

Narrative Review of Culinary Interventions with Children in Schools to Promote Healthy Eating: Directions for Future Research and Practice

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Abstract

Policymakers, scientists, and food and nutrition practitioners suggest that there is a societal decline in culinary skills, which is predictive of poor dietary habits contributing to childhood obesity. A narrative review was conducted to critically evaluate culinary skill interventions for children ages 5–12 y in schools to identify specific programs and programmatic factors associated with improvement in the quality of diet, body mass index (BMI), and positive changes in psychosocial variables. The culinary interventions were implemented in urban and rural areas in the United States, Australia, and England. PubMed and Medline, the Cochrane database, and a hand-search of publications identified 131 articles; 6 articles were selected for further examination on the basis of the inclusion criteria. Study designs included 1 randomized controlled trial and 5 quasi-experimental studies. Three interventions were grounded in behavioral theory, of which 2 incorporated the Social Cognitive Theory framework. The target population and setting included children and early adolescents in schools. The study methodology primarily included cooking classes combined with nutrition education lessons, parent and community components, gardening classes, tasting sessions, school lunchroom components, trips to a farmers market, or visits to a restaurant. Qualitative evaluations of the programs indicated positive findings in terms of program appeal and improvement in cooking skills and healthy eating. Quantitative analysis indicated improvement in food preferences, cooking skills, cooking self-efficacy, cooking behavioral intentions, food-preparation frequency, knowledge, healthy dietary intake, BMI, and blood pressure. The findings from this review support a positive relation between culinary interventions with children in schools and improvement in cooking skills, consumption of a healthy diet, and positive changes in anthropometric assessments. This review also suggests that integration with the academic curriculum and school lunch program may be potential avenues to explore for improving the longevity and success of the cooking programs. Further research should emphasize rigorous methodologic standards, develop theory-based standardized frameworks, and evaluate long-term effects of culinary interventions. *Curr Dev Nutr* 2018;2:nzy016.

Introduction

The persistence of the most severe forms of obesity and relatively high rates of childhood obesity suggest that more effective and comprehensive prevention efforts are needed (1, 2). According to NHANES 2011–2012, 32% of the children in the United States aged 2–19 y are overweight and 17% are obese (1, 3). Eating habits for Americans generally fall short of national nutritional recommendations for adults and children (3). Research indicates that a combination of insufficient vegetable and fruit intake, increased frequency of away-from-home meals, poor food-preparation skills, and increased portion size are related to the increase in obesity and related chronic diseases (4).

Common barriers to preparing food at home are perceived time constraints (5) and lack of cooking skills (6). Adults often turn to convenience foods and away-from-home foods (7).



Keywords: cooking programs, children, schools, healthy foods, adolescents, nutrition education

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In addition, parental work hours and child extracurricular activities hinder parents' efforts to prepare home-cooked meals and to involve children in food shopping and preparation, thus leading to a lack of transfer of essential food planning and preparation skills from one generation to the next (8–11). In 2000, 41% of Americans reported eating ≥ 3 commercially prepared meals/wk due to the lack of cooking skills and perceived time constraints (12).

The societal decline in culinary skills has been raised as an important issue by policymakers, scientists, and food and nutrition practitioners (4, 13). The 2010 Dietary Guidelines for Americans support the Task Force on Childhood Obesity's call to "empower individuals and families with improved nutrition literacy, gardening, and cooking skills to heighten [their] enjoyment of preparing and consuming healthy foods" (14). Lichtenstein and Ludwig (8) recently called for school systems in the United States to introduce a mandatory home economics curriculum to provide students with basic meal-planning and food-preparation skills. Similar initiatives are also being promoted in other countries, such as Iceland, where food skills are taught as compulsory modules in schools starting at 6 y of age (14, 15).

Although the US government has supported cooking and gardening programs for many decades, there is a lack of rigorous evaluations for such programs. The published literature in peer-reviewed journals on cooking interventions with children and families dates back to 1998. Varied approaches targeting children, adolescents, and adults have been used. However, to our knowledge, to date, there has not been a critical evaluation of the existing literature to assess the effects of these interventions on diet quality, the potential for the interventions to affect changes in weight status, and changes in attitudes toward healthy eating. Moreover, a systematic review of the available literature has not been conducted to identify impactful practices to guide future culinary interventions in schools with children. Hence, we conducted a narrative review of cooking interventions with children in schools to address these gaps in the literature. There is a general consensus that to enhance the effectiveness of dietary behavior interventions, theoretical frameworks should be applied to the development and application of the interventions (2, 16–18). Behavior change interventions are more effective if theoretically grounded. Thus, we framed the analysis to determine whether the interventions were grounded in a clearly identified behavioral theory as well as focusing on the key outcomes of interest (dietary changes, changes in weight status, and changes in attitudes toward healthy eating).

We aimed to conduct a narrative review to enable synthesis of the literature evaluating culinary skills interventions for children and adolescents in the school settings and to identify specific program attributes associated with improvements in diet quality, BMI, and psychosocial variables proposed to be associated with the eating behaviors. On the basis of a literature review, 4 program attributes, including multicomponent interventions, interventions with a theoretical foundation, interventions with a parental component, and interventions integrated within an academic curriculum, were of interest to the authors. The results of the review primarily indicate the gaps in the literature and are intended to guide the development of more-effective culinary skills interventions in schools. A systematic review of culinary interventions with children in school, community, and home settings was published in November 2014, which focused on the influence of cooking programs on children's food-related preferences, attitudes, and behaviors

(19). Our review will extend the body of literature of culinary interventions by identifying program attributes that are associated with the success of cooking programs with children and also examine the influence of culinary programs on diet quality and weight status. Moreover, our review focuses on cooking programs only in schools and identifies program attributes that are associated with the effectiveness of culinary programs with children in schools. The Institute of Medicine recommends that systematic reviews should be organized around Populations, Interventions, Comparators, and Outcomes (PICO) (20). Our narrative review was guided by an overarching hypothesis and 3 research questions grounded in PICO.

Our hypothesis was that cooking skills interventions implemented in school settings will result in positive dietary changes, reduce BMI and the percentage of participants classified as overweight or obese, and result in positive changes in psychosocial variables associated with healthy eating (self-efficacy, behavioral intentions, attitudes).

The 3 questions addressed were as follows:

1. Do intervention programs aimed at improving cooking skills improve quality of diet/healthy eating practices in children and adolescents?
2. Do intervention programs aimed at improving cooking skills improve BMI/weight status of children and adolescents?
3. Do intervention programs aimed at improving cooking skills promote positive changes in psychosocial variables proposed to be theoretically related to changes in eating behaviors in children and adolescents?

Methods

Literature search

This narrative review was conducted on the basis of the guidelines presented by the CDC-sponsored Laboratory Medicine Best Practices Initiative and the Institute of Medicine of the National Academies standards (21–23). PubMed/Medline (<https://www.ncbi.nlm.nih.gov/pubmed/>) and Cochrane databases (<http://www.cochranelibrary.com/>) were searched for relevant studies published between 1998 and 2013. A thorough hand-search (a search of the reference lists in the articles identified) was also conducted to identify any studies not identified in the 2 databases mentioned previously. The keywords used for literature search included "cooking," "culinary skills" crossed with "quality of diet," "healthy eating practices," "feeding styles," "fruits," "vegetables," "whole grains," "family mealtime intervention," "cohort," "randomized controlled trial," "psychosocial variables," "self-efficacy," "attitude," "outcome expectations," "knowledge," "families," "children," "preschoolers," "adolescents," "tweens," "teenagers," and "culinary interventions." We identified a total of 130 articles from the 3 search strategies used: 46 articles from PubMed, 51 articles from Cochrane, and 33 articles from the hand-search.

Inclusion and exclusion criteria

The inclusion criteria for this narrative review included the following: studies designed to teach "hands-on" culinary skills either as a stand-alone program or as part of a comprehensive intervention, the cooking classes were conducted in the school setting, the populations were

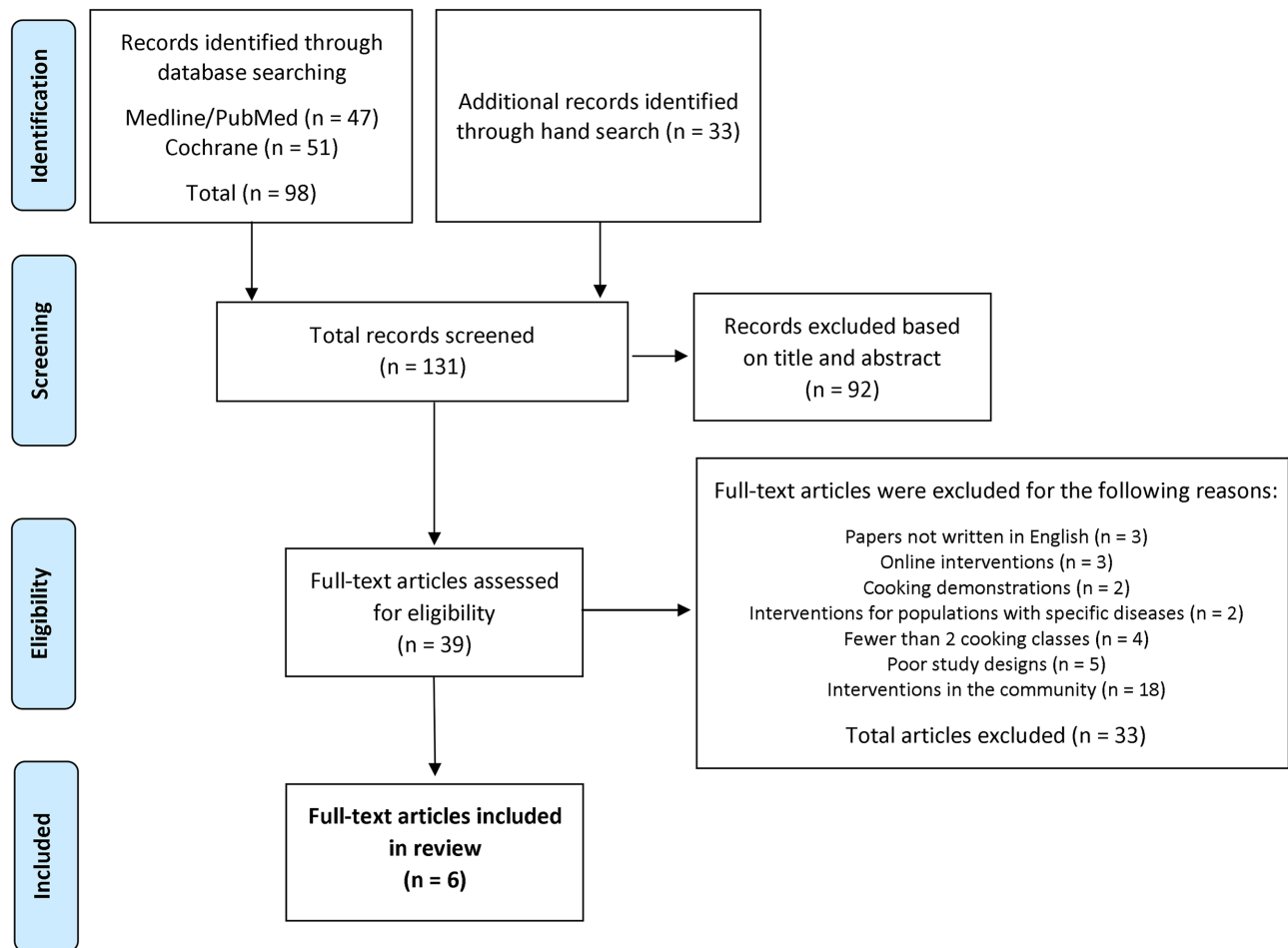


FIGURE 1 PRISMA flow diagram. PRISMA, Preferred Reporting Items for Systematic Review and Meta-Analysis.

children and adolescents with or without parental involvement, the interventions were conducted with a healthy population, the interventions were randomized controlled trials (RCTs) or quasi-experimental trials, the study participants provided either quantitative or qualitative data, and the programs were evaluated by the program staff. Variables of interest included diet-related behaviors such as increases in fruit and vegetable consumption, increased frequency of cooking, etc., and changes in anthropometric and psychosocial variables. Studies were excluded if the program was a demonstration program only and did not allow hands-on experience, if the intervention focused on specific diseases such as diabetes, and if <2 cooking classes were used as part of the intervention. (See [Figure 1](#) for inclusion and exclusion procedures.)

Data extraction

A codebook was developed on the basis of the guidelines presented by the Laboratory Medicine Best Practices and the Institute of Medicine of the National Academies of Science (21–23). The codebook contained details about necessary information to extract and score criteria for study quality (range for quality points: 1–10). One point each was given for clearly defined aims and objectives, having a control group, being a multicomponent study, grounded in theoretical framework, using methods that clearly assess the key outcome, using a valid or

well-established instrument, evaluating at 2 time points, having the main results detailed in the article, presenting significant results, and discussing the limitations. Although the quality point criteria were drawn from the Laboratory Medicine Best Practices and the Institute of Medicine of the National Academies of Science, our codebook criteria also appear in the PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analysis) guidelines, because these 2 sets of guidelines for conducting systematic reviews have significant overlap (24). Studies were classified as good (8–10 total quality points), fair (5–7 total quality points), or poor (≤ 4 total quality points) on the basis of the score for each study. The codebook also provided guidance for determining qualitative effect sizes for each study, which were then classified as substantial, moderate, or minimal (21). A “substantial” rating was given to a study if the results were large enough to clearly support practice and implementation; “moderate” if the results were large enough to support practice and implementation; and “minimal” if the results were of no practical consequence (21). Programs receiving a substantial rating should be identified as best practices for implementation in appropriate settings (21). Two independent researchers (HM and JJM) coded each article and the third author (BF) helped to resolve any disagreements. An average of 91% agreement was achieved, ranging from 75% to 100% agreement for the individual studies.

Due to the nascency of research in the area of culinary skills programs, there were insufficient RCTs published to limit the review to RCTs only. Thus, we also included quasi-experimental studies. Studies conducted outside the United States, in Australia and Europe, were also included. All of the studies were written in English and published in peer-reviewed journals.

Results

A total of 6 studies were included in the final review: 1 RCT and 5 quasi-experimental studies (Table 1) (25–30). Due to the small number of identified studies and lack of RCTs, a narrative review instead of a systematic review was conducted. Half of the studies were grounded in a behavioral theory (3 of 6, or 50%), 2 grounded in Social Cognitive Theory (25, 27), and 1 grounded in Social Ecological Theory (28). The number of sessions for the culinary intervention ranged from 3 to 36 sessions for the 6 studies. All 6 programs were multicomponent; “cooking classes” was the main focus for the studies, supplemented with gardening classes (26, 28), tasting sessions (27, 30), nutrition education (25, 26), parental involvement (25, 26, 28), school lunch (25), trips to a farmers market (26), or a visit to a restaurant (29). The study subjects for all 6 programs ranged from children in kindergarten through sixth grade.

Studies were rated for their overall quality; all 6 studies received a good rating, with scores ranging from 8 to 10. The program described by Gibbs et al. (29) was the only study that received a score of 10 for study rating. This program was a quasi-experimental study, had parental involvement, the longest duration of 36 sessions, 3 components (cooking class, gardening class, and parental involvement), and was grounded in Social Ecological Theory (28). Qualitative effect size was also determined for each of the studies; all 6 were considered of substantial quality, indicating that the study results were large enough to clearly support practice and implementation. Quantitative effect sizes were determined for 3 studies. However, these results were inconclusive due to the variability in the outcome measures used or reported by the different studies. Program details are presented in Table 1, and the evaluation results are detailed in Table 2.

The Cookshop Program is a quasi-experimental, pre-/postintervention-comparison group design program, for grades kindergarten through sixth-grade elementary school children (25). The primary objective of the program is to increase children’s consumption of minimally processed whole grains and vegetables. The secondary goals are to enhance children’s preferences for, and attitudes toward, self-efficacy and knowledge about these foods. Although participants were not randomly assigned to conditions in this program, classrooms in each condition were carefully matched to ensure that key factors such as teacher interest in nutrition and children’s reading level did not differ systematically between conditions. The authors did not report the drop-out rate in this study or use intention-to-treat analyses, but only participants who completed both the pre- and postintervention survey were included in analyses. Although implementation fidelity was not measured as part of this study, a Cookshop staff member conducted ongoing monitoring of classes to ensure that implementation procedures were consistent across classrooms. The Cookshop Program was indeed able to improve the intake of targeted foods. The program also led to significant improvements in knowledge, cooking

self-efficacy, behavioral intentions for cooking and eating plant foods, and preferences for cooking and eating healthy foods. However, the program did not affect the attitudes of the study participants.

LA Sprouts is a quasi-experimental pre-/postintervention-control group program for fourth- and fifth-grade students (26). The objective of the study was to test the effects of a 12-wk after-school gardening, nutrition, and cooking program on dietary intake and obesity risk in Latino children. Participants in the control and intervention conditions did not differ significantly in socioeconomic status, ethnicity, or anthropometric measures, but there were more male participants in the control group (67%) than in the intervention group (39%). Participants were not randomly assigned to conditions; instead, students who participated in the LA’s BEST after school program served as the intervention group, whereas students (from the same school) who did not participate in the afterschool program served as the control group. The LA Sprouts participants improved dietary intake (by increasing dietary fiber) and reduced blood pressure. The program also reduced BMI and the rate of weight gain in overweight Latino children.

Cooking with Kids (CWK) was implemented as a quasi-experimental intervention-comparison-group program for fourth-grade students (27). The main objective of this study was to obtain an in-depth understanding of the classroom cooking experience from the child’s and adult participant’s perspectives in comparison to their cooking experiences at home. The focus groups were conducted by an external research team who were not involved in the implementation of the program, and moderators were randomly assigned across all conditions. The results indicated that participants received the integration of CWK into school curriculum topics, cooking at home with family and classmates in school, and nonfood experiences positively. CWK’s strongest effect was in helping students learn school subjects and in developing future cooking skills and positive cooking attitudes, but not on changing the family and home cooking environment.

In a study reported by Cunningham-Sabo and Lohse (28), CWK was implemented as an RCT in a mostly non-Hispanic white sample of 257 fourth-grade children. CWK was initially implemented in low-income, predominantly Hispanic schools in a southwestern US city and has shown modest improvements in fruit and vegetable preference, food and cooking attitudes, and cooking self-efficacy among fourth-grade students (27). The objective of this study was to assess fruit preference, vegetable preference, cooking attitude, and cooking self-efficacy with the use of a tested 35-item questionnaire administered before and after CWK program implementation. The CWK questionnaire has been proven to be valid and reliable when used with children ages 9–11 y (31). Participants in the control and intervention groups were similar at baseline in sex and ethnicity, but intervention participants reported cooking more (85% compared with 73%) and making food with family more (91% compared with 82%) than participants in the control group. The results of this study indicate significant improvements in vegetable preferences, cooking and food preparation attitudes, and self-efficacy. Fruit preferences improved, but the change was not significant. These results suggest that the CWK curriculum is generalizable to a varied audience. Compared with the CWK implemented by Lukas and Cunningham-Sabo in 2011 (27), the study population (non-Hispanic compared with Hispanic) and evaluation measures (quantitative compared with qualitative) were different in this study.

TABLE 1 Interventions in schools¹

Study (ref), year; study rating; qualitative effect size	Design; theory; location	Study participants; socioeconomic status	Methods	Evaluation measure	Results
Liquori et al. (25), 1998; good; substantial	Quasi-experiment; social cognitive theory; New York, NY	590 kindergarten–sixth-grade children; urban; low-income schools	<ul style="list-style-type: none"> • 10 Sessions • Hands-on cooking classes and food and environment lessons took place in the classroom • Program included school lunch program, classroom cooking component, and parent (newsletters, workshops and assistance with parent school communications) and community components 	<ul style="list-style-type: none"> • Pencil-and-paper questionnaire assessing preferences for plant foods, attitudes, knowledge, self-efficacy, and behavioral intentions • Plate waste by visual estimate to measure the intake of whole grains and vegetables 	<ul style="list-style-type: none"> + Increased knowledge + Increased cooking self-efficacy + Increased behavioral intentions for cooking and eating plant foods + Increased preferences for cooking and healthy food + Improved intake of vegetables and minimally processed whole grains – No significant impact on attitudes toward cooking
Davis et al. (26), 2011; good; substantial	Quasi-experiment; no theory mentioned; Los Angeles, CA	104 students in fourth and fifth grades (34 in intervention group and 70 in control group); urban; low-income, primarily Latino, children	<ul style="list-style-type: none"> • Weekly 90-min lessons for 12 wk • After-school program at a community garden, hands-on cooking and gardening classes, monthly visits to farmers markets • Three 60-min nutrition and gardening classes for parents • Cooking and nutrition classes taught by RD and trained staff 	<ul style="list-style-type: none"> • Pre- and postintervention assessment of demographic characteristics, anthropometric measures, body composition, blood pressure, and dietary intake (Block Food Screeners Questionnaire) 	<ul style="list-style-type: none"> + Increased fiber intake – No significant impact on intake of energy (kcal) and individual foods + Decreased diastolic blood pressure + Decreased weight and BMI among obese/overweight participants
Lukas and Cunningham-Sabo (27), 2011; good; substantial	Quasi-experiment; social cognitive theory; Santa Fe, NM	178 students in fourth grade, 17 teachers, 5 food educators; lower-income public elementary schools	<ul style="list-style-type: none"> • Five 2-h cooking sessions and five 1-h tasting sessions • 32 classrooms assigned to 1 of 3 conditions: cooking + tasting intervention, tasting-only intervention, or comparison condition 	<ul style="list-style-type: none"> • Qualitative evaluation: focus group evaluation of the students', teachers', and food educators' perceptions 	<ul style="list-style-type: none"> + Participants received cooking at home with family, cooking with classmates, integrating CWK into curriculum topics, and nonprogram food experiences positively + CWK's strongest effect was in helping students learn school subjects and in developing future cooking skills and attitudes, but not on changing the family and home cooking environment + Students in the cooking + tasting schools were less averse to cooking-related chores at home and did not distinguish between classmates and friends in schools and had the strongest perceptions of the integration of CWK curriculum with the academic curriculum

(Continued)

TABLE 1 *Continued*

Study (ref), year; study rating; qualitative effect size	Design; theory; location	Study participants; socioeconomic status	Methods	Evaluation measure	Results
Cunningham-Sabo and Lohse (28), 2013; good; substantial	Randomized controlled trial; no theory mentioned; Fort Collins, CO	257 students in fourth grade; mixed socioeconomic status (18–28% participants qualified for free/reduced meals at school)	<ul style="list-style-type: none"> • CWK took place over 10 wk, 3 (2-h) cooking sessions and 3 (1-h) tasting sessions • Sessions took place in school classrooms 	<ul style="list-style-type: none"> • A 35-item measure shown to have test-retest reliability was administered before and after the 10-wk intervention to assess the effect of CWK on students' fruit and vegetable preference and cooking attitude and self-efficacy 	<ul style="list-style-type: none"> + Significant increase in preference for fruit and vegetables + Significant increase in cooking attitude and self-efficacy
Gibbs et al. (29), 2013; good; substantial	Quasi-experiment; social ecological theory; Victoria, Australia	764 children in grades 3–6, 562 parents; rural and metropolitan schools; mixed socioeconomic status	<ul style="list-style-type: none"> • 45- to 60-min gardening class and 90-min cooking class each week of the school year • Parents, volunteers, and teachers helped run sessions 	<ul style="list-style-type: none"> • Mixed methods • Separate focus group discussions with children, teachers, parents, and volunteers • Class observations to describe children's attitudes and behaviors • Parent and child questionnaires to assess willingness to try new foods 	<ul style="list-style-type: none"> + Increased willingness to try new foods + Children reported that they were making healthier choices and consuming more fruit and vegetables + Increased preference for organic produce over supermarket produce – No significant impact on children's ability to describe foods
Caraher et al. (30), 2013; good; substantial	Quasi-experiment; no theory mentioned; England	169 children, ages 9–11 y; urban and rural schools; mixed socioeconomic status	<ul style="list-style-type: none"> • 3 sessions occurred throughout school year with chefs going into schools • Sessions covered healthy eating and flavors, practical food preparation, and visit to a restaurant 	<ul style="list-style-type: none"> • A pilot-tested questionnaire was administered 2 wk before the intervention and 2 wk afterward to measure changes in food preparation and consumption as well as measuring cooking confidence 	<ul style="list-style-type: none"> + Significant increase in cooking confidence and asking confidence for healthy foods + Significant increase in vegetable consumption

¹CWK, Cooking with Kids; RD, registered dietitian; ref, reference; +, positive result –, negative result.

The Stephanie Alexander Kitchen Garden Program was implemented as a quasi-experimental pre/post comparison study in children in grades 3–6 (29). The primary objective of the program was to promote children's appreciation of a diverse range of foods, as indicated by an increased willingness to try new foods, and also improve children's capacity to describe foods. Intervention schools were selected to be diverse in geographic location (urban compared with rural), school size, and socioeconomic status; and control group schools were individually matched with intervention schools based on the same criteria. The program did not have a significant impact on children's ability to describe foods. Study results indicated a significant improvement in willingness to try new foods and preferences for organic produce over supermarket produce. Children reported that they were consuming more fruit and vegetables and making healthier choices after participation in the program.

Chefs Adopt a School Scheme is a United Kingdom–based program on food, health, nutrition, and cookery (30). The main objective of the program was to teach children about food, food provenance, healthy eating, and food preparation. This program is similar to the Cook-

ing Matters program in the United States, but the latter has not been evaluated in schools. Due to significant differences in survey scores between the control and interventions groups at baseline, the authors chose to only evaluate pre- to postintervention changes in the intervention group, instead of comparing these changes with those experienced by participants in the control group. The results showed a significant increase in reported overall vegetable consumption, cooking confidence, and asking confidence for healthy foods in the intervention group.

Discussion

For the past 3 decades, the use of culinary interventions has been promoted in the United States to reduce the consumption of away-from-home meals, to improve the health of families, and to reduce risks associated with childhood obesity (32). However, due to the small number of studies included in this review, varied study designs, lack of RCTs, and lack of valid and reliable outcome measures, conclusive findings are not possible at this time. Thus, instead of a systematic review, we conducted

TABLE 2 Program evaluation results¹

Study (ref), year	Study title	Study quality rating (0–10; good, 8–10; fair, 5–7; poor, ≤ 4)	Qualitative effect size (minimal, moderate, or substantial)	Quantitative effect size
Liquori et al. (25), 1998	The Cookshop Program: Outcome evaluations of a nutrition education program linking lunchroom food experiences with classroom cooking experiences	9 points (good); 1 point deducted as the validity of the evaluation measures is not mentioned in the study	Substantial	Data not provided
Davis et al. (26), 2011	LA Sprouts: a gardening, nutrition, and cooking intervention for Latino youth improves diet and reduces obesity	8 points (good); 2 points deducted: 1 because no theoretical framework was used for this study and 1 for not establishing validity of the outcome measures	Substantial	Meat, dairy, vegetables, fruit, and whole grains (separate for control and treatment groups)
Lukas and Cunningham-Sabo (27), 2011	Qualitative investigation of the CWK program: focus group interviews with fourth-grade students, teachers, and food educators	9 points (good); 1 point deducted as the evaluation of study participants was only done at 1 time point (postintervention)	Substantial	Data not provided
Cunningham-Sabo and Lohse (28), 2013	CWK positively affects fourth-graders' vegetable preferences and attitudes and self-efficacy for food and cooking	9 points (good); 1 point deducted because no theoretical framework is mentioned in the study	Substantial	Fruit preferences, vegetable preferences, attitude toward cooking, and food and cooking self-efficacy
Gibbs et al. (29), 2013	Expanding children's food experiences: the impact of a school-based kitchen garden program.	10 points (good)	Substantial	Data not provided
Caraher et al. (30), 2013	When chefs adopt a school? An evaluation of a cooking intervention in English primary schools	9 points (good); 1 point deducted because the intervention was not grounded in a theoretical framework	Substantial	Cooking confidence; vegetable consumption

¹CWK, Cooking with Kids; ref, reference.

a narrative review synthesizing the results from 6 studies, which suggest potentially positive dietary and eating behavior outcomes. The 6 studies reviewed here were successful in meeting their objectives, which fall into the 3 categories of improving quality of diet/healthy eating practices (25, 26, 28, 29), improving BMI/weight status (26), or promoting positive changes in psychosocial variables proposed to be theoretically related to changes in eating behaviors in children and adolescents (27–30). Here we provide a brief summary of the findings with recommendations for future program development and research.

The Cookshop Program, LA Sprouts program, Stephanie Alexander Kitchen Garden Program, and Chefs Adopt a School Scheme improved quality of diet and healthy eating practices of the participants (25, 26, 28, 29). These programs improved intake of vegetables and minimally processed whole grains (25), increased fiber intake (26), increased intake of healthier foods and specifically more fruit and vegetables (28), and significantly increased vegetable consumption, respectively (29). The LA Sprouts program was the only program in our review to affect BMI/weight status of children (26). The participants showed a significant reduction in diastolic blood pressure and reduced weight and BMI among obese or overweight participants (26). All of the programs except for the LA Sprouts program promoted positive changes in psychosocial variables related to changes in eating behavior. The programs were successful in improving knowledge, cooking self-efficacy, behavioral intention for cooking and eating plant foods, and preferences for cooking and healthy eating (25); developing future cooking skills and positive cooking attitudes (27); increased willingness to try new foods and pref-

erence for self-grown organic produce over supermarket produce (29); significantly increasing cooking confidence and asking confidence for healthy foods (30); and significantly increasing preference for fruit and vegetables and cooking attitude and self-efficacy (28).

The 6 studies included in this review did not consistently address issues of potential bias (e.g., drop-out rates, baseline comparisons, blinding), and as a result, we were not able to systematically assess potential study bias in this article. None of the 6 studies used intention-to-treat analyses or mentioned blinding of participants, teachers, or evaluators. Two studies included power analyses (29, 30) and only 1 specified drop-out rates by condition (28). Two studies explicitly addressed fidelity, one by having research staff monitor program implementation (25) and another by delivering all lessons through a trained food educator focused on ensuring curricular fidelity (28). Three studies explicitly assessed participants for significant differences at baseline before the intervention took place (25, 28, 30), and matching techniques were also used in attempts to reduce baseline differences between the treatment groups in some programs (25, 28–30).

There have been numerous calls for the introduction of home economics in schools to address chronic diseases by encouraging the choice of healthy options, more fruit and vegetable consumption, and the use of healthy cooking options (33). A review by Seeley et al. (34) suggests that practical cooking sessions were found to have a greater impact on the cooking confidence of older primary school children. The interventions included in this review, except for the Cookshop Program, were implemented with children in the third grade and higher. The interventions

yielded positive findings in terms of improved food preference and intake, increased cooking self-efficacy and skills, and improvement in anthropometric and psychosocial indicators. Researchers have identified schools as a primary setting to target children and adolescents, because schools offer regular contact with the children for a substantial part of the day (19, 35). The study ratings and qualitative effect sizes of the interventions in schools that were included in this review received a good rating and were in the substantial category (25–30). In addition, schools provide the added value of an existing infrastructure, which can often support cooking demonstrations, such as adequate kitchen space and room for large groups. The interventions in schools also allow the integration of school lunch program with classroom nutrition education, which may have led to the success of the Cookshop Program (25). The results of the CWK program suggest that integration into academic curriculum topics and providing hands-on learning may be the effective components of a successful program and support justification of nutrition education's continued place in the school curriculum (27, 30).

Culinary interventions have been implemented as either stand-alone cooking interventions or included cooking as part of a multimodal intervention. Such interventions have included gardening classes, tasting sessions, grocery shopping, trips to a farmers market, visits to a restaurant, and nutrition education sessions in addition to a cooking component. The interventions included in our review are all multicomponent. Multicomponent interventions tend to have enhanced outcomes as opposed to interventions that focus on a single component (2, 34–36). Two interventions (LA Sprouts and Stephanie Alexander Kitchen Garden Program) incorporated gardening classes in the intervention, which led to increased fruit and vegetable preference and intake (26, 28). The current literature also suggests that school gardens either alone or in conjunction with other components may be beneficial for improving fruit and vegetable preferences and intake (35–38). Some interventions in our review included tasting sessions in the intervention, which also led to an increase in the preference and consumption of new foods, fruit, and vegetables, as indicated by the evaluation measures and the parental reports (27, 30). Research suggests that taste exposure is needed to improve taste preferences and visual exposure leads to improvement in visual preference (39). An intervention in our review included grocery shopping/trips to the farmers market, which also helped to improve fruit and vegetable availability in the home, improved preference and consumption of produce, and increased the intake of fiber (26). Linking culinary interventions with meal planning, shopping, and budgeting may allow families to incorporate cooking as part of their overall household routines, which, in turn, reinforces healthy habits (40, 41). Thus, our body of literature suggests that cooking interventions can be more beneficial when combined with any of the above-mentioned components based on their study objectives.

Research has supported the importance of parental support of nutrition knowledge and skills for improving children's and adolescents' food consumption, because they still consume 65% of their total energy intakes at home (35, 42, 43). This may be due to parents' influence on household food purchases and foods served at meals (42–45). However, our review results did not indicate higher ratings or effect sizes for interventions with parental involvement (25, 26, 29) compared with no parental involvement (27, 28, 30). This may be due to the small number of studies included in our review or due to the low amount of parental involvement in most programs (e.g., newsletters).

Limitations

We identify limitations in the studies as well as to our review. The most significant review limitation is the lack of RCTs; only 1 of the 6 interventions was an RCT (30). Thus, results should be interpreted with caution. Second, the programs were of a short duration and there was no long-term follow-up of participants. Consequently, the long-term effects on dietary habits are unknown. In addition, the majority of the programs used evaluation measures that relied on memory and self-report. Furthermore, 2 studies used focus-group evaluation, which could have led to participant recruitment bias, because people with more positive experiences may be more likely to participate. Last, all but 2 programs (27, 29) were not evaluated by independent evaluators, which could have biased study findings.

Our own review was limited in that we were not able to systematically calculate overall quantitative effect sizes for dietary habits, BMI, or psychosocial behaviors associated with nutrition, because different programs used different evaluation measures and measured different outcomes. Second, we were only able to identify 6 cooking programs in schools, because some programs implemented in schools are not evaluated. The review was limited by the time frame in which it was conducted and only included articles published from 1998 to 2013. It is possible that additional articles that met the review criteria have been published since 2013 (46). In order to have complete confidence in our findings, we would ideally want to have a bigger pool of studies with similar objectives that use similar evaluation measures.

Implications for research and practice

This narrative review preliminarily suggests that cooking interventions in schools, when implemented as part of a multicomponent program and designed as an RCT or quasi-experimental study, have the potential to facilitate healthy food consumption, increase frequency of home-cooked meals, and improve anthropometric and psychosocial indicators. However, these results should be interpreted with caution, because larger, longer cluster-randomized controlled trials are needed before any significant evidence-based conclusions can be made. In contrast to the evidence in the literature, the theoretically grounded interventions and interventions with parental involvement in our review did not lead to more robust findings than the studies without these 2 characteristics. However, 1 study in this review suggests that the strategies of integration within the academic curriculum and the school lunch program are worth exploring to improve the longevity and success of the cooking programs. Our review of literature suggests that culinary interventions have come a long way in the past decade. However, there is still need for more rigorous methodologies, including control groups, long-term follow-up, attention to potential mediators, and use of standardized and validated assessment methods (13, 16, 19, 34, 39).

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References

1. Skinner AC, Skelton JA. Prevalence and trends in obesity and severe obesity among children in the United States, 1999–2012. *JAMA Pediatr* 2014;168(6):561–6.
2. Flay BR. Positive youth development requires comprehensive health promotion programs. *Am J Health Behav* 2002;26(6):407–24.
3. Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of childhood and adult obesity in the United States, 2011–2012. *JAMA* 2014;311:806–14.
4. Condrasky MD, Hegler M. How culinary nutrition can save the health of a nation. *JOE* 2010;48(2) [cited 2013 Jan 21]. Available from: <http://www.joe.org/joe/2010april/comm1.php>.
5. Pelletier JE, Laska MN. Balancing healthy meals and busy lives: associations between work, school, and family responsibilities and perceived time constraints among young adults. *J Nutr Educ Behav* 2012;44:481–9.
6. Adams LB. An overview of adolescent eating behavior barriers to implementing dietary guidelines. *Ann N Y Acad Sci* 1997;817:36–48.
7. Bezerra IN, Curioni C, Sichieri R. Association between eating out of home and body weight. *Nut Rev* 2012;70:65–79.
8. Lichtenstein AH, Ludwig DS. Bring back home economics education. *JAMA* 2010;303:1857–8.
9. Fulkerson JA, Kubik MY, Rydell S, Boutelle KN, Garwick A, Story M, Neumark-Sztainer D, Dudovitz B. Focus groups with working parents of school-aged children: what's needed to improve family meals? *J Nutr Educ Behav* 2011;43:189–93.
10. Woodruff SJ, Kirby AR. The associations among family meal frequency, food preparation frequency, self-efficacy for cooking, and food preparation techniques in children and adolescents. *J Nutr Educ Behav* 2013;45:296–303.
11. Hartmann C, Dohle S, Siegrist M. Importance of cooking skills for balanced food choices. *Appetite* 2013;65:125–31.
12. Levy J, Auld G. Cooking classes outperform cooking demonstrations for college sophomores. *J Nutr Educ Behav* 2004;36:197.
13. Nelson SA, Corbin MA, Nickols-Richardson SM. A call for culinary skills education in childhood obesity-prevention interventions: current status and peer influences. *J Acad Nutr Diet* 2013;113:1031–6.
14. USDA; US Department of Health and Human Services. 2010 Dietary guidelines for Americans. Washington (DC): US Government Printing Office; 2010:1–112 [cited 2013 Mar 31]. Available from: <http://www.cnpp.usda.gov/Publications/DietaryGuidelines/2010/PolicyDoc/PolicyDoc.pdf>.
15. Stitt S. An international perspective on food and cooking skills in education. *Br Food J* 1996;98:27–32.
16. Cerin E, Barnett A, Baranowski T. Testing theories of dietary behavior change in youth using the mediating variable model with intervention programs. *J Nutr Educ Behav* 2009;41:309–18.
17. Baranowski T, Cullen KW, Nicklas T, Thompson D, Baranowski J. School-based obesity prevention: a blueprint for taming the epidemic. *Am J Health Behav* 2002;26(6):486–93.
18. Guillaumie L, Godin G, Vezina-Im LA. Psychosocial determinants of fruit and vegetable intake in adult population: a systematic review. *Int J Behav Nutr Phys Act* 2010;7:12–23.
19. Hersch D, Purdue L, Ambroz T. The impact of cooking classes on food related preferences, attitudes, and behaviors of school-aged children: a systematic review of the evidence, 2013–2014. *Prev Chronic Dis* 2014;11:E193.
20. Shaw BC, Mass D. Evidence to practice: building the evidence for quality improvement in laboratory medicine. *Clin Leadersh Manag Rev* 2012;26:16–20.
21. Christenson RH, Snyder SR, Shaw CS, Derzon JH, Black RS, Mass D, Epner P, Favoretto AM, Liebow EB. Laboratory medicine best practices: systematic evidence review and evaluation methods for quality improvement. *Clin Chem* 2011;57:816–25.
22. Heyer NJ, Derzon JH, Wings L, Shaw C, Mass D, Snyder SR, Epner P, Nichols JH, Gayken JA, Ernst D, et al. Effectiveness of practices to reduce blood sample hemolysis in EDs: a laboratory medicine best practices systematic review and meta-analysis. *Clin Biochem* 2012;45:1012–32.
23. Institute of Medicine. Finding what works in health care. Standards for Systematic Reviews; March, 2011. [cited 2014 Jan 20]. Available from: <http://www.iom.edu/Reports/2011/Finding-What-Works-in-Health-Care-Standards-for-Systematic-Reviews/Standards.aspx>.
24. Moher D, Liberati A, Tetzlaff J, Altman DG; Prisma Group. Preferred Reporting Items for Systematic Reviews and Meta-Analyses: the PRISMA statement. *PLoS Med* 2009;6(7):e1000097.
25. Liquori T, Koch PD, Contento IR, Castle J. The Cookshop Program: outcome evaluation of a nutrition education program linking lunchroom food experiences with classroom cooking experiences. *J Nutr Educ* 1998;30:302–13.
26. Davis JN, Ventura EE, Cook LT, Gyllenhammer LE, Gatto NM. LA Sprouts: a gardening, nutrition, and cooking intervention for Latino youth improves diet and reduces obesity. *J Am Diet Assoc* 2011;111:1224–30.
27. Lukas CV, Cunningham-Sabo L. Qualitative investigation of the Cooking with Kids program: focus group interviews with fourth-grade students, teachers, and food educators. *J Nutr Educ Behav* 2011;43:517–24.
28. Cunningham-Sabo L, Lohse B. Cooking with Kids positively affects fourth graders' vegetable preferences and attitudes and self-efficacy for food and cooking. *Child Obes* 2013;9:549–56.
29. Gibbs L, Staiger PK, Johnson B, Block K, Macfarlane S, Gold L, Kulas J, Townsend M, Long C, Ukoumunne O. Expanding children's food experiences: the impact of a school-based kitchen garden program. *J Nutr Educ Behav* 2013;45(2):137–46.
30. Caraher M, Seeley A, Wu M, Lloyd S. When chefs adopt a school? An evaluation of a cooking intervention in English primary schools. *Appetite* 2013;62:50–9.
31. Lohse B, Cunningham-Sabo L, Walters L, Stacey JE. Valid and reliable measures of cognitive behaviors toward fruits and vegetables for children aged 9 to 11 years. *J Nutr Educ Behav* 2011;43:42–9.
32. Shields AT. Examination of the obesity epidemic from a behavioral perspective. *Int J Behav Consult Ther* 2009;5(1):142–58.
33. Vileisis A. Kitchen literacy: how we lost knowledge of where food comes from and why we need to get it back. Washington (DC): Shearwater; 2008.
34. Seeley A, Wu M, Caraher M. Should we teach cooking in schools? A systematic review of the literature of school-based cooking interventions. *J Home Econ Inst Australia* 2010;17(1):10–9.
35. Meehan M, Yeh MC, Spark A. Impact of exposure to local food sources and food preparation skills on nutritional attitudes and food choices among urban minority youth. *J Hung Env Nutr* 2008;3:456–70.
36. Jaenke RL, Collins CE, Morgan PJ, Lubans DR, Saunders KL, Warren JM. The impact of a school garden and cooking program on boys' and girls' fruit and vegetable preferences, taste rating, and intake. *Health Educ Behav* 2012;39:131–41.
37. McAleese J, Rankin L. Garden-based nutrition education affects fruit and vegetable consumption in sixth-grade adolescents. *J Am Diet Assoc* 2007;107:662–5.
38. Parmer S, Salisbury-Glennon J, Shannon D, Struempfer B. School gardens: an experiential learning approach for a nutrition education program to increase fruit and vegetable knowledge, preference, and consumption among second-grade students. *J Nutr Educ Behav* 2009;41:212–7.
39. Condrasky MD, Williams JE, Catalano PM, Griffin SF. Development of psychosocial scales for evaluating the impact of a culinary nutrition education program on cooking and healthful eating. *J Nutr Educ Behav* 2011;43:511–6.
40. Birch LL, McPhee L, Shoba BC, Pirok E, Steinberg L. What kind of exposure reduces children's food neophobia? Looking vs tasting. *Appetite* 1987;9:171–8.
41. Fiese BH, Hammons A, Grigsby-Toussaint D. Family mealtimes: a contextual approach to understanding childhood obesity. *Econ Hum Biol* 2012;10:365–74.
42. Larson NI, Perry CL, Story M, Neumark-Sztainer D. Food preparation by young adults is associated with better diet quality. *J Am Diet Assoc* 2006;106:2001–7.

43. Storfer-Isser A, Musher-Eizenman D. Measuring parent time scarcity and fatigue as barriers to meal planning and preparation: quantitative scale development. *J Nutr Educ Behav* 2013;45:176–82.
44. Fiese BH, Jones BL. Food and family: a socio-ecological perspective for child development. *Adv Child Dev Behav* 2012;42:307–37.
45. Larson NI, Story M, Eisenberg ME, Neumark-Sztainer D. Food preparation and purchasing roles among adolescents: associations with sociodemographic characteristics and diet quality. *J Am Diet Assoc* 2006;106:211–8.
46. Cunningham-Sabo L, Lohse B. Impact of a school-based cooking curriculum for fourth-grade students on attitudes and behaviors is influenced by gender and prior cooking experience. *J Nutr Educ Behav* 2014;46(2):110–20.