Title

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Journal

Journal of the Academy of Nutrition and Dietetics, 123(8)

ISSN

2212-2672

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Publication Date

2023-08-01

DOI

10.1016/j.jand.2023.03.015

Peer reviewed

HHS Public Access

Author manuscript

J Acad Nutr Diet. Author manuscript; available in PMC 2024 August 01.

Published in final edited form as:

J Acad Nutr Diet. 2023 August ; 123(8): 1187–1196.e1. doi:10.1016/j.jand.2023.03.015.

Dietary psychosocial mediators of vegetable intake in schoolchildren from low-income and racial/ethnic U.S. minority families: Findings from the Texas Sprouts intervention

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Abstract

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Authors Contributions: Dr. Vandyousefi conceptualized and designed the study, carried out the initial analyses, reviewed the analyses, drafted the initial manuscript, and reviewed and revised the manuscript. Dr. Davis secured funding, conceptualized and designed the study, supervised data collection and acquisition of data, analyzed data, reviewed the analyses, and reviewed and revised the manuscript. Dr. Ranjit substantially contributed to analysis and interpretation of data, conducted and reviewed data analyses, and revised the manuscript for important intellectual content. Dr. Landry, Ms. Ghaddar, and Mr. Jeans supervised data collection and acquisition of data, reviewed the analyses, and reviewed and revised the manuscript. All authors approved the final version to be published and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Clinical Trial Registration: CClinicalTrials.gov: (NCT02668744).

Conflict of Interest Disclosures: The authors have no conflicts of interest relevant to this article to disclose.

Background: Numerous school-based interventions have used cooking and gardening approaches to improve dietary intake; however, research is limited on the mediation effect of dietary psychosocial factors on the link between the intervention and increased vegetable intake, particularly in children from low-income and racial/ethnic U.S. minority families.

Objective: To examine: 1) the effects of the *Texas Sprouts* intervention on dietary psychosocial factors related to intake of vegetables; and 2) whether these psychosocial factors mediate the link between the intervention and increased intake of vegetables in schoolchildren from low-income and racial/ethnic U.S. minority families.

Design: This is an analysis of data on secondary outcomes from the *Texas Sprouts* program, a one-year school-based gardening, nutrition, and cooking cluster-randomized controlled trial consisting of elementary schools that were randomly assigned to either the *Texas Sprouts* intervention or to control.

Participants/setting: 2,414 3rd-5th grade students from low-income and racial/ethnic U.S. minority families from 16 schools (8 intervention and 8 control) in Austin, TX.

Intervention: The intervention group received 18 60-minute gardening, nutrition, and cooking student lessons in an outdoor teaching garden, and nine monthly parent lessons throughout the academic year.

Main outcome measures: Child psychosocial and dietary measures were collected at baseline and post-intervention via validated questionnaires.

Statistical analyses performed: Generalized-linear-mixed models assessed the intervention effects on dietary psychosocial factors. Mediation analyses examined if these psychosocial factors mediated the link between the intervention and increased child vegetable intake.

Results: Children in *Texas Sprouts*, compared to control, showed significant increases in the mean scores of gardening attitudes, cooking self-efficacy, gardening self-efficacy, nutrition and gardening knowledge, and preferences for fruit and vegetables (all $p<0.001$). Each of the above dietary psychosocial factors mediated the association between the *Texas Sprouts* intervention and child vegetable intake.

Conclusions: Besides targeting dietary behaviors, future school-based interventions should also focus on understanding the mechanisms through which teaching children to cook and garden influence dietary psychosocial factors as mediators of change in healthy eating behaviors.

Keywords

Gardening; nutrition; cooking intervention; dietary psychosocial factors; self-efficacy

INTRODUCTION

Many adulthood chronic diseases such as obesity, cardiovascular diseases, and type 2 diabetes have early life and childhood origins.[1] Practicing healthy dietary behaviors during childhood has been associated with lower risk of chronic diseases later in life.[2,3] Diets high in fruit and vegetables, in particular, are associated with improved overall health among all age groups.[4,5] Therefore, it is crucial to encourage children to eat more fruit and

vegetables, especially children from low-income and racial/ethnic U.S. minority families,[6] as low socioeconomic status is associated with lower consumption of fruit and vegetables.[7] Low-income and racial/ethnic U.S. minority families have limited access to healthy foods, making it difficult for children from these families to eat diets that are rich in fresh fruit and vegetables.[8–10]

Research shows that compared to other types of food, children's preferences for eating vegetables are low,[11–13] therefore, it is important to expose them to vegetables and other healthful food in an effort to improve their preferences, and ultimately influence their consumption of those foods.[14] Exposure to a food is positively associated with preference for that food,[15] and food preferences are largely shaped during childhood.[16] Children spend a significant amount of their time in schools,[17] therefore school-based cooking and gardening interventions are emerging as a useful tool to involve children in gardening and expose them to fruit and vegetables.[15] Similar to many school-based gardening interventions that have resulted in improved intake of fruit and vegetables in children,[15,18–27] we have previously reported that children who participated in the *Texas Sprouts* intervention had significantly higher intake of vegetables compared to children from control schools.[28] While school-based gardening and cooking interventions may be a promising strategy for improving intake of vegetables in children, the underlying mechanism by which these types of interventions improve dietary intake in children is less clear. Therefore, exploring the potential mechanisms of higher vegetable intake is warranted in order to understand how school-based interventions improve vegetable intake in children.[29]

According to Social Cognitive Theory (SCT), environmental factors (i.e., school and family) and other characteristics including cognitive and personal factors act together to influence behaviors.[30,31] Dietary psychosocial factors are personal cognitive factors that may explain how gardening- and cooking-based interventions can improve dietary behaviors in children.[31] Dietary psychosocial factors including children's self-efficacy and attitudes towards preparing and eating food, nutrition and gardening knowledge, and preferences for eating healthy food play a key role in their intake,[32] therefore it is worthwhile to attempt to improve these dietary psychosocial factors in children as a mean to encourage them to consume more produce.[33] An emerging body of literature has established a relationship between school gardening, cooking, and nutrition education programs and dietary psychosocial factors towards eating fruit and vegetables.[19,32,34–38] However, to our knowledge, none have examined how dietary psychosocial factors potentially mediate increased intake of vegetables in low-income and racial/ethnic U.S. minority families. Therefore, the present study aimed to assess: 1) the effects of a one-year, school-based gardening, nutrition, and cooking cluster randomized controlled trial (RCT) on dietary psychosocial factors (i.e., cooking and gardening attitudes and self-efficacy, self-efficacy to eat fruit and vegetables, nutrition and gardening knowledge, and preferences for fruit and vegetables) in 3rd-5th grade students from low-income and racial/ethnic U.S. minority families; and 2) if changes in these dietary psychosocial factors mediate the increases in vegetable intake seen in the intervention group. This study hypothesized that the *Texas Sprouts* intervention would result in increased cooking and gardening attitudes and self-efficacy, self-efficacy to eat fruit and vegetables, nutrition and gardening knowledge, and preferences for fruit and vegetables compared to the control group and these improvements

would mediate the improvements in vegetable intake in children from low-income and racial/ethnic U.S. minority families.

MATERIALS AND METHODS

Study Design

This study is an analysis of data on secondary outcomes from *Texas Sprouts*, a one-year cooking, gardening, and nutrition education cluster RCT that was conducted in 16 elementary schools in the Austin area, TX. The study design, methodology, recruitment protocol, and main outcome findings for the *Texas Sprouts* trial have been described in detail elsewhere.[28,39] *Texas Sprouts* randomized schools into either: (1) *Texas Sprouts* intervention (n=8 schools) or (2) Waitlist-control condition (n=8 schools). *Texas Sprouts* took place over the course of three school years (2016–2019), with the first two waves each including three intervention schools and three control schools and the final year including two intervention schools and two control schools. The intervention group received 18 one-hour gardening, nutrition, and cooking student lessons taught in an outdoor teaching garden by trained educators, and nine monthly parent lessons throughout the academic year. The control group received the same protocol as the intervention group a year after the completion of the intervention arm. The fidelity assessment of *Texas Sprouts* student lessons showed that 100% of the classes were taught to each classroom in grades 3rd to 5th, and 96% of students attended each class.[39] This study was approved by the University of Texas at Austin Institutional Review Board. This trial was registered at ClinicalTrials.gov (NCT02668744).

School Eligibility and Study Sample

Schools within 60 miles of the University of Texas at Austin campus were eligible for the *Texas Sprouts* randomized controlled intervention if: 1) >50% of the students were Hispanic, 2) >50% of the students received free or reduced-price lunch, 3) the school expressed interest in a school gardening program, and 4) the school did not have an existing school garden or gardening program. Figure 1 shows the flow of participants through the study. A total of 4,239 students at the 16 schools were eligible to participate in *Texas Sprouts*, 3,302 (or 78%) of whom were consented to be included in the trial. Of those consented, 3,135 students completed baseline clinical measures and child surveys, 2,721 (or 87%) of whom completed post-intervention clinical and survey measures. The present analysis used data from all participants in the first, second, and third waves with complete baseline and post-intervention data (n=2,414) for all demographics and dietary psychosocial factors.

Measures

***Texas Sprouts* Questionnaire Packets.—**Development of the *Texas Sprouts* child and parent questionnaire packets was initiated with a review of the literature for measures relevant to nutrition, gardening, and cooking behaviors. Many of the items on the *Texas Sprouts* child questionnaire packet[39] were adapted from the child questionnaire used in the LA Sprouts evaluation.[40] The *Texas Sprouts* child questionnaire packet included questions on demographic characteristics, food security, physical activities, dietary intake, family activities, and dietary psychosocial factors including cooking and gardening attitudes, self-efficacy to garden, cook, and eat fruit and vegetables, nutrition and gardening knowledge,

preferences for fruit, vegetable and beverage intake, and motivation to garden, cook, and eat fruit and vegetables. The *Texas Sprouts* parental questionnaire packet included similar questions to those in the child questionnaire packet and included a question on whether or not the child was eligible for free or reduced-price lunch.[39] Surveys were available in English and Spanish and bilingual interpreters were available to assist with comprehension.

Dietary Intake Measures.—In our prior study,[28] the *Texas Sprouts* intervention compared to control resulted in improvements in several dietary components, including intake of vegetables in children from low-income and racial/ethnic U.S. minority families. The current analysis focused on mediators of increased vegetable intake, given the known low preference for vegetables in this population. Vegetable intake of students was measured using the adapted version of the 2015 School Physical Activity and Nutrition (SPAN) questionnaire, a scale that has been validated to measure vegetable intake in 3rd-5th grade students.[41] The SPAN questionnaire included eight-items for daily frequency of eight different vegetable categories. Students were asked how many times in the past 24 hours they ate any vegetables from the vegetable categories (i.e., carrots, beets, sweet potatoes, and leafy green vegetables), with possible responses of “no, I did not eat any of these vegetables yesterday” coded as 0, “yes, I ate at least one of these vegetables one time yesterday” coded as 1, “yes, I ate at least one of these vegetables two times yesterday” coded as 2, or “yes, I ate at least one of these vegetables there or more times yesterday” coded as 3. We summed responses across the eight items for a possible range of 0 to 24. The measure was then interpreted as a count of the number of times the student reported eating vegetables in the past 24 hours of data collection date.

Dietary Psychosocial Factors Measures.—Selection of the dietary psychosocial mediators used in the present study were based on the conceptual framework of LA Sprouts[19] and SCT.[31] Child cooking and gardening attitudes were measured via an eight-item survey adapted from the LA Sprouts study.[40] Self-efficacy to garden, cook, and eat fruit and vegetables were measured via a 10-item scale adapted from Baranowski et al.[42] Nutrition and gardening knowledge was assessed by a seven-item scale adapted from the LA Sprouts study.[40] Preferences for fruit and vegetables was assessed using a validated 36-item questionnaire;[43] 16 questions asked about preferences for fruit (including apples, avocados, bananas, berries, eggplant, grapes, melons, kiwi, oranges, peaches, pears, pineapple, tomatoes, zucchinis, squashes, and sweet potato) and 20 questions asked about preferences for vegetables (basil, beets, broccoli, cabbage, cactus, carrots, cauliflower, chard, cilantro, corn, cucumber, garlic, jicama, kale, lettuce, onions, peas, peppers, radishes, and spinach) using a four-point response scale. Supplementary Table 1 shows the validation and reliability of dietary psychosocial constructs measured in the questionnaire packet. Prior to the intervention, test-retest reliability (bivariate correlations of averaged scale values for each rater) was computed using Kendall’s tau, for all dietary psychosocial questionnaire items with 44 3rd-5th grade students from low-income and racial/ethnic U.S. minority families, who were not enrolled in the study. In addition, intra-rater reliability was computed for all constructs, as was internal consistency (Cronbach’s alpha). Test-retest reliability ranged from 0.34 to 0.62, which is considered as fair/moderate[44,45] or good[46], depending on which standard used. Internal consistency for all constructs ranged from 0.53 to 0.88, and

intra-rater reliability ranged from 0.34 to 0.60, all were somewhat low, but within the range of satisfactory ($p<0.001$).[47]

Baseline Demographic Characteristics.—Child age, sex, and ethnicity/race and eligibility for free or reduced-price lunch were obtained via survey at the baseline visit. School demographic data were also obtained from Texas Education Agency (TEA) for all 3rd-5th grade students enrolled in the schools at the time of the study, to evaluate representativeness of the surveyed sample.

Statistical Analyses

Baseline demographic data were compared between all students at the school and eligible participants who consented to be in the study using independent t-tests and chi-square analyses. Demographic differences at baseline between the intervention and control groups were also examined using independent tests and chi-square analyses. To test differences between the intervention and the control estimates for the dietary psychosocial factors, generalized linear mixed models (GLMM) adjusting for repeated measures and a school level random effect were used. Potential clustering at the school level is quantified using intraclass correlation coefficients [ICC]). Next, mediation models were run to examine whether dietary psychosocial factors mediated the relationships of the *Texas Sprouts* intervention compared to control on increasing vegetable intake in children. The SPSS Macro PROCESS, developed by Hayes,[48] estimated separate regression models for the dietary psychosocial factors, as mediators, and the outcome to estimate the strength of each pathway in the mediation model. Bootstrapping (5000 bootstrap replicates) was used to generate standard errors for significance testing. Each psychosocial dietary factor that was significantly related to child vegetable consumption was tested as a mediator using the PROCESS macro for SPSS ("Model 4"). Path analysis was used to determine whether changes in dietary psychosocial factors mediated the effect of the *Texas Sprouts* intervention compared to control on increasing intake of vegetables in children. Because the ICCs between dietary psychosocial factors were all negligible, mediation models were run as fixed effect models, with no adjustment for school as random effect. All models were adjusted for potential covariates including child sex, grade, and free and reduced-price lunch program participation.

The *Texas Sprouts* trial was earlier shown to have sufficient power to detect small changes in intake of vegetables.[28,39] Briefly, to test the effects of intervention on child vegetable intake (serving/day), an *a priori* G*Power (version 3.1.9.7, Heinrich Heine University, Dusseldorf, Germany, 2020) analysis (effect size = 0.50; alpha = 0.05; power = 0.95; a 2-sided test, accounting for randomization by cluster, and assuming equal allocation between the 2 arms) determined a minimum sample size of 127 participants for each school. Of note, the present study is an analysis of secondary outcomes from the *Texas Sprouts* program, and therefore this analysis was not powered on these secondary dietary psychosocial outcomes. An alpha level of $p=0.05$ was used as the threshold for significance for all analyses. All statistical analyses were performed using SPSS version 26.0.

RESULTS

There were no significant differences in demographics (i.e., sex, eligibility for free and reduced school lunch program, or race/ethnicity) between all 3rd-5th grade students enrolled in the schools and those eligible participants in the analytic sample. Baseline demographic characteristics and intake of vegetables of the intervention and control schools, based on 2,414 children with complete baseline and post-intervention data, are presented in Table 1. Participants were 47% male with average age of 9.2 years old, 65% Hispanic, and 68% of them received free or reduced-price lunch. The analytic sample included 1,324 (or 55%; 8 schools; average of 166 students per school) children assigned as the control group and 1,090 children (or 45%; 8 schools; average of 136 students per school) assigned as the intervention group. Demographic characteristics were comparable across the intervention and control groups.

Children from intervention schools compared to children from control schools had significantly greater increases in the mean scores of gardening attitudes (0.24 vs. −0.1%, p=0.009), cooking self-efficacy (+0.92 vs. +0.51, p=0.011), gardening self-efficacy (+0.14 vs. no change, p=0.004), nutrition and gardening knowledge (+1.37 vs. +0.43, p<0.001), and preferences for fruit and vegetables (+3.34 vs. 1.14, p<0.001). There was no difference in the changes in self-efficacy to eat fruit and vegetable scores or in cooking attitudes between intervention and control schools, implying that *Texas Sprouts* did not have a measurable impact on this factor (Table 2).

Results from the mediation analyses showed that the association between the *Texas Sprouts* intervention and child vegetable intake decreased after adjusting for all dietary psychosocial factors (B=0.43, 95%CI=0.08–0.79, p=0.017 [direct effect]). The overall indirect effect (mediation pathway) was significant for gardening attitudes, cooking and gardening self-efficacy, nutrition and gardening knowledge, and preferences for fruit and vegetables, suggesting that these psychosocial factors mediated increases in intake of vegetables seen in children in the intervention schools (Table 3 and Figure 2). Mediation was not found for the other dietary psychosocial factors (i.e., cooking attitudes and self-efficacy to eat fruit and vegetables) associated with the *Texas Sprouts* intervention.

DISCUSSION

The present study found that the *Texas Sprouts* school gardening, nutrition, and cooking intervention, compared to control condition, resulted in significant increases in gardening attitudes, cooking and gardening self-efficacy, nutrition and gardening knowledge, and preferences for fruit and vegetables in 3rd-5th grade students from low-income and racial/ethnic U.S. minority families.

The findings of the present study are consistent with previous studies examining the effects of school gardening programs on dietary psychosocial factors towards eating fruit and vegetables in children across the world.[19,32,34–38] Similar to the findings here, a recent study of 202 3rd and 6th grade students in Korea reported significant improvements in dietary self-efficacy, gardening and nutrition knowledge, preferences for vegetables, and

vegetable consumption as a result of a 12-week school-based gardening, cooking, and nutrition education program. The association of school gardening with dietary psychosocial factors found in this study is in line with a recent review of the literature, including 35 studies from 12 countries, which also reported that school gardening, nutrition, and cooking interventions were associated with improvements in nutritional knowledge, and attitudes and preferences towards consumption of vegetables in children (8–12 years of age).[34] In contrast to the above studies, LA Sprouts, an after-school 12-week randomized cooking, gardening, and nutrition intervention in 319 3rd to 5th grade students from primarily low-income, Hispanic families in the Los Angeles area, reported no differences in cooking and gardening psychosocial behaviors (i.e., cooking attitudes, self-efficacy, and motivation to eat fruit and vegetables) between the LA Sprouts intervention and control groups.[19] However, compared to control condition, LA Sprouts resulted in improved nutrition and gardening knowledge and increased vegetable consumption[19] and when the groups were combined, increases in cooking and gardening behaviors were associated with increases in dietary fiber and vegetable intake.[22]

While the above studies have reported associations between school gardening, cooking, and nutrition education programs and students' dietary psychosocial factors,[19,32,34–38] to our knowledge, none have examined the potential mediation role of these dietary psychosocial factors on vegetable intake in children from low-income and racial/ethnic minority families in the U.S. In addition, many of the above studies included small sample sizes, were not cluster RCTs or only targeted some of the dietary psychosocial factors included in the present analysis.

The current study demonstrated that increases in gardening attitudes, cooking and gardening self-efficacy, nutrition and gardening knowledge, and preferences for fruit and vegetables mediated the *Texas Sprouts* intervention effects on increased intake of vegetables in children. The mediation effect of these dietary psychosocial factors on the link between the *Texas Sprouts* intervention and improved vegetable intake suggests a potential mechanism to explain how the school-based gardening, cooking, and nutrition education interventions increased vegetable intake in children. The underlying mechanism for increased intake of vegetables being mediated by dietary psychosocial factors might be explained by the Bandura's Social Cognitive Theory (SCT),[30] an interpersonal theoretical framework commonly used by nutrition interventions designed to promote behavior change.[31] According to SCT, environmental factors (i.e., schools, community, and family), and cognitive and personal characteristics such as self-efficacy and nutrition knowledge (i.e., dietary psychosocial factors) act together to influence behavior.[31] Schools are an ideal setting for implementing gardening, cooking, and nutrition education interventions and consequently promoting healthy eating behaviors (i.e., fruit and vegetable intake) in children.[31] According to SCT, nutrition interventions, such as *Texas Sprouts,* are more effective if they improve environmental factors (i.e., school gardens and family and community support), strengthen knowledge (i.e. gardening, cooking, and nutrition education), encourage attitudes and self-efficacy (i.e., directly involving the students in hands-on activities like cooking and gardening, and experiential learning in these activities) towards promoting a specific behavior (i.e., vegetable consumption), and are tailored for demographic groups.[30] The *Texas Sprouts* intervention targeted both environmental and

personal factors, consistent with the SCT, which may explain the effectiveness of the intervention in improving dietary psychosocial factors and intake of vegetables as well as the mediational effect of dietary psychosocial factors on the link between the *Texas Sprouts* intervention and improved intake of vegetables.

There are several strengths to this study. To date, *Texas Sprouts* has been one of the very few cluster randomized controlled trials to examine the effects of a multi-component (i.e., gardening, nutrition, and cooking) intervention on dietary psychosocial factors and the first to assess the potential mediation role of these dietary psychosocial factors in the pathways affecting intake of vegetables of children from low-income and racial/ethnic U.S. minority families. Other strengths worth mentioning are the large sample size and fairly intensive intervention with 18 hours of instruction throughout the school year. Another strength of this study is the majority of the children in this study were from a low-income and minority population who are known to be at increased risk for obesity and obesity-related diseases; therefore, it is particularly important to improve the dietary intake of this population.

There are a few limitations of the present study that need to be acknowledged. Participants were children from primarily low-income and Hispanic families with different cultural affinities towards cooking, gardening, and fruit and vegetable consumption. It is possible, therefore, that these results may not be generalizable to other race/ethnicities and populations. Another potential concern is the large amount of missing data, with incomplete data from 1,825 or about 50% of parent participants, pre- and post-intervention. However, a parent survey completion rate of 50% is not unusually low;[49,50] moreover, comparison of the analytic data with publicly available school enrollment data suggests that the analytic sample is representative of the target population. Another limitation of the present study is that test-retest reliability of measures used for psychosocial dietary factors, ranging from 0.34–0.62 for all psychometric constructs, are modest, and would be considered as good[46] by some standards, but only fair/moderate[44,45] based on other standards. Additionally, internal consistency for all constructs ranged from 0.53–0.88, and intra-rater reliability ranged from 0.34 to 0.60, which were all somewhat low, but within the range of satisfactory.[47] Although we used validated tools, such variations in psychometrics across different populations are possible, as psychometrics are usually assessed for specific populations.[50] Finally, other personal, behavioral, and socioenvironmental factors that were not included in the present analyses may be contributing to changes in intake of vegetables.

CONCLUSIONS

Our study findings suggest that improving children's cooking and gardening experiences, attitudes, and self-efficacy through exposure to cooking and gardening activities is an effective way to improve intake of vegetables in a feasible and cost-effective manner. Our findings also suggest that psychosocial mediators targeted by cooking and gardening activities elicited the greatest effect on increased intake of vegetables and need to be retained and sustained in future school-based gardening, cooking, and nutrition interventions. Efforts to improve cooking and gardening experiences, encourage attitudes and self-efficacy, and strengthen knowledge in school settings as a means to increase healthy eating behaviors are warranted. Our findings highlight the need for future school-based interventions targeting

dietary behaviors in children to consider dietary psychosocial factors and other possible mediators or moderators (i.e., other dietary psychosocial and environmental factors) that are known to be associated with healthy eating behaviors.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments:

We would like to thank all the *Texas Sprouts* participants for their contributions to this study. We thank the *Texas Sprouts* study team for all of their hard work in conducting the in-person research visits and other data collection.

Funding/Financial Disclosures:

This work was supported by the National Institutes of Health [1R01HL123865, 2015–2020). Whole Kids Foundation, Home Depot, and Sprouts Healthy Communities Foundation gave funding for garden builds and enhancements. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

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Research Snapshot

Research Question:

What are the effects of the *Texas Sprouts* intervention on dietary psychosocial factors in schoolchildren from low-income and racial/ethnic U.S. minority families? Do these psychosocial factors mediate the link between the intervention and increased vegetable intake?

Key Findings:

This was a school-based cluster-randomized controlled trial where 16 schools with low-income and racial/ethnic U.S. minority population were randomly assigned to either the *Texas Sprouts* intervention or to control. Students enrolled at *Texas Sprouts*, compared to control, showed significant increases in gardening attitudes, cooking and gardening self-efficacy, nutrition and gardening knowledge, and preferences for fruit and vegetables. Each of the above psychosocial factors mediated the association between the intervention and child vegetable intake.

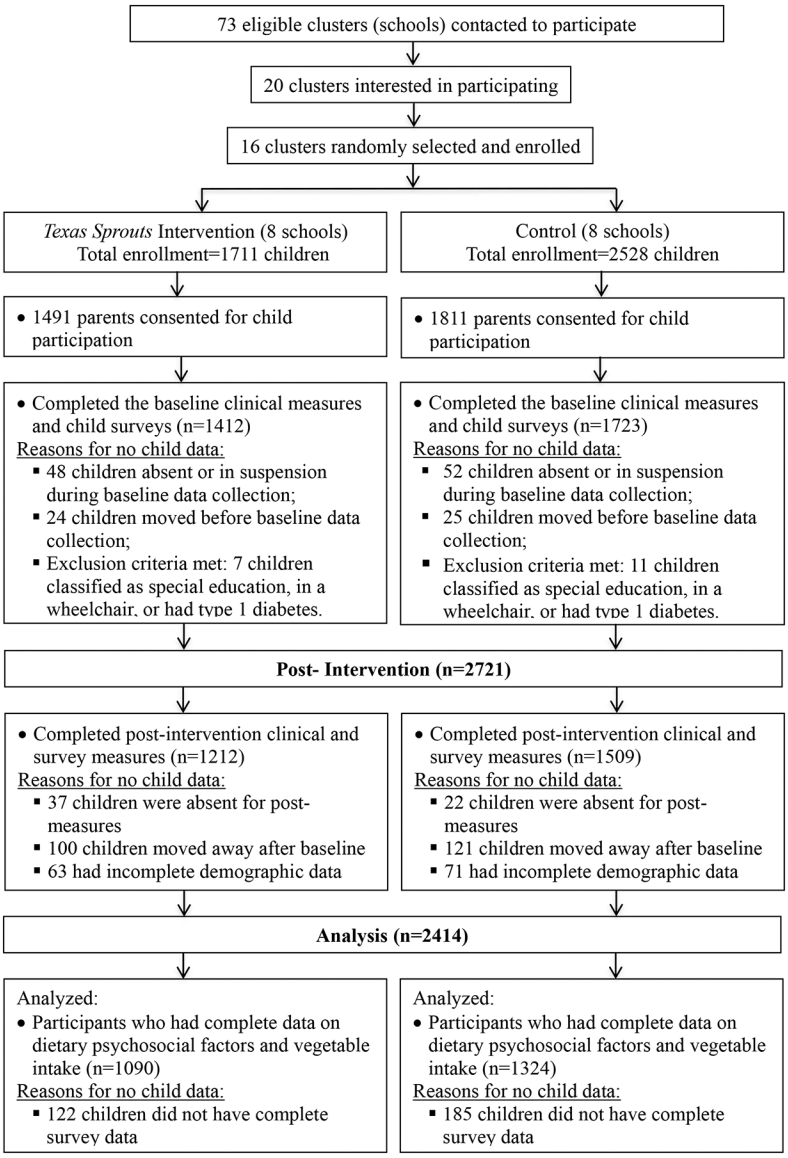

Figure 1.
CONSORT Flow Diagram for the *Texas Sprouts* CRCT

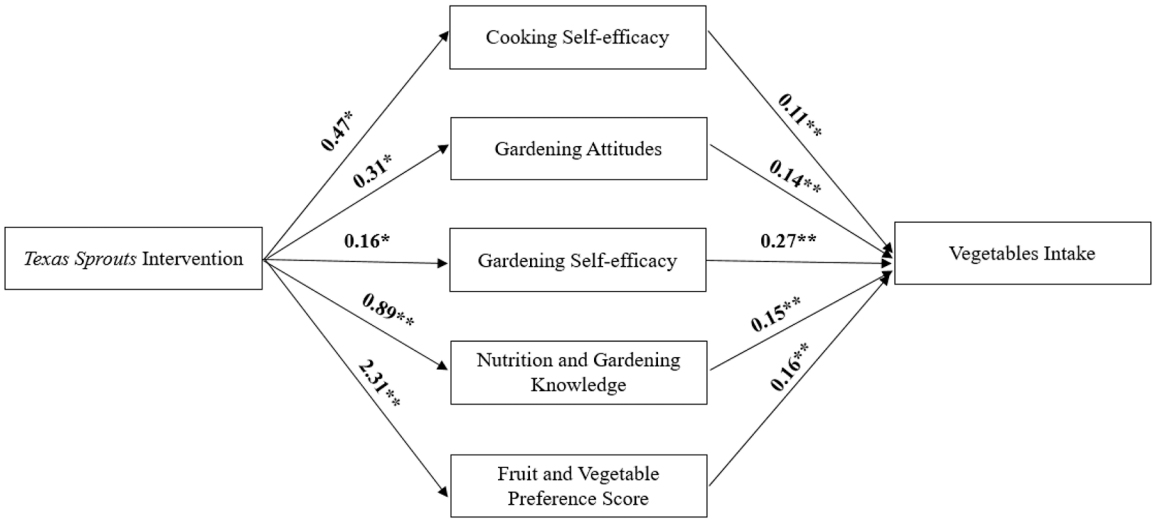

Figure 2.

Path analysis – Gardening attitudes, cooking and gardening self-efficacy, nutrition and gardening knowledge, and preferences for fruit and vegetables mediated the relationship between the *Texas sprouts* intervention and vegetable intake in 2,414 3rd-5th grade students

[a] Values shown are unstandardized regression coefficients

*p < 0.01, **p < 0.001.

Table 1.

Baseline demographic and dietary characteristics of students enrolled in participating schools and the analytic sample participating in the *Texas Sprouts* intervention.

	Students enrolled in participating schools[a]	Analytic sample[b]		Control (8 schools)	Intervention (8 schools)	
	n=4,239	n=2,414	p-value[c]	n=1,324	n=1,090	p-value[d]
Age (y)	----	9.3 (0.07)	----	9.2 (0.06)	9.3 (0.07)	0.35
Male (%) (SE)	51.4	46.8 (3.88)	0.77	48.0 (3.67)	45.3 (4.08)	0.23
Race/ethnicity % (SE)						
White	16.0	20.4 (2.75)	0.71	19.9 (2.73)	20.9 (2.76)	0.67
Black	9.7	9.1 (2.22)	0.63	9.0 (2.20)	9.2 (2.23)	0.76
Hispanic	69.9	65.3 (3.46)	0.76	66.1 (3.45)	64.4 (3.46)	0.78
Nat.Amer/Asian/Pac.Island/Other[e]	4.4	5.2 (1.72)	0.51	5.0 (1.65)	5.5 (1.79)	0.77
Eligible FRL[f]% (SE)	77.4	68.1 (3.55)	0.75	69.4 (3.41)	66.5 (3.69)	0.62
Vegetable intake (freq./day)	----	2.9 (0.08)	----	3.0 (0.09)	2.8 (0.09)	0.15

[a] Demographic data were obtained from Texas Education Agency (TEA) for all 3rd-5th grade students enrolled in the 16 schools at the time of the study. SE values not available.

[b] Demographic data were obtained from all participants in the analytic sample (those with complete baseline and post-intervention demographic, dietary psychosocial and intake data).

[c] Independent t-tests and chi-square tests were run to assess differences in demographic variables between all students enrolled in the schools and those in the analytic sample.

[d] Independent t-tests and chi-square tests were run to assess differences in demographic variables between the control and intervention participants in the analytic sample.

[e] Nat. Amer Native American; Pac Island Pacific Islander

[f] FRL free and reduced school lunch.

Table 2

Effects of the *Texas Sprouts* intervention compared to control on psychosocial outcomes and dietary intake in 2,414 3rd–5th grade students

Outcomes	Baseline ICCs	Control (n=8 school) (n = 1,324 students)		Intervention (n=8 schools) (n = 1,090 students)		Intervention Effect[b]		
		Pre	Change	Pre	Change	B (SE)	95% CI	*p* [c]
Cooking attitudes	0.006	4.14 (0.05)	0.13 (0.05) **	4.27 (0.05)	0.10 (0.06)	−0.04 (0.08)	−0.19, 0.12	0.65
Gardening attitudes	0.007	5.99 (0.1)	−0.07 (0.08)	5.92 (0.1)	0.24 (0.09) **	0.30 (0.12)	0.08, 0.53	**0.009**
Cooking self-efficacy	0.009	10.62 (0.15)	0.51 (0.11) **	11.13 (0.15)	0.92 (0.12) **	0.41 (0.16)	0.09, 0.72	**0.011**
Gardening self-efficacy	0.003	2.15 (0.04)	0.0 (0.03)	2.15 (0.04)	0.14 (0.04) **	0.15 (0.05)	0.05, 0.24	**0.004**
Self-efficacy to eat FV[a]	0.014	8.74 (0.13)	0.13 (0.08)	8.87 (0.13)	0.22 (0.09) **	0.09 (0.12)	−0.15, 0.34	0.452
Nutrition and gardening knowledge	0.037	2.37 (0.13)	0.43 (0.04) **	2.8 (0.13)	1.37 (0.05) **	0.94 (0.06)	0.81, 1.06	**<0.001**
Preferences for FV[a]	0.010	17.36 (0.36)	1.14 (0.17) **	18.5 (0.36)	3.34 (0.19) **	2.20 (0.25)	1.71, 2.69	**<0.001**

[a] FV: Fruit and vegetables

[b] Mixed effects models, adjusting for repeated measures and a school level random effect, were used to assess differences between the intervention and control groups

[c] p values<0.05 are bolded.

* $p < 0.01$,

** $p < 0.001$.

Table 3

The mediation effect of dietary psychosocial factors on the link between the *Texas Sprouts* intervention and improved vegetables intake in 2,414 3rd-5th grade students

	Effect of X on M (a)	Effect of M on Y (b)	Indirect effect of X on Y (ab)		
Mediator	**B (SE)**	**B (SE)**	**B (SE)**	**95% CI**	
Gardening attitudes	0.309 (0.119) *	0.142 (0.033) **	0.044 (0.020)	0.012	0.094
Cooking self-efficacy	0.466 (0.165) *	0.110 (0.025) **	0.052 (0.022)	0.017	0.108
Gardening self-efficacy	0.161 (0.052) *	0.267 (0.074) **	0.043 (0.019)	0.013	0.091
Nutrition and gardening knowledge	0.887 (0.064) **	0.145 (0.060) **	0.129 (0.057)	0.019	0.241
Preferences for fruit and vegetables	2.310 (0.255) **	0.164 (0.015) **	0.380 (0.062)	0.267	0.507

[a] X= *Texas Sprouts* intervention, M = Mediator (psychosocial dietary behaviors), Y = Child vegetable intake.

* p < 0.01,

** p < 0.001.

The total direct effect of the intervention on child vegetable intake (c path) was b = 0.29, SE = 0.13,95%CI = 0.03–0.55, p<0.029. When controlling for the mediators, the direct effect of the intervention on child vegetable intake (c' path) was b = 0.49, SE = 0.03, 95%CI = 0.43–0.54, p <0.001. All coefficients reported for paths a, b, and ab are unstandardized slopes with the corresponding standard error of the slope in parentheses.