

Evaluation of a Nutrition Intervention through a School-Based Food Garden to Improve Dietary Consumption, Habits and Practices in Children from the Third to Fifth Grade in Chile

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Abstract

Objective: Use a school-based food garden as an instrument to improve healthy dietary consumption, habits, and practices among children from the third to fifth grade in public schools in Chile. **Design:** Quasi-experimental, six-month intervention with an evaluation of dietary consumption, habits, and practices and use of the school-based food garden among the 3rd to 5th grade students. **Setting:** Two municipal schools in a low-middle income district in Santiago de Chile; one with a school garden intervention and a control school without a garden. **Subjects:** 155 third to fifth grade children, 63 in the intervention school and 92 in the control school (average age 10 years old, 58% boys). **Results:** In the intervened school, there was a significant improvement in the children's dietary habits, such as peeling and slicing fruit ($p < 0.05$), making sandwiches ($p < 0.05$), and increased motivation to cook ($p < 0.05$). Fruit purchases at the school rose from 4% to 37% ($p < 0.05$) by the end of the intervention. Interest in growing vegetables or fruits at home increased from 48% to 70% ($p < 0.05$). The school children at the intervention school significantly increased their knowledge about 16 of 21 garden crops ($p < 0.05$), expanding the spectrum of the vegetables they can consume. There were no significant changes in the control school. **Conclusions:** The school-based food garden was effective in achieving change in dietary habits and practices among the third to fifth grade children. The project should be carried out for a longer period of time, so that the changes will be reflected in the students' food consumption and nutritional status.

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Keywords

Nutritional Education, School-Based Food Gardens, Elementary Education, Healthy Eating

1. Introduction

Chile has evolved in recent decades from high malnutrition and low obesity rates to the eradication of malnutrition and high prevalence of obesity, especially in children [1]. Since 1987, the National School Assistance and Scholarship Board (*Junta Nacional de Auxilio Escolar y Becas*, JUNAE), part of the Chilean Ministry of Education, has measured obesity among the first graders in all public schools which represent 92% of all schools in the country. According to these data, obesity prevalence increased from 7.5% in 1987 to 25.3% in 2013. When this is added to 26.5% of children with overweight, more than 50% of children in the first grade weigh more than what is considered normal for their age. These data are alarming because there has been an increase of almost 34% in childhood obesity since 2007 [2].

The progressive increase in overweight and obesity is more frequent among people of a low socioeconomic level, because as income improves, people purchase food with a high fat, carbohydrate, and salt content, with a marked preference for processed, high-calorie food accompanied by low consumption of fruits and vegetables and a high level of sedentarism [1].

Although the problem of obesity has existed in Chile since the 1990s, the population still does not consider it an important risk factor in the leading health problems, which are cardiovascular disease, cancer, diabetes, and obesity; nor are there any policies currently in effect to address obesity [3].

Based on this information, strategies have been proposed to combat childhood obesity by promoting appropriate consumption of healthy food among the population. These strategies have contributed to addressing obesity among children, but they have not had an impact due to the lack of a government policy to ensure the necessary continuity [4].

This project is part of a line of research on food and nutrition education with an intervention program using educational materials on healthy eating for teachers and preschool, the first-grade and second-grade students and their families. Among the findings is that one of the two pillars for conducting a successful intervention in promoting student health is encouraging healthy lifestyles with participative activities and the use of information and communication technologies (ICT) [5]. This line of research was continued in a project focused on children from the third to fifth grade, where one of the strategies was the use of school-based food gardens to promote new eating habits among children [6].

School-based food gardens have been used in several countries, following the three basic Food and Agriculture Organization of the United Nations (FAO) pillars: 1) teaching and promoting basic food security in order to supplement the population's dietary needs; 2) environmental protection; and 3) teaching students how to use food from the garden to eat a healthy diet and supplement various nutritional needs, which has been highlighted recently by the FAO [7].

Nicaragua has implemented the "Integral School Nutrition Program, School-based Food Gardens Component", which seeks to develop cognitive skills by improving dietary diversity through changes in eating and nutrition of children and their families, using the "learn by doing" approach. This program involves several different actors (local governments, schools, civil society organizations, private companies), each of which contributes technical, financial, or organizational resources [8].

In El Salvador, school-based food gardens have been consolidated as an educational strategy that links together parents, students, and teachers. Those involved participate actively in organizing the gardens, generating "school garden committees". Products from the gardens are used to make healthy food that has become an important component of school snacks [9].

In recent years, various international studies have been conducted on this topic, and the findings indicate the importance of using school-based food gardens to educate students about healthy eating. In Idaho, United States, a nutritional study was conducted using school-based food gardens with the aim of improving consumption of fruits and vegetables among adolescents through a 12-week nutritional education program. The program resulted in an increase in the portions of fruit and vegetables consumed by adolescents [10].

Another experience in the United States showed how school-based food gardens can positively influence eating habits at an early age. Children who participated in a nutritional program with activities in the garden were more likely to choose vegetables for school lunch [11]. One of the most successful strategies is combining teaching in school-based food gardens with cooking workshops for children. An intervention with excellent results was conducted in an elementary school in Los Angeles, United States. The study included 12 sessions, each with a duration of 90 minutes (a 45-minute cooking workshop and 45 minutes of lessons in the school garden), resulting in a reduction in the risk of obesity and metabolic diseases among children at the end of the intervention [12].

In 2013 the government of Chile, with the Choose to Live Healthily (*Elige Vivir Sano*) program and the Solidarity and Social Investment Fund (*Fondo de Solidaridad e Inversión Social*, FOSIS) launched an initiative called “Experience Your Garden”, the objective of which is to promote an integral, outdoor learning space that enables students, teachers, and parents to come into contact with nature. This educational opportunity contributed to generating healthy habits and lifestyles throughout the school community. In 2013, 100 school-based food gardens were implemented, with limited follow-up after installation. No additional school-based food gardens were implemented in 2014, and by 2015 the only gardens functioning were those that had received support from directors or teachers interested in the topic [13].

This study is based on the use of one of the gardens in the FOSIS “Experience Your Garden” program as an instrument to promote healthy dietary consumption, habits, and practices among third to fifth graders in a municipal school in a district of the Metropolitan Region, compared to a control school.

2. Methods

2.1. Design

Quasi-experimental, six-month intervention with an initial and a final evaluation of dietary consumption, habits, and practices and uses of the school-based food garden to encourage healthy eating habits, compared with a control school.

The study was conducted in two urban schools in the Peñalolen district of the Santiago Metropolitan Region. One of the schools (Luis Arrieta Cañas) has a food garden that served as an educational tool for the intervention while the other school (Carlos Fernández Peña), which did not have a garden, was used as the control.

2.2. Subjects

All children from third to fifth grade of two schools were measured, a total of 155 children, including 63 at the intervention school and 92 at the control school (average age 10 years old, 58% boys).

On the basis of 80% power to detect a significant difference ($p = 0.05$, two-sided), a sample size of 50 students from third to fifth grade for each group was needed to detect an 80 g increase in consumption of fruit and vegetables, which was based on a similar study carried out in Peñalolen [14].

The control school chosen is in the same district, with similar socioeconomic characteristics as the intervention school, and with a minimum of 50 children in the third to fifth grades. The School Vulnerability Index (*Índice de Vulnerabilidad Escolar*, IVE), which measures poverty among children attending public schools, was used to evaluate the socioeconomic level. The poverty rate, measured by IVE considering poverty over 40%, was very high for both schools: 83.1% for the intervention school and 84.2% for the control school [15].

The study included 15 teachers from the intervention school and 17 from the control school, with a special emphasis on the lead teachers of each grade in the intervention school, since they can have a greater impact on changing habits. The study also included educational activities for the parents and guardians of the third to fifth grade students.

Initial and Final Evaluation

A survey that was recently validated by the project researchers for evaluating dietary consumption, habits, and practices among students from third to fifth grade was used [16]. To measure the change, a survey was prepared and validated that was focused on the children’s knowledge about the crops and their motivations for working in the garden. Validation was performed by a group of experts using the consensus technique; it was then tested with third to fifth graders in a school in Santiago, to evaluate comprehension of the questions by the children.

With this evaluation, the group of experts reformulated the questions for later use in the project.

An initial and final anthropometric measurement was obtained of the children's weight and height at the start and end to describe the group with whom the study was conducted. The measurements were taken using a SECA ROBUSTA 813® electronic scale, Santiago, Chile with 200 kg capacity and a sensitivity of 0.1 kg, and a SECA 213® stadiometer, Santiago, Chile with a maximum height of 205 cm and precision to 0.1 cm. The weight and height measurements as well as the surveys were applied by trained nutritionists from the Institute of Nutrition and Food Technology (INTA) at the University of Chile.

The initial measurements were taken in May 2015. The educational intervention was conducted from June to September and the final measurements were taken in October and November 2015.

The project was approved by the Ethics Committee of INTA at the University of Chile.

2.3. Intervention

2.3.1. Implementation of the Garden

To implement a school-based food garden, the methodology used was the one validated by the "Process Mapping: Project Creation and Implementation" project from Brazil [17]. This required training the person from the school who was to be responsible for the garden in appropriate technology and providing them with supplies. The choice of crops used in the intervention process was based on the space available for implementing the school-based food garden, the time of the year, the variety of crops to be taught to the children based on the validated questionnaire, and the simplicity of implementation and care for the crops by the designated teacher.

2.3.2. Educational Intervention

1) Teachers

The teacher workshops were aimed at providing the initial motivation and covered topics such as how to maintain the school-based food garden and ways to incorporate it into teaching. Specific activities were agreed on for each of the grades, using the school-based food garden as a practical tool for teaching. This process also took into consideration the general curriculum that the teachers were following with their students. Finally, the teachers participated in a cooking workshop to verify the ease and practicality of preparing healthy dishes based on products of the garden, in accordance with the methodology proven in the previous project [18]. Educational materials were provided to the teachers in all four workshops and five planned visits were made to the school-based food garden.

2) Students

The students participated in visits to the school-based food garden and classroom activities, and also received educational materials. There were five workshops to familiarize them the school-based food garden and the food that can be grown in it and to review dietary guidelines. The students learned about appropriate consumption frequency, the variety of food that should be included in their diet and the health benefits of food supplied by the garden for children. The students increased their knowledge about garden crops through picking vegetables in the garden. At the end of the intervention, the children participated in a cooking workshop with their parents designed not only to help them learn about preparing food, but also to enable them to bond with family members in activities linked to healthy eating.

3) Parents

The parents were informed about the project to promote healthy eating from home through consumption of fruit and vegetables, how they can grow vegetables at home, and the benefits of eating them.

The parents participated in the cooking workshop with their children so that they would be able to visualize the ease and practicality of making healthy dishes using products from the garden and how the products can promote a healthy diet among their children.

2.4. Statistical Analysis

Continuous variables were expressed as mean \pm SD (standard deviation) and 95% confidence intervals (95% CI). Categorical variables were expressed as median or percentages. The difference between the control and intervention groups was calculated using the two-sample mean-comparison test or Pearson's Chi² test, depending on the kinds of variables. Each child's BMI (kg/m²) was calculated using the weight and height data.

The Z-score was calculated using the OMS 2007 algorithm [19]. The students' nutritional status was deter-

mined by classifying them as thin (BMI Z-score < -1), normal (-1 to +1), overweight (+1 to +2), and obese (> +2).

The Mann Whitney test was used to analyze whether the intervention produced changes in eating habits and practices, as well as for the questions asked of the control and intervention groups regarding the school-based food garden.

The statistical analyses were performed using STATA 14 software [20].

3. Results

Table 1 contains a description of the sample with the distribution of children by grade, which shows that there are no differences between the control group and the intervention group for the whole sample and by sex ($p > 0.2$ and $p > 0.4$).

Table 2 shows that the desire to cook in the intervention school improved significantly from 44% to 68% ($p = 0.0065$). This is reflected by preparation of sandwiches and peeling and slicing fruit by the students, who increased this activity in the intervention school, while no changes were observed in the control school. After the six-month period, the children in the control school tended to eat fruit more frequently in front of their friends. Although the percentage of fruit that they brought from home did not increase, purchasing of fruit with the money they brought to school increased significantly, from 4.7% to 36.5% ($p < 0.0001$). This did not occur in the control school, where fruit purchases remained low (3.2% at the start and 4.3% at the end).

Table 1. Description of the sample of the third to fifth grade students by sex, age, and nutritional status at the intervention and control schools, Peñalolen, Chile, 2015.

	Boys n = 90		Girls n = 65		Total n = 155	
	Intervened n = 42	Control n = 48	Intervened n = 21	Control n = 44	Intervened n = 63	Control n = 92
Grades ¹						
Third n (%)	13 (30.95)	15 (31.25)	3 (14.29)	13 (29.55)	16 (25.39)	28 (30.43)
Fourth n (%)	11 (26.19)	17 (35.42)	9 (42.86)	12 (27.27)	20 (31.74)	29 (31.52)
Fifth n (%)	18 (42.86)	16 (33.33)	9 (42.86)	19 (46.43)	27 (42.85)	35 (38.04)
Age (years) ² mean ± SD	10.0 ± 1.1	9.8 ± 1.3	9.9 ± 0.7	10.0 ± 1.5	10.0 ± 1.0	9.9 ± 1.4
CI 95%	9.6 - 10.3	9.4 - 10.2	9.6 - 10.2	9.6 - 10.5	9.7 - 10.2	9.6 - 10.2
Weight (kg) ² mean ± SD	37.1 ± 10.1	39.3 ± 10.1	44.6 ± 15.3	41.4 ± 16.8	39.6 ± 12.5	40.3 ± 13.8
CI 95%	34.1 - 40.1	36.6 - 42.1	37.9 - 51.2	36.6 - 46.1	36.6 - 42.6	37.7 - 43.0
Height (m) ² mean ± SD	137.2 ± 7.4	138.7 ± 8.9	140.8 ± 10.6	139.4 ± 10.9	138.2 ± 8.6	139.0 ± 10.0
CI 95%	135.0 - 139.3	136.2 - 141.1	136.3 - 145.4	136.3 - 142.4	136.3 - 140.5	137.1 - 140.9
BMI (kg/m ²) ² mean ± SD	19.5 ± 3.9	20.2 ± 3.6	21.8 ± 4.8	20.7 ± 5.3	20.3 ± 4.3	20.5 ± 4.5
CI 95%	18.3 - 20.6	19.2 - 21.2	19.8 - 23.9	19.2 - 22.2	19.2 - 21.3	19.6 - 21.3
ZBMI score ² mean ± SD	1.08 ± 1.28	1.45 ± 1.23	1.52 ± 1.30	1.17 ± 1.28	1.2 ± 1.3	1.32 ± 1.26
CI 95%	0.70 - 1.46	1.11 - 1.79	0.95 - 2.08	0.81 - 1.53	0.91 - 1.54	1.07 - 1.56
Nutritional status ¹						
ZBMI < -1 n (%)	2 (4.8)	1 (2.1)	1 (4.8)	3 (6.8)	3 (4.8)	4 (4.4)
-1 ≤ ZBMI ≤ 1 n (%)	19 (45.2)	17 (35.4)	6 (28.6)	18 (40.9)	25 (39.7)	35 (38.0)
1 < ZBMI ≤ 2 n (%)	11 (26.2)	13 (27.1)	6 (28.6)	12 (27.3)	17 (27.0)	25 (27.2)
ZBMI > 2 n (%)	10 (23.8)	17 (35.4)	8 (38.1)	11 (25.0)	18 (28.6)	28 (30.4)

¹Pearson Chi² test (intervened-control, by sex and total): $p > 0.4$; ²Two-sample mean-comparison test (intervened-control, by sex and total): $p > 0.2$; SD: standard deviation; CI: confidence interval.

Table 2. Dietary practices and habits among children from the third to fifth grade, intervention and control schools, after 6 months of a school-based food garden intervention. Peñalolen, Chile, 2015.

Dietary Practices and Habits	Intervened		p-value ¹	Control		p-value ¹
	Start	6 months		Start	6 months	
	n (%)	n (%)		n (%)	n (%)	
You like to cook						
Yes	28 (44.4)	43 (68.3)		64 (69.5)	68 (73.9)	
No	26 (41.3)	17 (26.9)	0.0065	22 (23.9)	13 (14.2)	0.2199
Don't know	9 (14.3)	3 (4.8)		6 (6.6)	11 (11.9)	
Prepare salads						
Never-1 day per week	32 (50.8)	34 (53.9)		40 (43.4)	36 (39.1)	
2 - 3 days per week	20 (31.8)	20 (31.8)	0.3471	27 (29.4)	39 (42.4)	0.6608
4 - 5 days per week	11 (17.4)	9 (14.3)		25 (27.2)	17 (18.5)	
Make a sandwich						
Never-1 day per week	29 (46.0)	12 (19.0)		34 (37.0)	32 (34.8)	
2 - 3 days per week	19 (30.2)	23 (36.5)	0.0037	30 (32.6)	32 (34.8)	0.9556
4 - 5 days per week	15 (23.8)	28 (44.5)		28 (30.4)	28 (30.4)	
Peel and slice fruit						
Never-1 day per week	29 (46.0)	22 (34.9)		41 (44.5)	33 (35.9)	
2 - 3 days per week	17 (27.0)	14 (22.3)	0.0326	23 (25.1)	35 (38.0)	0.3609
4 - 5 days per week	17 (27.0)	27 (42.8)		28 (30.4)	24 (26.1)	
Eat fruit in front of friends						
Never	22 (34.9)	16 (25.4)		30 (32.6)	24 (26.1)	
Sometimes	27 (42.9)	31 (49.2)	0.6129	50 (54.3)	43 (46.7)	0.0517
Always	14 (22.2)	16 (25.4)		12 (13.1)	25 (27.2)	
Food brought from home						
Fruit	25 (39.6)	31 (49.2)	0.2733	42 (45.6)	48 (52.1)	0.2888
Vegetables	0 (0)	0 (0)		0 (0)	3 (3.2)	0.0833
Food purchased at school						
Fruit	3 (4.7)	23 (36.5)	<0.0001	3 (3.2)	4 (4.3)	0.6547

¹Mann Whitney test.

Table 3 shows that in terms of knowledge and cultivation of vegetables at home, there were no changes in the intervention school but those students were more interested in growing vegetables or fruit at home, increasing from 47.6% to 69.8% ($p = 0.0028$). In addition, the motivation to engage in activities in a school-based food garden is high in both cases, increasing from 84.1% to 95.2% ($p = 0.0348$) in the intervention school and from 78.2% to 91.3% ($p = 0.042$) in the control school.

From **Figure 1** it is evident that the children in the intervention school improved their knowledge about a great variety of crops. Initially, most knew about lettuce and tomatoes, which are the vegetables with the highest consumption in Chile, which did not change in knowledge during the intervention. However, at the end of the intervention they had increased their knowledge expanding the spectrum of the vegetables they can consume in strawberry ($p = 0.0012$), zucchini ($p = 0.0218$), beet ($p < 0.0001$), chard ($p = 0.0003$), parsley ($p = 0.0343$), broccoli ($p = 0.016$), spinach ($p = 0.0116$), mint ($p = 0.0003$), bell peppers ($p = 0.0012$), cilantro ($p = 0.0046$), radish ($p = 0.0001$), oregano ($p = 0.0071$), basil ($p = 0.0046$), onion ($p = 0.0116$), green onion ($p = 0.0011$), car-

rots ($p = 0.0067$). There were no significant changes in tomato ($p = 0.4$), lettuce ($p = 0.5637$), squash ($p = 0.5127$), water melon ($p = 0.2513$) and melon ($p = 0.1266$).

Figure 2 shows that, as expected, in the control school there were no significant changes in the children’s knowledge of crops that can be grown in the school-based food garden ($p > 0.1$).

Figure 3 shows that there were not significant changes in nutritional status after the intervention.

4. Discussions

Childhood obesity has continued to increase in Chile despite various initiatives aimed at reducing it [4]. Among these initiatives there has been insufficient consideration of the use of school-based food gardens to support changes in habits for healthier eating, even with implementation of the “Experience Your Garden” program [13] in schools. This initiative has not been continuous or sustained over time, nor has it been evaluated. Therein lies the importance of evaluating an educational intervention using a school-based food garden as a means to change eating habits.

School-based food gardens are an excellent tool for changing habits and preferences in terms of healthy eating,

Table 3. Knowledge, work in the garden and motivation to work or grow fruit or vegetables among children from the third to fifth grade, intervention and control schools, after 6 months of a school-based food garden intervention. Peñalolén, Chile, 2015.

Garden Food	Intervened		p-value ¹	Control		p-value ¹
	Start	6 months		Start	6 months	
	n (%)	n (%)		n (%)	n (%)	
Grow vegetables or fruit at home	18 (28.5)	23 (36.5)	0.1967	31 (33.7)	44 (47.8)	0.0158
Grow vegetables or fruit in a food garden	30 (47.6)	44 (69.8)	0.0028	52 (56.5)	47 (51.0)	0.3841
Would grow vegetables or fruit at home	55 (87.3)	57 (90.5)	0.4795	75 (81.5)	84 (91.3)	0.0290
Garden knowledge	46 (73.0)	63 (100)	<0.0001	39 (42.4)	59 (64.1)	0.0003
Would grow vegetables or fruit in the school garden	23 (36.1)	49 (77.8)	<0.0001	12 (13.0)	22 (23.9)	0.0124
Would like to do something in the school garden	53 (84.1)	60 (95.2)	0.0348	72 (78.2)	84 (91.3)	0.042

¹Mann Whitney test.

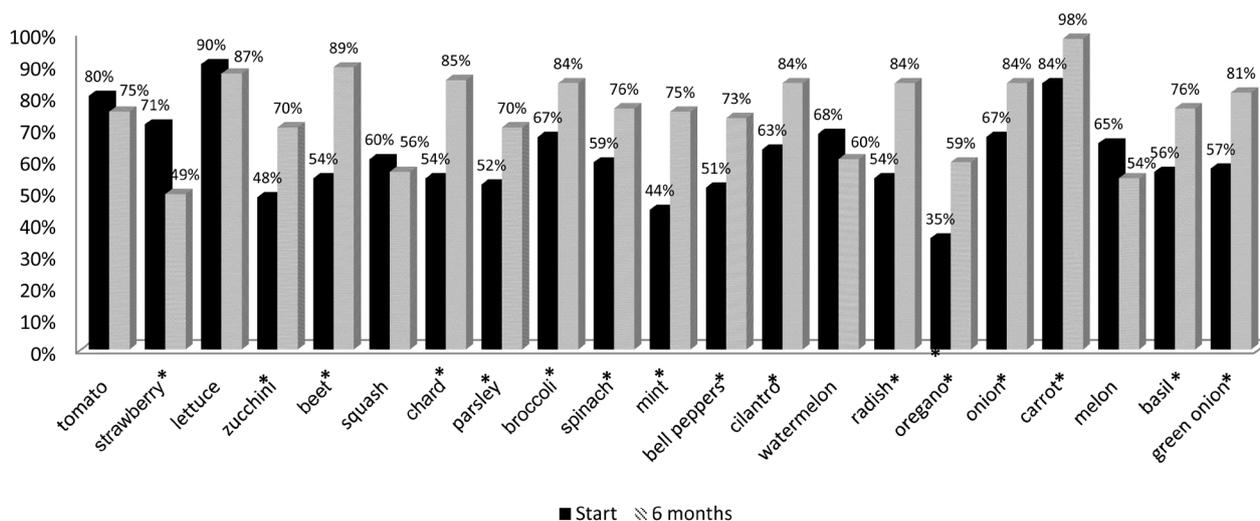


Figure 1. Knowledge of vegetables, intervention school. Mann Whitney test: * $p < 0.05$.

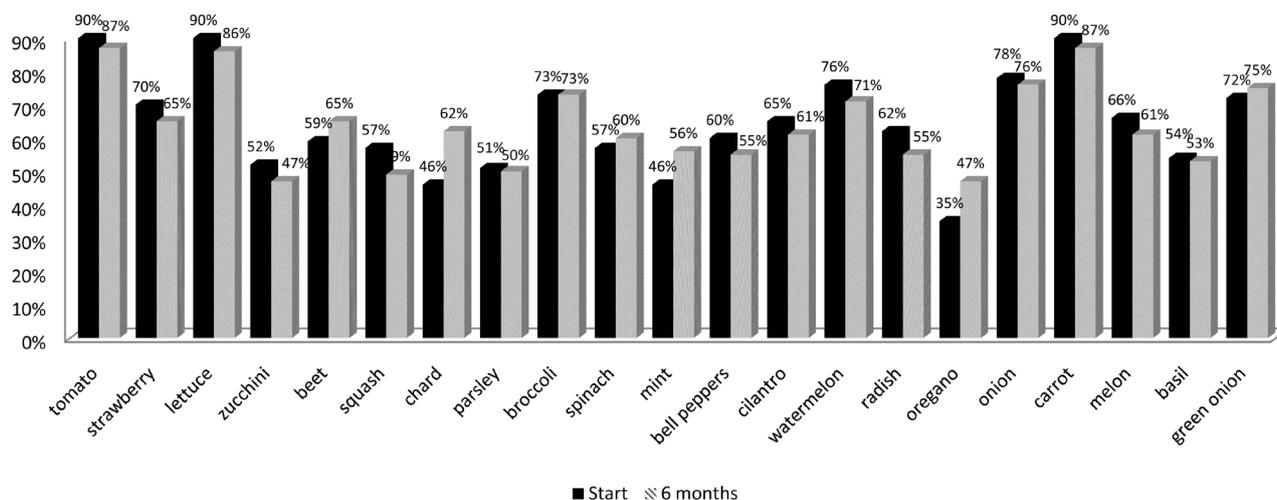


Figure 2. Knowledge of vegetables, control school. Mann Whitney test: $p > 0.1$.

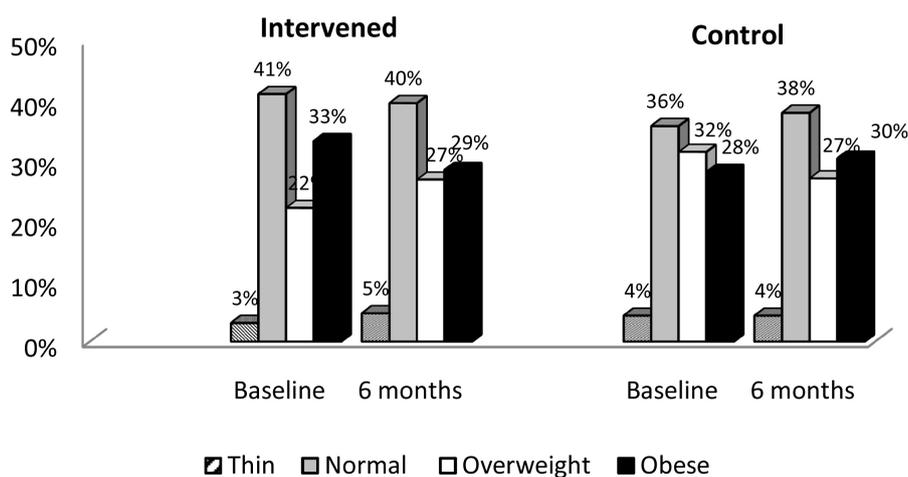


Figure 3. Assessment of the nutritional status of the entire sample at the baseline and at 6 months of intervention. Mann Whitney Test: $p > 0.1$.

mainly fruit and vegetables, for children and their families [21]-[23]. One study has shown that by planting and harvesting vegetables, children from 4 to 7 years of age increased their knowledge of nutrition and their preference for fruit and vegetables [24]. In our intervention, the children’s eating habits improved, including peeling and slicing fruit, making sandwiches or cooking, although there were no significant changes in fruit and vegetable consumption among the students in the period studied. This finding coincides with other studies such as the one conducted in schools in Texas, in which students’ preference for vegetables increased significantly but there was no real change in consumption [25]. A recent review by Davis *et al.* [26] of 13 studies on the impact of school-based food gardens on student health found that consumption increased in only six schools, but the rest were able to significantly increase preference for and positive attitudes toward fruit and vegetables, the desire to try them, and better ability to identify them. One of the conclusions is that changing consumption patterns is by nature a complex task that requires ongoing intervention over time during a longer period than the one studied in this project.

Regarding the food that students bring from home, parents do not provide fruit as a snack, and so do not promote consumption of fruits and vegetables among their children. However, after the intervention it was observed that the children prefer to use some of the money they receive from their parents to purchase fruit at school. Different studies have corroborated the enormous importance of active parent participation in the education of their children, and that this constitutes a fundamental pillar for their nutrition, both within and outside the home

[27]. Some research has suggested that low-income parents, like the ones in this study, are less likely to participate in school activities. Therefore, the students need to take products from the garden and share or cook them at home to promote greater family participation. The students begin to improve their habits through cooking workshops, which in conjunction with planned harvests in the school-based food garden, achieved a high level of motivation [28].

One of the important results of the study was the broadening of the spectrum of vegetables that the children are familiar with and can eat. This reinforces the theory that seeing, touching, planting, cooking, and harvesting food are powerful and positive ways to expose children to vegetables and fruits [29]. Even when the children did not correctly answer questions about the school-based food garden concept (Table 3), they did recall that the school garden, as observed in Figure 1, was where they gained knowledge about practically all of the garden crops, which they had not been familiar with previously. This agrees with several studies that involved the use of school-based food gardens as an educational tool that strengthens children's desire to try new food, especially fruits and vegetables [8]-[11] [24].

This study's strength is that it is the first evaluation of an educational school-based food garden intervention in Chile, using a control school. The limitations included its short duration and the relatively small number of students per school (63 in the intervention school and 92 in the control school), which does not allow for generalization of the results. This has been a problem in other studies as well [22] [27].

Another limitation was the sale of unhealthy food both within and outside the schools. Therefore, this strategy should be complemented by healthy eating rules inside each school, such as healthy spaces and kiosks [30] to strengthen the work carried out in the school-based food garden intervention.

One of the major challenges in the continuity of using gardens to teach children about healthy eating is the lack of ongoing work to sustain them [26]. In this intervention, activities that link teachers to tasks in the school-based food garden were added to the curriculum. However, for the gardens to be sustainable, there needs to be a strong commitment and support from the directors of the educational establishment and the entire community must be involved. This has been observed in several studies showing that including the school-based food garden program in its curriculum helps sustain the garden and improves the impact on the students' education. Therefore, it is essential that this initiative be included in each school's Institutional Educational Project (*Proyecto Educativo Institucional or PEI*), as has been proposed for all activities related to healthy eating education in Chile [31]. One of the ways to do this is to link the activities currently included in the general curriculum for each grade with tasks in the school-based food garden. Also, instruments and tools should be provided for the teachers to use the garden in the educational process. The school garden should be a management instrument for materializing the strategic definitions planned in the PEI [32].

5. Conclusion

This study shows that school gardens are effective educational tools, capable of achieving change in the eating habits and practices of students at municipal schools serving disadvantaged areas. We recommend that school-based food garden projects be operated for longer periods of time so that the changes will be reflected in the students' food consumption and nutritional status. In addition, new school garden evaluation studies should be conducted in different circumstances, such as in schools outside the metropolitan region, by socioeconomic level, and with other age groups.

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References

- [1] Albala, C., Vio, F., Kain, V., et al. (2002) Nutrition Transition in Chile: Determinants and Consequences. *Public Health Nutrition*, 5, 123-128. <http://dx.doi.org/10.1079/phn2001283>
- [2] (2013) Ministry of Education, National School Assistance and Scholarship Board (JUNAEB). Nutritional Map Report

2013. <http://www.junaeb.cl/wp-content/uploads/2013/03/Informe-Mapa-Nutricional-2013.pdf>
- [3] Vio, F., Albala, C. and Kain, J. (2011) Nutrition Transition in Chile Revisited: Mid-Term Evaluation of Obesity Goals for the Period 2000-2010. *Public Health Nutrition*, **11**, 405-412.
- [4] Salinas, J. and Vio, F. (2011) Health and Nutrition Programs without a State Policy: The Case of School Health Promotion in Chile. *Revista Chilena de Nutrición*, **38**, 100-116.
- [5] Vio, F., Fretes, G., Montenegro, E., et al. (2015) Prevention of Children Obesity: A Nutrition Education Intervention Model on Dietary Habits in Basic Schools in Chile. *Food and Nutrition Sciences*, **6**, 1221-1228. <http://dx.doi.org/10.4236/fns.2015.613128>
- [6] Vio, F., Lera, L., González, C.G., et al. (2015) Food Consumption, Dietary Behaviour and Cooking Skills in Third to Fifth Grade School-Age Children and Parents. *Revista Chilena de Nutrición*, **42**, 374-382.
- [7] Food and Agriculture Organization of the United Nations (FAO) (2010) School Gardens New Policy. FAO, Rome.
- [8] (2015) Government of Nicaragua. Ministry of Education, Culture and Sports. Special Education Directorate. Orientation Guidelines to Implement a Food Garden. <http://www.mined.gob.ni/Documents/ETFP/Huerto.pdf>
- [9] Food and Agriculture Organization of the United Nations (FAO) (2011) Meeting Report: Food and Nutrition Information, Communication and Education for Promoting Food and Nutrition Security in Latin American and Caribbean Countries. El Salvador, 6-9 December. <http://www.fao.org/ag/humannutrition/nutritioneducation/icean-sansalvador/es/>
- [10] McAleese, J. and Rankin, L. (2007) Garden-Based Nutrition Education Affects Fruit and Vegetable Consumption on Sixth-Grade Adolescents. *Journal of American Dietetic Association*, **107**, 662-665. <http://dx.doi.org/10.1016/j.jada.2007.01.015>
- [11] Parmer, S.M., Salisbury-Glennon, J., Shannon, D., et al. (2009) School Gardens: An Experiential Learning Approach for a Nutrition Education Program to Increase Fruit and Vegetable Knowledge, Preference, and Consumption among Second-Grade Students. *Journal of Nutrition Education and Behavior*, **41**, 212-217. <http://dx.doi.org/10.1016/j.jneb.2008.06.002>
- [12] Gatto, N.M., Martinez, L.C., Spruijt-Metz, D., et al. (2015) Sprouts Randomized Controlled Nutrition and Gardening Program Reduces Obesity and Metabolic Risk in Latino Youth. *Obesity Silver Spring*, **23**, 1244-1251. <http://dx.doi.org/10.1002/oby.21077>
- [13] Ministry of Agriculture of Chile (2015) Government Boost School Gardens to Improve Food and Culinary Skills in School-Age Children. <http://www.minagri.gob.cl/gobierno-impulsa-creacion-de-huertos-para-desarrollar-habilidades-en-escolares/>
- [14] Vio, F., Zacarías, I., Lera, L., et al. (2011) Obesity Prevention in Primary Schools in Peñalolén: Food and Nutrition Component. *Revista Chilena de Nutrición*, **38**, 268-276.
- [15] (2015) Ministry of Education, National School Assistance and Scholarship Board (JUNAEB). Annex No. 5 Focalization—Junaeb. <http://www.junaeb.cl/wp-content/uploads/2015/06/ANEXO-N%C2%B05-Focalizaci%C3%B3n.pdf>
- [16] Lera, L., Fretes, G., González, C., et al. (2015) Validity of an Instrument for Assessing Food Consumption, Food Habits and Cooking Skills in 8-11 Years Old Students. *Nutrición Hospitalaria*, **31**, 1980-1991.
- [17] Simões, E., Juarez, A., Araújo, M. and Sampaio, M. (2010) Mapeo del proceso: creación e implementación del proyecto: Educando con el huerto escolar. Brasilia.
- [18] Montenegro, E., Salinas, J., Parra, M., et al. (2014) Evaluation of a Nutrition Education Intervention in Teachers and Students in Pre-School and Primary Schools in Los Andes, Chile. *Archivos Latinoamericanos de Nutrición*, **64**, 182-191.
- [19] World Health Organization (WHO) (2007) The WHO 2007 SAS Macro Package. World Health Organization (WHO), Geneva.
- [20] StataCorp (2015) Stata Statistical Software: Release 14. StataCorp LP, College Station.
- [21] Morgan, P.J., Warren, J.M., Lubans, D.R., et al. (2010) 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 Nutrition*, **13**, 1931-1940. <http://dx.doi.org/10.1017/S1368980010000959>
- [22] Somerset, S. and Markwell, K. (2008) Impact of a School-Based Food Garden on Attitudes and Identification Skills Regarding Vegetables and Fruit: A 12-Month Intervention Trial. *Public Health Nutrition*, **12**, 214-221. <http://dx.doi.org/10.1017/S1368980008003327>
- [23] Davis, J.N., Martínez, L.C., Spruijt-Metz, D., et al. (2016) LA Sprouts: A 12-Week Gardening, Nutrition, and Cooking Randomized Control Trial Improves Determinants of Dietary Behaviours. *Journal of Nutrition Education Behavior*, **48**, 2-11. <http://dx.doi.org/10.1016/j.jneb.2015.08.009>
- [24] Morris, J. and Zidenberg-Cherr, S. (2002) Garden-Enhanced Nutrition Curriculum Improves Fourth-Grade School

- Children's Knowledge of Nutrition and Preference for Vegetables. *Journal of the American Dietetic Association*, **10**, 91-93. [http://dx.doi.org/10.1016/S0002-8223\(02\)90027-1](http://dx.doi.org/10.1016/S0002-8223(02)90027-1)
- [25] Lineberger, S. and Zajicek, J. (2000) School Gardens: Can a Hands-On Teaching Tool Affect Students' Attitudes and Behaviors Regarding Fruit and Vegetables? *HortTechnology*, **10**, 593-597.
- [26] Davis, J.N., Spanil, M.R. and Somerset, S. (2015) Sustenance and Sustainability: Maximizing the Impact of School Gardens on Health Outcomes. *Public Health Nutrition*, **18**, 2358-2367. <http://dx.doi.org/10.1017/S1368980015000221>
- [27] Gutman, L. and Eccles, J. (1999) Financial Strain, Parenting Behaviors, and Adolescents' Achievement: Testing Model Equivalence between African American and European American Single- and Two-Parent Families. *Child Development*, **70**, 1464-1476. <http://dx.doi.org/10.1111/1467-8624.00106>
- [28] Jaenke, R.L., Collins, C.E., Morgan, P.J., et al. (2012) The Impact of a School Garden and Cooking Program on Boys' and Girls' Fruit and Vegetable Preferences, Taste Rating, and Intake. *Society for Public Health Education*, **39**, 131-141. <http://dx.doi.org/10.1177/1090198111408301>
- [29] Ozer, E. (2007) The Effects of School Gardens on Students and Schools: Conceptualization and Considerations for Maximizing Healthy Development. *Health Education Behavior*, **34**, 846-863. <http://dx.doi.org/10.1177/1090198106289002>
- [30] Bustos, N., Kain, J., Leyton, B., et al. (2011) Changes in Food Consumption Patterns among Chilean School Children after the Implementation of Healthy Kiosk. *Archivos Latinoamericanos de Nutrición*, **61**, 302-307.
- [31] Salinas, J., Correa, F. and Vio, F. (2013) Regulatory Framework for Promoting Healthy Food Intake in Basic Schools in Chile. *Revista Chilena de Nutrición*, **40**, 274-282.
- [32] Ministry of Education (2015) Guidelines for Reviewing and Updating the Institutional Education Project. http://www.convivenciaescolar.cl/usuarios/convivencia_escolar/File/2015/orientaciones-elaboracion-pei-para-jornada-junio.pdf



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