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Design and methodology of the LA Sprouts nutrition, cooking and gardening program for Latino youth: A randomized controlled intervention

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ABSTRACT

Objective: The LA Sprouts 12-week nutrition, cooking and gardening intervention targets obesity reduction in Latino children. While other gardening and nutrition programs are shown to improve dietary intake, LA Sprouts is unique in that it utilized a curriculum demonstrated to decrease obesity. This methodology paper outlines the design and processes of the LA Sprouts study, and discusses key strategies employed to foster successful implementation of the program.
Setting: After-school program in four Los Angeles elementary schools.
Subjects: 3rd–5th grade students.
Design: Randomized controlled trial. Gardens were built on two of four school campuses, and the 90-minute weekly lessons focused on strategies to increase fruit and vegetable consumption, gardening at school and home, and cooking healthy meals/snacks. Data collection was conducted pre- and post-intervention and included basic clinical and anthropometric measures, dietary intake and psychosocial constructs measured by questionnaire, and an optional fasting blood draw.
Results: Baseline data was collected from 364 children, and 320 (88%) completed follow-up. No participants withdrew from the program (data were missing for other reasons). Intervention students attended 9.7 ± 2.3 lessons. Fasting blood samples were collected on 169 children at baseline, and 113 (67%) at follow-up. Questionnaire scales had good internal consistency (IC) and intra-rater reliability (IRR; in child scales: 88% items with IC > 0.7 and 70% items with IRR > 0.50; in parent scales: 75% items with IC > 0.7).
Conclusions: The intervention was successfully implemented in the schools and scales appear appropriate to evaluate psychosocial constructs relevant to a gardening intervention.
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1. Introduction

Given that one third of US children are overweight [1], public health professionals, researchers and advocates have called for novel approaches to target obesity and associated metabolic diseases. One such approach that has gained popular support in recent years is the use of garden-based interventions to supplement nutrition education, led in part by First Lady Michelle Obama's "Let's Move!" campaign [2]. Garden-based approaches may be more meaningful than traditional nutrition programs because they increase children's exposure to fruits and vegetables [3], which is positively associated with increased liking of these foods [4,5]. It has also been hypothesized that by teaching children about the origins of foods through a direct experience of growing foods, children become more attentive to making healthful choices [6]. Finally, gardening may be beneficial particularly in low-income communities because it

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provides access to fresh, high-quality produce at low monetary cost [7], which may help to remedy poor availability of healthy foods in such obesogenic neighborhood environments [8].

To date, several nutrition and gardening interventions have been developed, many of which take a generalized approach to healthy eating and gardening, and demonstrate mixed effectiveness in improving dietary intake [9–12]. The LA Sprouts nutrition, cooking and gardening intervention for urban, predominantly Latino elementary school children in many ways employs a similar theoretical foundation as these programs, yet specifically targets obesity prevention and treatment. Like previous garden-based nutrition interventions, LA Sprouts draws on Bandura's "self-efficacy", or the expectation of success of a behavior, as the theoretical foundation for behavior change [13]. In LA Sprouts, we hypothesized that by developing increased self-efficacy in their ability to perform positive nutritional behaviors, children will be more likely to engage in these practices outside of the intervention.

However, differently from previous work, LA Sprouts utilizes a nutrition curriculum with lessons specifically targeting reductions in obesity and improvements in metabolic health. Our data from Latino children in Los Angeles indicate that over 50% are overweight [14], over 30% have pre-diabetes and high visceral adiposity [15], and 38% exhibit clinical signs of non-alcoholic fatty liver disease [16]. We have previously shown that high total sugar, high sugar sweetened beverage intake and low dietary fiber intake are linked to increased adiposity and risk factors for type 2 diabetes in overweight Latino youth [17–19]. Thus, the LA Sprouts curriculum was developed to target carbohydrate quality, specifically reducing added sugars (i.e., sugar-sweetened beverages) and increasing dietary fiber intake (i.e., FV and whole grains) [20].

To test the effectiveness of the LA Sprouts intervention on reducing obesity risk, a randomized controlled trial (RCT) was conducted in four Los Angeles elementary schools. One goal of the project was to provide an evidence-based framework that may serve as a resource for educators and public health leaders wishing to conduct their own garden-based programs for obesity prevention (materials available at lasprouts.org). Thus, this methodology paper outlines the recruitment of schools and families; curriculum development; garden design and construction; program implementation; collection of dietary, behavioral and clinical data, including a fasting blood draw; and program maintenance. Baseline participant characteristics are also presented. Finally, key strategies for successful implementation are discussed, as are challenges encountered by the research team, along with suggestions.

2. Methods

2.1. Recruitment

LA Sprouts partnered with an existing after-school program ("LA's BEST") within the Los Angeles Unified School District (LAUSD), which provides a free/low-cost on-site service for families. Elementary schools within LAUSD were identified as eligible for LA Sprouts if they: 1) offered the after-school program, 2) had a student body population ≥ 75% Latino, 3) had ≥75% of students participating in the LAUSD free lunch program, 4) were within 10 miles of University of Southern California (USC) Health Science Campus, 5) had expressed interest by the school principal and staff in having a school garden/hosting a gardening program, and 6) could make an administrative commitment (included participation in securing LAUSD approval, providing input in garden design and installation, and assisting with fostering parent support for the project). We additionally took into consideration whether schools had existing programs that could be a source of supplemental instruction to our program, and thus selected schools that were willing to refrain from augmenting their curriculum with competing lessons during the study period, if currently offered. Four schools were enrolled in the study from 2011–13; two were randomly assigned to receive the intervention and two served as controls with a delayed intervention.

At each school, 3rd–5th grade students enrolled in the after-school program and their families were invited to participate in LA Sprouts. Site coordinators for the after-school program were instrumental in participant recruitment, which included obtaining both child assent and parental permission. At least one parent meeting was held at each school to introduce the program and obtain consent. Since few parents were able or willing to attend the meeting, study staff set up an informational table during child pick-up times at the schools to meet with parents one-on-one, provide program information and collect consent. Parent contact information, child date of birth, and brief medical history to screen for medication use or major illnesses were also collected.

Once consented to participate, children were invited to take part in a fasting blood draw. The study staff first visited applicable grade levels after school to introduce this procedure, and give informational flyers to take home to their parents. Parents were also contacted via telephone and provided details about the blood draw. Finally, with parents who agreed, reminder text messages were sent the night before and morning of scheduled blood draws. Child assent and parental permission for participation in blood collection were separately required and obtained on-site at the time of the blood draw.

All materials and parent information were provided in both English and Spanish, and members of the LA Sprouts team were bi-lingual.

2.2 . Data collection

Intervention and control participants completed questionnaires and had anthropometric data collected at baseline and at 12-weeks post intervention (collected within one week of the final lesson) during after-school sessions.

2.2.1. Clinical data

Height was measured with a free-standing stadiometer (Seca, Birmingham, UK); weight and percent body fat were measured via bioelectrical impedance (Tanita TBF 300A, Arlington Heights, IL). BMI percentiles were determined using Centers for Disease Control cut-points for age and sex [21]. Blood pressure was measured with an automated monitor with appropriate child cuffs (Omron, Schaumberg, IL), and waist circumference measures followed NHANES protocol [22].

2.2.2. Child questionnaire

Development of the child questionnaire was initiated with a review of the literature for measures relevant to nutrition,

gardening and cooking behaviors. Selections of existing survey instruments were made based on relevancy to study hypotheses and were adapted to more specifically relate to constructs of interest, were simplified for readability at grade level, and/or shortened to reduce participant burden. Additional items were created when no appropriate sources were available. Focus group testing of the resulting composite questionnaire with six Latino 3rd and 4th grade students guided modifications for content, readability/comprehension, and clarity (i.e., students suggested additional questions to be added, and editorial changes were made). A test–retest assessment for all questionnaire items (1 week between testing; excluding dietary intake, which was previously evaluated in this demographic) [23], was conducted with nineteen 3rd–5th grade predominantly Latino students who were not in the LA Sprouts randomized trial.

The final questionnaire included the following constructs: demographics and socioeconomic status; [24] acculturation (AHIMSA scale, unmodified; composed of four subscales: assimilation, separation, integration and marginalization); [25] motivation to eat and cook FV, and to garden; [26,27] self-efficacy for eating FV, cooking and gardening behaviors; [28] FV neophobia (a lack of willingness to try new foods); [29] FV preferences; [30] attitudes about cooking and gardening and current home gardening practices; school engagement; [31] nutrition and gardening knowledge (tailored for the LA Sprouts curriculum); and food insecurity [32]. Dietary intake was measured using the Block Kids Food Screener ("last week" version) [23].

Child questionnaire scales were assessed for internal consistency (Cronbach's alpha, using baseline data from the RCT) and intra-rater reliability (bivariate correlations of averaged scale values for each rater, using the test–retest data from the 19 non-participants in the RCT; Table 1). Internal consistency and intra-rater reliability were satisfactory (alpha > 0.7) [33], with the exception of nutrition and gardening knowledge questions. However, knowledge questions differ from others in that they test ability, rather than measure individual characteristics, so psychometric principals may not be as applicable. School engagement internal consistency (alpha = 0.680) did not meet the cut-point for acceptability [34], so a principal components analysis was conducted to test latent variables given that the original scale was comprised of multiple subscales [31]. This resulted in two subscales: school engagement and school disaffection. The school engagement subscale had poor internal consistency, likely due to the small number of items included. Two items were removed from the questionnaire due to poor psychometric properties, one from the motivation to eat FV scale and the other from the school engagement subscale (n = 7 final items, n = 8 final items, respectively).

2.2.3. Parent questionnaire

A parent questionnaire was produced in a manner similar to the child version, and had been previously used in community-based work by investigators at USC. The parent questionnaire consisted of similar constructs to those in the child questionnaire, but included different wording, number of items, or response options. Also, additional scales were added to the parent version, including eating behaviors related to FV intake (in lieu of a dietary screener); [35] intention to eat and cook FV, and to garden; [36] barriers to cooking and gardening; and interest in participating in cooking and gardening workshops.

Internal consistency was good for adult scales (Table 2; no reliability assessment was conducted), with the exception of nutrition knowledge and healthy eating habits (which measures behavior, and similarly to knowledge, psychometric properties may not be as applicable). Two items were removed from their respective scales due to poor internal consistency with other items, one on nutrition knowledge (although this item may still have individual value) and one on cooking and gardening attitudes.

Table 1
Child questionnaire scale psychometric values[a].

Item	Number of items	Internal consistency	Intra-rater reliability
Acculturation[b]	8	0.743–0.830	0.242 (marginalization), 0.590–0.734
Motivation to eat FV	7	0.809	0.665
Motivation to garden	9	0.858	0.739
Motivation to cook FV	7	0.850	0.635
Self-efficacy for FV consumption and related behaviors	14	0.883	0.478
Fruit neophobia	6	0.800	0.521
Vegetable neophobia	6	0.901	0.542
Preferences for fruit	8	0.809	0.722
Preferences for vegetables	17	0.866	0.575
Cooking and gardening attitudes	8	0.842	0.912
Nutrition and gardening knowledge	8	0.472	0.400
Food insecurity	5	0.743	0.727
School disaffection	5	0.734	0.816
School Engagement	3	0.560	0.373

[a] Cronbach's alpha was used to determine internal consistency (n = 350 questionnaires completed at baseline), and correlations were used to evaluate intra-rater reliability (n = 19 students participated). All questionnaire items had four response options, with the exception of demographic questions and current home gardening practices (which ranged from 2–7 response options, not included in validity assessment), and food insecurity (3 response options).

[b] The acculturation measure is comprised of 4 subscales: assimilation, separation, integration and marginalization. For brevity, the range of subscale scores is provided.

Table 2
Parent questionnaire scale psychometric values[a].

Item	Number of items	Internal consistency
Healthy eating habits	8	0.620
Nutrition knowledge	3	0.526
Self-efficacy for FV consumption and related behaviors	9	0.743
Intention to serve FV and related behaviors	9	0.902
Motivation to eat FV	6	0.812
Motivation to garden	6	0.964
Motivation to cook FV	6	0.969
Cooking and gardening attitudes	11	0.866

[a] Cronbach's alpha was used to determine internal consistency (n = 54 questionnaires completed at baseline). Response options varied, including scales with three options (self-efficacy and intention), five options (nutrition knowledge) and seven options (healthy eating habits, motivation subscales and attitudes). Not included in the validity assessment are demographic questions (11 items), current home gardening practices (3 items), barriers to cooking and gardening (2 items) and interest in participating in workshops (2 items), with response options ranging from 2–10 choices.

Children were asked to take home copies of the questionnaire for their parents, and to return them to after-school staff. Site coordinators and staff reminded students and families to complete and return the surveys. In some cases, parent questionnaires were mailed home (at post-test for individuals who provided questionnaires at pre-test).

2.2.4. Blood draws

Optional fasting blood draws at baseline and follow-up were collected for measurement of glucose, insulin, lipids and inflammatory markers (i.e., leptin, adipoenctin, plasminogen activator inhibitor 1, resisten, and interleukin-6). Investigators were given permission by the school district to include blood draws in this project, provided they did not take place at school sites and participation was not required by students.

Children that elected to participate were asked to not drink or eat anything aside from water, after 8 pm the night prior. Blood samples were collected by bilingual, licensed phlebotomists with experience drawing blood in overweight children. The majority of blood draws occurred before school on weekdays or on weekends at locations nearby the schools, either inside a USC mobile clinical RV or under a portable USC tent. Some blood draws were done at neighborhood community gardens, and in some rare instances phlebotomists visited the children's homes ($n = 4$). Following sample collection, specimens were brought to USC where they were processed, stored and sent for analysis.

As an incentive for participation, students and their families were given results of their clinical fasting glucose test (an indicator of diabetes risk), and received $20 for each draw at baseline and 12-week follow-up. For later waves of data collection, children were given $15 at baseline and $25 if they participated at follow-up, given that attrition for blood draw participation was higher than expected. Alternatively, an additional glucose reading for a family member was offered, and the incentive was reduced by $10.

2.3. Curriculum

The LA Sprouts curriculum was systematically developed to be culturally- and age-appropriate for urban, Latino upper elementary school children, and consisted of two topical components: nutrition/cooking and gardening. The principle investigators, in their respective fields of expertise, led curriculum development. Existing curricula served as resources: the modified carbohydrate dietary intervention from the USC Childhood Obesity Research Center was used for the nutrition and cooking component [20,37], and for the gardening component, the University of California Cooperative Extension (UCCE) Common Ground Master Gardener Program curriculum [38]. A review of the literature was conducted to identify supplemental lesson content that was comprehensive, age-appropriate and relevant to gardening and nutrition. Next, topic experts (at least two experts per topic) created and detailed individual lesson content. The initial version of the curriculum was pilot tested with 104 fourth and fifth graders to verify effectiveness, comprehension, cultural appropriateness and difficulty for grade level [14,39]. Feedback from educators was solicited throughout the pilot program, and was used to update and modify lessons.

The final curriculum consisted of 12 weekly lessons, 90 min each (45 min each for nutrition/cooking and gardening) and included interactive, hands-on learning activities (Table 3). Nutrition lessons focused on integration of FV and whole grains into the regular diet, and emphasized reduction of processed food intake, especially refined carbohydrates and sugar-sweetened beverages. An outdoor kitchen was set up in the school garden for students to participate in cooking activities. For these, students worked in small groups with the direction of educators or college student volunteers (volunteers trained by and under the guidance of educators) to prepare a snack with recipes that integrated fresh FV, and which could be replicated at home. Students used lettuce knives and other child-safe cooking utensils, and instructors used a portable gas burner when heat was required for cooking. Students consumed their snacks family-style while the instructor and volunteers facilitated discussions on likes and dislikes of the snack and what other FV could be incorporated. Children ate on non-disposable flatware, and assisted with dishwashing using a sink installed at the garden and biodegradable soap. Gardening lessons focused on the growth and maintenance of edible plants, both at home and in the school garden, and emphasized environmental stewardship and reuse of existing resoures. Gardening activities were progressive from week to week, initiating with planting seeds and culminating with harvesting FV. Both the nutrition and gardening lessons included suggested take-home activities that children could complete at home with their parents (to encourage parent participation in healthy eating and reinforce both child and parent lessons).

A parent version of the curriculum was developed following the same process as the student curriculum. Six parent lessons, also 90 min each, were designed to be taught twice per month and to be consistent with concepts covered in student lessons. The topics and activities of these lessons additionally incorporated the caregiver's role in encouraging children to eat healthier meals and to garden at home. Children were invited to attend these lessons. To encourage parents to attend these classes, flyers were sent home with children, announcements were made to children to remind parents, and classes were offered on different days and times (weekday mornings and evenings, weekends) to attempt to accommodate differing schedules.

2.4. Intervention implementation

2.4.1. Garden construction

School garden designs integrated considerations from investigators, school principals, and after-school program leaders; and were drafted by an experienced landscape architect. Two district ombudsmen were instrumental in assisting the study team in securing school district approvals, and in identifying district funding for asphalt removal and soil testing when possible. Construction of gardens was completed by a combination of after-school program staff, volunteers and the Los Angeles Conservation Corps, an organization that provides job training to at-risk youth. The Los Angeles Community Garden Council, a non-profit organization that supports community gardens, assisted with fiscal management.

2.4.2. Instruction

All lessons were conducted at school gardens, weather permitting. No more than three lessons were held indoors per

Table 3
Overview of LA Sprouts curriculum.

Week	Nutrition lessons and topics covered	Gardening lessons and topics covered	Snack
1	*Introduction*: name game, overview of the program, make class rules, kitchen safety and hand washing	*Introduction*: basic botany, importance of growing food, history of agriculture	Seasonal green salad
2	*Real food*: real food vs. packaged food, where can you find real food, reading ingredients label, number of ingredients in real food, cooking with real food	*Planning a garden*: garden design, soil types and testing	Fresh veggies with yogurt dip
3	*Sugar*: natural vs. added sugar, liquid candy (soda), demonstration of how much sugar is in popular drinks, low sugar beverage taste test	*Sowing and transplanting*: starting seeds for the school garden and home, how-to use of garden tools	Apples with peanut butter, cucumber, lemon water, and agua de jamaica
4	*Fruits*: types of fruits, health benefits of eating a variety of colors of fruits, fruit intake recommendations, ways to add fruit to your diet, mystery fruit game	*Composting*: importance of recycling, greens and browns, hands-on starting and maintaining a compost pile	Fruit rainbows with yogurt
5	*Vegetables*: parts of the plant you can eat, benefits of eating different colors of vegetables, vegetables intake recommendations, ways to add vegetables to your diet, mystery vegetable game	*Recycling and gardening at home*: review of composting, using items from home in the garden	Vegetable quesadillas with pico de gallo
6	*Fiber*: what is fiber, juice vs. whole fruit, what foods have fiber, where can you find fiber on a nutrition label, adding fiber to your diet, fiber taste test	*Watering*: how-to, how much do plants need, water cycle, measuring seedling progress	Whole grain pasta with veggies
7	*Food and family*: importance of eating together as a family, family dining habits, dinner conversation starters	*Botany*: plant nutrition, plant life cycles, pollination	Breakfast taco
8	*Garden to table*: eating in season, where does our food come from, shopping at the farmers market activity	*Garden maintenance*: weeding, fertilization, good and bad garden bugs	Beet, carrot and avocado salad
9	*Breakfast*: school day skit (with and without breakfast), why is breakfast important, what is a healthy breakfast, choosing a healthy breakfast at school	*Food preservation and seed saving*: preservation methods, herb drying, seed saving history, plant genetics	Yogurt parfait
10	*School lunch*: importance of a healthy lunch important, choosing a healthy lunch at school, making your own lunch	*Seasonal crops*: climate, length of day, seasonality, local vs. imported foods, where our food comes from	Ultimate sandwich
11	*Parties and holidays*: healthy vs. unhealthy party foods, how to make parties healthier, planning your own party, tips for eating well at parties	*Plant anatomy*: what we use plants for, parts of plants, edible parts of different plants, indentifying plant parts in cut fruit	Bean dip and pita chips
12	*Review*: jeopardy game	*Harvesting*: gardening awards	Cook-off (make your own snack)

grade level, and associated activities remained the same in these instances. Parent lessons were held at school or community gardens at various times (weekday mornings and evenings, or weekends) to best accommodate parent schedules. Each elementary school was assigned one paid part-time nutrition educator with a strong background in cooking and nutrition, and one paid part-time gardening educator (UCCE Common Ground certified Master Gardeners). Instructors were assisted by several undergraduate and graduate student volunteers. At least one staff member from the after-school program was present at all lessons to oversee student safety and to assist with classroom management when needed.

Educators compiled weekly notes about the successes and challenges of lessons, in addition to documenting any omitted content to be revisited during later lessons. The project manager observed educators on at least two occasions to check for adherence to curriculum content and give feedback on pedagogical style. Select lessons were documented on individual school garden blogs (lasprouts.org). Participants in the control schools received a delayed intervention (same as LA Sprouts intervention).

2.4.3. Program sustainability

Funding for long-term program sustainability at individual schools was limited. Therefore, empowering schools to transition into leadership roles for their own gardens was an important priority. To encourage future curriculum delivery, after-school staff were provided introductory training on the curriculum prior to the start of the 12-week program, were encouraged to observe classes each week, and were given copies of the curriculum. The formation of a garden club was encouraged at each school, to be composed of interested parents, teachers, students and after-school staff, with the purpose of managing garden operations and ensuring the longevity of its use. Each school's principal was highly influential in encouraging teachers to join the garden club, and in one case, a cash stipend was provided to two participating teachers who would assist with continued maintenance of the garden. Classroom teachers were offered train-the-trainer workshops on introductory garden maintenance and other topics included in the LA Sprouts curriculum. Additional curriculum resources with ideas to further incorporate gardening into educational activities were also provided.

2.5. Statistical analysis

For baseline characteristics, means $\pm$ standard deviation or frequencies were calculated. Differences between intervention and control groups were assessed using independent t-tests and chi-square tests. Statistics were performed using PASW (SPSS) Statistics version 18.0 (Chicago, IL) with a significance level set at $p \leq 0.05$.

3. Results

Of 409 children enrolled in the after-school program in eligible grades at four elementary schools, 375 children (92%)

agreed to participate in LA Sprouts (Fig. 1). Those who did not participate in the study still received the curriculum as part of the after-school program (but did not complete any study measures). At least partial clinical and questionnaire data was collected on 364 participants at baseline, and 320 (88% of those with baseline data) had at least partial post-intervention data collected. No participating students withdrew from LA Sprouts; reasons for missing follow-up data (n = 55) included: changed school, left the after-school program, or absent on several days. One hundred and sixty-nine children (46% of the total sample) participated in blood draws at baseline, and 113 children returned for follow-up (67% of initial blood draw participants). Sixty parents (16% of baseline child sample) completed the parent questionnaire at baseline, yet only 13 of these same parents returned their questionnaires again at follow-up (22% of initial parent sample). Enrollment in LA Sprouts across the four schools ranged from 51 to 115 students at each site. Students attended an average of 9.7 ± 2.3 intervention classes, yet only 11 parents (6% of families with children in classes) attended at least one parent class.

Participating students were 48% male and 87% Latino, with a mean age of 9.3 ± 0.9 years (Table 4). One hundred eighty-two (53%) students had a BMI > 85th percentile for age and sex, and 121 (36%) had a BMI > 95th percentile. At baseline, there were no differences between intervention and control groups for BMI, body fat percent, waist circumference, fasting glucose and socio-demographic variables (computer at home, internet at home, mother having her own car, eligible for free lunch at school). The intervention group had lower blood pressure (BP) at baseline compared to the control group (109.4 ± 11.8 vs. 112.3 ± 13.9, p = 0.04 for systolic BP; and 64.0 ± 10.9 vs. 66.9 ± 13.3, p = 0.03 for diastolic BP, respectively). Intervention families were less likely to speak English at home compared to controls (69.8% vs. 81.5% of families speaking English, p = 0.01).

4. Discussion

LA Sprouts is the first nutrition, cooking and gardening RCT that specifically targets obesity reduction and treatment in elementary school children. This culturally-tailored program was developed for a high-risk population of Latino youth, of which over 50% were overweight or obese. Although other interventions have combined gardening and cooking practices with nutrition education in order to increase FV intake, the LA Sprouts curriculum also aimed to reduce obesity by utilizing strategies from previous research shown effective in decreasing BMI in overweight Latino youth [20]. The hands-on curriculum underwent extensive development and testing, including a 12-week pilot program and evaluation [14,39]. Also, LA Sprouts is the only study to our knowledge that directly measured metabolic risk in participants by collecting

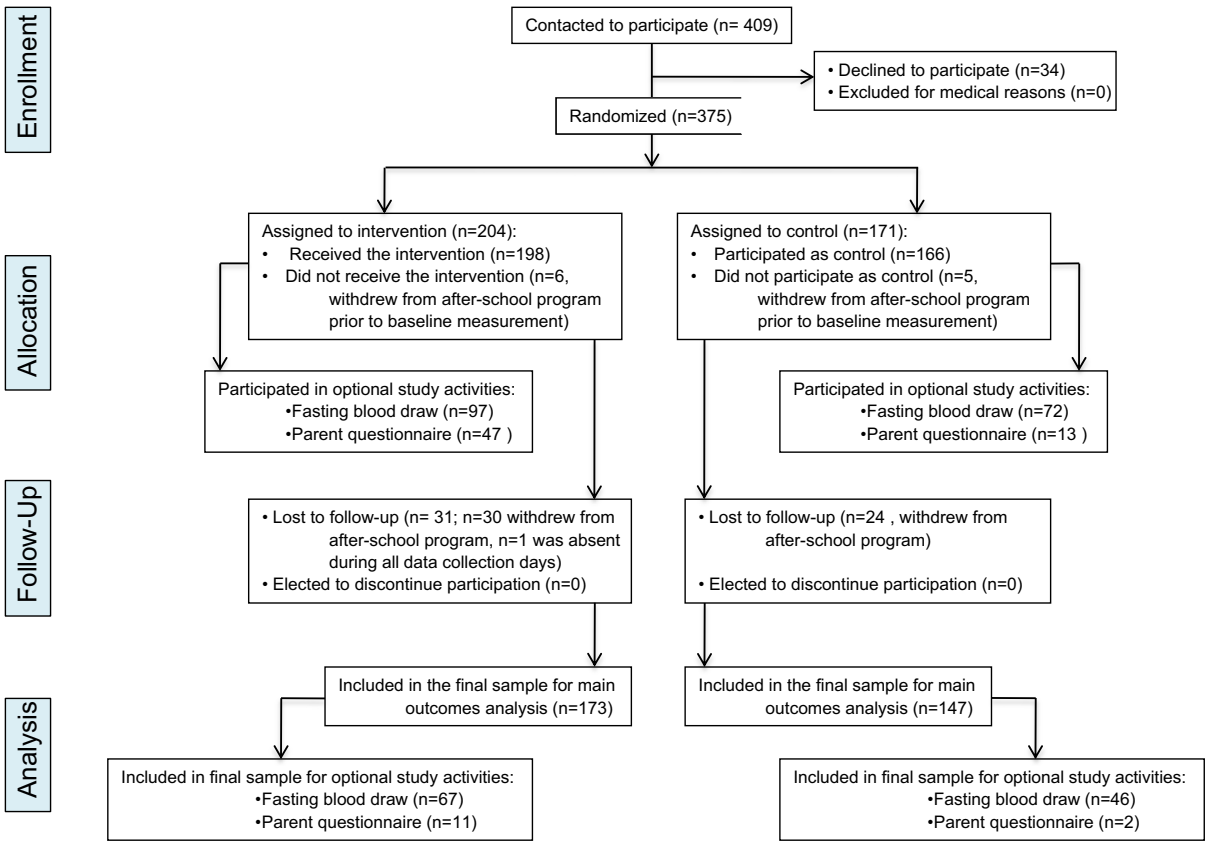

Fig. 1. Enrollment and participation of 3rd–5th grade children in LA Sprouts study*. *Among those who withdrew from the after-school program, some were reported as having moved to a different school. No individuals will be excluded in entirety from analyses, but some may be excluded from analyses of specific outcomes if outliers are detected.

Table 4
Descriptive characteristics at baseline of 3rd–5th grade students by study group[a].

	LA Sprouts	Controls	
	n = 198	n = 166	p-value
Male (n,%)	94 (47.5%)	79 (47.6%)	0.98
Latino (n, %)	175 (88.4%)	142 (87.7%)	0.83
Age (years)	9.3 (0.9)	9.3 (0.9)	0.70
Height (cm)	135.0 (8.5)	135.1 (8.6)	0.91
Weight (kg)	36.9 (10.9)	38.1 (12.2)	0.30
BMI percentile	74.6 (26.8)	77.2 (25.5)	0.35
≥85th percentile (n, %)	97 (52.4%)	85 (54.5%)	0.71
≥95th percentile (n, %)	61 (33.0%)	60 (38.5%)	0.29
Socio-demographic characteristics			
No English spoken at home (n, %)	58 (30.2%)	29 (18.5%)	0.01
Computer at home (n, % yes)	131 (71.2%)	118 (75.2%)	0.41
Internet at home (n, % yes)	141 (73.1%)	120 (76.4%)	0.47
Mother has own car (n, % yes)	122 (63.9%)	113 (71.1%)	0.15
Eligible for free lunch (n, % yes)	175 (90.7%)	142 (89.3%)	0.67
Clinical characteristics			
Body fat (%)	24.5 (9.3)	25.9 (9.9)	0.18
Systolic blood pressure (mm Hg)	109.4 (11.8)	112.3 (13.9)	0.04
Diastolic blood pressure (mm Hg)	64.0 (10.9)	66.9 (13.3)	0.03
Waist circumference (cm)	70.6 (11.6)	71.8 (12.8)	0.37
Fasting glucose (mg/dL)	92.0 (6.4)	90.5 (6.6)	0.13

[a] Data for gender, % Latino, percent over 85th and 95th BMI percentiles and socio-demographic characteristics are n(%), with p-value obtained via chi-square tests. Data for all clinical outcomes are mean (SD), with p-value obtained via independent t-tests.

waist circumferences, blood pressure and a fasting blood sample to analyze glucose, insulin, lipid and inflammatory changes pre- and post-intervention. Program evaluation tools were developed specifically for LA Sprouts to examine mediators and moderators for obesity reduction, including measures on motivation and self-efficacy to garden; cooking and gardening attitudes; and nutrition and gardening knowledge.

Many strategies were employed for successful implementation of the program. Table 5 provides a summary of key strategies identified by the research team. Given the extensive collaboration required for project implementation, it was essential to have initial and continued strong support from school principals, teachers, after-school staff and parents throughout the program. Similarly, Hazzard et al. conducted key informant interviews with school leaders and community members and found that successful school gardens involve individuals from a variety of different roles within the school committed to the garden success [40]. A review by Ozer also identifies broad support as essential for garden success [41]. One way we found to maximize support was to enlist stakeholder input throughout, and to have in-depth conversations with principals and after-school staff prior to program start in order to outline expected responsibilities of all players. Also, in some cases, financial incentives were provided by the school district for teachers and staff to participate in trainings, which was a very helpful mechanism in promoting staff investment.

Another key strategy for implementation was to deliver the program during an existing after-school program. The LA Sprouts program was also mutually beneficial for the after-school program, as it provided free enrichment activities for their participating children. Partnership with the after-school program expanded financial resources available for garden construction and staff training. Given the demands on schools and teachers to meet educational performance goals, offering LA Sprouts after school hours was important so as not to compete for regular school day hours, allowing for dedicated time and energy to the curriculum. Holding lessons after school also allowed both classroom teachers and after-school staff to observe LA Sprouts lessons and learn the curriculum, which we hope will inspire the use of the garden for other classroom lessons, such as science and math. A limitation of holding the program after school is that not all students at a school were exposed to the intervention (also, although classes were well-attended, attendance in an after-school program may be more inconsistent than attendance during the regular school day).

Several strategies were involved in the creation of the evaluation measures. First, an extensive review of literature on gardening programs was conducted to identify constructs (or, determinants of dietary behavior) that have been shown to change in response to a gardening intervention. Then focus groups were conducted to guide modifications for content, readability/comprehension, and clarity. Finally, internal

Table 5
Key strategies for success.

- School partnerships
  - Strong partnership with after-school program leaders and on-site staff; school principals and teachers; and parents
    - Initial conversations on responsibilities and expectations of all parties
    - Constant communication and input from all stakeholders
  - On-site staff facilitated all participant interaction, including recruiting, data collection and curriculum lessons
- Garden build-out
  - Garden design facilitated by landscape architect with experience in school gardens
  - School district ombudsmen assisted to secure approvals and funding when available
  - Principles highly involved in giving design input and meeting district requirements
  - Volunteers and non-profit organization oversaw acquisition of materials and on-time project completion
- Evaluation
- *Questionnaire*
  - Extensive review of literature and adaptation of existing resources to suit study hypotheses and population
  - Creation of new survey items where needed
  - Focus group testing for content and clarity
- *Clinical measures*
  - Strong workflow to facilitate data collection during after-school hours
  - Blood draw sessions held during different times to accommodate varying schedules, with school-branded tent or mobile unit
  - Several reminders delivered to students and parents about blood draws, including morning text messages
  - Use of bilingual phlebotomists experienced in drawing blood with children
- Curriculum
  - Use of evidence-based materials to create basic content
  - Involvement of panel of experts to refine materials for target audience
  - Pilot test of full curriculum with feedback from educators throughout
  - Delivered by experienced educators with assistance from several undergraduate students at each lesson
- Sustainability
  - Meetings held with on-site after-school staff prior to program start to introduce curriculum and data collection plan
  - After-school staff assisted and observed weekly lessons
  - Train-the-trainer workshops help with teachers to introduce gardening and relevant learning activities
  - Encouraged formation of garden club at each school to ensure ongoing maintenance and use of garden

consistency and intra-rater reliability were run on the questionnaire packets.

A key strategy related to designing and building the gardens in the schools was to meet with a variety of school and district stakeholder prior to the design and build of the garden, to allow for the project team to have full knowledge of relevant construction and design considerations. Some of the specific tasks involved in garden construction included design of a functional space within the restrictions of school environments (landscape architect); securing LAUSD departmental approvals, soil testing, and removal of asphalt (school principals and district personnel), and procurement of supplies and building the garden within a limited timeline (construction team). Given the support of school gardens in California, LAUSD initially provided funding and ombudsmen support to streamline the process, though it was ultimately not without delays and subject to budget cuts.

Another key strategy for successful implementation of the program was to provide a part-time garden and nutrition educator to teach the lessons. This approach may be expensive, but it ensures that the program is taught correctly and as designed. A recent review of school garden programs showed that seven of the eleven garden programs targeting dietary intake provided instructors to teach lessons [42], which may help alleviate stress and additional responsibility from regular classroom teachers. However, use of specialized instructors may limit sustainability. For this study, the after-school staff shadowed the LA Sprouts educators for every lesson, enabling them to learn the curriculum and observe best teaching practices. Additionally, all after-school staff attended a training workshop after the intervention on how to deliver the material. Future research is needed to assess how the provision of instructors affects long-term sustainability.

Communication was also identified as a key area of focus. Areas without strong communication and partnerships between study staff and school personnel manifested in poor project outcomes. For example, although there was moderate participation from families in the parent questionnaire at baseline, few follow-up questionnaires were collected because schools had limited availability to help during post-intervention data collection, and study staff had minimal access to families directly. An attractive incentive structure for parents likely could have mitigated this low response. Furthermore, parent classes were poorly attended, even with substantial efforts to encourage parents to attend. This could possibly be due to busy work schedules or family demands. Exploring additional creative strategies to encourage parent attendance, such as those that excite children and promote family attendance, should be a priority for future programs. Student participation in follow-up blood draws was also not as robust as hoped, and the primary reason cited by non-participants was lack of interest. In some cases families did not understand the purpose of two separate diabetes-screening tests (because this was highlighted as an incentive for participation), which perhaps speaks to a shortfall in communication from the study team on the importance of both pre- and post-data collection.

Another limitation of this project is that long-term sustainability of the gardens and educational program was not assessed. Efforts were made to involve classroom teachers, after-school staff, students and parents in garden utilization and maintenance for the future, yet ultimately this was a responsibility of each individual school. The study team offered training workshops, guidance on creating a maintenance and sustainability plan, and appointed a team member to be accessible for additional hands-on help and to answer ongoing questions. There were also some limitations in the measurement tools used, including the dietary screener, which was challenging for study participants, and use of BMI and bioelectrical impedance as measures of obesity. However, these measures are more robust than many used previously in this area of research. A major strength of this study, in addition to those mentioned above, was the use of an RCT study design.

5. Conclusions

Notwithstanding logistical challenges associated with this project, the LA Sprouts intervention was successfully implemented in four elementary schools. Given that over half of the participating students were overweight, an amount well above the national average, the interest among schools and principals in having a garden-based after-school program for obesity prevention is encouraging. Lessons learned and challenges presented here should be considered when implementing future school-based nutrition programs, especially those with hands-on cooking and gardening activities.

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