A scoping review of school-based nutrition and physical activity interventions conducted in Mexico

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Author Contribution(s)

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Abstract

Introduction: As the Mexican economy has developed, ultra processed, high fat, low fiber, and high sugar foods have become more prevalent. Almost one in four children in the country is overweight or obese. The Mexican government has school nutrition guidelines and policies. Several schools have implemented programs to improve child nutrition and physical activity knowledge and behaviors in an effort to reduce childhood overweight and obesity. The aim of this review is to assess the range of school-based nutrition and physical activity interventions and their possible impact on health and wellness.
Methods: A scoping review of English and Spanish language published peer-reviewed studies examined existing literature on school-based nutrition and physical activity interventions implemented in Mexican schools for children and adolescents. The 17 studies meeting inclusion criteria were analyzed for program content and outcomes.
Results: All interventions had some impact on either knowledge, attitudes, and/or behaviors. Almost all interventions incorporated parents. These programs occurred within the context of national guidelines issued by the Mexican government and a renewed focus on the increasing problem of childhood obesity.
Conclusion: Mexico's school-based nutrition and physical activity interventions can impact nutritional knowledge, food and beverage choices, and physical activity behaviors.

Keywords

School health; nutrition; children; adolescents; Mexico

Introduction

Childhood obesity and overweight is a serious public health problem in Mexico [1,2]. The World Health Organization reports that Mexico has a high prevalence of childhood obesity and overweight with an estimated nearly 39% of children classified as either overweight or obese [3-5]. Mexican children are doubly burdened with undernutrition (low caloric intake and/or nutrient-poor intake) in some socioeconomic subgroups and overnutrition (excessive caloric intake, with or without appropriate nutrients) in others [6,7]. The double burden is increasing rates of childhood overweight and obesity alongside persistent problems associated with undernutrition, such as stunting and underweight [8-11]. Childhood nutrition is a critical aspect of overall health and development, playing a pivotal role in shaping the future health outcomes and well-being of individuals [9,12].

Mexico is classified by the World Bank as an upper-middle-income country [13]. As countries move towards an improved level of income, nutritional choices increase, including more processed and calorie-dense foods. This dietary transition moves these populations from near-famine conditions to more Western-style diets high in calories and fat but low in fiber and nutrient density [4,14,15]. The increased consumption of nutrition-poor, calorie-dense foods contribute to rising obesity and overweight [14,15].

School-based nutrition is an important component of childhood nutrition in many countries [16], as children may spend up to a third of their waking hours in school-based activities [17]. Latin American countries are globally recognized for efforts made to build effective school food programs, providing important nutritional support for schoolchildren in Latin American countries, including Mexico [12,18]. In an effort to combat the rising consumption of highly processed foods, Latin American countries, including Mexico, were among the first to embrace an environmental/ecological approach to using labeling and taxes to communicate nutrition information to the consumer in an easy-to-read way, including mandating front-of-package labels indicating foods high in sugar, fats, salt, or calories. Mexico also implemented warnings [19] and was the first Latin American country to impose taxes on sugary beverages and ultra-processed foods [12].

However, Mexico is not among the top Latin American countries that offer school food programs. While Mexico has developed national guidelines and directives aimed at improving school nutrition programs, it ranks behind Chile, Ecuador, and Honduras in terms of covering all schools across the country [20]. A variety of factors drive uneven implementation of national school nutrition policy, including geography (remote and rural), access to healthy foods, the logistics of transporting food supplies, the diversity of socioeconomic status within Mexican populations, school policies among Mexican states and regions, and the lack of national oversight and supervision of school nutrition programs [3,21,22].

The benefits of school nutrition programs are well established [16]. These programs offer food to children who might otherwise go without a meal at school. School-based food programs offer economic opportunities for local food suppliers and farmers [23]. Parents and community members express satisfaction with well-developed school food programs [20]. Yet, school nutrition research in Mexico identifies characteristics of school systems across the country that hinder the development of comprehensive and consistent school feeding programs [24]. Some of Mexico's schools are in rural or remote areas where there is limited access to clean drinkable water [22]. Some schools have dedicated on-site kitchens, while others depend on catered food from outside vendors. Many schools have available refrigeration and electricity, but some do not, instead depending on charcoal or wood stoves for food preparation [20].

Many Mexican school systems feature established school food programs, but the food offered is not always consistent with national directives [25]. Many participants in school breakfast programs are overweight and consume more sugary drinks and snacks and less dietary fiber as a part of school nutrition programs [3,26]. Other research studies have found the outcomes of government-supported nutrition programs are affected by student access to food vendors selling unhealthy foods near schools, a lack of knowledge among school authorities about national school food programs, and a lack of nutrition education targeted to school children and their parents [22].

The WHO has published evidence about effective school nutrition programs [16]. Specific recommendations from this report include promoting participation by parents and community members in the development of school feeding programs, using locally sourced foods, and providing nutrition education to school children and their families [16]. These recommendations are consistent with research reported from Latin America and Mexico. The aim of this scoping review seeks to bridge existing knowledge gaps in this body of research evidence to examine, organize, and characterize information from the literature currently available about school-based nutrition and physical activity interventions in Mexico.

Methods

Selection criteria

The Population, Intervention, Comparison, Outcomes, and Study (PICOS) design guidelines [27] were incorporated to develop the research question: *"Do children and adolescents in Mexico (P) that are offered school-based nutrition and physical activity interventions (I) have improved health and wellness parameters (O) compared with those that do not participate in* *school-based nutrition and physical activity interventions(C)?"* and subsequent inclusion and exclusion criteria (see Table 1). Peer-reviewed articles published in English or Spanish languages were included. Interventions reported outside traditional peer-reviewed articles were excluded in this review. The search was conducted in the spring of 2024 and the results communicate literature published between 2004 through May 2024. In addition, reference lists of relevant studies were screened to identify publications from other studies that might be eligible for this review.

Search procedure

For this scoping review, we followed the PRISMA Extension for Scoping Reviews [28] and began a comprehensive search within biomedical bibliographic databases using a combination strategy of medical subject heading keywords, terms, phrases, and Boolean operators (see supplementary material). The following 14 databases were searched: EBSCOHost; BIOSIS; CINAHL; ScienceDirect; ArticleFirst; Biomed Central; BioOne; ProQuest; SAGE Reference Online; Scopus; SpringerLink; PubMed; Taylor & Francis; and Wiley Online. The search strategies were adapted according to the indexing systems of each respective database.

Study selection and Data Extraction

Two of the authors [BAE and ED] conducted the searches for relevant articles and one author utilized Rayyan QCRI software [29] to assist in the screening process. All retrieved articles were screened for relevance to the topic (see figure 1). In addition, reference lists from retrieved articles were also hand reviewed to identify any additional relevant publications. Titles and abstracts were screened for relevancy, and potentially relevant journal abstracts were reviewed by four of the authors [SB, ED, TK and NR]. Potential articles for inclusion in this review were evaluated independently for relevance, merit, and inclusion/exclusion criteria (see Table 1).

Articles accepted for inclusion were individually reviewed by each author. Additionally, each study was assessed by an independent reviewer and the reference list of each included article was screened for potentially eligible articles. Once the list of selected studies was finalized, SB and BAE extracted and cross-checked each study. NR updated the search, reviewed the articles, and wrote first draft of the results and discussion sections of the review. Differences in opinion in data extracted were discussed to reach consensus and tabulated (Table 2 and Table 3). A total of 17 articles were included in this review. Given that methodological quality assessment is not a prerequisite for scoping reviews, we did not appraise the included studies [30].

Results

Target ages, locations, and duration of interventions

The interventions targeted 6–18-year-olds. The majority (14/17, 82%) included 10-year-olds. Only three (18%) addressed adolescents. Studies examined interventions in nine different states of Mexico. The majority of studies (13/17) reported interventions of six months or more. Slightly more than a third (6 out of 17) of the interventions were a year in duration or longer.

Intervention components

The studies incorporated components for school nutrition programs recommended by WHO [16] (Table 2). All had an educational component. All but four [31-34] of the 17 incorporated parents into the program. Nine of the interventions included physical activity incorporated into the school routines. Twelve included environmental changes.

Intensity of the interventions varied. Physical activities (PA) ranged from 50 minutes a day five days a week for nine months [35] to individualized food and exercise plans and support every three weeks [36]. Colín-Ramírez, Castillo-Martínez, Orea-Tejeda, Vergara and Villa [37] reported on an intervention that included 10 weeks of weekly classroom education on nutrition and PA, including 20-30 minutes of activity, as well as daily classroom breaks of 2-10 minutes of physical activity, and a school wide requirement for 2 times a week PE classes of 30 minutes/session for a year. One study [38] looked at nutrition education 20 minutes per week for seven weeks.

Environmental interventions included increasing the availability of healthier food options, limiting unhealthy options, increasing water consumption, and creating a school culture of physical activity and healthy eating. One study [39] modified available food options. One study [31] implemented a school garden to teach students 12–18 years old and provide nutritious options. One study [33] examined the impact of school breakfasts. Four studies [34,40-42] provided healthier food options and water while reducing availability of calorie dense snacks and beverages. Four studies reduced the availability and/or intake of sweetened beverages [32,35,38,41].

Theoretical Frameworks and Behavior Change Models

Fourteen of the 17 (82%) included articles utilized a theoretical framework or behavior change model to inform the education component of their interventions, while the remaining 3 did not note the use of a theoretical framework [33-35]. The majority of the articles utilizing a theoretical framework or educational or behavioral change model noted that the intervention was designed based on a variety of social-ecological models (n=7) [32,37,39,41,43-45], including three that use a combination of Social Cognitive Theory and Social Ecological Model [37,39,45], one based on Brofenbenner's Ecological Model [43], one on Booth's Ecological Model [44], one that is culturally tailored and based on the Social Ecological Model [32], and one described as an Ecologically-driven school based intervention [41]. Another article noted the use of Cognitive Constructivism as the basis for the intervention [31]. Four more interventions relied on Lifestyle Behavior

Interventions [36,42,46,47], while one study [38] based their intervention on the Health Promotion and Behavior Change Model. Finally, one intervention noted one on one education sessions with a nutritionist.

Outcomes

All of the reported school-based nutrition programs had positive effects in knowledge, attitudes and/or behaviors, or had improved anthropometric or biometric results (Table 3). Decreases in sugars occurred in four programs [32,35,38,39]. However, one study [34] found an unexpected increase in total sugar consumption, although fiber intake and nutritional knowledge scores increased. Salt intake was reduced in two studies [37,43]. Fruit and vegetable consumption increased in three initiatives [31,43,46]. Physical activity, integrated into nine of the studies, increased in eight studies [34,36,37,41,43,44,46,47]. Interventions were associated with a lower increase in BMI or a decrease in BMI or weight in five studies. Other findings from the interventions include increased physical fitness, decreased systolic blood pressure, decreased waist circumference. Only two of the interventions studied measured outcomes longer than a year after the intervention. One study [43] found vegetable intake and physical activity had increased at 24 months. One study [41] found a sustained increase in physical activity (steps taken) and in the availability of drinking water and healthy snacks.

Discussion

Each of the programs cited in the literature occurred with the backdrop of the Mexican government's emphasis on the problem of childhood overweight and obesity, as well as national guidelines for school nutrition efforts and policies. The diversity of strategies to address the need for healthy nutrition and physical activity and the potential impact are evident in this scoping review. While many of the studies impacted knowledge, attitudes, and behaviors, only five yielded a decrease in BMI or a decrease in the rate of increase in BMI. The process of changing behaviors sufficiently to change biometric indicators occurs over time. These studies show that interventions can change nutrition intake and physical activity, the precursors to reducing overweight and obesity over time.

Program duration may also impact the extent to which a certain behavior is changed. The shortest intervention ran only 2 months, with a 12-month follow-up and found that an education intervention based on the Health Promotion and Behavior Change model resulted in significant decreases in the consumption of processed meats, sweetened cereals, and sugar sweetened beverages (SSB's). However, while overweight decreased in the intervention group, obesity increased in both groups [38]. In contrast, the longest studies (n=3) [34,39,44] ran for 36 months and found significant increases in nutrition knowledge [34], improved physical fitness [44], and a significant decrease in total kcal, bread, fat and sugar consumption [39]. Interestingly, one study [34] also found an unexpected and significant increase in total sugar consumption in the intervention group. The majority of studies (13/17) reported interventions of six months or more, and for nutrition and health related outcomes those interventions that were offered over 6 months or more found significant reductions in processed foods and SSB's, as well as fat, sugar, sodium [32,35,37-39,43,46], increased vegetable, fruit, and/or water intake [32,34,43,46]. It is important to note that while conducted over 5 months, one study [31] also found an increase in fruit and vegetable consumption and a decrease in overall kcal consumption.

For those interventions that were 6 months or more and included intervention components on physical activity and assessed physical activity participation and/or anthropometric outcomes, three demonstrated a reduction in weight and/or BMI [36,39,43], and 7 studies found an increase or improvement in PA [34,36,37,41,43,44,46]. One additional study also found a significant (p=0.02) increase in physical activity, but was offered over a shorter duration of 2.5 months with a 5.5 month follow-up [47]. It is interesting to note that of the interventions without a stated theoretical framework, the findings related to BMI were non-significant [33,35].

Only one study specifically noted cultural tailoring of the intervention [32]. This study found a significant increases in water consumption (p=0.01) in the intervention schools compared to the control school, as well decreased flavored milk consumption (p = 0.04), caloric intake (p = 0.02) and sugar intake (p = 0.01). As cultural tailoring can increase the success of nutrition education interventions [48-50], future research could investigate whether including cultural tailoring of the intervention can further impact intervention efficacy.

It is noteworthy that the majority of programs, 12, addressed environmental issues, such as increasing the availability of healthy foods, limiting access to unhealthy foods and drinks, and incorporating physical activity into daily school activities. Each of these initiatives with environmental components impacted behaviors. It is worth noting, however, that the reporting of successful outcomes may be a result of publication bias; unsuccessful interventions are less likely to be published [51].

Limitations and Opportunities for further research

This review identified several limitations in the existing literature on school-based nutrition interventions in Mexico. Heterogeneity across studies limits the ability for direct comparisons and generalizability about intervention effectiveness. Because the majority of interventions included a variety of different approaches to effecting change in nutrition and physical activity behaviors, it is difficult to determine the impact of individual intervention components. Finally, potential selection bias due to study locations and potential publication bias due to studies with neutral or negative findings not being published may skew the available data.

Future research would benefit from standardized intervention protocols and outcome measures, based on clearly defined theoretical frameworks and measures associated with the relevant constructs. Further, developing interventions that have similar intensity levels and durations would facilitate comparison and produce data that can assess individual component effectiveness. Longitudinal studies are needed to assess the long-term impact of such interventions on dietary and physical activity behaviors and related health outcomes. Additionally, we found a paucity of investigations targeting adolescents in the school-setting, and recommend further studies on cost-effectiveness analyses, and implementation strategies to strengthen the evidence base regarding school-based nutrition interventions in Mexico.

Conclusion

The evidence reviewed to date shows positive trends for school-based nutrition and physical activity interventions in Mexico and the ability to impact health and physical activity outcomes can improve knowledge, attitudes, and behaviors. The national policy focus on these issues most likely added additional support to the initiatives and their impacts. With economic advances and transnational trade of processed foods, school-based programs are an important service to promote long-term health of the population.

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Table 1. PICOS Criteria for Inclusion and Exclusion of Studies

Parameter	Inclusion Criteria	Exclusion Criteria
Population	• School-aged students (i.e. around 6 years old and above), who were examined in Mexico within the school setting	• Students who are not of school-age. • Students who are not studying in Mexico • Students undergoing medical nutrition therapy-based diets
Intervention type	Any kind of school-based intervention that addresses nutrition and physical activity-related aspects, including: • Educational interventions • Environmental Interventions • Multi-componential Interventions	• Interventions that are not based on school facilities • Interventions that do not address nutrition and physical activity-related outcomes
Comparators	Pre-intervention, baseline nutrition and physical activity-related variables (i.e. anthropometric measures, biochemical parameters, nutrition and physical activity-related knowledge, dietary habits, perceived hunger) of student groups who were: • Control: received no intervention. • Received partial intervention e.g., educational intervention only vs. multi-componential intervention	• N/A
Outcomes of Interest	• changes in anthropometric outcomes, e.g.: BMI for age, height for age • changes in biochemical outcomes • changes in nutrition and physical activity-related knowledge • changes in meeting the dietary macronutrient and/or micronutrient recommendations • changes in adherence to healthy dietary habits and avoidance of unhealthy ones	• Non- nutrition and physical activity-related outcomes

	• changes in risks of nutrition-related diseases e.g.: obesity or iron-deficiency anemia • changes in short-term hunger	
Language	English or Spanish	All other languages
Study Type	Experimental intervention studies with measured outcomes Peer-reviewed original research articles Original research conference publications	Non Peer-Reviewed articles Non-numeric/categorical assessments or qualitative studies Commentaires Narratives Protocols Communications Non-intervention based studies White papers Similar article types Grey literature

Abbreviations
BMI – Body Mass Index
N/A – Not applicable

Table 2. Study and intervention characteristics of included studies

Author (Year)	n, age	Location in Mexico	Intervention Duration in months	Follow up period (months)	Delivered by	Components : environmental, physical activity, parent involvement	Intervention/theoretical framework
Alvirde-García et al. (2013)	1224 9 y.o.	Hidalgo	36	6	TTE, RT	EV, PA, PR	Education for children and parents on healthy habits, modification of available food and physical activity. Social Cognitive Theory and Social Ecological Model
Bacardí-Gascon et al. (2012)	532 7-8 y.o.	Baja California	6	18, 24	T, E	EV PA PR	Nutrition and physical activity professionals interacted with parents, children, and teachers to show how food choices and physical activity depend on personal behavior, individual health and school and family environment. Brofenbenner's Ecological Model
Briones-Villalba et al. (2018)	35 9-10 y.o.	Baja California	9	NA	E, TTE	PA, PR	Physical activity sessions of 50 minutes and 10 minutes of nutritional education with a frequency of 5 days per week for nine months, parental education None noted
Colín-Ramírez et al. (2009)	498 8-10 y.o.	Mexico City	12	NA	E, TTE	EV, PA, PR	Classroom instruction and 2-10 minutes of physical exercises, school environment: physical education activities, promotion of healthy behaviors, and healthy food options;

							parent involvement with education, recipes for home, messages about healthy behaviors. Social Cognitive Theory and Social Ecological Model
Elizondo-Montemayor et al. (2013)	96 6-12 y.o.	Monterrey	10	NA	E	PR, PA	Individualized structured daily meals and a physical activity plan, tailored-made for each child, were provided every 3 weeks at the schools, with required parental attendance. Lifestyle Behavior Intervention
Figueroa-Piña et al. (2021)	126 12-18 y.o.	Queretaro	5	NA	T, TTE	EV	Educational intervention and school garden as an educational didactic tool in vegetable and fruit consumption Cognitive Constructivism
Gatica-Domínguez et al. (2019)	214 8-14 y.o.	Morelos	36	NA	TTE, RT	PA, PR	Trained staff worked daily with the school community to stimulate participation of students, parents, and teachers in physical activity. Booths Ecological Model
Olvera et al. (2024)	314 9-12 y.o	Hidalgo	6	NA	RT	EV	Installation of water fountains in school and 30-minute lessons on water v sugary drinks Culturally tailored nutritionist delivered curricula, Social Ecological Model
Perichart-Perera et al. (2008)	360 8-14 y.o.	Queretaro	4	4	E, T	PA, PR	Educational workshops on nutrition and physical activity aimed to the students and educational talks on nutrition and physical activity aimed to parents. Social Cognitive Theory and Social Ecological Model

Quizán-Plata et al. (2014)	126 6-8 y.o.	Sonora	9	11	RT	PA, PR	20-minute physical activity routine every school day for16 weeks, Parental education. Lifestyle Behavior Intervention
Ramírez-López et al. (2005)	254 6-10 y.o.	Sonora	9	9	NR	EV	Participation in school breakfast program compared to non-participants None noted
Ramírez-Rivera et al. (2021)	41 10 y.o.	Sonora	2.5	5.5	R, students	PA, PR	18 nutrition education sessions, 20 physical activity classes and six brochures for parents. Lifestyle Behavior Intervention
Ríos-Reyna et al. (2022)	309 9-11 y.o.	Tamaulipas	2	12	T	EV PR	Nutrition education, healthy snacks, 20 minutes/week x 7 weeks and pamphlets sent to parents. Health Promotion Behavior Change Model
Rosado et al. (2008)	147 6-12 y.o.	Querétaro	3	NA	E, RT	EV PR	For children with BMI>85 percentile, varying nutritional value of breakfast and a both oral and written parental nutrition educational component (weekly x 12 weeks). Participant education 1:1 with nutritionist
Safdie et al. (2013)	830 9-10 y.o.	State of Mexico	18	7, 11, 18	T, RT, E	EV PA PR	Provide healthy food options and water, reduce availability of calorie dense snacks and beverages, increase physical activity resources, and communicate messages about healthy food choices to parents and children, and prohibit eating in class. Ecologically-driven school based intervention
Shamah-Levy et al. (2017)	1620 10-11 y.o.	Mexico City	36	NA	NR	EV PA	Gradual decrease in the energy content of school breakfasts and increase in fruits and vegetables, gradual regulation of food

							offered in the school, gradual adherence to national physical activity education, and an educational campaign. None noted
Shamah Levy et al. (2012)	1020 10 y.o	State of Mexico	6	NR		EV PA PR	Nutritional education, nutritious hot meals, nutrition workshops, art education (dance, theatre, music), physical activity, and parental education. Lifestyle Behavior Intervention

Abbreviations

+: written in the study article; **NR:** not reported in the study; **RT:** Research Team; **T:** Teachers; **TTE:** Teachers trained by experts; **E:** Experts; **SS:** School Staff; **NA:** Not Applicable or Assessed; **EV** environmental changes such as water and healthy food options; **PA** physical activity; **PR** parent involvement

Table 3. Study design, overall study quality, and overall intervention effectiveness on anthropometrics and dietary behavior of included studies (n=17)

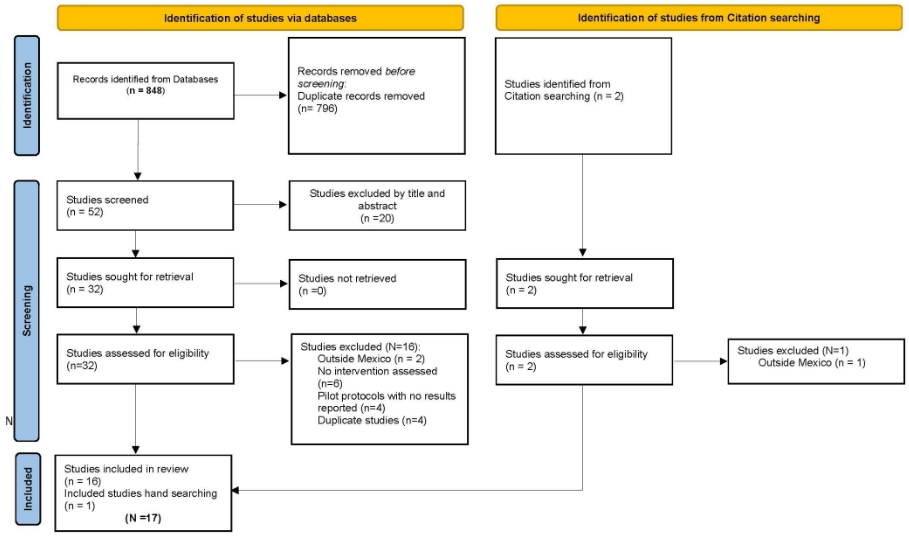
Author (year)	Study design	Study effect on anthropometrics and/or biometrics	Study effect on nutrition and PA knowledge, attitudes, and/or behaviors
Alvirde-García et al. (2013)	RCT	• Lower increase in BMI (p<0.01)	• Decrease consumption of total calories (p=0.000), bread (p=0.000), fat (p=0.000) and sugar (p=0.001)
Bacardí-Gascon et al. (2012)	Randomized cluster controlled trial	• Decrease in BMI at 6 months (p<0.01) decrease in abdominal obesity at 24 months (p<0.01)	• increase (p =0.007) in vegetable intake • increase physical activity (p =0.0001) • reduce SSB's (p=0.0001) • Decrease snacks containing sodium and fat (p=0.03)
Briones-Villalba et al. (2018)	Quasi-experimental pre/post with control group	• BMI did not significantly change	• Decrease in sugar consumption (p=0.05) and calories from sugary beverages (p=0.05)
Colín-Ramírez et al. (2009)	Randomized control field trial	• Decrease in systolic BP (p=0.04)	• Reduction in sodium consumption (p=<0.01) • Increase in knowledge and attitude regarding nutrition and health (p=0.04) • Increase in PA (p=0.04)
Elizondo-Montemayor et al. (2013)	Cross-sectional intervention study	• Decreased BMI (P< 0.01), body fat % (P< 0.01), WC ≥90th percentile, (p=0.01), metabolic syndrome (p < 0.01), HBP >90th percentile (p=.01), triglycerides (p<0.01), low HDL-C (< 0.01) • 32% of the overweight children achieved normal weight, 24% of the obese children converted to overweight and 1% reached normal weight	• Increase in PA (p=0.02)

Figueroa-Piña et al. (2021)	3-arm, controlled, comparative impact study	• NR	• Increase in understanding of information and willingness to include fruits and vegetables into daily diet • Increase in fruit and vegetable consumption (P<0.01) • Decrease in overall energy consumption (P<0.01)
Gatica-Domínguez et al. (2019)	RCT	• Improved physical fitness among IG. Increase in steps/day (p< 0.05), improved speed (p<.01) and distance (p<.01) in physical activity tests	• NR
Olvera et al. (2024)	RCT	• NR	• Increased water consumption (p=0.01), • Decreased flavored milk consumption (p = 0.04), caloric intake (p = 0.02) and sugar intake (p = 0.01).
Perichart-Perera et al. (2008)	intervention study	• No change in BMI and WC • Decrease in systolic BP (P<0.01), triglycerides (p=0.000) and total cholesterol (p<0.01)	• NR
Quizán-Plata et al. (2014)	RCT	• NR	• Increase in fruits and vegetables consumption (p=0.003) • Decrease in total fat intake (p=0.02) • Increased nutrition knowledge at end of intervention (p=0.05) • Increase in PA (p=0.04) and decrease in sedentary activities (p=0.01)
Ramírez-López et al. (2005)	Quasi-experimental prospective study	• No difference in BMI between groups.	• NR

		• Increased lean mass in both groups (p>0.05)	
Ramírez-Rivera et al. (2021)	RCT	• Reduced fat percentage (p<=0.02), waist circumference (p<0.01). No change in BMI	• Increase in physical activity (p=0.02) and nutrition knowledge (p=.02)
Ríos-Reyna et al. (2022)	Longitudinal study	• Decrease in overweight in intervention group and increase in control group. Obesity increased in both groups.	• Small decrease in the consumption of processed meats (p=0.004), sweet cereals (p=0.001) and sweetened non-dairy beverages(p=0.001) Increased water consumption
Rosado et al. (2008)	RCT	• Decrease in body weight (p< 0.01), BMI (p<0.01), total body fat (p<0.05), triglycerides (p<0.05),and VLDL (p<0.05). • Increase in HDL-C levels (p<0.01)	• NR
Safdie et al. (2013)	RCT	• No change in obesity prevalence	• Increase in the availability of healthy foods (p<0.05) • Increase in the availability of potable drinking water (p<0.05) • Increase in steps taken (p<0.05)
Shamah Levy et al. (2012)	Two-stage cluster trial	• BMI did not increase over time in either group.	• Notes on self-efficacy notes higher (0.04)
Shamah-Levy et al. (2017)	Three cohort comparative study	• NR	• Increase in nutrition knowledge score (p=0.003) and fiber intake (p=0.06) • Unexpected increase in total sugar consumption (p=0.01) • Increase in PA (p=0.002) between 2013 and 2014, maintained through 2015 (p=0.032)

Abbreviations - **PA**=physical activity, **WC**=waist circumference, **NR:** not reported in the study **IG:** Intervention group

Figure 1. Search Flow Diagram Following PRISMA 2020 Guidelines



297x210mm (200 x 200 DPI)

Supplementary material

“School” [All Fields]; “school-based” [All Fields]; “elementary” [All Fields]; Primary” [All Fields]; “Secondary” [All Fields]; “nutrition” [All Fields]; “physical activity” [All Fields]

AND “Intervention” [All Fields]; “Program” [All Fields]

AND “Mexico”