Nutr Res Pract. 2021 Apr;15(2):235-247
https://doi.org/10.4162/nrp.2021.15.2.235
pISSN 1976-1457·eISSN 2005-6168

Nutrition Research and Practice

Original Research

Evaluation of the effect of a school garden as an educational didactic tool in vegetable and fruit consumption in teenagers

Diana Gabriela Figueroa-Piña [1], Jorge Luis Chávez-Servín [1§], Karina de la Torre-Carbot [1], María del Carmen Caamaño-Pérez [1], Gabriela Lucas-Deecke [2], Patricia Roitman-Genoud [1], and Laura Regina Ojeda-Navarro [1]

[1]Facultad de Ciencias Naturales, Campus Juriquilla, Universidad Autónoma de Querétaro, Querétaro, Qro. CP 76230, México
[2]Centro de Innovación de Agricultura Sostenible en Pequeña Escala, A.C. CIASPE, Querétaro, Qro. CP 76246, México

Received: Aug 18, 2019
Revised: Feb 17, 2020
Accepted: Jun 19, 2020

[§]Corresponding Author:
Jorge Luis Chávez-Servín
Facultad de Ciencias Naturales, Campus Juriquilla, Universidad Autónoma de Querétaro, Av. de las Ciencias S/N, Juriquilla, Querétaro, Qro. CP 76230, México.
Tel. +52-442-192-12-00 (ext 5391)
Fax. +52-442-234-29-58
E-mail. jorge.chavez@uaq.edu.mx

ORCID iDs
Diana Gabriela Figueroa-Piña
https://orcid.org/0000-0002-9350-0391
Jorge Luis Chávez-Servín
https://orcid.org/0000-0002-5866-4825
Karina de la Torre-Carbot
https://orcid.org/0000-0002-6001-7061
María del Carmen Caamaño-Pérez
https://orcid.org/0000-0002-0096-2854
Gabriela Lucas-Deecke
https://orcid.org/0000-0003-2514-6439
Patricia Roitman-Genoud
https://orcid.org/0000-0002-4212-3979
Laura Regina Ojeda-Navarro
https://orcid.org/0000-0003-3793-8740

ABSTRACT

BACKGROUND/OBJECTIVES: Increasing the consumption of vegetables and fruits in Mexico remains a challenge. Promoting sustainable food production systems through schools may be an effective way to educate young people about food and nutrition issues. A study of nutritional education in adolescents, based on the school garden, is necessary in order to evaluate its effects on the consumption of fruits and vegetables among middle- and upper-income segments of the population. The objective of this study was to evaluate the effect of an educational intervention, accompanied by a school garden as an educational teaching tool, to improve vegetable and fruit consumption by Mexican teenagers attending a private middle/high school.
SUBJECTS/METHODS: Teenagers between 12 and 18 years of age (n = 126) attending a private middle/high school in Queretaro, Mexico participated in a 3-arm, controlled, comparative impact study using a vegetable and fruit consumption frequency questionnaire, food consumption diaries, a psychosocial factor assessment questionnaire of vegetable and fruit consumption, and structured interviews. The participants were randomized into 3 experimental groups: 1) food education + school garden (FE + SG), 2) FE only, and 3) control group (CG).
RESULTS: The FE + SG and FE groups significantly increased the frequency and daily intake of vegetables and fruits compared to the CG. The FE + SG group showed greater understanding of, reflection upon, and analysis of the information they received about vegetable and fruit consumption, as well as a greater willingness to include these in their daily diet.
CONCLUSIONS: FE accompanied by a SG as a teaching tool is more effective at promoting vegetable and fruit consumption than either education alone or control in teenagers in middle-upper income segments of the population.

Keywords: Vegetables; fruit; teenagers; gardening; health education

Conflict of Interest
The authors declare no potential conflicts of interests.

Author Contributions
Conceptualization: Figueroa-Piña D, Chávez-Servín JL, de la Torre-Carbot K, Lucas-Deecke G, Roitman-Genoud P; Data curation: Figueroa-Piña D, Chávez-Servín JL, Caamaño-Pérez MC; Formal analysis: Figueroa-Piña D, Chávez-Servín JL, Caamaño-Pérez MC; Investigation: Figueroa-Piña D, Chávez-Servín JL, Lucas-Deecke G; Methodology: Figueroa-Piña D, Chávez-Servín JL, Roitman-Genoud P, Ojeda-Navarro LR; Supervision: Chávez-Servín JL, de la Torre-Carbot K, Lucas-Deecke G, Roitman-Genoud P, Ojeda-Navarro LR; Writing - original draft: Figueroa-Piña D, Chávez-Servín JL, de la Torre-Carbot K; Writing - review & editing: Figueroa-Piña D, Chávez-Servín JL, de la Torre-Carbot K.

INTRODUCTION

The World Health Organization (WHO) recommends that the general population consume 400 g of vegetables and fruits daily in order to prevent the development of chronic non-communicable diseases, including cardiovascular diseases [1]. Mexican teenagers have been reported to consume a mean of 235 grams of vegetables and fruits per day, excluding potatoes, cereals and tubers. The Western diet today includes a tendency toward "fast food," and teenagers and children are more vulnerable to attraction to this type of food, which put them in higher risk of developing cardiovascular diseases [2]. Low vegetable and fruit consumption by Mexican teenagers places them at risk of developing chronic non-communicable diseases in adulthood [3]. The consumption of vegetables and fruits in adolescents could replace high energy density foods which are rich in fats, refined sugars and sodium [3]. Hence, it is important to measure vegetable and fruit consumption in this population, and to design methods to increase the consumption of these food groups. There are reports indicating that school nutrition programs can improve children's vegetable consumption and intention, as well as their preference, attitude, and self-efficacy [4,5]. Various food education (FE) strategies may be implemented to encourage healthy eating habits among teenagers. One of these is the use of the school garden (SG) as an educational tool [6].

It has been reported that SGs, combined with educational activities in agriculture and nutrition, can help schoolchildren make better decisions about the food they eat [7]. This educational strategy must be accompanied by training for the teaching staff in charge of transmitting the knowledge [8]. Nutritional education for students can be provided through basic subjects that are already part of the current curriculum, both in the classroom and in the SG [9].

Most nutrition programs are aimed at preschoolers and schoolchildren (6 to 12 years old), and very little has been published regarding the effects of such intervention on adolescents [7]. Adolescence (defined as the period between 12 to 18 years of age), is a highly important stage in which decision-making can be positively shaped around an appropriate diet. In selecting this sample group for the study—adolescents attending a private school—researchers' intent was to avoid the distortions that socioeconomic status might cause in gauging the impact of FE accompanied by a SG: adolescents in lower socioeconomic groups, for example, although they may want to consume vegetables and fruits, may not have access to them or find them readily available. The objective of this study was to evaluate the effect of an educational intervention, accompanied by a SG as an educational didactic tool, on improving vegetable and fruit consumption according to the WHO recommendation, among middle-high school students attending a private school in Querétaro, Mexico.

SUBJECTS AND METHODS

Study design and participants

The study design is 3-arm, controlled, comparative impact study, which lasted for 20 weeks from January to June 2017. The principal of a private school in Queretaro, Mexico, gave researchers authorization to work with 6th to 12th grade students during school hours, and parental consent was obtained from all participants. The Review Board of the Universidad Autonoma de Queretaro approved the procedures (IRB number 02FCN2014). Forty-two individuals were required per group considering an alpha error of 0.05, a statistical power

Nutrition Research and Practice

of 0.8 to detect a difference of 55 g between 2 groups, with a standard deviation of 80 g, and a lost cases percentage of 10%. A total of 126 students participated in the study. Subjects were randomly assigned to one of 3 study groups. Teenagers in the FE + SG group (n = 42), received a total of 29 FE lessons. Nineteen education lessons were given in the classroom and 10 education lessons were given in the SG, which focused on teaching adolescents about vegetable production, with the garden serving as a didactic tool. Each lesson included a driving question, an objective, materials and methods, guidelines and directives and final evaluation. Activities such as debates, real case analysis, and the use of electronic tablets accompanying the gardening activities, were part of the lessons given; each lesson lasted 60 minutes [10]. **Table 1** lists the objectives of each of the class lessons. Teenagers in the FE group (n = 42), received the same 19 education lessons in the classroom (without the 10 education lessons in the SG). Teenagers in the control group (CG) (n = 42), did not receive any type of intervention.

Intervention materials, FE study program and gardening component

The study program was designed to promote the development of key competencies defined by the Organization for Economic Cooperation and Development [11,12], based on the pedagogical approach of cognitive constructivism [13,14] and the pedagogical renewal movement of Rousseau's New School [15]. In this program, information and communication technologies were used as educational tools [16,17]. Inside the school premises, an outdoor vegetable garden was designed for the study, consisting of 25 boxes made of compressed recycling plastic, each measuring 1 × 1 × 0.40 meters, with access to 2 water faucets and direct sunlight for 5 hours a day. The vegetable garden was installed in a 11 × 2.5 m space with cement flooring, and was operated following the guidelines for a sustainable outdoor vegetable garden. Each box was prepared with 180 kg of substrate consisting of 50% black earth, 30% compost, 20% coconut fiber and 10% earthworm humus. Vegetables and aromatic plants acquired from a local organic greenhouse were transplanted directly into the seed bed [18-21].

Participants of the FE + SG group were given a class in the garden once a week. Students in this group were involved in the care and maintenance of the garden as part of the lessons designed in the educational program [6,22]. Through the process of applying an educational strategy and observing its effects on the students' knowledge, researchers were able to draft a “Teachers' Guide to High School Food Education”. The educational material was provided to the teachers who conducted the education. The competency-based curriculum was designed based on the Mexican education system [23]. It consisted of 29 sixty-minute lessons. Ten of these lessons were designed to be taught in a SG and 19 in the classroom. The series of lessons covered 5 topics: 1) the current food system and its impact on the environment and health, 2) the seed, its cultural and biological value, 3) food security, 4) healthy eating and 5) sustainable food production. Each lesson included a driving question, an objective, materials and methods, guidelines and instructions and final evaluation. Activities such as debates, real case analysis, and the use of electronic tablets accompanying the gardening activities, were part of the lessons given.

Evaluation tools

The students' vegetable and fruit consumption were evaluated by means of 2 quantitative questionnaires: a questionnaire on the frequency of vegetable and fruit consumption [24,25] and a non-consecutive 3-day food consumption diary, excluding weekends [26]. The food consumption diary indicated the quantity and measurements (cup, tablespoon,

https://doi.org//10.4162/nrp.2021.15.2.235

Table 1. Objectives of each of the class lessons of food education and school garden program

Lesson	Objective
1. Sustainable agriculture vs. industrial agriculture (classroom)	The student described agriculture history and was able to distinguish between sustainable and industrial agriculture practices and their impact on human health. The student also described the advantages and disadvantages of industrial agriculture and analyzed the need for some countries to implement a sustainable agriculture system.
2. Seed bank (classroom)	The student described the importance of seeds in economy and cultures. In addition, the student described a seed bank and the nutritional importance of protecting biodiversity in seeds.
3. Hunger and food security (classroom)	The student understood the causes of food insecurity and hunger as well as the definition of food security. The student developed a proposal to help to combat hunger and food security in the world.
4. Introduction to GMOs (classroom)	The student described the biotechnological process for synthetizing GMOs and their impact in human health based on scientific evidence. In addition, the student described the pros and cons for human nutrition.
5. Debate on GMOs (classroom)	The student analyzed the possible advantages and disadvantages of GMOs for human nutrition and proposed a motion to regulate their production.
6. Delicious and nutritious (classroom)	The student understood how to use the nutrition facts label. The student analyzed the ingredients of different foods, and determined their nutritional value. In addition, the student determined whether their food choices were beneficial for their health.
7. Food research part I (classroom)	The student analyzed food habits of families around the world and the food guides for some countries. The student analyzed their food choices and their environment impact.
8. Food research part II (classroom)	The students analyzed their food habits during 7 days and proposed healthy and sustainable food choices for themselves.
9. Food basics part I (classroom)	The students defined food and its value for societies.
10. Food basics part II (classroom)	The students analyzed the specific reasons for their food choices. In addition, the students understood food distribution systems and their impact on human nutrition and the environment.
11. Fresh products from farm part I (classroom)	The students analyzed the advantages of local farms. They examined 6 categories of food systems: transport, disposal, nutritional quality, economy, community and retail sale.
12. Fresh products from farm part II (classroom)	The students generated a marketing campaign to promote local food consumption and its benefits to human health.
13. Nutrition facts label design (classroom)	The students analyzed and evaluated the nutritional facts labels of most common processed foods. They designed a nutrition facts label that informed the consumer about the nutritional benefits and risks of processed food products.
14. Animal farm (classroom)	The students described the history of animal farming. The students examined the importance of consuming animal products in human nutrition. In addition, they analyzed the environmental consequences of animal farming and proposed a sustainable animal farm production.
15. Food, health and nutrients (classroom)	The students explained macronutrients, oligo elements and vitamins and their role in human nutrition. They identified these nutrients in different foods.
16. Vegetable and fruit campaign part I (classroom)	The students understood the health benefits of vegetable and fruit consumption. They also identified health problems resulting from low vegetable and fruit intake.
17. Vegetable and fruit campaign part II (classroom)	The students designed and implemented a vegetable and fruit campaign in their school to promote their consumption.
18. School food audit part I (classroom)	The students registered and analyzed information about the food available in the school cafeteria. In addition, the students analyzed the school's actions to promote vegetable and fruit consumption.
19. School food audit part II (classroom)	The students analyzed the importance of getting parents, teachers and school administrators involved in promoting vegetable and fruit consumption. They proposed an initiative to get the entire school community involved in increasing vegetable and fruit consumption.
20. Garden design (garden)	The students described the school garden concept. They analyzed the advantages of having a school garden in order to increase their vegetable and fruit consumption. They designed a plan for a school garden.
21. Seeds (garden)	The students understood the seed germination process and began sprouting seeds according to their harvest plan.
22. Garden setup (garden)	The students analyzed and implemented the square-foot gardening method and set up a completely functional sustainable garden.
23. Compost (garden)	The students understood the composting process and its importance for garden health. They set up a compost pile in the garden.
24. Crop association (garden)	The students understood the importance of soil nutrition and its impact on crops and as a result, on human nutrition. They understood the crop association method and implemented it in the garden.
25. Life bombs (garden)	The students analyzed the importance of seeds in human nutrition and they understood an alternative method of seed germination.
26. Pest prevention and control (garden)	The students analyzed the various natural methods for preventing and controlling garden pests. In addition, they identified the principal pests and diseases present in the garden.
27. Garden coaches (garden)	The students shared their gardening knowledge with preschool children. In addition, they shared the health benefits of consuming enough vegetables and fruits, and the importance of harvesting their own food. The students helped the preschoolers to start a garden.
28. Parent session (garden)	The students shared their gardening knowledge with their parents. In addition, they shared the health benefits of consuming enough vegetables and fruits and the importance of harvesting their own food at school and at home. They worked together in the school garden.
29. Harvest and cooking (garden)	The students designed a dish that includes ingredients from the garden and that follows the Mexican guide to healthy eating. They explained the nutritional benefits of the dishes to their classmates and shared the food.

GMO, genetically modified organism.

https://doi.org//10.4162/nrp.2021.15.2.235

serving size). Prior training was provided to the students to complete both questionnaires. These questionnaires were administered to all 3 experimental groups, before and after the intervention. From the food consumption diary, we calculated the consumption of vegetables and fruits, as well as energy, carbohydrates, proteins and lipids, using the Mexican foods and food products composition tables (2015) [27], and the results were reported as the mean of the 3 days (kcal/day). Additionally, an evaluation of psychosocial factors related to vegetable and fruit consumption was applied to the 3 groups using the Pro Children qualitative questionnaire, validated for the Mexican population [28]. The factors evaluated were: personal cognitive skills developed, personal attitudes, personal preferences, perceptions of physical environmental regarding accessibility at home, perceptions of physical environmental regarding accessibility at school, perception of personal barriers, and social environmental perception about modeling. The impact of the SG on vegetable and fruit consumption was evaluated through a structured qualitative interview. The interview questions were grouped into 5 categories according to the example given by Mertens [29,30]: students' opinion about the SG in their school, the feelings the SG generated, the knowledge they believe they developed during the activities carried out in the SG, their social environment or background regarding vegetable and fruit consumption, and their willingness to simulate or replicate the knowledge acquired in the SG at home. The structured interview was applied at the end of the intervention to 10 randomly selected individuals from the FE + SG group.

Statistical analysis

The results of the numerical scale variables are shown as the mean (95% confidence interval). To evaluate the difference in vegetable and fruit consumption, as well as nutrient intake, before and after the intervention, a paired t-test was performed. The baseline, final and change means were compared between groups through an analysis of variance, followed by a Tukey *post hoc* test. All analyses were tested for possible confounders, and the test assumption of normality was verified to avoid bias in the parameters. All analyses were performed using the SPSS V23 (IBM Corp., Armonk, NY, USA).

RESULTS

Vegetable and fruit consumption

A total of 126 students participated in the study (84 treatments, 42 controls; 57 male, 69 female). The study groups were homogeneous, with the following mean values: age 14.9 ± 1.8 years, weight: 58 kg, height: 164.6 cm and body mass index: 21.3 (**Table 2**). Students in the FE + SG group increased their vegetable and fruit consumption by 65.2 g/day compared to the CG and 44.8 g/day compared to the FE group (**Table 3**). Likewise, the FE + SG group showed an increase in frequency of vegetable and fruit consumption to 1.4 days more per week and FE 1.2 day per week, compared to the CG (**Table 4**). The CG showed no differences in vegetable and fruit consumption or in the frequency of consumption (**Tables 3** and **4**).

Table 2. Age and anthropometric characteristics of the participating students

Experimental groups	Number	Age (yrs)	Weight (kg)	Height (cm)	Body mass index (kg/m^2)
FE + SG	42	15.0 ± 1.7	59.4 ± 9.7	165.3 ± 9.2	21.6 ± 3.7
FE	42	14.9 ± 1.7	57.0 ± 9.2	164.3 ± 9.1	21.0 ± 2.7
CG	42	14.9 ± 1.8	57.5 ± 9.0	164.1 ± 8.3	21.2 ± 2.8
Total	126	14.9 ± 1.8	58.0 ± 10.5	164.6 ± 8.9	21.3 ± 3.1

The results are shown as the mean ± SD. No significant differences were found in any variable between the groups ($P > 0.05$).
FE + SG, food education + school garden; FE, food education only; CG, Control group.

https://doi.org//10.4162/nrp.2021.15.2.235

Table 3. Report on consumption of vegetables and fruits (grams) before and after the intervention

Experimental groups (g/day)	FE + SG (n = 42)	FE (n = 42)	CG (n = 42)	*P*-value
Vegetable consumption				
Pre	67.7 (56.6, 78.8)	71.5 (55.9, 87.0)	74.7 (57.7, 91.8)	0.793
Post	111.2 (96.1, 126.3)[a]	79.6 (62.2, 96.9)[b]	68.9 (51.6, 86.2)[b]	0.001
Change	43.5 (31.7, 55.3)[1)a]	8.1 (−2.3, 18.5)[b]	−5.8 (−16.5, 4.9)[b]	< 0.001
Fruit consumption				
Pre	84.8 (60.5, 109.1)	76.5 (57.5, 95.5)	89.3 (71.7, 106.9)	0.665
Post	106.5 (87.2, 125.8)	88.8 (71.5, 106.1)	85.8 (70.3, 101.2)	0.189
Change	21.7 (11.8, 31.6)[1)a]	12.3 (0.5, 24.1)[1)]	−3.5 (−14.2, 7.1)[b]	0.004
Vegetable and fruit consumption				
Pre	152.5 (124.7, 180.3)	148.0 (122.5, 173.4)	164.0 (137.0, 191.1)	0.678
Post	217.7 (190.3, 245.2)[a]	168.4 (145.3, 191.5)[b]	154.7 (129.0, 180.4)[b]	0.001
Change	65.2 (49.8, 80.6)[1)a]	20.4 (6.1, 34.7)[1)b]	−9.4 (−25.5, 6.8)[b]	< 0.001

Data obtained from the food consumption diary for 3 non-consecutive days, excluding weekends. All values represent the mean (95% confidence interval).
FE + SG, food education + school garden; FE, food education only; CG, Control group.
[1)]Significant difference between baseline and post intervention mean values in paired t-test ($P < 0.05$).
[a,b]Different letters represent significant difference between intervention groups in Tukey *post hoc* test ($P < 0.05$).

Table 4. Frequency of weekly consumption of vegetables and fruits (days/week) before and after the intervention

Experimental groups (days/week)	FE + SG (n = 42)	FE (n = 42)	CG (n = 42)	*P*-value
Frequency of vegetable consumption				
Pre	3.8 (3.2, 4.3)	3.2 (2.6, 3.8)	4.0 (3.4, 4.6)	0.114
Post	5.1 (4.8, 5.5)[a]	4.0 (3.4, 4.6)[b]	4.0 (3.4, 4.6)[b]	0.003
Change	1.4 (0.9, 1.8)[1)a]	0.8 (0.3, 1.4)[1)a]	0.0 (−0.5, 0.5)[b]	0.001
Frequency of fruit consumption				
Pre	3.6 (3.0, 4.2)	2.9 (2.3, 3.5)	3.7 (3.1, 4.4)	0.144
Post	5.0 (4.6, 5.3)[a]	4.1 (3.6, 4.6)	4.0 (3.5, 4.6)[b]	0.019
Change	1.4 (0.9, 1.8)[1)a]	1.2 (0.7, 1.8)[1)]	0.3 (0.0, 0.6)[b]	0.002

Data obtained from the food consumption diary for 3 non-consecutive days, excluding weekends. All values represent the mean (95% confidence interval).
FE + SG, food education + school garden; FE, food education only; CG, Control group.
[1)]Significant difference between baseline and post intervention mean values in paired t-test ($P < 0.05$).
[a,b]Different letters represent significant difference between intervention groups in Tukey *post hoc* test ($P < 0.05$).

Energy contribution from the diet

In terms of energy consumption, the FE + SG group decreased its energy consumption by 6.1% (−158 kcal), within which calories from fat decreased 11% (−77 kcal) after the intervention. Caloric intake from vegetables increased 54.8% (+18 kcal) and caloric intake from fruits increased 32.3% (+21 kcal). In the FE group, energy consumption decreased 3% (−80 kcal), while the calories obtained from the fruits increased 22.4% (12 kcal). CG showed no significant difference in total energy consumption after the intervention. However, for CG, calories from fats increased 2.4% and from carbohydrates 2.6%. At the end of the intervention, a difference was observed in total energy consumption between the FE + SG group and the CG, with the latter showing an energy consumption 7.9% higher than the FE + SG group. Caloric intake from vegetables was 35.5% higher for the FE + SG group than for the FE group and 50.4% higher than for the CG. Finally, the FE + SG group showed 34.8% higher caloric intake from fruits than CG (**Table 5**).

Psychological factors related to vegetable and fruit consumption

The main findings of each of the categories of the Pro Children qualitative questionnaire applied to the 3 groups are discussed below (**Table 6**).

Evaluation of personal cognitive skills developed

The group FE + SG showed greater understanding of, reflection upon, and analysis of the information they received from their environment about vegetable and fruit consumption, having learned about the characteristics of a healthy diet and recommendations on daily

https://doi.org//10.4162/nrp.2021.15.2.235

consumption of vegetables and fruits. They perceived that they consumed more vegetables and fruits than their peers and applied a reasoning by which they could incorporate the knowledge acquired to favorably modify their habits regarding consumption of this food group.

Table 5. Energy consumption (kcal) before and after the intervention

Experimental groups	FE + SG (n = 42)	FE (n = 42)	CG (n = 42)	*P*-value
Energy intake (kcal/d)				
Pre	2,558.79 (2,456.74, 2,660.84)	2,614.19 (2,507.35, 2,721.03)	2,566.55 (2,481.80, 2,651.30)	0.685
Post	2,400.83 (2,286.95, 2,514.72)[a]	2,534.48 (2,424.90, 2,644.05)	2,609.52 (2,511.11, 2,707.93)[b]	0.022
Change	−157.95 (−241.40, −74.50)[1)a]	−79.71 (−147.56, −11.87)[1)a]	42.98 (−10.76, 96.71)[b]	< 0.001
Protein intake (kcal/d)				
Pre	394.11 (352.13, 436.09)	399.49 (366.13, 432.86)	368.40 (334.06, 402.74)	0.437
Post	365.83 (336.82, 394.84)	367.20 (341.80, 392.60)	357.10 (321.17, 393.02)	0.876
Change	−28.28 (−56.00, −0.56)[1)]	−32.29 (−53.25, −11.33)[1)]	−11.31 (−25.88, 3.26)	0.347
Fat intake (kcal/d)				
Pre	697.65 (653.27, 742.02)	711.03 (672.35, 749.72)	735.88 (697.44, 774.31)	0.397
Post	620.15 (588.67, 651.63)[a]	689.78 (654.40, 725.16)[b]	754.24 (716.67, 791.81)[c]	0.000
Change	−77.49 (−110.95, −44.04)[1)a]	−21.25 (−49.59, 7.08)[b]	18.36 (0.69, 36.03)[1)b]	0.000
Carbohydrate intake (kcal/d)				
Pre	1,467.03 (1,397.19, 1,536.86)	1,503.66 (1,436.14, 1,571.18)	1,462.27 (1,412.45, 1,512.09)	0.592
Post	1,416.03 (1,345.02, 1,487.04)	1,477.49 (1,409.33, 1,545.66)	1,502.12 (1,442.08, 1,562.17)	0.168
Change	−51.00 (−104.85, 2.86)[a]	−26.17 (−75.65, 23.31)	39.86 (0.96, 78.75)[1)b]	0.022
Energy from fruit intake (kcal/d)				
Pre	45.14 (30.82, 59.46)	41.28 (32.49, 50.07)	45.98 (35.02, 56.94)	0.827
Post	66.74 (52.51, 80.98)[a]	53.22 (39.99, 66.45)	43.47 (33.65, 53.30)[b]	0.032
Change	21.60 (13.99, 29.22)[1)a]	11.94 (0.55, 23.32)[1)]	−2.51 (−12.96, 7.95)[b]	0.003
Energy from vegetables intake (kcal/d)				
Pre	14.97 (12.65, 17.30)	17.96 (11.74, 24.19)	17.66 (13.00, 22.32)	0.606
Post	33.21 (29.43, 36.98)[a]	21.42 (15.22, 27.62)[b]	16.46 (11.75, 21.17)[b]	0.000
Change	18.23 (14.44, 22.03)[1)a]	3.45 (−3.91, 10.81)[b]	−1.20 (−5.96, 3.57)[b]	0.000

Data obtained from the food consumption diary for 3 non-consecutive days, excluding weekends. All values represent the mean (95% confidence interval).
FE + SG, food education + school garden; FE, food education only; CG, Control group.
[1)]Significant difference between baseline and post intervention mean values in paired t-test ($P < 0.05$).
[a,b,c]Different letters represent significant difference between intervention groups in Tukey *post hoc* test ($P < 0.05$).

Table 6. Psychosocial factors related to vegetable and fruit consumption using the Pro Children qualitative questionnaire (n = 126)

Evaluated area	Pre intervention (%)			Pos intervention (%)		
	FE + SG	FE	CG	FE + SG	FE	CG
Evaluation of the personal cognitive skills developed.						
Respondents who believed they consume more vegetables than their peers.	50.5	55.3	51.2	81.3	68.4	50.3
Respondents who believed that the amount of vegetables they should consume for a healthy diet is 3 servings (cups) a day.	45.6	44.5	45.8	76.5	62.4	46.7
Respondents who totally agreed that they like to consume vegetables every day, in fact they make it a habit because they taste good.	45.3	42.3	44.2	76.4	62.8	41.2
Respondents who believed they consume more fruit than their peers.	55.3	55.6	57.8	77.5	70.2	58.4
Respondents who believed that the amount of fruit they should consume for a healthy diet is 3 servings (cups) a day.	40.2	43.4	41.3	68.5	65.4	43.2
Respondents who totally agreed that they like to consume fruit every day, in fact they make it a habit because it tastes good.	41.3	42.2	41.2	79.2	71.3	40.3
Evaluation of personal attitudes relating to vegetable and fruit consumption.						
Respondents who totally agreed that consuming vegetables every day is beneficial to their health.	55.2	53.2	55.2	86.5	82.1	54.5
Respondents who totally agree that their close friends consume vegetables every day.	30.1	33.2	32.1	54.6	58.3	30.3
Respondents who were totally willing to consume vegetables on a daily basis.	70.3	69.8	71.3	97.5	91.2	72.3
Respondents who totally agreed that consuming fruit every day is beneficial to their health.	60.3	61.2	61.6	83.8	77.3	62.3
Respondents who totally agree that their close friends consume fruit every day.	31.3	29.8	30.1	65.3	66.5	33.2
Respondents who were totally willing to consume fruit on a daily basis.	75.4	75.4	77.5	95.6	93.4	76.5
Evaluation of personal preferences relating to vegetable and fruit consumption.						
Respondents mentioned high preference for some vegetables (tomato, cucumber, lettuce, spinach, onion, celery, cauliflower, kale, broccoli).	24.6	25.6	23.2	41.2	37.4	24.5
Respondents mentioned high preference for some fruit (banana, pear, orange, tangerine, apple, cantaloupe, strawberry, grape, pineapple, plum).	41.1	42.3	44.5	55.2	50.8	43.8

(continued to the next page)

Table 6. (Continued) Psychosocial factors related to vegetable and fruit consumption using the Pro Children qualitative questionnaire (n = 126)

Evaluated area	Pre intervention (%)			Pos intervention (%)		
	FE + SG	FE	CG	FE + SG	FE	CG
Evaluation of perceptions of physical environmental regarding accessibility of vegetables and fruit for consumption at home.						
Respondents who reported that they are always allowed to consume vegetables at home.	85.4	88.7	86.7	98.1	93.1	85.3
Respondents who reported that they actively participated in the decision to consume vegetables at home.	64.3	62.3	63.2	81.2	82.3	64.4
Respondents who reported that there was a variety of vegetables available at home already.	59.6	58.4	58.9	79.4	70.3	58.4
Respondents who reported that their mothers or fathers encouraged them to eat vegetables.	Mother: 46.5; father: 4.8	Mother: 48.3; father: 4.7	Mother: 48.3; father: 4.5	Mother: 67.1; father: 15.4	Mother: 60.3; father: 10.4	Mother: 47.3; father: 4.5
Respondents who reported that they are always allowed to consume fruit at home.	73.8	73.2	75.1	85.4	87.8	74.2
Respondents who reported that they actively participated in the decision to consume fruit at home.	77.2	75.2	75.2	87.5	81.3	73.2
Respondents who reported that there was a variety of fruit available at home already.	58.1	56.3	57.8	72.1	68.3	54.3
Respondents who reported that their mothers or fathers encouraged them to eat fruit.	Mother: 60.3; father: 8.0	Mother: 64.8; father: 7.6	Mother: 64.5; father: 7.8	Mother: 74.3; father: 17.3	Mother: 77.3; father: 15.4	Mother: 67.3; father: 8.0
Evaluation of the physical environment regarding accessibility of vegetables and fruit for consumption at school.						
Respondents who reported having brought vegetables to school from home, purchased or been given them at school.	52.3	57.5	55.5	75.4	65.4	53.4
Respondents who reported that limited recess time was not a barrier to consuming vegetables.	62.1	66.5	65.7	90.1	88.9	63.1
Respondents who did not perceive their peers' low vegetable consumption as a barrier.	13.1	12.5	16.3	26.5	27.4	15.5
Respondents who did not recall still being hungry after having eaten vegetables.	37.6	32.3	33.4	72.1	65.4	35.4
Respondents who reported having brought fruit to school from home, purchased or been given it at school.	62.9	63.6	66.2	86.4	88.3	65.9
Respondents who reported that limited recess time was not a barrier to consuming fruit.	73.7	75.3	72.1	89.6	88.6	74.3
Respondents who did not perceive their peers' low fruit consumption as a barrier.	27.7	26.2	25.3	35.4	30.5	28.6
Respondents who did not recall still being hungry after having eaten fruit.	63.6	67.4	62.7	85.4	80.5	65.3
Evaluation of perception of personal barriers to vegetable and fruit consumption.						
Respondents who did not perceive the time it takes to consume vegetables as a personal barrier.	85.6	84.2	86.4	83.4	81.3	82.4
Respondents who disagreed with the statement that they preferred other high-energy-density foods over vegetables.	56.4	54.7	55.2	76.5	69.8	58.4
Respondents who disagreed with the statement that they avoided eating vegetables because they might stain when consumed or because vegetables could be crushed in their backpack.	82.2	85.6	84.7	88.4	84.3	81.2
Respondents who did not perceive the time it takes to consume fruit as a personal barrier.	77.5	72.7	76.2	76.5	78.5	75.4
Respondents who disagreed with the statement that they preferred other high-energy-density foods over fruit	64.2	66.7	65.8	74.3	72.1	62.7
Respondents who disagreed with the statement that they avoided eating fruit because it might stain when consumed or because fruit could be crushed in their backpack.	75.6	71.4	72.8	86.4	82.1	70.3
Evaluation of social environmental perceptions on role models for vegetable and fruit consumption.						
Respondents who mentioned that their mothers consumed vegetables every day.	78.6	79.1	78.6	79.8	83.4	81.2
Respondents who mentioned that their fathers consumed vegetables every day.	28.6	26.9	30.5	32.1	27.8	30.2
Respondents who mentioned that their parents urged them to consume vegetables every day.	55.1	52.2	53.2	85.4	75.4	53.2
Respondents who mentioned that television or Internet promoted vegetables consumption through advertising during the past month.	19.5	20.3	19.2	21.3	17.2	19.5
Respondents who mentioned that their mothers consumed fruit every day.	83.3	85.4	80.5	83.6	87.2	80.3
Respondents who mentioned that their fathers consumed fruit every day.	54.2	56.1	51.5	51.4	55.6	51.3
Respondents who mentioned that their parents urged them to consume fruit every day.	85.4	83.2	84.1	81.2	85.4	81.2
Respondents who mentioned that television or Internet promoted fruit consumption through advertising during the past month.	33.6	32.4	35.1	37.4	31.4	33.4

FE + SG, food education + school garden; FE, food education only; CG, Control group.

Evaluation of personal attitudes relating to vegetable and fruit consumption

The FE + SG group and the FE group showed greater willingness to consume vegetables and fruits on a daily basis. Both groups recognized the benefits to their health from consumption of this food group.

https://doi.org//10.4162/nrp.2021.15.2.235

Evaluation of personal preferences relating to vegetable and fruit consumption

Preference for fruits was higher in the FE + SG group with an acceptance of 55.2% and 50.8% for the group FE, while a higher percentage of CG subjects mentioned not having tried any of the vegetable or fruit options mentioned.

Evaluation of perceptions of physical environmental regarding accessibility of vegetables and fruits for consumption at home

The FE + SG and FE groups reported that vegetables and fruits were more accessible for consumption at home. This enabled them to play an active role in the decision to consume these foods, as there were a variety of them available at home already. All 3 groups responded that they were always allowed to eat all the vegetables and fruit they wanted at home. However, they reported that mothers were more available than fathers to encourage their teenage children to consume vegetables and fruits. One barrier to the consumption of vegetables reported by CG was that there were not always vegetables that they liked available in their homes.

Evaluation of the physical environment regarding accessibility of vegetables and fruits for consumption at school

The FE + SG group did not perceive school to be a barrier to vegetable and fruit consumption, because they could either bring them from home, buy them or obtain them for free. They reported that recess time was not a barrier to consuming vegetables and fruits. Nor did they report still feeling hungry after eating vegetables or fruits. All 3 study groups perceive their peers' low vegetable and fruit consumption as a barrier.

Evaluation of perception regarding personal barriers to vegetable and fruit consumption

Respondents from all 3 study groups did not perceive the time it takes to consume vegetables and fruits as a personal barrier, nor the fact that they might stain when consumed or be crushed in their backpack. One barrier to vegetable and fruit consumption mentioned by CG, however, was that the vegetable and fruit group tended to be displaced by other foods, as they preferred eating foods with higher energy density.

Evaluation of socio-environmental perceptions regarding role models for vegetable and fruit consumption

Members of all 3 study groups mentioned that their mothers consumed more vegetables and fruits than their fathers. However, the FE + SG group reported that their fathers did urge them to consume vegetables and fruits every day. Respondents did not perceive that television or the Internet promoted vegetable and fruit consumption through the advertising shown there.

Interview

The categories created for each item of the interview are shown in **Table 7**. Opinions in the FE + SG group focused on the fact that the SG was a space that motivated them to consume vegetables and fruits, since they could access it during school hours. They also said that the SG helped them save money, because the vegetables or fruits they obtained there were free. In addition, they claimed that these foods were healthy, with a low impact on the environment, since they themselves had planted and harvested them, giving them a feeling of satisfaction and pride at having participated. The teenagers reported feeling proud of making a change in themselves and in their school to promote a healthier environment. The students reported that taking classes in the SG area made them feel free and more interested in the subject, and in fact, classes in the garden seemed more fun to them than those in the classroom.

https://doi.org//10.4162/nrp.2021.15.2.235

Nutrition Research and Practice

Table 7. Generation of categories of analysis from the post-intervention interview

Category	Description
Opinion	Motivation to consume vegetables and fruits.
	Access to nutritious foods.
	Helps the economy.
	Foods free of chemicals.
Expression of feelings	Happiness.
	Pride.
	Freedom.
	Fun.
Knowledge	Vitamins and inorganic nutrients present in vegetables and fruits.
	Education.
	Change of habits.
	Production of organic foods.
Background	Balanced diet.
	Effects of the food system on global warming, land use and health.
	Change of habits.
Simulation	I already have a space for food production at home.
	Initiative to allocate a space for food production at home.

Fe+SG group; n=10.
FE + SG, food education + school garden.

The students reported that their classes in the SG taught them about the vitamins and inorganic nutrients present in vegetables and fruits, and to equate their consumption with good health. They also said they learned enough to replicate the SG at home and consume this food group on a regular basis. Likewise, they reported being aware of the effects of the food system on global warming, changes in land use, and on their health. Finally, they mentioned having begun or being willing to begin a vegetable garden at their own home or at the home of a family member.

DISCUSSION

The results of the study showed a significant increase in vegetable and fruit consumption by students who received nutritional education along with the didactic tool of a SG. The increase in vegetable and fruit consumption could be due to the practical activities in the SG that accompanied the nutrition education sessions, where students were exposed to farming techniques that exemplified the principles of food sustainability.

In 2007, McAleese and Rankin [31] conducted a similar intervention in garden-based nutrition education with sixth-graders and, through a 24-hour food-recall, they reported an increase in adolescents' fruit and vegetable servings. In addition, they described an increase in vitamin A, vitamin C, and fiber intake. The FE + SG group showed a significant increase in vegetable and fruit consumption, even greater than that reported by a similar study in Mexican adolescents [3]. Despite the observed increase, the reported intake of vegetables and fruits in teenagers after they received FE + SG, was equivalent to only 54% of the WHO recommendation. Although gardening has shown to have a positive effect on vegetable and fruit consumption, it has been suggested that the persistence of gardening habits and vegetable and fruit intake increase through adulthood should be studied as well [32]. It is possible that a longer intervention could help to further increase vegetable and fruit intake to levels consistent with the WHO recommendation (400 g per day).

Some countries have launched a strategy of encouraging vegetable and fruit consumption in a “5-a-day” campaign promoted jointly by the government and civil society. The impact of

https://doi.org//10.4162/nrp.2021.15.2.235

these campaigns has been evaluated in adults, with no significant change in the frequency of vegetable and fruit consumption, and the authors of this study reported that the campaign's message was not well understood by the population [33]. A SG as a nutritional education tool has shown to be an effective strategy for improving dietary behavior in adolescents, according to this study's results and findings reported by other authors [34,35]. As reported by Bell [36], green schools have considerable potential to promote health and well-being, so we may conclude that a nutritional education intervention through a guided gardening experience in schools improves intake of vegetables and fruits and can help promote health and well-being in adolescents. In Mexico, there is a general lack of skills and knowledge in the population on how to produce, choose, combine, prepare and distribute food according to their family budget, which can lead to food insecurity [37]. Therefore, SGs could also be a strategy for food security in low-income segments of the population, as a public policy, so that subjects about food production and nutrition are taught in schools as part of the educational curriculum [38]. To replicate the SG strategy, teachers should be trained in these areas in the manner described in this study.

Human resources, specifically teachers, were trained in FE and SG management and served as a guide in this study. This study did not evaluate adolescent's willingness to try new foods, or biological mechanisms of behavior, which could be an area of interest for future study. It has been reported that schoolchildren's exposure to educational gardens promotes consumption of a wider variety of fruits and vegetables, as well as a greater willingness to try new vegetables [6]. A wider variety of vegetables and fruits consumed would provide a higher variety of micronutrients and fiber. Peña Fernández and María Reidl Martínez reported in 2015 [39] that eating patterns in adolescents were related to emotions. Thus, bread, pasta and milk were the main foods consumed, and enjoyment, pleasure and happiness were the main emotions present during eating. Vegetable and fruit intake could be related to certain emotions in adolescents. This points to an area of research for future study because of the age-typical transformation in the brain, such as increases in novelty-seeking/risk-taking behavior and the increase in food intake associated with the growth spurt [40].

It is important to note that the school in which the study was performed had sufficient technical, economic and human resources for the program to be implemented without budget limitations. The study was funded by the school itself. The study population had physical and economic access to sufficient, safe and nutritious food to meet their dietary needs at all times. The families of participants in the study were on average high-income, a group that represents about 16.9% of Mexico's population according to the National Institute for Statistics and Geography and the National survey of Income and Spending 2018 [41]. The important thing about this strategy is that the teacher serves as a guide in the lessons, and it is the teenagers themselves who are responsible for analyzing and structuring the information and proposals. It should be noted that for the purposes of replicating this intervention, the teaching staff who are to be in contact with the students must receive training in the 5 main themes of this guide.

Further studies with a longer duration are required to evaluate the effectiveness of a SG as a didactic tool in the educational intervention to meet WHO recommendations on vegetable and fruit intake. It is also necessary to evaluate whether the strategy would have similarly favorable results in low-income populations.

https://doi.org//10.4162/nrp.2021.15.2.235

Nutrition Research and Practice

REFERENCES

1. World Health Organization; Food and Agriculture Organization of the United Nation. Diet, Nutrition and the Prevention of Chronic Diseases: Report of a Joint WHO/FAO Expert Consultation. WHO Technical Report Series: 916. Geneva: WHO; 2003. p.1-30.
2. Gao Y, Huang Y, Zhang Y, Liu F, Feng CX, Liu T, Li C, Ling DD, Mu Y, Tarver SL, Wang M, Sun W. Evaluation of fast food behavior in pre-school children and parents following a one-year intervention with nutrition education. Int J Environ Res Public Health 2014;11:6780-90.
PUBMED | CROSSREF
3. Ramírez-Silva I, Rivera JA, Ponce X, Hernández-Avila M. Fruit and vegetable intake in the Mexican population: results from the Mexican National Health and Nutrition Survey 2006. Salud Publica Mex 2009;51 Suppl 4:S574-85.
PUBMED
4. Bai Y, Kim YH, Han YH, Hyun T. Impact of a school-based culinary nutrition education program on vegetable consumption behavior, intention, and personal factors among Korean second-graders. Nutr Res Pract 2018;12:527-34.
PUBMED | CROSSREF
5. Choi EB, Lee JE, Hwang JY. Fruit and vegetable intakes in relation to behavioral outcomes associated with a nutrition education intervention in preschoolers. Nutr Res Pract 2018;12:521-6.
PUBMED | CROSSREF
6. Gibbs L, Staiger PK, Johnson B, Block K, Macfarlane S, Gold L, Kulas J, Townsend M, Long C, Ukoumunne O. Expanding children's food experiences: the impact of a school-based kitchen garden program. J Nutr Educ Behav 2013;45:137-46.
PUBMED | CROSSREF
7. Morgan PJ, Warren JM, Lubans DR, Saunders KL, Quick GI, Collins CE. The impact of nutrition education with and without a school garden on knowledge, vegetable intake and preferences and quality of school life among primary-school students. Public Health Nutr 2010;13:1931-40.
PUBMED | CROSSREF
8. Hazzard EL, Moreno E, Beall DL, Zidenberg-Cherr S. Factors contributing to a school's decision to apply for the California Instructional School Garden Program. J Nutr Educ Behav 2012;44:379-83.
PUBMED | CROSSREF
9. Graham H, Zidenberg-Cherr S. California teachers perceive school gardens as an effective nutritional tool to promote healthful eating habits. J Am Diet Assoc 2005;105:1797-800.
PUBMED | CROSSREF
10. Barale K, Gaolach B, Wells NM, Myers BM, Ferenz G, Aitken M, Gao JC. Healthy Gardens, Healthy Youth. J Nutr Educ Behav 2014;46:S137-8.
CROSSREF
11. García Retana JÁ. Educational model based in competenciy: importance and necessity. Actual Investig Educ 2011;11:1-24.
CROSSREF
12. Rychen DS, Salganik LH. Las Competencias Clave Para el Bienestar Personal, Social y Económico. 1st ed. Granada: Enseñanza Abierta de Andalucía, Consorcio Fernando de los Ríos; 2006.
13. Pimienta J. Metodología Constructivista Guía Para la Planeación Docente. 2nd ed. Naucalpan de Juárez: Pearson Education; 2007.
14. Serrano JM, Parra RM. Constructivism today: constructivist approaches in education. Rev Actual Investig Educ 2011;13:1-27.
15. Narváez E. Una mirada a la escuela nueva. Educere 2006;10:629-36.
16. Jaimez CR, Miranda KS, Moranchel M, Vázquez E, Vázquez F. Innovación Educativa y Apropiación Tecnológica: Experiencias Docentes con el Uso de las TIC. 3rd ed. México: Universidad Autónoma Metropolitana; 2015.
17. Sancho Gil JM. Tecnologías Para Transformar la Educación. 1st ed. Madrid: Akal Ediciones; 2006.
18. Jeavons J, Cox C, Jeavons J. The Sustainable Vegetable Garden: a Backyard Guide to Healthy Soil and Higher Yields. 1st ed. Willits: Ten Speed Press; 1999.
19. Denckla T, Alcorn S. The Gardener's A-Z Guide to Growing Organic Food. 2nd ed. North Adams: Storey Publishing; 2003.
20. Sherman J, Muehlhoff E. Setting Up and Running a School Garden. 1st ed. Rome: Food and Agriculture Organization of the United Nations; 2009.

https://doi.org//10.4162/nrp.2021.15.2.235

21. Food and Agriculture Organization of the United Nations. El Huerto Escolar como Recurso de Ensenanza-Aprendizaje de las Asignaturas del curriculo de Educion Basica [Internet]. Rome: FAO; 2009 [cited 2018 May 3]. Available from: http://www.fao.org/docrep/013/am042s/am042s00.htm.
22. Mercon J, Escalona-Aguila MA, Noriega Armella MI, Figueroa Nuñe II, Atenco Sánchez A, González Méndez ED. Cultivando la educación agroecológica. Rev Mex Investig Educ 2012;17:1201-24.
23. Díaz Barriga Á. El enfoque de competencias en la educación: ¿Una alternativa o un disfraz de cambio? Perf Educ 2006;28:7-36.
24. Rodríguez IT, Ballart JF, Pastor GC, Jordà EB, Val VA. Validation of a short questionnaire on frequency of dietary intake: reproducibility and validity. Nutr Hosp 2008;23:242-52.
PUBMED
25. Palenzuela Paniagua SM, Pérez Milena A, Pérula de Torres LA, Fernández García JA, Maldonado Alconada J. Food consumption patterns among adolescents. An Sist Sanit Navar 2014;37:47-58.
PUBMED | CROSSREF
26. Ferrari MA. Intake estimation by means of a 24-hour reminder. Diaeta (B Aires) 2013;31:20-5.
27. INCMNSZ. Tables of Composition of Mexican Foods and Food Products. Ciudad de México: Instituto Nacional de Ciencias Médicas y Nutrición Salvador Zubirán; 2016.
28. Ochoa-Meza G, Sierra JC, Pérez-Rodrigo C, Aranceta Bartrina J, Esparza-Del Villar ÓA. Reliability and validity of a Mexican version of the Pro Children Project questionnaire. Nutr Hosp 2014;30:293-300.
PUBMED | CROSSREF
29. Mertens DM. Research and Evaluation in Education and Psychology: Integrating Diversity with Quantitative, Qualitative, and Mixed Methods. 3rd ed. Thousand Oaks: Sage; 2010.
30. Hernández Sampieri R, Fernández Collado C, Baptista Lucio P. Metodología de la Investigación. Ciudad de México: McGraw-Hill Education; 2014.
31. McAleese JD, Rankin LL. Garden-based nutrition education affects fruit and vegetable consumption in sixth-grade adolescents. J Am Diet Assoc 2007;107:662-5.
PUBMED | CROSSREF
32. Loso J, Staub D, Colby SE, Olfert MD, Kattelmann K, Vilaro M, Colee J, Zhou W, Franzen-Castle L, Mathews AE. Gardening experience is associated with increased fruit and vegetable intake among first-year college students: a cross-sectional examination. J Acad Nutr Diet 2018;118:275-83.
PUBMED | CROSSREF
33. Zacarías I, Keller I, Muzzo S. Programes 5 a day for the promotion of consumption of vegetables and fruits. Rev Chil Nutr 2006;33:222-3.
CROSSREF
34. Bontrager Yoder AB, Liebhart JL, McCarty DJ, Meinen A, Schoeller D, Vargas C, LaRowe T. Farm to elementary school programming increases access to fruits and vegetables and increases their consumption among those with low intake. J Nutr Educ Behav 2014;46:341-9.
PUBMED | CROSSREF
35. Greer AE, Davis S, Sandolo C, Gaudet N, Castrogivanni B. Agricultural experiences are positively associated with high school students' fruit and vegetable perceptions and consumption. J Nutr Educ Behav 2018;50:133-140.e1.
PUBMED | CROSSREF
36. Bell S. Project-based learning for the 21st century: skills for the future. Clearing House 2010;83:39-43.
CROSSREF
37. Huesca Reynoso L, López Salazar R, Palacios Esquer MR. The food support program and the comprehensive social policy in the crusade against hunger in Mexico. Rev Mex Cienc Polit Soc 2016;61:379-407.
CROSSREF
38. Bucher K. Opening garden gates: teachers making meaning of school gardens in Havana and Philadelphia. Teach Teach Educ 2017;63:12-21.
CROSSREF
39. Peña Fernández E, María Reidl Martínez L. Las emociones y la conducta alimentaria. Acta Investig Psicol 2015;5:2182-93.
CROSSREF
40. Institute of Medicine and National Research Council. The Science of Adolescent Risk-Taking. Washington, D.C.: National Academies Press; 2011.
41. National Institute of Statistics, Geography and Informatics. National Survey of Household Income and Expenditure (ENIGH). 2018 New Series [Internet]. Aguascalientes City: INEGI; 2018 [cited 2020 March 22]. Available from: https://en.www.inegi.org.mx/programas/enigh/nc/2018/.