Effectiveness of an educational strategy to increase plain water consumption in children

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Abstract

Objective. We tested the effectiveness of the *I prefer plain water* educational strategy used to increase water consumption in elementary school children. **Materials and methods.** A community intervention trial was performed in eight public elementary schools in Mexico City. The schools were randomized into an intervention (IG) and a control (CG) group. Each school was provided water dispensers inside the classrooms. The IG received the educational strategy. The strategy was considered effective if the students increased their water consumption by ≥220 ml. **Results.** Water consumption in the IG increased 167 ml vs. 37 ml in CG ($p < 0.001$). The goal of the educational strategy for water consumption was achieved in 166/413 children in the IG and 95/364 children in the CG ($p < 0.001$). **Conclusions.** *I prefer plain water,* associated with free access to water inside the classrooms, proved to be effective to increase water consumption.

Keywords: water consumption; intervention study; elementary school; effectiveness

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Resumen

Objetivo. Evaluar la efectividad de la estrategia *Prefiero agua simple* para incrementar el consumo de agua en niños de escuelas primarias públicas. **Material y métodos.** Ensayo de intervención comunitaria en ocho escuelas en la Ciudad de México. Las escuelas se aleatorizaron en grupo de intervención (GI) y de control (GC). Se instalaron dispensadores de agua dentro de las aulas. Implementamos la estrategia al GI. Consideramos efectiva la estrategia si los estudiantes incrementaron su consumo de agua en ≥220 ml. **Resultados.** El incremento global en el consumo de agua del GI fue de 167 ml vs. 37 ml en GC ($p <0.001$). La efectividad de la estrategia para el consumo de agua se logró en 166/413 niños del GI y en 95/364 niños del GC ($p <0.001$). **Conclusiones.** *Prefiero agua simple*, asociada con libre acceso al agua dentro de las aulas, demostró ser efectiva para incrementar el consumo de agua.

Palabras clave: consumo de agua; estudio de intervención; educación primaria; efectividad

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Analyses of diverse populations have demonstrated that children do not consume an adequate amount of liquid and do not comply with the daily recommendations proposed by international organizations, such as the European Food Safety Authority (EFSA), Panel on Dietetic Products, Nutrition, and Allergies.[1] The total daily intake varies between 0.6 and 3.5 L/day within different age groups (higher in males than in females), and plain water contributes to up to 58% of the total beverage intake in children.[2]

In Mexico, the last National Health and Nutrition Survey (Ensanut 2012) reported that children 4-8 years of age had a total liquid consumption from beverages of 922 ml/day and that plain water represented 24.5% of the total intake.[3] Another survey, which was performed in 13 countries including Mexico, concluded that a high percentage of children and adolescents were at risk from an inadequate intake of liquids. The study reported that approximately 55% of boys and 65% of girls in Mexico had inadequate water intake.[4]

Diverse strategies have been proposed to improve water consumption in children,[5-7] and school appears to be the ideal location in which to administer intervention programs.[8] The Mexican proposal includes training of the parents, students and educational personnel.[5]

Randomized trials on water consumption have been published. However, these studies are oriented more toward the replacement of sugar-sweetened beverages than the promotion of plain water intake.[9-12]

The goal of this study was to evaluate the effectiveness of the educational strategy *I prefer plain water* (*Prefiero agua simple* [www.prefieroaguasimple.com, web page under construction]) in increasing plain water consumption in first, second and third graders at public elementary schools in the southern part of Mexico City.

Materials and methods

Study design

The study used a controlled, randomized trial with two groups. The first group received the educational intervention and the second served as a control. Schools were considered the units of the intervention, and randomization was performed by school. The intervention lasted one school year from September 2014 until July 2015. The sample size determination was performed based on the Muckelbauer and colleagues[13] study to detect a difference in the plain water consumption of 220 ml between the intervention group (IG) and the control group (CG), with $\alpha = 0.05$ and a power of 0.8. We estimated 102 children per school and thus required seven schools, 714 per group and a total of 1 428 children.

Participants

A community intervention study was performed in the Coyoacan Jurisdiction of Health including two health centers adjacent to the National Institute of Pediatrics. There exists a collaboration agreement with these two health centers. These centers have epidemiological oversight of 21 primary schools that were invited to participate. Eight schools accepted. These schools have an enrollment of 1 748 students in first, second and third grades of primary. Children whose parents accepted to participate and signed a privacy agreement were included. Children with a disease that, in the investigator's opinion, could interfere with the study were excluded. Subjects that delivered a beverage consumption register (BCR) that were incomplete or incorrectly filled out were also excluded.

Intervention

At the beginning of the school year 2014-2015, the parents received a lecture by one of the investigators to inform them of the general characteristics of the study, clarify any doubts and receive instructions on how to fill out the beverage consumption register (BCR). Also, a nutritionist gave a session to sensitize the parents about the habits of consuming beverages to encourage them to drink plain water at home. The investigator also explained to the participating teachers the general characteristics of the study and clarified doubts. The teachers of the intervention groups were prepared by a nutritionist to use the educational strategies in a workshop that lasted six hours. At the beginning of the study, the teachers received a manual with the program and material necessary to give educational sessions.

The *I prefer plain water* education strategy was designed by Ogali (a nutrition consulting company [www.ogali.com]) and was validated in a previous study (unpublished). The educational support was based on three theories of knowledge: the social cognitive theory, social constructivism, and multiple intelligences. These have shown behavioral modification and the development of life abilities, permitting children to build permanent foundations to obtain a healthy life style (see "Educational Basis for the Strategy" [www.prefieroaguasimple.com, web page under construction]). The strategy is designed for children in first, second and third grades of elementary school and adapted for each school year. It is based on games and a collaborative system in which the student, teacher, and family take part. It consists of four sessions of approximately 50 minutes each and is given every two weeks during class time (see "manual for teachers" [www.prefieroaguasimple.com, web page under construction]).

During the study, a group of nutritionists verified the presentation of the educational sessions and supported the teachers when asked to do so. There was a register of the date, duration, and the name of the teacher that gave the session.

A *peemeter* is a urine color chart that shows the hydration state according to the urine color and thus indicates whether the user needs to consume more water.[14] *Peemeters* were placed in the lavatories of the IG schools. Additionally, the children received personal *peemeters*.

Instrumentation

The beverage consumption was evaluated using a diary BCR, which was completed only by the parents or caregivers at home during a 24-hour period for three separate days (two weekdays and one weekend day). The beverage intake during school hours was quantified when the student returned home after the parents could corroborate how much of the beverages that they sent were consumed.

Nine beverage categories were included and recorded seven times a day. The amounts were recorded in milliliters. This BCR has previously been used in large cross-sectional surveys among children and adolescents.[15] The BCR was classified as implausible when a daily record in one category was > 3 500 ml.

The beverage categories were established based on a proposal by the National Health and Nutrition Examination Survey 2006.[16]

Process evaluation

During September 2014, each student's clinical examination was performed. The beverage consumption baseline records were created in October 2014 (baseline or time point 1). Subsequently, the water dispensers were placed in each classroom of the eight schools. The four educational sessions were provided at the intervention schools during the November-December 2014 and January 2015 time periods. The second BCR was completed in February 2015 (four months – time point 2). From March to June, the water supply was maintained in both groups, and the third BCR was completed two weeks before the end of the school cycle in June 2015 (eight months – time point 3).

Human subjects approval statement

This study was conducted according to the guidelines established in the Declaration of Helsinki and the "International Ethical Guidelines for Health-related Research Involving Humans" (CIOMS). All procedures involving human subjects/patients were approved by Institutional Review Board of the National Institute of Pediatrics (IRB 8064, CONBIOETICA-09-CEI-025-20161215, approval number INP 013/2014). A consent form was received from the parents and directors of each school. One of the parents signed a privacy agreement. All data were recorded anonymously.

Statistical analysis

The analysis was performed using the IBM SPSS 22.0 statistical package. We compared the baseline consumption of the different beverage categories between the two groups using the Mann-Whitney U test. To compare the differences in beverage consumption at the three time points for both groups, we performed a Friedman test of related samples. The educational strategy was considered effective if the student's consumption of plain water increased by ≥ 220 ml. We compared the percentages of children who at the end of the study increased water consumption by 220 ml using the χ^2 test. We considered $p < 0.05$ to indicate statistical significance.

Results

The school enrollment for first, second and third grades at the eight participating schools for the 2014-2015 school year was 1 748 students. A total of 21 subjects did not agree to participate, six were excluded for presenting different diseases that interfered with the performance of the study, and another 616 subjects were excluded for not providing a correct and properly filled out baseline BCR. A total of 1 105 subjects were included, and 777 were analyzed, for a follow-up loss of 328 children (29.6%). A flow chart that describes the schools and participants throughout the study is shown in figure 1.

Baseline consumption

Of the 777 children, 408 were girls and 369 boys, with a median age of 7.1 years and an age range from 5.6 to 9.4 years. The average baseline consumption of total liquids was 1 337 ml/day (SD 546). No significant differences were identified in the baseline consumption of total liquids and categories between the IG and CG (the results are not shown). The baseline results are shown in table I.

Beverage consumption

A total of 413/777 subjects were assigned to the IG, including 214 girls and 199 boys with a median age of 7.1 years, a minimum age of 5.6 years and a maximum age of 8.8 years. A total of 364/777 subjects were as-

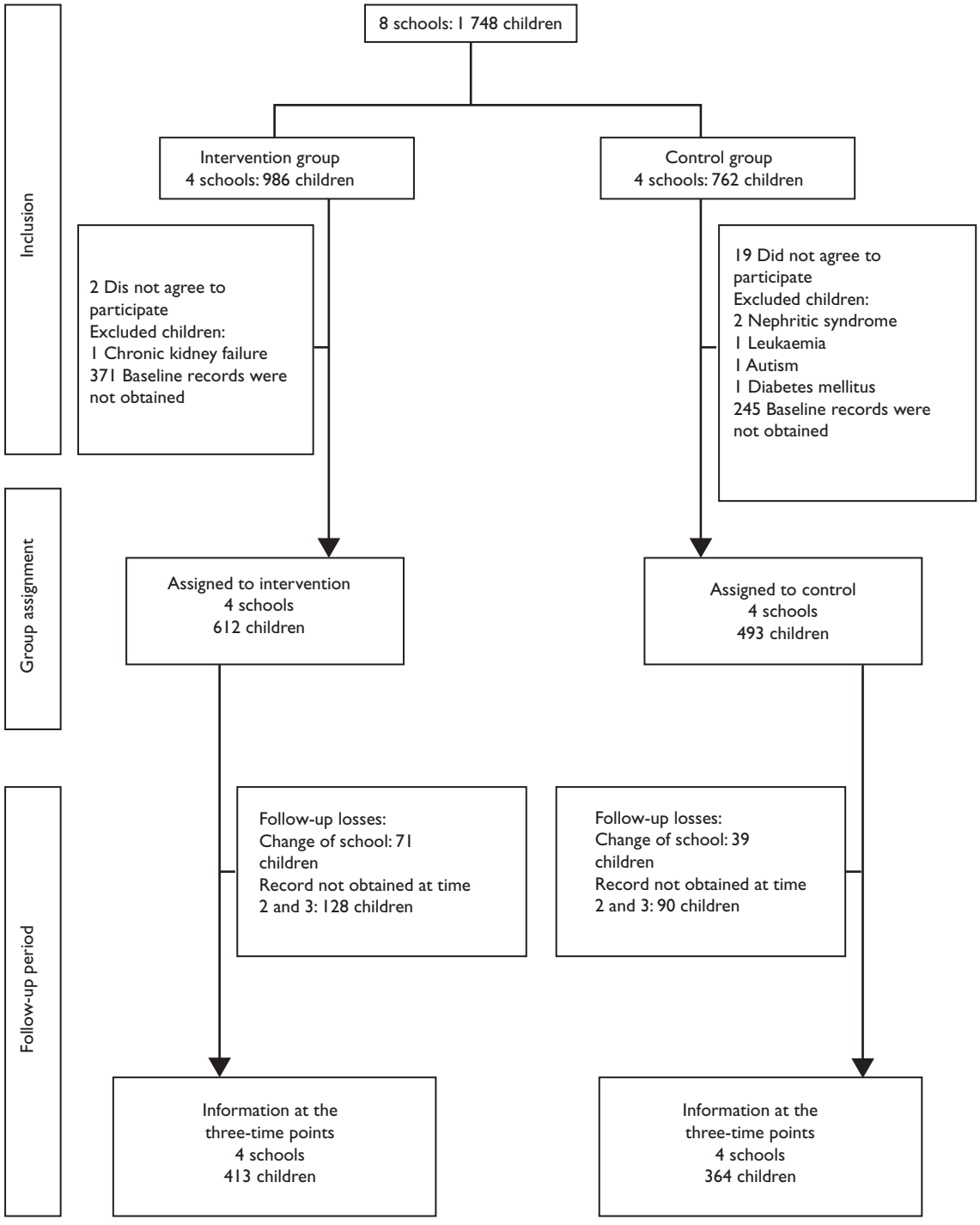


Figure 1. Schools and participants flow throughout the study. Mexico City, 2015

Table I

Baseline consumption by beverage category (median, minimum and maximum, ml/day). Mexico City, 2015

Beverage category	Intervention group				Control group				Total population
	1st grade	2nd grade	3rd grade	Total	1st grade	2nd grade	3rd grade	Total	
Plain water	408 0-1 415	438 0-2 223	416 0-2 153	416 0-2 223	343 0-1 533	458 0-2 083	442 0-1 720	421 0-2 083	416 0-2 223
Sugar-sweetened beverages	250 0-2 201	291 0-1 433	266 0-1 385	250 0-2 201	250 0-1 250	241 0-1 116	222 0-1 000	245 0-1 250	250 0-2 201
Sodas	79 0-500	41 0-776	41 0-716	41 0-776	83 0-483	83 0-566	41 0-600	83 0-600	75 0-776
Milk and milk beverages	333 0-913	300 0-1 101	291 0-1 170	318 0-1 170	291 0-1 360	283 0-1 650	291 0-763	291 0-1 650	308 0-1 650
Hot beverages	0 0-746	75 0-1 166	33 0-583	41 0-1 166	41 0-566	41 0-666	37 0-541	41 0-666	41 0-1 166
Light beverages	0 0-166	0 0-292	0 0-333	0 0-333	0 0-110	0 0-193	0 0-413	0 0-413	0 0-413
Functional beverages	0 0-41	0 0-125	0 0-450	0 0-450	0 0-283	0 0-41	0 0-83	0 0-283	0 0-450
Total liquids	1 166 400-3 083	1 309 400-4 000	1 288 433-4 323	1 250 400-4 323	1 190 466-2 776	1 303 400-4 383	1 161 541-2 613	1 212 400-4 383	1 231 400-4 383

Table II

Median consumption by beverage category at the 3 time points (median, minimum and maximum, ml/day). Mexico City, 2015

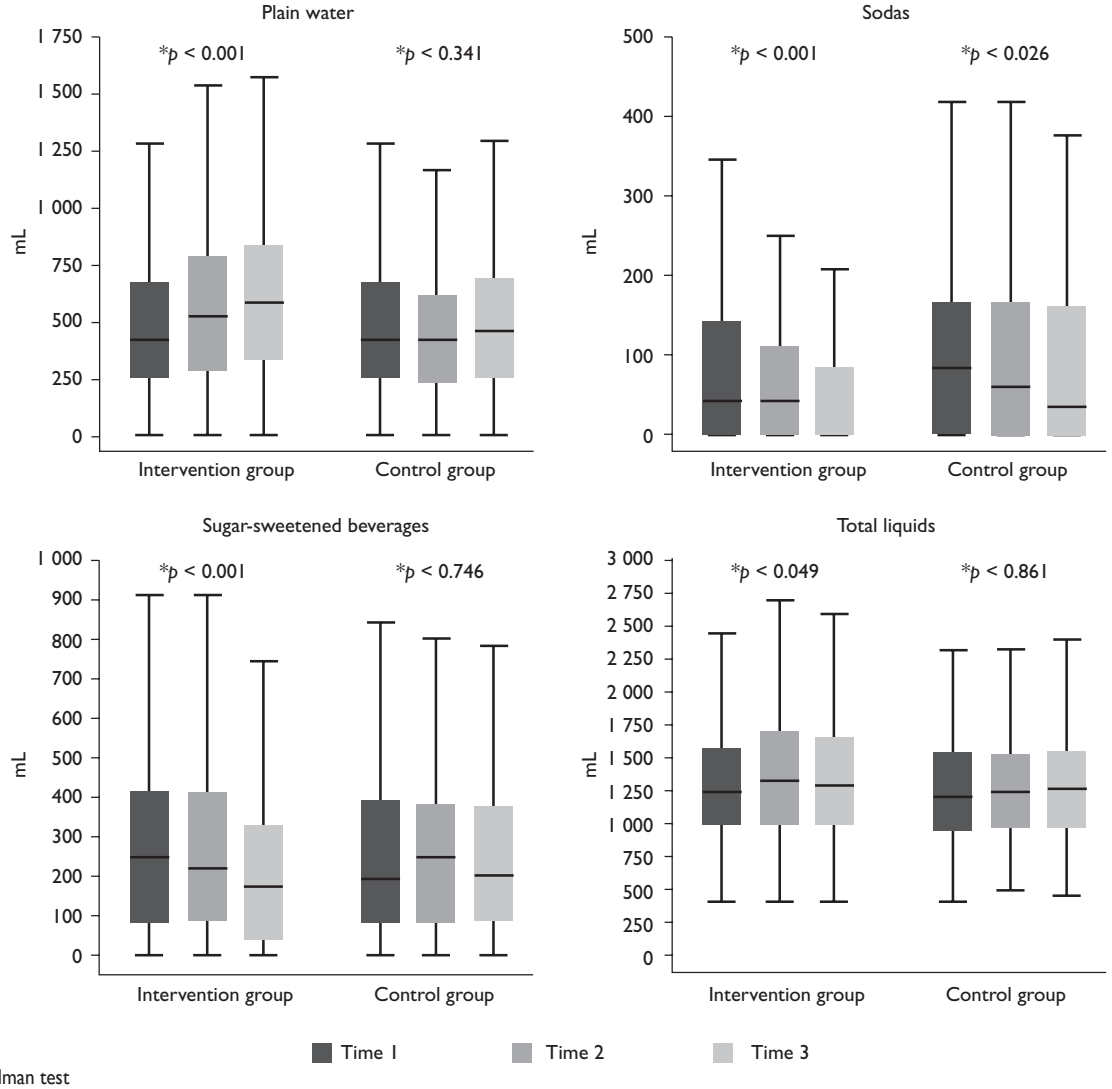
Beverage category	Intervention group			Control group		
	Time 1	Time 2	Time 3	Time 1	Time 2	Time 3
Plain water	416 0-2 223	525 0-3 160	583 0-3 485	421 0-2 083	416 0-2 018	458 0-1 770
Sugar-sweetened beverages	250 0-2 201	250 0-1 670	208 0-1 625	245 0-1 250	250 0-1 208	209 0-1 950
Sodas	41 0-776	41 0-1 376	0 0-580	83 0-600	58 0-1 333	33 0-666
Milk and milk beverages	318 0-1 170	333 0-1 360	333 0-1 293	291 0-1 650	333 0-1 166	333 0-1 250
Hot beverages	41 0-1 166	0 0-651	0 0-1 333	41 0-666	0 0-750	0 0-833
Light beverages	0 0-333	0 0-500	0 0-333	0 0-413	0 0-553	0 0-310
Functional beverages	0 0-450	0 0-333	0 0-600	0 0-283	0 0-166	0 0-166
Total liquids	1 250 400-4 323	1 330 416-5 223	1 291 416-5 068	1 212 400-4 383	1 245 491-3 996	1 250 458-3 496

signed to the CG, including 194 girls and 170 boys with a median age of 7.2 years, a minimum age of 5.6 years and a maximum age of 9.6 years. The median baseline of the total liquid consumption in the population was 1 231 ml/day (mean 1 337 ml/day, SD 546). The beverage consumption at the three evaluation time points is shown in table II.

In the IG, the increase in the median quantity of plain water consumption was 109 ml at time point 2 (four months) and 167 ml at time point 3 (eight months). In the CG, no increase was found during the first period. During the final period, we found an increase of 37 ml. During the study, significant changes occurred between the groups. At the end of the school year, an increase of 220 ml was achieved in plain water consumption in 95/264 children in the CG and in 166/413 children in the IG (X^2 $p < 0.001$).

The total liquid intake in the IG presented a median increase of 80 ml from time point 1 to time point 2 and 41 ml from time point 1 to time point 3. The CG presented median increases of 33 ml from time point 1 to time point 2 and 38 ml from time point 1 to time point 3. The changes were not significantly different between the groups; however, the changes in the IG measurements were significantly different between time point 1 and time point 2 (figure 2).

When comparing the consumption of other beverages between the groups, we found significant changes



* Friedman test

FIGURE 2. CHANGE IN BEVERAGE CONSUMPTION AT THE THREE TIME POINTS (INTERVENTION GROUP). MEXICO CITY, 2015

in sugar-sweetened beverages and sodas (figure 2). Except milk and milk beverages, the consumption of hot beverages, light beverages and functional beverages was low, and no significant changes were observed throughout the study.

Milk and milk beverages represented the second most commonly consumed liquids after plain water, with a similar median in the two groups throughout the study. No significant differences were found. Figure 3 shows the percentage differences between the baseline (time point 1) and final consumption (time point 3) medians of plain water, sugar-sweetened beverages, sodas and total liquids.

Discussion

The *I prefer plain water* educational strategy managed to increase plain water consumption in the subject population. This finding was similar to reports from other authors with the implementation of different educational strategies in schools,[12,13] which are recognized as the main centers for childhood behavior modifications.[8] Since 2003, the WHO has acknowledged the importance of schools and promoted a series of recommendations based on the implementation of the Health Promoting Schools (HPS) program.[17] In 2012, Wang documented the benefits of this type of program in a systematic review.[8] This strategy was conceived under this guideline in agreement with the recommendations on beverage consumption issued by the Ministry of Health for the Mexican population.[5]

In contrast to other approaches, this educational strategy was designed using three theories of knowledge, which proved to be useful measures for behavior modification and the development of life skills. Additionally, the educational session contents aligned with the educational program of the Ministry of Public Education of Mexico (SEP), which allowed reinforcement of the content of the different subject areas and thus promoted better acceptance by teachers. Because the contents and educational materials were different for first, second and third graders, students could receive the strategy throughout the three grade levels, which increased the likelihood that the learned behavior would persist over time.

The average baseline consumption of total liquids in our population was 1 337 ml/day (SD 546), which was very similar to the 1 350 ml/day (SD 650) reported by Iglesia and colleagues[4] for Mexican children aged 4-9 years. During follow-up, no significant changes were observed in the overall fluid consumption; however, plain water consumption increased by displacing the consumption of sweetened beverages and sodas, significant in the IG. A similar finding was described by Mesirow[18] in the United States and by Illescas-Zárate[19] in Mexico, who observed that modifying the fluid intake pattern resulted in an increase in plain water consumption and decrease in the consumption of caloric beverages. These findings highlight the importance of

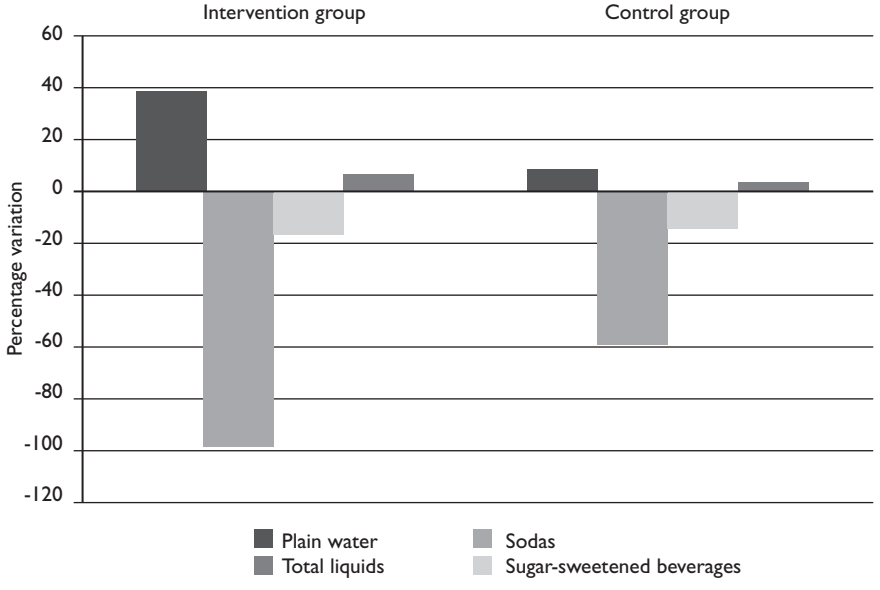


Figure 3. Percentage variation between consumption medians at time 1 and time 3 points (intervention group). Mexico City, 2015

modifying the pattern of beverage consumption without prioritizing an increase in liquid intake. In the CG a significant reduction in the consumption of sodas, without an increase in the consumption of plain water was detected. This could be explained by the Hawthorne effect, since the included population identifies sodas as an unrecommendable beverage, which is a different perception than for other sugary drinks.

In 2010, the need to promote plain water consumption in schools was established through an agreement between the Mexican Ministry of Health and the Ministry of Public Education.[20] In 2014, the General Law on Physical Educational Infrastructure was passed, which in article 11 guaranteed the existence of sufficient drinking fountains in every school; however, facilitating access to plain water and reducing the supply of sugary drinks will not suffice to increase the consumption of plain water. Creating positive values associated with its consumption is also necessary, as suggested by Théodore and colleagues.[21] This possibility could explain why the control group did not increase consumption of water despite having it available inside the classrooms.

The consumption of beverages varies between populations; however, plain water was the main liquid for consumption in all age groups, whereas the other drinks varied according to the age group. The second most commonly consumed drinks were milk in young children and soda in adolescents.[2] The subject population was not different; plain water represented the main liquid consumed, followed by milk and dairy. Guelinckx reported that 43% of the liquids consumed by Mexican school children apart from dairy were calorie-supplying beverages.[15] Barquera showed that 29.6% of the beverages consumed in a similar population were sugary drinks and those beverages contributed to 20.7% of the overall dietary energy intake,[22] which far exceeds the 10% recommended by the WHO to maintain a healthy diet.[23,24] In our population, the consumption of caloric beverages, excluding dairy products, was 26.4%, which was similar to the consumption reported by Barquera.

Water availability is a crucial aspect for the implementation of strategies to increase consumption. Subjects do not consume water when they perceive it as unsafe.[25,26] Notably, Latino people in the USA consider drinking water from fountains or tap water unsafe, which may encourage the consumption of sugary drinks.[21] This finding was also noted in the present study because all the schools at the beginning of the study had drinking fountains, but their use was limited because people thought the water was dirty, had an unpleasant taste or posed a risk to their health; in contrast, bottled water was perceived as safe.[26] We consider that the marginal increase in water consumption in the control group resulted from providing water inside the classrooms and a reusable bottle for its consumption.

Limitations

The present study provided the BSR, a validated research instrument,[15] to the parents to gather key research information. Some parents were not committed to tracking fluid consumption and others were confused about how it should be completed causing the removal of records from the analysis. Also, during school hours, only the drinks that the parents sent to be consumed during recess were quantified reducing the proportion of children who increased their water consumption by 220 ml/day.

In conclusion, when incorporated into the educational program for each school grade of early primary school and associated with free, convenient access to plain water inside the classrooms, the *I prefer plain water* educational strategy is effective in increasing the consumption of plain water and decreasing the consumption of sugar-sweetened drinks. This strategy did not modify the consumption of total liquids, milk and milk beverages or other beverages

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Declaration of conflict of interests. MD, PhD José Luis Arredondo García mantains a collaboration with Danone Nutricia Research under a non-lucrative interinstitutional research agreement. The remaining authors declare that they have no conflicts of interest.

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