promotion of their role in daily care. The training focused on three main themes with interactive dynamics: feeding behaviors and individual physical activity of children; the eating environ-

ment and physical activity in daycare centers; and strategies for providing health information to parents in order to improve the home environment in both areas.

- 2) Educational sessions for children. Childcare officials, with support from educators, conducted 12 interactive educational sessions (one per week) with game dynamics for key eating behaviors and physical activity. These sessions were designed by researchers in collaboration with educators of intervention childcare centers and were approved by the directors, in order to ensure their applicability. The content and procedures of the sessions were included in an implementation manual that was designed specifically for the project, and is currently published.²⁰ It was developed for the cultural context of the target population, based on information from a formative research that was conducted prior to the start of the intervention that is described in another publication.²¹ All sessions included the two components (diet and physical activity). The nutrition component focused on introducing children to a variety of healthy snacks and natural water in order to strengthen their good habits for healthy food and beverage preferences. The activities offered some options of different foods and beverages as well as games to direct their personal choices to the best one(s). For the physical activity component, children were presented with purpose-built games, designed to be easy to perform, in order to identify the most accepted and feasible games that could also be performed at home. The material and equipment for each childcare center intervention to perform the activities were provided.
- 3) Workshops with parents. Educators in childcare centers, in collaboration with the childcare officers and the research group, conducted an afternoon workshop every 2 months throughout the implementation period, with dynamics in which they communicated key messages to promote behavior changes in accordance with whatever was touched on in the sessions with the children. As a reinforcement, they developed posters with the monthly target of changes, included in meetings with the children as well as card games and short messages that were permanently available to the parents throughout the study. The eight childcare centers included in the non-intervention group continued their usual activities, which consisted of educational sessions for parents who were taught by the staff of the Mexican Social Security Institute (IMSS) on different health issues of children, and with a monthly frequency.

2.3. Result variables

The result variables included individual changes in obesogenic behaviors, like the frequency of consumption of sugary drinks and foods with high calorie count and low nutritional value, in addition to performing physical activity, and changes in the nutritious environment and physical activity at home.

Three measurements were made of the variables: basal (baseline), at 6 months (intermediate) and at 12 months (final) in the 16 childcare centers, using the same procedure.

Parents were handed a questionnaire to be answered at home within 4 days. The questionnaire was designed to determine the following information:

- a) Availability of food at home. Parents had to make an inventory of existing food in the pantry and refrigerator, selecting them from a list of 108 and 113 foods, respectively, grouped into 13 categories. The response was dichotomous (Yes/No).
- b) Perceptions and maternal feeding styles for children. We included ten questions with four choices of responses (strongly agree, agree, disagree, strongly disagree).
- c) Frequency of food consumption (modified from the individual questionnaire of children aged 0 to 9 years of the National Health and Nutrition Survey 2006²²). We included 144 choices to assess the number of occasions a food was consumed during the last month, weekdays and weekends.
- d) Physical activity. We included a list of 12 activities for parents to select the ones their children performed and, if necessary, the usual average time spent on the activity per day, weekdays and weekends.

2.4. Statistical analysis

A descriptive analysis of the variables obtained in each of the three measurements to characterize the sample group (intervention and usual care) was performed. We compared the change by stage in each group, and the proportion of variable availability and food consumption between the two groups, as well as physical activity using X^2 test. The analysis was performed using the statistical software *Stata* version 12.

The study was approved by the National Commission of the Mexican Social Security Institute (No. 2007-785-049) Scientific Research and was recorded in the database Clinical Trials (NCT01679938).

3. Results

The basal stage included 674 children, 336 in the intervention group and 338 of the non-intervention group (response rate of 68.2 and 66.3%, respectively). The age of the mother was, on average, 32 years old; the majority were living with a partner and full-time working hours. Almost two thirds of households had a maximum income of \$15,000 MXN per month (Table 1).

The data of the variables related to the availability of food at home, perception and maternal feeding styles, consumption of selected foods and physical activity are presented in each evaluation (basal stage, 6 and 12 months), with comparisons of the variables between the two groups (intervention and usual care), by stage and within each group between stages. It can be observed that there are differences in the number of children in each group stage because, throughout the study, there were admissions of children from other rooms that met two years of age and departures of others who completed 4 years old and who changed room or left the childcare center. Despite this replacement, the study sample was similar in number during the three stages.

Table 1 Participant basal characteristics

Child characteristics	Intervention n = 336 (%)	Usual care n = 338 (%)	p value
<i>Gender</i>			
Female	172 (51.2%)	165 (48.8%)	NS
Male	164 (48.8%)	173 (51.2%)	
<i>Age (months)*</i>	32.9 (6.1)	33.1 (6.1)	NS
<i>Mother characteristics</i>			
<i>Age (years)*</i>	32.6 (5.6)	32.5 (6.1)	NS
<i>Civil status</i>			
Married	170 (50.6%)	163 (48.2%)	NS
Free union	84 (25.0%)	87 (25.7%)	
Single	57 (17.0%)	50 (14.8%)	
Divorced	16 (4.8%)	24 (7.1%)	
Non specified	9 (2.7%)	14 (4.1%)	
<i>Employment</i>			
Full-time (≥ 35 h/week)	244 (73.7%)	249 (73.7%)	NS
Part-time (<35 h/week)	29 (8.6%)	36 (10.7%)	
Full-time rotary working day	29 (8.6%)	26 (7.7%)	
Full-time double working day	18 (5.4%)	16 (4.7%)	
Non specified	16 (4.8%)	11 (3.3%)	
<i>Home monthly income (MXN)</i>			
< \$5,000	52 (15.5%)	64 (18.9%)	NS
\$5,000-\$15,000	147 (43.8%)	129 (38.2%)	
\$15,001-\$25,000	48 (14.3%)	48 (14.2%)	
>\$25,000	18 (5.4%)	21 (6.2%)	
Non specified	71 (21.1%)	76 (22.5%)	

*Mean (SD). NS: not significant.

Table 2 shows the proportion of availability at home for selected food. Sugary drinks and some food with high energy content and low nutritional value, as well as natural water, some vegetables and fruit were included. There was a significantly higher proportion of availability of apples and soft drinks, as well as a lower proportion of fritters and cakes in the intervention group compared to the non-intervention group in the stage of 6 months. There was also an increase in the flavored water content and a decreased availability of yoghurt, cream and Danonino (dairy product) in the measurement of 12 months compared to baseline measurement in the intervention group. The latter food were also found significantly less frequently than in the control, as well as in-shell peanuts in the final measurement.

Maternal perceptions and feeding styles were similar between groups at basal stages and 6 months. At 12 months, only three items showed differences: the insistence on offering new food that the child refuses, that had a diminished frequency in the intervention group, and to avoid the excessive intake of sweets and favorite foods, both of which showed higher frequency in mothers in this group (Table 3).

Table 4 shows examples of food and drinks not recommended. In the table, the comparison with the proportion of natural water and fruit water for both consumer report on weekdays to weekends is shown. Importantly, we detected a similarity of proportions in most of the areas, both between groups at all stages and in comparison with 6 and 12 month follow-up in both groups. In the measurement at 6 months there were no changes in consumption compared to baseline, and in the 12 months measurement only fruit water and yogurt showed differences. The highest frequency of consumption was observed among children in the intervention group compared to usual care. The consumption of “hot

dogs” (bread with sausage) was about 10% lower in children with intervention, but remained similar with regard to the previous stages of the same group.

Physical activity of children during the week, determined as the performance of the activity for more than 15 minutes (on average), is shown in Table 5. In the basal stage, we found a lower frequency in the activity “climb up or down stairs” and “ball game” in children in the intervention group. In the 6 months stage, a higher proportion of “climbing games at the park” was observed, although less in use of “bicycle/tricycle” was shown compared with the control. At 12 months, the increase in the frequency of “games in the park” in children of the intervention group with respect to the baseline stage (about 15%) was very significant, and the frequency increase of “walk away from home”, “climb up or down stairs” and use of “bicycle/tricycle” was significant. In this same stage we observed differences in the children in control group, who presented a higher rate of games in the park (“climb”, “slide/swing”), “bicycle/tricycle” and “skating”.

4. Discussion

The results of a year of activities—mainly targeting children in kinder in daycare centers and in workshops and in the ongoing interaction with the parents in the intervention group—showed the important role of the family as environment and model for shaping healthy habits in children. The identification of perceptions and maternal styles of feeding showed favorable behaviors for excessive consumption, little concern to avoid the intake of food with low nutritional value (even at the end of the follow-up period) and to per-

Table 2 Home availability of selected foods over the three measuring stages

Food	Stage 1 (basal)		Stage 2 (6 m)		Stage 3 (12 m)	
	Intervention % (n = 336)	Usual care % (n = 338)	Intervention % (n = 366)	Usual care % (n = 287)	Intervention % (n = 298)	Usual care % (n = 307)
Plain water	88.7	84.9	90.2	85.7	93.3	88.6
Fruit water	24.4	26.3	23.0	23.7	31.5**	29.3
Packaged juice/nectar	40.8	36.1	35.5	36.9	40.3	38.4
Apples	88.1	87.9	91.0*	85.7	87.9	86.8
Soft drinks	29.2	34.0	32.2*	25.8	26.2	30.0
Yogurt	53.9	52.1	59.8	52.3	47.7**	52.8
Boing ^a	48.8	53.0	49.5	46.0	50.3	45.0
Broccoli	40.8	37.3	44.3	39.7	36.2	39.1
Raw peanuts	28.9	32.0	28.7	29.3	35.9*	26.7
Dairy cream	62.5	55.9	61.5	60.3	50.0***	57.7
Danonino ^b	52.7	50.3	52.2	48.1	40.4***	49.8
Green beans	36.6	33.4	39.3	39.4	34.6	35.2
Fritters	22.9*	30.2	23.2*	29.6	27.5	27.0
Chicken/beef nuggets	21.1	23.1	19.1	20.2	21.1	21.5
French fries	25.0	30.8	23.5	26.8	27.9	27.0
Cakes	11.9	14.5	8.7*	14.3	13.8	12.4
Sausages	57.7	52.4	59.8	56.4	53.7	56.0

^aSugary drink; ^bdairy product similar to yogurt.

m: months * $p < 0.05$ among groups of same stage; ** $p < 0.05$ among stages for same food.

Table 3 Mother perceptions and styles to feed participant children over the three measuring stages

	Stage 1 (basal)		Stage 2 (6 m)		Stage 3 (12 m)	
	Intervention % (n = 336)	Usual care % (n = 338)	Intervention % (n = 366)	Usual care % (n = 287)	Intervention % (n = 298)	Usual care % (n = 307)
Often I have to insist my child to eat more	50.0	49.4	47.8	48.1	45.6	43.3
I have to make sure my child finishes the whole drink	50.3	52.1	48.6	53.7	50.0	49.2
I have to make sure my child finishes the whole meal	58.0	59.5	60.1	60.6	58.7	53.3
If my child refuses a new food, I insist more	78.0	79.0	77.3	74.9	73.8*	81.8
My child likes vegetables	82.7	78.7	79.8	76.3	85.9	85.7
Usually my child likes new foods	69.3	66.0	67.6	71.85	72.45	70.43
I have to be careful for not to overfeed my child	55.7	52.1	50.0	55.7	56.7	55.0
Often I cook something else just in case my child does not eat the first dish I offered him/her	26.8	29.9	24.9	29.3	27.2	24.4
I have to make sure my child does not eat too many sweets	74.1	68.6	74.3	73.2	78.5*	72.0
I have to make sure my child does not overeat his/her favorite foods	33.0	35.5	34.7	31.7	38.3*	30.9
I have to make sure my child does not overeat junk food	75.9	73.7	76.5	73.2	77.9	73.0

m: months. * $p < 0.05$ among groups in the same stage.

form group activities in workshops with parents in order to promote the consumption of nutritionally desirable foods. This finding reinforces the need to strengthen programs for the prevention and treatment of obesity with strategies of innovative and permanent work to educate the parents, particularly the mother, who has the most influence on decisions on the type and amount of food offered to the child at home.^{16,23}

Regarding food availability, it is also important to highlight the small change in those with low nutrimental value and high-calorie level as a result of the intervention. Even by gaining acceptance of healthy foods in childcare centers, the preferences will not be consolidated if the continuity at home is lost.²⁴ Numerous studies have found that eating healthy foods (such as fruits and vegetables) is directly related to the availability of these foods at home.^{25,26} Meanwhile, the intake of sugar-sweetened beverages is associated with the habits of the parents to consume soft drinks and the availability of these at home.²⁷ Some experiences in Hispanic communities in the United States have reported difficulties in achieving a parental involvement in conducting family activities,²⁸ which demonstrates the need to search for innovative strategies to achieve it.

In this study, foods provided to children in kinder were not modified, since the institutional regulations prevents changes in the established organization; therefore, the menus that the children received during the hours spent in the

childcare center remained unchanged, and only the use of sugary drinks for natural water was replaced. A previous report of this research group where the current menus in childcare centers from IMSS were analyzed at the intervention period, showed that although these included a variety of foods, they had an excessive caloric value.²⁹ Therefore, a limitation of this study was that the analysis of foods consumed by children was conducted exclusively for the data reported by the parents regarding the intake out of the childcare center, and only the frequency of consumption was estimated, which allowed an approach to the type of food consumed at home but not the amount (in portions) that children received in the daycare. It will be necessary to design studies aimed to analyze this component and that include a complete nutritional assessment.

In contrast, the increased physical exercise by children as a result of the intervention was notorious, mainly in outdoor activities which increased within one year follow up. The analysis emphasized the assessment of physical activity during the week, which implied a change in routines for parents and children, unlike weekend activities that could be sporadic. Assuming that these activities require an effort of parents to devote to family life after their workday—and apparently they are willing to do so—it will be necessary to strengthen social policies that allow this, like a greater number of suitable spaces (parks and gardens). This aspect is fundamental, especially in large cities where most of the

Table 4 Selected foods consumed by participant children over the three measuring stages

Food	Stage 1 (basal)		Stage 2 (6 m)		Stage 3 (12 m)	
	Intervention	Usual care	Intervention	Usual care	Intervention	Usual care
	% (n = 336)	% (n = 338)	% (n = 366)	% (n = 287)	% (n = 298)	% (n = 307)
<i>Food consumption from Monday to Friday</i>						
Sugary water	76.4	77.4	81.8	75.4	80.5	80.9
Plain water	80.6	78.0	82.9	87.7	83.8	82.9
Fruit water	79.4	76.7	79.3	76.8	81.3	75.8
Yogurt	79.2	79.9	79.8	79.3	81.9	82.3
Fritters	4.5	6.6	6.0	4.2	7.1	6.7
Hamburgers	21.7	22.3	23.9	27.6	22.8	26.3
Hot dogs	21.0	21.4	24.6	21.6	23.2*	32.5
Processed juice	79.4	74.8	74.8	78.4	79.7	74.6
Savory milk	75.1*	86.4	81.0	84.6	81.2	83.6
French fries	16.3	19.4	16.1	17.1	16.3	18.2
Pizza	22.3	19.3	24.8	26.6	21.9	27.8
Soft drinks	72.3	73.6	75.1	70.6	79.9	75.5
<i>Food consumption on Saturday and Sunday</i>						
Sugary water	30.8	32.3	28.3	28.9	31.9	33.9
Plain water	91.4	92.1	96.1	94.9	96.9	97.3
Fruit water	79.1	76.8	78.3	77.9	83.6*	74.1
Yogurt	58.8	68.8	67.0	63.7	73.6*	64.3
Fritters	54.3	54.1	52.6	56.0	58.1	55.3
Hamburgers	29.2	33.3	30.1	37.8	36.1	33.5
Hot dogs	24.1	26.4	24.1	34.1	29.5	25.6
Processed juice	73.4	72.3	66.9	67.6	72.8	71.3
Savory milk	48.3	51.6	51.7	48.9	53.1	52.1
French fries	52.9	60.7	52.9	48.4	53.3	51.7
Pizzas	38.3	39.5	36.7	37.7	45.2	41.3
Soft drinks	54.1	57.2	53.2	52.2	54.2	57.7

m: months; * $p < 0.05$ among groups in the same stage.

Table 5 Physical activity performed by participant children over the three measuring stages

Activity ^s	Stage 1 (basal)		Stage 2 (6 m)		Stage 3 (12 m)	
	Intervention	Usual care	Intervention	Usual care	Intervention	Usual care
	% (n = 336)	% (n = 338)	% (n = 366)	% (n = 287)	% (n = 298)	% (n = 307)
Running	43.5	47.3	45.4	48.3	46.6	48.2
Jumping	39.6	42.0	36.1	41.1	40.6	38.4
Walking outside	50.3	52.1	55.2	57.8	61.1**	60.0
Swimming	2.7	4.1	4.4	5.2	6.0	5.2
Up or down stairs	26.2*	36.2	32.8	35.2	36.8**	41.7
Climbing in a park	23.8	26.6	33.9*	27.9	37.2****	29.6
Toboggan/swing	22.9	25.1	33.1	29.6	35.6****	25.7
Activity in game area	18.5	19.5	23.0	20.2	22.1	20.5
Cycling	24.7	24.6	22.7*	30.7	31.2***	25.1
Ball game	34.5*	43.5	39.3	39.0	43.0	40.7
Skating	3.6	2.1	3.0	4.2	5.4*	2.0
Dancing	26.5	29.3	30.1	28.2	30.2	30.6
Active videogames	2.4	3.3	3.3	3.5	3.0	3.6

^sMore than 15 min (average) over weekdays. m: months.

* $p < 0.05$ among groups in the same stage; ** $p < 0.05$ among stages for same activity; *** $p < 0.01$ among stages for same activity.

population live in housing complexes and lacks own spaces to facilitate healthy activities.

In conclusion, the intervention had a substantial effect in improving the physical activity habits of children, which was mainly observed in the stage of 12 months. This suggests that working together with parents to plan their time is a valuable tool to reduce sedentary behavior in children and, in addition, the provision of larger spaces to spend time with their children. It is also remarkable the difficulty of achieving changes in eating behaviors, both in the availability and consumption of food at home, reflecting deeply rooted maternal styles that favor a not recommended environment for proper nutrition of preschool children and their families. Further studies will be needed to assess whether a closer work with the family, with interventions aimed at increasing understanding and acceptance of parents for a better selection on food purchases with higher nutritional value and lower caloric counts, could have better results. Therefore, it is important to continue with strategies to promote better eating habits aimed to the family.

It will be necessary to assess whether the maintenance of implemented activities in day care for a longer period can demonstrate effectiveness that justifies scaling. Also, working together with decision makers is essential for strengthening social programs that enable greater availability of public spaces suitable for the performance of physical activities.

Ethical disclosure

Protection of human and animal subjects. The authors declare that the procedures followed were in accordance with the regulations of the relevant clinical research ethics committee and with those of the Code of Ethics of the World Medical Association (Declaration of Helsinki).

Confidentiality of data. The authors declare that no patient data appear in this article.

Right to privacy and informed consent. The authors have obtained the written informed consent of the patients or subjects mentioned in the article. The corresponding author is in possession of this document.

Funding

Consejo Nacional de Ciencia y Tecnología, No. S0008-114027.

Conflict of interest

The authors declare no conflict of interest of any nature.

References

1. Low LCK. Childhood obesity in developing countries. *World J Pediatr.* 2010;6:197-9.
2. Steinbeck KS. The importance of physical activity in the prevention of overweight and obesity in childhood: a review and an opinion. *Obes Rev.* 2001;2:117-30.
3. O'Connor TM, Yang SJ, Nicklas TA. Beverage intake among preschool children and its effect on weight status. *Pediatrics.* 2006;118:e1010-8.
4. Goldfield GS, Harvey A, Grattan K, Adamo KB. Physical activity promotion in the preschool years: a critical period to intervene. *Int J Environ Res Public Health.* 2012;9:1326-42. doi: 10.3390/ijerph9041326
5. Dehghan M, Akhtar-Danesh N, Merchant AT. Childhood obesity, prevalence and prevention. *Nutr J.* 2005;4:24. doi: 10.1186/1475-2891-4-24
6. Ward DS, Vaughn A, Story M. Expert and stakeholder consensus on priorities for obesity prevention research in early care and education settings. *Child Obes.* 2013;9:116-24.
7. Birch LL, Ventura AK. Preventing childhood obesity: what works? *Int J Obes (Lond).* 2009;33 Suppl 1:S74-S81. doi: 10.1038/ijo.2009.22
8. Finch M, Wolfenden L, Falkiner M, Edenden D, Pond N, Hardy LL, et al. Impact of a population based intervention to increase the adoption of multiple physical activity practices in centre based childcare services: a quasi-experimental, effectiveness study. *Int J Behav Nutr Phys Act.* 2012;9:101. doi: 10.1186/1479-5868-9-101.
9. Piziak V. A pilot study of a pictorial bilingual nutrition education game to improve the consumption of healthful foods in a head start population. *Int J Environ Res Public Health.* 2012;9:1319-25. doi: 10.3390/ijerph9041319
10. de Silva-Sanigorski AM, Bell AC, Kremer P, Nichols M, Crellin M, Smith M, et al. Reducing obesity in early childhood: results from Romp & Chomp, an Australian community-wide intervention program. *Am J Clin Nutr.* 2010;91:831-40. doi: 10.3945/ajcn.2009.28826
11. Waters E, de Silva-Sanigorski A, Hall BJ, Brown T, Campbell KJ, Gao Y, et al. Interventions for preventing obesity in children. *Cochrane Database Syst Rev.* 2011;12:CD001871. doi: 10.1002/14651858.CD001871.pub3.
12. Budd GM, Volpe SL. School-based obesity prevention: research, challenges, and recommendations. *J Sch Health.* 2006;76:485-95.
13. Ickes MJ, McMullen J, Haider T, Sharma M. Global school-based childhood obesity interventions: a review. *Int J Environ Res Public Health.* 2014;11:8940-61. doi: 10.3390/ijerph110908940
14. Lyn R, Maalouf J, Evers S, Davis J, Griffin M. Nutrition and physical activity in child care centers: the impact of a wellness policy initiative on environment and policy assessment and observation outcomes, 2011. *Prev Chronic Dis.* 2013;10:120232. doi: 10.5888/pcd10.120232
15. Baranowski T, Watson K, Missaghian M, Broadfoot A, Cullen K, Nicklas T, et al. Social support is a primary influence on home fruit, 100% juice, and vegetable availability. *J Am Diet Assoc.* 2008;108:1231-5. doi: 10.1016/j.jada.2008.04.016
16. Spurrier NJ, Magarey AA, Golley R, Curnow F, Sawyer MG. Relationships between the home environment and physical activity and dietary patterns of preschool children: a cross-sectional study. *Int J Behav Nutr Phys Act.* 2008;5:31. doi:10.1186/1479-5868-5-31.
17. Gutiérrez JP, Rivera-Dommarco J, Shamah-Levy T, Villalpando-Hernández S, Franco A, Cuevas-Nasu L, et al. Encuesta Nacional de Salud y Nutrición 2012. Resultados Nacionales. Cuernavaca, Morelos: Instituto Nacional de Salud Pública; 2012.
18. Rivera JA, Irizarry LM, González-de Cossío T. Overview of the nutritional status of the Mexican population in the last two decades. *Salud Publica Mex.* 2009;51(Suppl 4):S645-56.
19. Meinert CL. *Clinical trials. Design, conduct, and analysis.* New York: Oxford University Press; 2012.
20. Jiménez Aguilar A, Escalante Izeta EI, Uribe Carbajal R. Prevención de obesidad en niños: una intervención basada en la atención en guarderías del Instituto Mexicano del Seguro Social. Manual de implementación para educadoras y oficiales

- de puericultura. Programa para niños. Cuernavaca, Morelos: Instituto Nacional de Salud Pública; 2013.
21. Rodríguez-Oliveros G, Haines J, Ortega-Altamirano D, Power E, Taveras EM, González-Unzaga MA, et al. Obesity determinants in Mexican preschool children: parental perceptions and practices related to feeding and physical activity. *Arch Med Res.* 2011;42:532-9. doi: 10.1016/j.arcmed.2011
 22. Olaiz-Fernández G, Rivera-Dommarco J, Shamah-Levy T, Rojas R, Villalpando-Hernández S, Hernández-Avila M, et al. Encuesta Nacional de Salud y Nutrición 2006. Cuernavaca, México: Instituto Nacional de Salud Pública; 2006.
 23. McMinn AM, Griffin SJ, Jones AP, van Sluijs EMF. Family and home influences on children's after-school and weekend physical activity. *Eur J Public Health.* 2013;23:805-10. doi: 10.1093/eurpub/cks160
 24. Osei-Assibey G, Dick S, Macdiarmid J, Semple S, Reilly JJ, Ellaway A, et al. The influence of the food environment on overweight and obesity in young children: a systematic review. *BMJ Open.* 2012;2. pii:e001538. doi:10.1136/bmjopen-2012-001538.
 25. Wyse R, Campbell E, Nathan N, Wolfenden L. Associations between characteristics of the home food environment and fruit and vegetable intake in preschool children: a cross-sectional study. *BMC Public Health.* 2011;11:938. doi:10.1186/1471-2458-11-938.
 26. Bryant M, Stevens J, Wang L, Tabak R, Borja J, Bentley ME. Relationship between home fruit and vegetable availability and infant and maternal dietary intake in African-American families: evidence from the exhaustive home food inventory. *J Am Diet Assoc.* 2011;111:1491-7. doi: 10.1016/j.jada.2011.07.007
 27. López NV, Ayala GX, Corder K, Eisenberg CM, Zive MM, Wood C, et al. Parent support and parent-mediated behaviors are associated with children's sugary beverage consumption. *J Acad Nutr Diet.* 2012;112:541-7. doi: 10.1016/j.jand.2011.11.013
 28. Fitzgibbon ML, Stolley MR, Schiffer L, Kong A, Braunschweig CL, Gomez-Perez SL, et al. Family-based hip-hop to health: outcome results. *Obesity (Silver Spring).* 2013;21:274-83. doi: 10.1002/oby.20269
 29. Benjamin Neelon SE, Reyes-Morales H, Haines J, Gillman MW, Taveras EM. Nutritional quality of foods and beverages on child-care center menus in Mexico. *Public Health Nutr.* 2013;16: 2014-22.