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Promotion of water consumption in elementary school children in San Diego, USA and Tlaltizapan, Mexico

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Abstract

Objective. Consumption of water may help promote health and prevent obesity in children by decreasing consumption of sugar-sweetened beverages. This study used evidence-based strategies to increase water consumption in Mexican-American and Mexican children. **Materials and methods.** In 2012, two schools in San Diego, USA and two other in Tlaltizapan, Mexico were recruited to *Agua para Niños* (Water for Kids), a program designed to promote water consumption among elementary grade students. Guided by operant psychology, the intervention focused on school and classroom activities to encourage water consumption. One control and one intervention school in each country were included. **Results.** *Agua para Niños* resulted in increases in observed water consumption and bottle possession among US and Mexican students. Teacher receptivity to the program was very positive in both countries. **Conclusions.** *Agua para Niños* yielded sufficiently positive behavioral changes to be used in a future fully randomized design, and to contribute to school nutrition policy changes.

Key words: Latinos; water consumption; school; obesity; prevention

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Resumen

Objetivo. Explorar cómo el consumo de agua proporciona salud y previene la obesidad en los niños al disminuir el consumo de bebidas endulzadas con azúcar, a partir del empleo de estrategias basadas en la evidencia para aumentar el consumo de agua en niños mexicanos y mexicano-estadounidenses. **Material y métodos.** En 2012, se eligieron dos escuelas en San Diego, EU y otras dos en Tlaltizapán, Morelos, México para implementar el programa *Agua para Niños* (Water for Kids), diseñado para promover el consumo de agua en los niños de nivel primaria. Bajo el enfoque de la psicología operante, la intervención se centró en las actividades escolares en general y dentro del aula para fomentar el consumo de agua. **Resultados.** *Agua para Niños* logró un aumento en el consumo de agua y la utilización personal de una botella con este líquido entre los estudiantes mexicano-estadounidenses y mexicanos. La receptividad del programa por parte de los maestros fue bastante positiva en ambos países. **Conclusiones.** *Agua para Niños* produjo cambios conductuales suficientemente positivos, lo que la hace una estrategia que puede utilizarse en futuros estudios aleatorizados que contribuyan a lograr cambios en las políticas escolares de nutrición.

Palabras clave: latinos; consumo de agua; escuela; obesidad; prevención

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The global obesity epidemic continues apace, affecting not only wealthy but also middle-income countries. With a third of its adult population in this category, the United States has the highest prevalence of adult obesity internationally. According to the Organization for Economic Co-operation and Development Mexico is now second in adult and fourth in childhood obesity.¹ Obesity and overweight is extending to ever-younger children, and in both the USA and Mexico especially impacts economically disadvantaged groups.¹

Research and public health initiatives have increasingly emphasized younger populations, prevention as well as control, and environmental as well as individual targets encompassing both nutrition and physical activity variables to achieve healthy energy balance. Various nutrition programs have emphasized reductions in calories, or high fat, high sugar or 'empty calorie' foods, usually accompanied by increases in vegetable and fruit consumption. Physical activity interventions have embraced increases in moderate to vigorous activity, usually accompanied by reductions in sedentary behaviors. Childhood obesity programs have been implemented through school teachers, parents, recreation directors^{*2} or primary care staff;^{2,5} indirectly through changes in physical environments, using other elements such as frequent weight monitoring,⁶ or a combination.²

Tools available to scientists and practitioners to address childhood obesity have become increasingly complex and bulky. Parents also may struggle to understand the multitude of behavioral targets, especially if they are limited by education, economic and work circumstances, and other barriers.[‡] Teachers and medical providers may place lower priority on obesity prevention efforts given their many other tasks. Obesity prevention guidelines often violate a central principal of behavior modification, namely, to focus on well-defined and observable behaviors with clear behavior change criteria.⁷

Water consumption may not only suppress sugar-sweetened beverage (SSB) drinking (which is high in the U.S. and Mexico and in turn relates to overweight, dental caries and other problems), but also protect against other health problems such as constipation, kidney problems, urinary tract infections, and diminished cognitive functioning.^{8,9} Nevertheless, water consumption rates are low (above 60%) among primary and secondary

school children especially among Latino students.¹⁰ In a study conducted by Park and colleagues,¹⁰ consumption of snacks and sodas while watching television was predictive of low water consumption, further potentiating obesity problems among these children.

Previous efforts to promote water consumption in schools have met with mixed success. Water cooler placement in Dutch schools, for example, did not suppress the sales of SSBs in intervention versus control conditions.¹¹ In contrast, in a quasi-experimental study the provision of cold, filtered drinking water and water bottles in Los Angeles schools increased self-reported water consumption (no impact on other beverage consumption was seen).¹² Findings from a group randomized trial, showed a decrease in beverages (e.g., juice and milk) and increase in water served in after-school programs.¹³ In another randomized controlled cluster experiment, the installation of classroom water fountains was combined with four didactic sessions on water consumption. Although measurement included potentially a biased recall of water consumption, objective measures of body mass index and water fountain flow further strengthened the validity of the results. The intervention yielded a 31% greater impact on achieving a healthy weight status than in the control condition.¹⁴ The promotion of water consumption in elementary schools presents a promising but unproven approach to child health promotion, including healthy body weight. The state of this science is currently unclear, given the mixture of the rigor of research designs. In the present study we seek to contribute to the literature by examining the promotion of drinking water in schools in the USA and Mexico. This quasi-experimental, controlled study examined the impact of a school-based intervention promoting water consumption among school-age children. We compared intervention implementation strategies across the US and Mexico to better understand, assess and develop evidence-based strategies and recommendations to effectively prevent and treat childhood obesity in Latino populations.

Materials and methods

The present study was developed using best practices and innovations highlighted within a systematic review of obesity-related interventions (Project GOL - Guide to Obesity Prevention in Latin America and US).¹⁵ Project GOL comprises a network of collaboration to develop programs aimed at reducing obesity among Mexicans and Mexican-Americans. The present study was carried out as a collaboration between the San Diego Prevention Research Center and the Mexican National Institute of Public Health (*Instituto Nacional de Salud Pública*).

* Elder JP, Crespo NC, Corder K, *et al.* Childhood obesity prevention and control in city recreation centers and family homes: the MOVE/me Muevo Project. Under Review.

‡ Corder K, Crespo NC, Van Sluijs N, *et al.* Parental awareness of young children's physical activity. *Prev Med* (in press).

This 8-12 week school-based intervention in the spring of 2012 aimed to promote water consumption among elementary school-age children of predominately Mexican-American (San Diego, USA) or Mexican (Tlaltizapan, in the state of Morelos, Mexico) backgrounds in economically disadvantaged neighborhoods. These populations are of special interest given the differentially high rates of obesity among children throughout Mexico, and among Latino children within the USA.

The San Diego State University Institutional Review Board approved the San Diego intervention study. The Human Subjects and Ethics Committee of the National Institute of Public Health, Mexico approved the Tlaltizapan intervention study. Written consent for participation was obtained from the mother or caretaker in each household in Tlaltizapan. In San Diego, school consent was deemed adequate as no self-report was involved and only aggregate group behavior was observed.

Theoretical framework

The primary theory guiding the development of the intervention and measurement methods was operant Psychology. Operant psychology (referred to also as "behavior modification" or "applied behavioral analysis") describes the direct mechanism by which individual behaviors may be changed,^{7,16} and implies a positivistic approach to measurement including direct observation of behavior. Specifically, behaviors are strengthened through the process of reinforcement, whereas cues, prompts, modeling, and other antecedents to the behavior may also make it more likely to occur (and subsequently, to be reinforced). These principles can be applied without reference to culture or community. The operant approach to behavior change has comprised the basis for successful school health intervention trials such as TAAG¹⁷ and has been demonstrated to be central in the promotion of physical activity.¹⁷ Increased positive reinforcement for water consumption through teacher appraisals coupled with reduced access to SSBs, and reduced barriers to obtaining healthy water, were central to the design of *Agua para Niños*. These 'contingencies of reinforcement' were applied at both individual and classroom levels.

Participants

Four schools, two in San Diego and two in Tlaltizapan, were included in the study. Two school districts in San Diego County with a high proportion of Latino residents were approached by contacting the Office of Operations Services. One district declined and one accepted, and research proposal was accepted by the Board of

Directors on behalf of researchers. Elementary schools in the approved district were approached beginning with schools with the highest percentages of Latino students. Six schools were sent email recruitment letters, three responded positively, and two were available to participate given the study time line. In Tlaltizapan, elementary schools within one hour of the research institute were selected to match characteristics of the US schools (e.g., providing lunch during school, having functional water fountains in common areas and in classrooms).

The four schools invited to participate comprised a convenience sample, and school principals were aware of their role within the intervention or control before the study began. Two schools were assigned to the intervention condition (one in each country) and two assigned to the control condition (one in each country).

The two San Diego elementary schools chosen were in the city of Chula Vista, which is approximately 6 miles north of the US/Mexico International Border. The intervention school had an enrollment of 368 students, with nearly 90% (n=329) of Latino background. Over 56% (n=209) of students were Spanish-speaking, English learners, and 69.3% (n=255) were eligible for free/reduced priced meals. Similarly, the control school had an enrollment of 373 students, with over 85% (n=319) of Latino origin. About 40% (n=148) of students were Spanish-speaking, English learners, and 57.6% (n=215) were eligible for free/reduced priced meals.

The participating elementary schools in Tlaltizapan were located in towns in semi-rural areas of about 10 000 inhabitants, similar in terms of demographics and climate. The intervention school had 280 students and the control school had 297 students. Classrooms contained *garrafrones* (a 20-liter bottle of filtered water) paid for by parents through a small monthly fee. Both school cafeterias cooked meals on-site, and students chose plain or flavored sugared (fruit-based) water with lunch. SSBs and sodas were offered for sale outside of the cafeteria in both schools, however bottled water was not available for sale.

Procedure

Once all schools were enrolled in the study, teachers in the intervention schools were recruited to participate, and underwent training. Teacher training included a simple informational session on the status of childhood obesity in the US or Mexico, as well as the importance of modeling and prompting behaviors (especially drinking water, but also discouraging unhealthy nutrition). A full list of intervention activities was given to teachers for initial feedback (table I). In San Diego, teachers at-

tended a one-hour training, while in Tlaltizapan teachers received a brief study orientation and instructions on how to carry out promotional activities.

In both San Diego and Tlaltizapan, one bilingual Intervention Coordinator facilitated 6-8 activities with students either during class or library time. The intervention was initiated by an opening school-wide assembly, introducing students to the program. Activities were intended to raise awareness around the benefits of water and encourage water consumption by reducing barriers to the behavior (e.g., each student was given a water bottle) and through contingency management^{18,19} (e.g., teachers were encouraged to model and reinforce the behavior).

The intervention included the following elements:

1. *Distribution of 13oz water bottles to all students and staff in week 3 of the intervention.* The bottles distributed in the US schools included filters, which allowed students to fill their bottles from any water source in the school. Students were instructed to write their names on the bottle. While students in the US stored their water bottles in the classroom, students in Mexico took them home.
2. *Distribution of water during lunch (San Diego only).* Water was distributed to all students daily in their eating area at lunchtime. Water was pre-pumped from a 5-gallon jug into 5oz cups and placed on a cart.
3. *Class activities around water consumption.* All students in grades 1-6 participated in weekly educational lessons about water consumption. To avoid inte-

rupting lectures and physical education classes, lessons were pre-scheduled during library time in San Diego and during regular class time in Tlaltizapan. Activities typically lasted 20-30 minutes. Lessons included both educational activities (e.g., Jeopardy trivia game or opinion writing prompt about water consumption) and promotional activities (e.g., poster contest about the benefits of drinking water).

4. *Pipímetros installed in bathrooms.* Literally “pee meters”,²⁰ pipímetros are colorful illustrations used to compare the color of urine with different shades of yellow roughly corresponding to adequate or inadequate hydration. Especially in the absence of laboratory analysis, urine color has been used, with reasonable accuracy, as a quick estimation of hydration indicated by the high concentration of urobilin (or lack of water to dilute urobilin which is responsible for urine’s yellow color).²¹ This innovative print material is designed to simplify the complex concept of dehydration to the elementary students and provide them with feedback and reinforcement for drinking adequate amounts of water.
5. *Take-home parent materials.* Materials for parents in San Diego (offered in English and Spanish) and Tlaltizapan were developed and distributed to students to take home. Materials included a magnet and brochure about the importance of choosing water over SSBs, as well as tips to help families stay healthy at home. The school principal approved all materials before distribution.

Table I
AGUA PARA NIÑOS INTERVENTION ACTIVITIES TO PROMOTE WATER CONSUMPTION,
COMPLETED IN 2012 IN SAN DIEGO, CA AND TLALTIZAPAN, MEXICO

Week	San Diego activities	Tlaltizapan activities
1	Introduction	Introduction
2	Teacher prompts; filtered water offered at lunch	School assembly and Initiation
3	School assembly; introduction and distribution of water bottles	Water bottles – the new <i> Mascota</i> [roughly translated as “mascot”]
4	Water jeopardy game	Water jeopardy game
5	Poster contest	Poster contest
6	[no activity- student testing]	Poster contest (cont.)
7	[no activity]	Word soup and <i>pipímetro</i>
8	“Word soup” and <i>pipímetro</i>	Continuation
9	Opinion paper writing	Opinion paper writing
10	Flavored water <i>fiesta</i> (end of school)	End of school

Instruments

Time-series data were collected (observational measures of water drinking and related behaviors) at regular intervals before and after interventions in all four schools. Research teams in San Diego and Tlaltizapan coordinated evaluation activities for equivalent measures to be collected in equivalent time periods. San Diego schools evaluated grades 1-6 and Tlaltizapan schools evaluated grades 1-4. Two trained evaluation research assistants (RAs) per site conducted observations in the school classrooms and school environment, including the lunch area and playground. Two observation tools were developed for this study:

Classroom Direct Observation. RAs used this tool once a week for 10 weeks to observe students' behavior (e.g., using available water sources, having a water bottle with water on the desk) and the classroom environment (whether there was an easily accessible water source in the classroom or whether the teacher allowed time to leave the classroom to access another water source, and presence of classroom material or games promoting water consumption).

School Environment Direct Observation. RAs used this tool once a week for 10 weeks to assess available water sources in the school grounds, including quality (e.g., cleanliness) and usability of water fountains and other water sources (e.g., water jets), and usage of these water sources. RAs directly observed specific water sources in planned interval times of 15 minutes. RAs recorded how many students were in line at the water source, how many students used the water source, how long each student drank from the water source (if applicable), and each student's gender. The types of drinks students consumed during lunch were also assessed.

Post-Intervention Qualitative Research. Following completion of program activities, focus groups were conducted with teachers to understand acceptability and feasibility of the intervention.

Data analysis

As schools rather than individuals comprised the units of analysis, the study's data were not appropriate for standard statistical analyses. Consistent with empirical methods embraced by operant psychology,^{9,16,19} the time series data are presented for visual inspection of trends between baseline and intervention phases.

Results

Observed water consumption

San Diego. From equivalent baseline rates in each school, observed water bottle possession increased eightfold in the intervention school during the first week of the intervention (figure 1). Observed water consumption at lunchtime in the intervention school increased substantially with the introduction of the intervention (figure 2). Although consumption remained substantially above that of the nearly zero rate in the control school

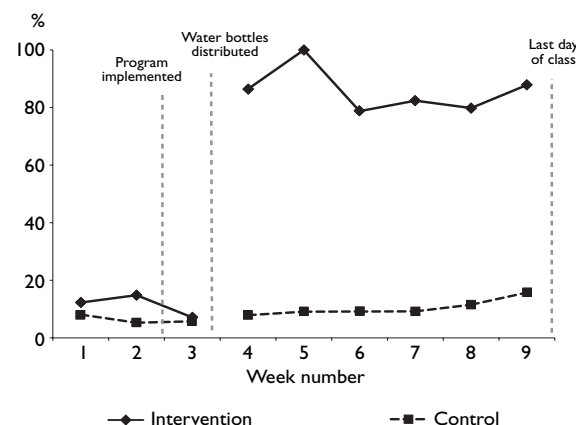


FIGURE 1. PERCENT OF STUDENTS WITH WATER BOTTLES IN CLASS. SAN DIEGO, 2012

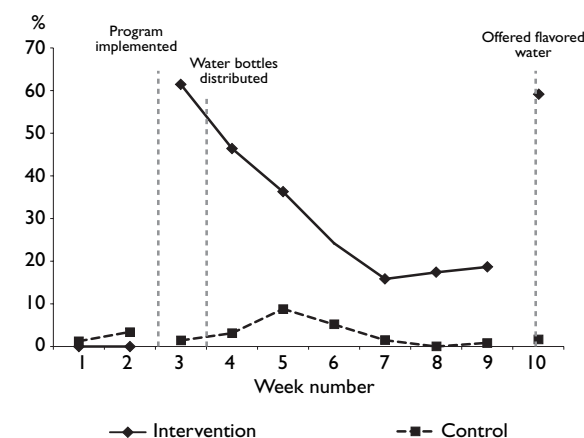


FIGURE 2. PERCENT WATER CONSUMPTION OBSERVED AT LUNCH. SAN DIEGO, 2012

over the ensuing weeks, the rate decreased steadily and then leveled off until the intervention team introduced powered, sugar-free flavored water with fresh fruit slices during the last week of the study (and of the spring semester). At this point, consumption rose to the highest level of the primary intervention phase (about 60% of the students observed).

Tlaltizapan. There were substantial baseline differences in the proportion of water in bottles in class between schools (figure 3). During the intervention phase, the intervention school increased water bottles in class by approximately 13% immediately once the intervention began, a positive trend that was evidenced again at the end of five weeks of the study. In the control school, positive trends at the beginning of the study fell off in its final week. There were also differences at baseline in observed water consumption in class by school. Again, there were no sustained improvements in the control school; however, the intervention school increased water consumption by over 10% compared to the baseline assessment. Results for observed water consumption at lunch were highly variable, with no apparent intervention effect (figure 4). Observed water consumption in the intervention school remained at about 40% 6 weeks post-intervention. A cautionary note should be made regarding potential contamination between the communities and schools which could in part explain why the differences between control and experimental schools were modest.

Post-intervention qualitative research

San Diego. At the end of the study, nine teachers, one lunchtime staff and a custodian in the intervention

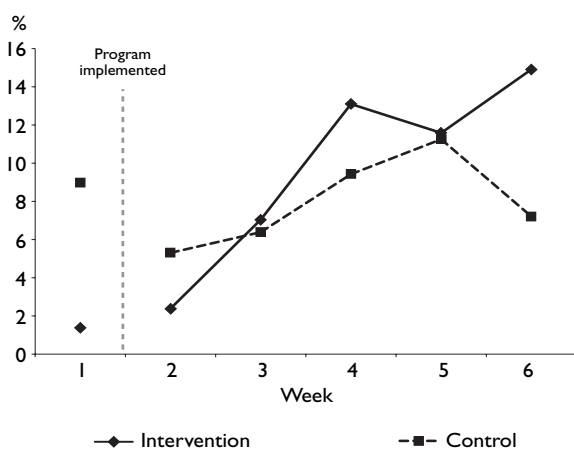


FIGURE 3. PERCENT OF STUDENTS WITH WATER BOTTLE IN CLASS. TLALTIZAPAN, 2012

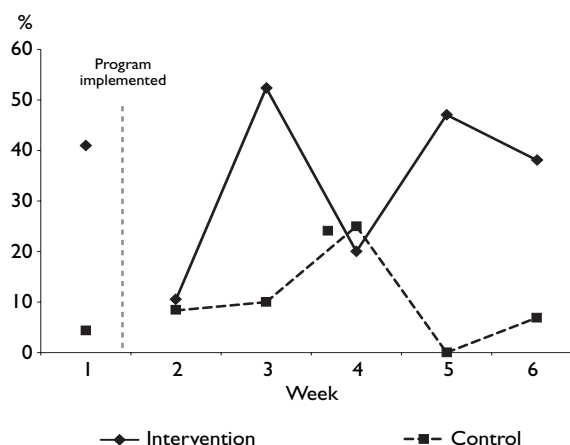


FIGURE 4. PERCENT OF WATER CONSUMPTION OBSERVED AT LUNCH. TLALTIZAPAN, 2012

school participated in a focus group to explore their experiences with the intervention. Participants were asked to give examples of strengths and weaknesses of the intervention. All agreed that the water bottles were a very effective intervention tool, engaging students and bringing focus to water consumption. The “Jeopardy” game, poster contest and other intervention activities complemented and reinforced the promotion of water consumption, and the *pipímetro* enabling understanding of the complexity of dehydration in an entertaining and engaging fashion. The visual quality of these materials was especially important for English as a second language students. Staff reported improving their own water consumption and healthier eating (and in one case, losing substantial weight) because of the intervention. However, teachers noted that a stronger rationale and better coordination of program components for increasing water consumption would have been helpful (at least for themselves). They also explained that the intervention could have been further strengthened by an exchange of experiences (perhaps involving Skype links) with other participating schools in Tlaltizapan and San Diego). Ready access to good-tasting, cold water may also have sustained and added to the impact of the intervention. Overall, teachers were enthusiastic about being directly involved with implementation of *Agua para Niños*, consistent with the process and format of a health curriculum already in statewide use.²²

No focus group participants believed that the intervention created notable extra work or disruption. Although some teachers had expressed concern before the program that classes could be disrupted by more frequent bathroom visits, in retrospect they

stated that this had not been a problem. The teachers explained, however, that a bottle cleaning, drying and deodorizing system was needed in the classroom sink. Additionally, staff noted that lunchtime milk consumption (already low) seemed to be further suppressed by having the water readily available to quench the students' thirst.

Tlaltizapan. All 12 teachers in the intervention school participated in a focus group with the same purpose as that in San Diego. Teachers agreed that the activities involving water bottle contests inside the classroom motivated the students most. The bottle contest (in which the class received a star if all students brought their water bottles and filled them two times from the *garrafón*) was especially effective, and encouraged students to remind each other bring in their water bottles. Teachers also said that the poster contest helped reinforce regular curriculum messages. Overall, teachers thought that intervention materials (including the *pipímetros*) were creative although one teacher noted that the "Jeopardy" activity was difficult for first grade students.

Teachers reported that students generally consumed more water, aided by the provision of water bottles. However, some parents complained and declined to contribute additional funds for *garrafones* (students in classrooms without water filled their bottles in those that still had water available). Teachers expressed no major concerns regarding program implementation, stating it could be integrated into the usual curriculum. However, they noted a preference for implementing the program throughout the school year. Finally, teachers stressed the importance seeking parental support at the start of the program through effective communication about program goals and objectives. Outside of the focus groups, RAs spoke with cafeteria personnel, who agreed that in the future they could limit students to having just one glass of sweetened, flavored water; and thereafter, offer only plain water to students who were still thirsty.

Discussion

A brief health behavior change intervention based in operant psychology, *Agua para Niños* was designed to promote water consumption in elementary schools in San Diego, USA and Tlaltizapan, Mexico. Directly observed possession of water bottles in classrooms in both San Diego and Tlaltizapan increased compared to control schools. The proportion of San Diego students consuming water at lunchtime increased substantially with the introduction of the intervention, declined over the ensuing weeks, and then recovered this gain when flavored (non-sweetened) water was introduced in the final week of school. Although there was more vari-

ability in student drinking behavior in Tlaltizapan, the intervention school outperformed the control school on two of the three water consumption outcomes – percent of students 1) with water bottles in class, and 2) consuming water in class.

There were many similarities between the programs implemented in the US and Mexico. In both countries, the educational and promotional activities implemented were well received by teachers and students. Despite these similarities, important distinctions are also worth noting. In terms of implementation, in the US, water bottles with filters were provided because the students disliked the taste of the water from drinking fountains. In comparison, the Mexican schools provided water through *garrafones* purchased by the schools and parents; water bottles with filters were not offered because students were willing to drink water from the *garrafones*. The climates of the two regions are also unique to their own countries and different from one another as well. The Tlaltizapan region has higher temperatures and less humidity as most of Mexico. Although San Diego has a dry climate the temperatures are very moderate compared to most of the American Southwest. These factors could have important implications for water consumption.

In 2005, the California legislation eliminated the sale of sodas and set sugar content limits for other SSBs in the schools. However, a potential barrier to promoting water consumption among children in Mexico is that the widespread sale of SSBs in schools likely competes with healthy alternatives like water. National data from Mexico show that soda is among the top consumed beverages in youth and adults.²³

Strengths of the evaluation included the use of controlled, time series designs and direct observations of bottle use and observed water consumption. However, the amount of water consumed in school per student is not known, nor is any information available about overall patterns of the consumption of liquids (or even food) over the course of a full day, especially in the home environment. For example, we do not know if parents were the driving force that encouraged their children to drink more water once they learned more about the benefits. A full evaluation at the individual level would need to further incorporate measures of SSB, milk, water and other liquids, both inside and outside of school. These changes could be related to specific health outcomes, such as dental caries, obesity and other variables. At the school level, objective measures of water supply turnover or drinking fountain flow would complement direct behavioral observations. Such measures within an ecological or public health context could be considered to comprise primary outcomes themselves.

Other ecological variables that could have at least an indirect impact on water consumption should also be addressed in future research. Climate and temperature (although fairly consistent in the two study areas), frequency and intensity of physical activity periods (recess or PE classes), availability and maintenance of standard and filtered water outlets, pricing for bottled or even filtered water (and for other refreshments), and other broader forces could be expected to moderate drinking behavior. A cost-benefit analysis to compare the cost and maintenance of cooled filtered water fountains versus bottled water would also help inform future programs. Both observational and intervention studies should consider these factors.

Intervention researchers must also consider more robust designs and sampling procedures, as the current study was not a fully powered randomized controlled trial (RCT). A large RCT would require resources sufficiently ample for addressing not only many of the aforementioned measurement challenges but also for sampling, recruitment and random assignment at the school level. Thus, the two study populations cannot be generalized to other Latino subgroups nor even to other Mexican or Mexican-American children. At the same time, the current study's use of a time series research design and related measurement carried out concurrently in schools in two nations are among its more commendable features, and should be replicated in future efforts of this nature.

Agua para Niños was very well received by teachers and students alike. In contrast to our previous obesity prevention research which had been based on all aspects of energy balance,³ teachers in both San Diego and Tlaltizapan found *Agua para Niños* easy and enjoyable to implement and monitor, and appreciated not having to concurrently emphasize unhealthy nutritional behaviors. Students seemed to participate enthusiastically in classroom activities and using their water bottles, and seemed especially interested in using the *pipímetros* for conceptualizing hydration.

Teachers and study staff alike identified a variety of issues that should be addressed in future research or implementation efforts. Access to free or low cost and healthy water must be guaranteed for all students, whether through better maintenance of drinking fountains or provision of filtered or bottled water. Indeed, specific water promotion techniques can be tailored to the needs and resources of individual schools, as with the "Water is Cool in School" campaign in the United Kingdom.¹⁰ Finally, parents must not only be convinced of the benefits of programs such as *Agua para Niños* but should be encouraged to implement parallel changes at home to benefit the whole family. Future programs may

involve parents because, according to teachers' reports, students drink notable amounts of SSBs at home.⁴ At the same time, any changes made in the school and home environments must be affordable to both schools and parents in order for intervention effects to be sustained. This is especially true for parents in Tlaltizapan who pay for the water in their children's classroom. Future studies should include water consumption in the home environment.

A main study goal was to identify intervention strategies promoting water consumption that would be effective in the US and Latin America. Many of the strategies implemented in both countries in *Agua para Niños* appeared to be effective in increasing water consumption among Mexican and Mexican-American students. Finding common strategies to target obesity is important given the high migration rates of Mexicans to the US. Obesity is a global problem and international solutions are needed. School settings can provide an opportunity to make a difference in obesity.

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

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