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Impact of cooking and home food preparation interventions among adults: outcomes and implications for future programs

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Abstract

Objective—Cooking programs are growing in popularity; however an extensive review has not examined overall impact. Therefore, this study reviewed previous research on cooking/home food preparation interventions and diet and health-related outcomes among adults and identified implications for practice and research.

Design—Literature review and descriptive summative method.

Main outcome measures—Dietary intake, knowledge/skills, cooking attitudes and self-efficacy/confidence, health outcomes.

Analysis—Articles evaluating effectiveness of interventions that included cooking/home food preparation as the primary aim (January 1980 through December 2011) were identified via OVID MEDLINE, Agricola and Web of Science databases. Studies grouped according to design and outcomes were reviewed for validity using an established coding system. Results were summarized for several outcome categories.

Results—Of 28 studies identified, 12 included a control group with six as non-randomized and six as randomized controlled trials. Evaluation was done post-intervention for five studies, pre- and post-intervention for 23 and beyond post-intervention for 15. Qualitative and quantitative measures suggested a positive influence on main outcomes. However, non-rigorous study designs, varying study populations, and use of non-validated assessment tools limited stronger conclusions.

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Conclusions and Implications—Well-designed studies are needed that rigorously evaluate long-term impact on cooking behavior, dietary intake, obesity and other health outcomes.

Keywords

cooking; food preparation; intervention; diet outcomes; review

INTRODUCTION

The importance of away-from-home meals and convenience foods in the American diet may relate to a lack of time to plan and prepare meals at home.¹ A recent review also implicates a lack of cooking skills and food preparation knowledge as barriers to preparing home-cooked meals.² The percentage of total household food dollars spent on food eaten away from home is now higher compared to 30 years ago (33% in 1970 to 47% in 2010).³

Consumption of fast food and food from away-from-home locations is associated with lower diet quality and obesity among adults.^{4–8} National dietary intake data from 1994–1996 and 2003–2004 shows that each meal away from home is related to an increase in calories by 130 per day and a reduction in diet quality by two points on the Healthy Eating Index scale.⁹ Food prepared at home provides fewer calories per eating occasion, and on a per-calorie basis, provides less total and saturated fat, cholesterol and sodium, and more fiber, calcium and iron compared to food prepared away from home.¹⁰ Among low-income women, increased frequency of consuming foods prepared from scratch over a three-day period is associated with an increase in fruit and vegetable, protein, vitamin C, iron, zinc and magnesium intakes.¹¹

Furthermore, time usage data shows that time spent in food preparation and cleanup is less for the average household compared to 30 years ago. In 1995 time spent on food preparation and clean-up is about half (41 minutes/day) that spent in 1965 (85 minutes/day) by working women in the U.S.^{12–13} More recent time usage data (2003–2004) also shows that time spent in food preparation decreases as time spent working outside the home increases,¹⁴ with a greater number of women in the U.S. workforce (an increase of 44% from 1984 to 2009).¹⁵ This rise in working women, an amplified perception of time scarcity¹ and increased availability of convenience foods based on technological advances and societal demands contributes to the decline in cooking and home food preparation. An observational study of 64 home cooked dinner meals shows that most meals contain processed, commercial foods possibly because of limited cooking skills.¹⁶

Several cross-sectional, observational studies show a relationship between food preparation skills among adults and associated outcomes. Among mothers of school-aged children, confidence in the ability to prepare a healthy meal is positively associated with healthfulness of the meal.¹⁷ A survey of German adults indicates that readymeal consumption (i.e., consumption of complete, main-course meals prepared externally) is inversely associated with cooking skills.¹⁸ A high perceived value of food preparation is associated with greater intakes of fruits and vegetables among women in Australia,¹⁹ and when the main home cook is confident in preparing vegetables, households buy a greater variety of vegetables.²⁰

Given the potential positive outcomes related to cooking skills, nutritionists and public health professionals are promoting cooking interventions as a way to improve health. For example, one large-scale cooking initiative known as Cooking Matters is underway in at least 35 states. Through the program, local chefs partner with community organizations to teach cooking skills.²¹ Even though the programs are becoming more popular and well-established, an extensive review of the literature that examines the short and long-term impact of cooking interventions for adult populations is not available. A review of this type can provide information to improve the effectiveness of current programs and inform the development of new programs. The purpose of this study is to review previous research on cooking/home food preparation interventions and diet and health-related outcomes among adults. Relevant studies include interventions that focus primarily on home food preparation/cooking as the primary aim. Studies are also reviewed to identify implications for practice and future research.

METHODS

Relevant research studies published between January 1980 and December 2011 were identified via searches of OVID MEDLINE, Agricola, and Web of Science databases. The following keywords were used in various combinations to perform searches: intervention, demonstration, health promotion, education or class; and food preparation, home food preparation, cooking or cookery; and food habits, food intake, eating patterns, diet, dietary intake, dietary outcomes or skills. The search was limited to those studies published in the English language and those involving adults (i.e., primarily 18 years of age or older), including college students.

A total of 373 journal articles and 85 educational materials were retrieved. Educational materials included mostly books as well as visual aids (slide sets, filmstrips, videos, transparencies), teaching kits and government publications. Of the 373 journal articles, 54 were repeated in two or three databases, leaving 319 for further review. Abstracts for all articles were reviewed and studies were excluded if they were not intervention studies (n=209, those having a cross sectional design with qualitative and quantitative methods such as dietary assessment, attitude and behavioral surveys; focus group and individual interviews; case studies). Articles were not included if they reported on studies that involved children as the target group, were reports or commentaries on recommendations or resources, or review articles. Articles were also not included if they were intervention studies that did not have cooking or food preparation as the primary aim, or if only formative development of programs that involved cooking or food preparation was described without evaluation measures. After these exclusions (n=306), thirteen applicable studies that had cooking or home food preparation as their primary aim were included for further review. Other potentially relevant studies were identified from bibliographies of these applicable studies. This study was exempt from Institutional Review Board review because it involved a review of previously completed, published studies.

Twenty-eight studies meeting the inclusion criteria were identified through this search strategy.²²⁻⁴⁹ Intervention studies included cooking or home food preparation through cooking assignments,²²⁻²³ cooking classes/demonstrations in community or clinical

settings,^{24–44, 46–49} and viewing a cooking TV show.⁴⁵ Studies were grouped according to design (intervention without control groups, non-randomized control trials (RCT) and RCTs) and intended outcomes. One author extracted information from studies into a standardized table (Table 1) structured to provide objective information about the population, intervention duration, measures and measurement tools and outcomes. Information extraction was checked independently by a second author to ensure that consistent detailed information was included for each study.

The validity questions from a quality criteria checklist were used to critically appraise the validity of each study included in this review with respect to research design and implementation. The checklist was available as part of the Evidence Analysis process of the Academy of Nutrition and Dietetics Evidence Analysis Library (EAL) and allowed for rating of primary research studies as positive (“clearly addressed issues of inclusion/exclusion, bias, generalizability, data collection and analysis”), negative (“these issues have not been adequately addressed”) or neutral (“neither exceptionally strong nor exceptionally weak”).⁵⁰ The process to appraise study validity involved several steps where an external reviewer first used the checklist to generate responses to all the validity questions for 26 of the 28 studies (two based on primarily qualitative evaluation methods were not included in this process^{24, 38}). Next, authors generated responses to all validity questions for two to six studies each for a total of 13 of the 26 studies. Lastly, one author reviewed responses to the validity questions for all papers reviewed by the external reviewer and other authors and generated an overall rating of positive, negative or neutral for each study. Inter-rater reliability was determined for ratings of the 13 papers by the external reviewer and multiple authors based on a simple Kappa coefficient (0.71) and percentage agreement of 84.6%.

Table 2 presents information about the evaluation tools used to measure quantitative outcomes, literature sources and pilot testing. A wide variety of outcomes (either qualitative or quantitative dietary outcomes and health outcomes such as weight or blood lipids) across studies was reported based on a variety of evaluation measures.

To better describe the type of cooking/food preparation studies conducted from 1980–2011, the number of studies was quantified based on study design (inclusion of a control group and randomization of participants), and the type and timing of evaluation to assess effectiveness (post-assessment only, pre- and post-assessment, and whether follow-up was completed after post-assessment). Outcomes based on study objectives were summarized based on several categories including dietary change, knowledge/cooking skills, self-efficacy and intentions, and changes in health outcomes such as metabolic biomarkers or weight. Overall findings were highlighted and examples were provided to further illustrate the type of studies and participants used to generate the findings for each outcome category.

RESULTS

Study Type and Outcome Measures

Of the 28 studies, 16 did not include a control group. Of these, four utilized post-assessment measures only,^{22–24, 34} while 12 had pre and post-intervention assessments.^{25–33, 35–37} Of the 12 studies including a control group, six did not randomize group assignment^{38–43} and

six did.^{44–49} The total number of sessions in each intervention varied widely, from three,³⁵ four,^{33–44} six,^{26–28, 30} eight,^{31–32, 36} 12–13^{29, 37} to 38 sessions.²⁵ Some studies also contained additional components, such as refresher sessions six months after intervention completion.³⁷ Across all 28 studies identified in this review, 15 assessed potential impacts of the intervention beyond the immediate post-intervention assessment, including five that did not include a control group^{25–27, 33–34} and 10 that did.^{39–43, 45–49} These follow-up assessments ranged from one to 48 months after the intervention concluded.

Studies varied with respect to type of participant, intervention activities and duration, and expected outcomes. Most studies involved adults, however several targeted parents because of the role they play in promoting healthful diets and prevention of chronic disease among children.^{42, 44} The majority of the 28 studies focused on changing outcomes that could be measured quantitatively. Table 2 presents information about quantitative tools used to assess dietary outcomes and outcomes related to nutrition or cooking knowledge, attitudes and practices. Diet-related assessment tools ranged from questionnaires regarding frequency of dietary behaviors (e.g., eating fruits and vegetables, drinking low-fat milk) to standard dietary intake data collection methods (e.g., 24-hour dietary recalls). For some studies, little or no information was provided about the source of some evaluation tools or whether they had been validated.^{25, 32, 34} Other studies described a process whereby content validity, internal consistency and/or test-retest reliability were assessed.^{26, 39, 45–46} Still other studies referenced previous research from which tools were drawn directly, with or without modification,^{29–30, 43} or research from which tools had been adapted for use in the intervention.^{35–36, 39, 45} Some studies used qualitative interviews alone or in conjunction with other measures to assess outcomes^{22–24, 34, 38} or physical and laboratory measures for outcomes, such as change in blood pressure or serum cholesterol.^{36–37} Only 4 studies examined effects on body weight.^{36, 37, 43, 49}

Process Evaluation

Process measures were not reported for some studies and varied widely for studies that included this type of evaluation. Most studies reported the number of participants recruited and the number in the final sample, but few discussed the differences in these samples brought about by attrition. Some studies reported attendance at intervention sessions or completion of intervention activities,^{25–27, 29, 33, 37} differences in outcomes according to attendance,²⁷ and preferences for follow-up methods.²⁶ Other studies explored opinions and feedback about programs and participant experiences.^{28, 32–34, 38, 44–45} Reasons for not completing intervention sessions were presented in several studies,^{39, 47–49} and only a few studies provided information about program cost.^{43, 46}

Evidence Analysis Library Process of Validity Ratings

Based on the EAL validity questions, a positive rating was assigned to 11 studies, a neutral rating to one study, and a negative rating to 13 studies. A “no” response to more than six validity questions resulted in a negative rating. Most often these questions were related to specification of inclusion/exclusion criteria, handling of withdrawals, use of standard, valid and reliable data collection instruments, and adequate description of statistical analysis. Not applicable responses to questions were not considered in the rating. Most often these

questions were related to comparability of study groups and blinding for studies without a control group.

Outcome Evaluation: Dietary Intake

Nineteen of the 28 studies evaluated the impact of a cooking intervention on dietary intake, assessed in various ways. Despite varying study designs and measurement tools, 16 studies reported a positive impact on food intake. Ten of these were interventions without a control group; all showed beneficial changes in intake of various nutrients, food groups, and specific foods following the intervention, each using different measurement tools.^{24–27, 29–31, 33, 35–36} Using dietary questionnaires, one of which was a previously tested Eating Styles Questionnaire,³⁰ an intervention aimed at members of a South Asian community in the United Kingdom²⁵ and an intervention aimed at African American faith community members³⁰ resulted in reported improvements rather than significant improvements in intakes of dietary sources of fat, fiber, sugar or sodium.^{25, 30} The intervention arm of the Women's Healthy Eating and Living (WHEL) Study included 12 monthly cooking lessons for women previously treated for breast cancer.²⁹ Increased cooking class attendance was significantly associated with improvement in participants' WHEL Adherence Score, an index measuring achievement of dietary targets, such as fruit, vegetable and fiber intakes and percentage of energy from fat.

Of the interventions including a control group (n=12), five showed that intervention participants' dietary intakes improved to a greater degree than those of the control group.^{39, 41, 43, 47, 49} For example, a multiple-pass, 24-hour recall was used to assess outcomes of a healthy eating class for men with prostate cancer versus a control group receiving usual treatment.⁴⁹ A significant reduction in the consumption of saturated fat and animal proteins and increased vegetable protein consumption was observed for the intervention group compared to the control group.

Two of the non-randomized trials showed mixed results for the intervention group compared to the control group, as measured by Food Frequency Questionnaire (FFQ) or food diaries.^{39, 41} Cooking class intervention participants significantly increased consumption of grains compared to the control group that received no intervention, but their intakes of dairy, fruits and meats were not significantly different.⁴¹ Adults living in areas of social deprivation in Scotland who were exposed to a nutrition education and cooking class intervention significantly increased their intake of fruit pre- to post-intervention, but this was not maintained at the six-month follow-up.³⁹

Outcome Evaluation: Knowledge/Skills

Using qualitative measurements/tools, three cooking class interventions assessed cooking knowledge/skills.^{24, 32, 38} Participants of all three interventions reported an improved understanding of healthy food preparation and healthier cooking strategies. Four studies reported effects on nutrition and fruit and vegetable knowledge.^{35, 38, 40, 45} For example, using theory-based knowledge questions adapted from a questionnaire used in an existing program, a diabetes education and cooking demonstration intervention resulted in an increase in nutrition knowledge pre- to post-intervention.³⁵

Outcome Evaluation: Cooking Self-Efficacy/Confidence, Intention/Behavior, and Attitudes

Three cooking class interventions,^{32, 34, 39} two aimed specifically at men, resulted in an increase in cooking confidence. Two of these studies also showed an increase in cooking activity at post-intervention³² and at four or six week follow-up.³⁴ A third study found a significant increase in confidence in following a recipe between baseline and six-month follow-up, as measured by an untested cooking skills questionnaire.³⁹ Two cooking class interventions reported positive results with respect to participants' cooking attitudes and enjoyment,^{32, 41} although the findings were either not significant or significance was not reported. Attitudes were determined by various surveys, one of which had been evaluated for test-retest reliability⁴¹ and another by key informant interviews.³²

Outcome Evaluation: Health Outcomes

Four studies reported positive health outcomes,^{36–37, 43, 48} and two of these involved positive changes in serum cholesterol.^{36–37} Other studies addressed improvement in parameters associated with conditions/diseases. For example, patients with rheumatoid arthritis significantly improved a variety of rheumatoid arthritis measures when compared to the control group, which received only healthy eating information.⁴³ More patients with chronic kidney disease improved in parameters such as urinary protein, urinary sodium, and blood pressure in an experimental group receiving cooking and exercise classes compared to a standard care control group.⁴⁸ Men with biopsy-confirmed prostate cancer who completed a cooking class intervention showed a significant increase in quality of life compared to the control group but no impact on body weight was observed.⁴⁹ Similarly, BMI did not change from pre to post intervention among hypercholesterolemic individuals.^{36,37}

DISCUSSION

This review indicates that interventions involving home food preparation and/or cooking may result in favorable dietary outcomes, food choices, and other health-related outcomes among adults. However, the results should be interpreted with caution based on weaknesses in study design, varying study populations and lack of rigorous assessment.

Findings related to changes in dietary intake and health outcomes

Dietary behavior change for an individual may be based on a progression of tasks involving food selection/acquisition, preparation and consumption. Given this progression, food preparation knowledge and skills are critical components that can facilitate dietary change. As expected, the majority of interventions in the current study that targeted changes in food preparation knowledge and skills produced positive effects on dietary intake. Previous cross-sectional studies have suggested a relationship between food preparation knowledge or skills and consumption of particular foods.^{51–52} For example, among adult WIC participants, the likelihood of consuming fruits and vegetables was strongly related to knowing how to prepare most fruits and vegetables⁵¹ and barriers to long term intake of whole grain foods was related to cooking skills among adults in the UK.⁵² Several calls have been made recently for culinary skills education programs for children,^{53–54} based on the likelihood that these skills would persist into adulthood. However if adults lack these skills and the confidence that might accompany their development as observed in several studies

reviewed,^{32, 34, 39} programs to educate adults with respect to food preparation knowledge and skills are also important.

Several studies in this review identified barriers to dietary changes based on implementing practices encouraged by the cooking intervention.^{24, 40} Primary barriers were family food norms/preferences and resistance to change, as well as financial constraints. Cooking programs have the unique ability to help parents address resistance to dietary change by including family members in the instruction or by providing information about ways to make dietary change more palatable and acceptable. Studies included in this review expanded the intervention's breadth in such ways as providing professional support and including budgeting sessions alongside cooking instruction. It may not be practical to target all cooking barriers (e.g., a deficit of cooking skills, nutrition knowledge, cooking facilities, and food accessibility) in a single intervention. Furthermore, if these barriers were addressed through an intervention, it is unlikely long-term positive outcomes would result unless the removal of barriers was sustained. Multiple cooking barriers are an opportunity for researchers to creatively partner with organizations working on such issues as food access. Interventions that target multiple cooking barriers are also an opportunity to demonstrate the need for comprehensive community responses to food environment issues.

Certain promising strategies emerged from intervention studies designed for community programs interested in implementing cooking programs. Several studies used peer leaders to guide cooking, nutrition and budgeting sessions, and demonstrated positive outcomes.^{25, 33} In addition to positive outcomes for the participants, peer advisors of one intervention indicated positive dietary intake changes four years after the completion of the intervention.³³ Four additional studies were successful in tailoring healthy cooking interventions to populations with specific health concerns, specifically hypercholesterolemia,³⁷ rheumatoid arthritis,⁴³ prostate cancer,⁴⁹ and myocardial infarction.⁴⁷ In addition to having a significantly positive impact on dietary intake, these interventions positively affected rheumatoid arthritis measurements and blood pressure,⁴³ serum cholesterol,³⁷ and quality of life for men with prostate cancer.⁴⁹

Interpretation of results based on study design

Study design differences make it challenging to draw conclusions about the potential benefits of interventions. More than half of the studies included in the review (16 of 28) did not include a control group and of the 12 studies that did include a concurrent control group(s) only six involved randomization of group assignment. The limited number of studies with longer-term follow-up assessments (15 of 28) imposes further restrictions on the ability to draw conclusions about effectiveness. While some exceptions exist, the majority of longer-term follow-up assessments demonstrated maintenance of positive dietary and health outcomes. However, the length of time between post-intervention and follow-up assessment varied widely. Although the measured outcomes for most interventions were primarily positive, little consistency existed among the intervention programs with respect to method of delivery (i.e., cooking class, cooking show, etc.), number of participants, type of participant (i.e., men, college students, low-income women), or the time passed between post-intervention and the final assessment.

Community programs almost certainly suffer from selection bias, where participants interested in cooking are naturally drawn to a cooking intervention, resulting in a higher likelihood that positive outcomes will be found. Selection bias can be moderated by conducting interventions among preformed groups (e.g., senior housing complexes) where there is a wider range of interest in cooking because participants do not self-select to participate. Small sample sizes and a small number of intervention sessions also yield concerns about representativeness, generalizability, and intervention dose in many intervention studies.

Interpretation of results based on evaluation/outcome assessment

A wide assortment of measurement tools were used to evaluate effectiveness of the cooking/home food preparation interventions, many of which were neither validated nor well-established measures of dietary intake, such as the 24-hour dietary recall. The wide range of non-validated, unique surveys and questionnaires makes it difficult to compare results across studies. Few validated instruments exist for measurement of cooking intervention outcomes including cooking knowledge, self-efficacy and skills. For example, only recently has the validation/testing of several measures of cooking self-efficacy been reported.^{55–56}

For many studies reviewed, consistent process evaluation was absent. While several studies addressed participant withdrawals, discussion of program implementation and expected output is noticeably absent from most studies. Process evaluation measures are particularly important as cooking programs are being implemented more widely. Process evaluation is important in measuring the degree to which interventions are implemented as planned.⁵⁷ Without these measures, it is difficult to assess the efficiency of a cooking program or how well the program is being implemented.

IMPLICATIONS FOR RESEARCH AND PRACTICE

Regardless of the lack of definitive evidence to support a relationship between cooking instruction and long-term cooking behavior or health outcomes, public health professionals have aggressively moved forward with cooking initiatives. Many programs exist at the national, state and community levels that promote cooking as a necessary and appropriate response to overweight/obesity and food insecurity, such as the Cooking Matters program.²¹ To enhance the impact of these types of popular programs, additional research is needed regarding the needs of non-cooking individuals and the most effective methods of delivering and evaluating cooking interventions. The most pertinent and essential recommendation for future studies is the necessity for stronger study designs, such as those utilizing control groups. Recruitment strategies and sampling biases should also be considered. The use of standard, valid and reliable data collection instruments and adequate description of statistical analysis is necessary to move this research area forward with rigor. Additional validated evaluation tools may become available as more studies are published with respect to cooking intervention outcomes. Research teams should also incorporate process evaluation measures to report recruitment and retention of study participants, exposure to the intervention, and fidelity of program implementation to the study design. Reporting inclusion/exclusion criteria and handling of withdrawals has become more common in recent studies, but should be a priority to address validity of studies in the future.

Despite imperfections, public excitement over cooking programs is an opportunity for public health professionals to harness this energy and discover the most beneficial approaches to affecting long-term dietary changes and subsequent health outcomes. What is essential is the continued conversation about the direction of cooking initiatives, and the implementation of these initiatives alongside inter-related measures such as increasing food accessibility and affordability. Given the current rates of overweight and obesity in the United States, strong public enthusiasm for cooking classes provide a rare public health opportunity to engage the community while working to affect dietary outcomes, overweight and obesity and related health conditions.

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Table 1

Study characteristics, intervention methods, evaluation measures and summary of outcomes regarding diet and health

Intervention Without Control Group					
Reference	Design	Population	Intervention Duration	Measurement Tools and Measures	Dietary and/or Health Outcomes
Brown & Richards (2010) (22)	Post-assessment of intervention without control group: "Cook-an-Entrée" assignment	Students enrolled in a university nutrition course (n=579) Brigham Young University, UT	One assignment	Open-ended qualitative survey "What did you learn from this experience?" to assess perception of food prepared	Students perceived the entrée they prepared to be nutritious (46%), easy to prepare (42%) and quick (28%). Most (98%) intended to prepare the entrée again.
Lacey (2007) (23)	Post-assessment of intervention without control group: cooking assignment involving whole cereal grains	Students enrolled in a university Experimental Foods course (n=60) West Chester University, PA	One assignment	Activity evaluation survey; qualitative responses to assess perception of overall experience	Median student ranking for the overall experience was highly positive (seven on a Likert scale ranging from one- highly negative to seven-highly positive).
Abbott et al. (2010) (24)	Post assessment of intervention without control group: interviews six months to five years after participation in cooking classes	Aboriginal people, ages 19–72 years (mean 48 yrs), mostly women, who participated in cooking courses at the Aboriginal Medical Service, Western Sydney (n=23 of 73 total participants)	Attendance at two-nine cooking classes)	In-depth semi-structured interviews analyzed thematically to assess cooking course experience, nutrition knowledge, cooking skills, dietary behavior, factors impacting application of knowledge and skills from course	Participants reported an improved understanding of healthy eating and cooking skills. Dietary changes most often reported were decreased salt and fat intake, and increased use of fresh vegetables. Families' willingness to accommodate dietary changes was the most important influence on applying knowledge/skills from course.
Davies et al. (2009) (25)	Pre-/post-assessment of intervention without control group: peer-led cooking sessions and community nutrition campaigns (Assessment at baseline, post-intervention and one-year follow-up)	South Asian community members in Southampton, UK (46 individuals attended cooking sessions)	Ten tasting sessions and 28 cooking sessions offered (timeline unknown)	Dietary questionnaires, qualitative and quantitative techniques (non-specific description of tools) to measure healthy eating knowledge, attitudes and behaviors (eating, shopping and cooking), barriers to change and maintenance	At one-year post-intervention participants reported using low-fat dairy products, FV, and high-fiber starchy foods more often; and using less salt and eating fewer fatty, fried and sugary foods (no information on statistical significance provided). At one-year post-intervention, participants reported using less fat in cooking and making positive changes in cooking practices.
Swindle et al. (2007) (26)	Pre-/post assessment of intervention without control group: nutrition education classes with cooking demonstration and food preparation skills (Assessment at baseline, post intervention, three or six month follow up)	Limited resource adults (n=53) in the Denver metropolitan area	Six weekly classes	Three behavioral scales (Eating, General, and Shopping Behaviors Scales) with acceptable internal consistency	Adults significantly improved all behaviors immediately post intervention based on retrospective pretest and posttest (n=53). Most changes were retained at three and six months after the intervention.

Shankar et al. (2006) (27)	Pre-/post-assessment of intervention without control group: cooking lessons, meal planning, grocery shopping and nutrition education (Assessment at baseline, post-intervention and four months follow up)	Urban, African American women, ages 20–50, living in 11 public housing communities in Washington, DC; Eighteen waves of the intervention conducted over a 28-month time period (n=212)	Six 90-minute sessions twice/week for three weeks, + one 90-minute follow-up booster session six weeks later (20 week intervention)	Multiple pass 24-hour recalls at each time point (NDSR protocol) to measure dietary change and sustained dietary patterns based on class attendance; interviews to assess knowledge, attitudes, practices related to food preparation and consumption	Participants who attended at least five sessions (n=68) did not change average servings of FV; non-attendees had a significant decrease (n=23) at follow up. Those attending at least five sessions (n=75 and 68) showed significant decreases in total calories and % calories from fat at both post-test and follow-up.
Condrasky (2006) (28)	Pre-/post-assessment of intervention without control group: interactive cooking classes featuring commodity foods with cooking demonstrations	Head Start parents/guardians in South Carolina (n=41; two men and 39 women; 60% African American, 30% Hispanic)	Two-hour weekly sessions for six weeks	24-hour dietary recall to assess changes in dietary intakes; Food Behavior Checklist to assess general food behaviors	From pre- to post-intervention, there were no differences in intake of FV, dairy and grains. Participants were more likely to report shopping with a grocery list, thawing foods less often at room temperature, reading the Nutrition Facts label when making food choices, and eating something within two hours of waking up (statistical analyses not reported).
Newman et al. (2005) (29)	Pre-/post-assessment of intervention without control group: cooking classes + telephone counseling and newsletters, (Assessment at baseline and 12 months)	Women (mean age of 54 years at study entry) who had been treated for early stage breast cancer (n=739), adhered to Women's Health Eating and Living Study (WHEL), multicenter counseling and diet assessment protocols	Twelve monthly cooking classes and newsletters + 15 to 23 dietary counseling calls	24-hour dietary recalls via telephone (NDSR protocol) to assess changes in dietary intakes; WHEL Adherence score (58) to assess relationship between target and estimated dietary intake, association between cooking class attendance and WHEL Adherence score	Telephone and print intervention was associated with a significant increase in WHEL Adherence Score. WHEL Adherence Score improved significantly with increased cooking-class attendance. Daily servings of fruit and vegetables increased; mean fiber intake increased, and fat intake decreased significantly.
Woodson et al. (2005) (30)	Pre-/post-assessment of intervention without control group: cooking class conducted by peer educators	African American members of faith communities who participated in <i>Food for Health and Soul</i> 2001–2003 (n=485)	Six 60-minute weekly classes in church facilities	Eating Styles Questionnaire (16-item) (59) to assess changes in fat, sodium, and fiber intakes, stage of change for reducing fat and sodium intakes	Significant improvements in intakes of fat, fiber and sodium (n=349), no significant advancement in stage of change from baseline to post-intervention (n=285).
Brown & Hermann (2005) (31)	Pre-/post assessment of intervention without control group: produce cooking classes	Oklahoma residents from 28 counties (n=373 adults), led by county Extension educators	Average of eight classes over two months	Pre versus post education questionnaire to assess changes in FV intakes and safe food-handling behaviors (pilot-tested for reliability)	Mean FV intakes significantly increased, 11% and 8% significantly increased hand and produce washing behaviors before food preparation, respectively.
Keller et al. (2004) (32)	Pre-/post-assessment of on-going intervention program without control group: Men's Cooking Group	Retired men from the Evergreen Senior Center (n=29 in 2000 and 2001), Guelph, Ontario	Monthly two-hour sessions for eight months	Cooking skills and attitudes questionnaire; key informant interviews to assess changes in cooking confidence, enjoyment and attitudes; long-term food intake	Of 19 men completing pre/post questionnaires, most reported developing multiple cooking skills through the program, as well as increased pleasure and confidence cooking (statistical analyses not reported). The majority indicated developing strategies to reduce fat and salt in cooking and to increase fiber and variety.

Foley & Pollard (1998) (33)	Pre-/post-assessment of intervention without control group: budget and cooking sessions delivered by trained community advisers, and grocery store tour (Assessment at baseline, post intervention, six-week and four year follow-up)	Low-income earners, the majority women and the usual shopper, living in Western Australia (n=612, 150 of these were trained as advisers) (formative research began in 1991, outcome evaluation completed in 1996)	Four 90-minute sessions	FFQ (Diet Check) to assess changes in dietary (FV, breads and plain cereal foods, foods high in fat, salt and sugar) intake and behavior; questionnaire and in person or telephone follow up to assess spending changes and healthy food budgeting	For paired budget session attendees (n=86), at the 6-week follow-up there was a significant increase in the proportion who spread their margarine thinly and who rarely ate lollies [candies] or bought cakes. Of those who attended budget/cooking sessions (n=133), at six weeks 28% indicated making changes in spending and 35% reported making changes in diet as a result of the program. Advisers at four-year follow-up (n=44) indicated spending more on FV (71%) and bread and cereal foods (50%), and less on chocolate/treats (70%) and convenience foods (69%) than before FoodCents.
Ranson (1995) (34)	Post intervention and follow up of intervention without control group: men's cooking class (Assessment post-intervention and four-six week follow-up)	Self-selected adult men (n=60) (35–65 years) in South Australia (March 1993 and November 1994)	One two-hour session once a week for four weeks	Subjective process and impact questionnaire; group discussion; telephone follow-up to assess changes in cooking frequency and confidence, use of recipes provided	Most common verbal and written comment was to report more cooking confidence (detail not provided). At a four to six week follow-up, most reported cooking at home at least once and using a featured recipe regularly (statistical analyses not reported).
Chapman-Novakofski & Karduck (2005) (35)	Pre-/post-assessment of intervention without control group: diabetes nutrition education + cooking demonstrations, tasting	Self-selected adults with diabetes in 11 counties in Illinois in 2000 (n=239 participants with pre/post data from ~180)	Three sessions (~two hours each)	Nutrition knowledge, stage of change and social cognitive theory questionnaires to assess changes in stage of change for diet behaviors, social cognitive theory variables related to diet, nutrition knowledge	Participants significantly increased their nutrition knowledge pre- to post-intervention. Confidence to change one's diet, prepare healthful meals, use the Nutrition Facts label, and overcome meal preparation difficulty also significantly improved. Significantly different stage distributions for using herbs instead of salt, using artificial sweeteners, and controlling carbohydrates.
Hermann et al. (2000) (36)	Pre-/post-assessment of intervention without control group: cooking demonstration and tasting + nutrition education and supermarket tour	Oklahoma residents over 55 years old in ten counties (n=76) (mean age 69 ± 8 years)	Eight weekly sessions	Food and Nutrition Behavior Questionnaire (18-item) to assess food selection and preparation, food intake and food safety, pre/post 24-hour dietary recall to assess food group intake changes; BMI; fasting total cholesterol	Significant increases were seen in total Food and Nutrition Behavior score, and subscale scores with respect to "Food Selection and Preparation", "Food Intake", and "Food Safety" (n=70). Participants significantly increased mean daily servings of vegetables, grains and dairy; and decreased mean daily servings of fats, oils and sweets (n=67). No change in BMI, average fasting total serum cholesterol concentration significantly decreased (n=72).

McMurry et al. (1991) (37)	Pre-/post assessment of intervention without control group: nutrition education + cooking demonstrations + group discussion taught by dietitians	Individuals identified with hypercholesterolemia (n=336 who attended at least one class, n=49 attending 4+ classes evaluated for plasma lipid changes	12–13 monthly nutrition refresher classes at six-month intervals	Plasma cholesterol measurements, BMI Plasma cholesterol concentrations	Of those participants completing at least four nutrition classes (n=unknown), 49 could be evaluated for plasma lipid changes. For all participants combined, mean plasma total and LDL cholesterol significantly decreased on average 8% from the initial to final measurement; plasma HDL cholesterol, triglycerides and BMI did not significantly change.
Non-Randomized Controlled Trial					
Reference	Design	Population	Intervention Duration	Measurement Tools and Measures	Dietary and/or Health Outcomes
Condrasky et al. (2010) (38)	Post-assessment of intervention with control group: cooking classes with a professional chef and nutrition educator vs. printed program material only	Low-income and minority caregivers (three focus groups participated in evaluation, n unknown, interviews with 12 key stakeholders)	Five sessions (two hours each)	Focus groups with participants, in-depth interviews with key stakeholders to assess perceived impact of program	Focus group participants reported increased awareness of healthy eating guidelines and preparation techniques for fruits and vegetables, and increased confidence to try new foods. Key stakeholders commented on program delivery logistics, need to expand program, and importance of hands-on skill building.
Wrieden et al. (2007) (39)	Non-randomized controlled trial: introductory educational session + cooking lessons vs. introductory educational session only (Assessment at pre/post-intervention and six-month follow-up)	Adults living in areas of social deprivation in eight urban communities (n=113 total, dietary intake data from 29 intervention and 21 control participants)	Seven weekly classes	7-day food and shopping diaries to assess FV, fiber, fish, bread, pasta, rice and starchy food consumption; cooking skills questionnaires (60) to assess cooking confidence and ability	Between baseline and six-month follow-up, intervention participants significantly increased confidence in following a recipe. Fruit intake increased significantly in the intervention group (n=29) between pre- and post-intervention compared to control (n=21), but not maintained at follow-up. No other significant changes were observed for reported dietary intake.
Kennedy et al. (1998) (40)	Non-randomized controlled trial: nutrition education classes with guided “hands-on” food preparation and cooking sessions vs. no intervention (Assessment at baseline, post intervention and three month follow up)	Low-income mothers with young children, 26 intervention participants and 13 non-participants matched for sociodemographic characteristics (UK)	Ten weekly two-hour sessions	Semi-structured interviews to assess changes in dietary habits, attitudes and factors that support and inhibit dietary change; questionnaire items on nutrition knowledge adapted from those used in similar studies to assess nutrition knowledge changes	Significantly higher quantitative scores in two of four treatment groups compared to the control in nutrition knowledge, about half of participants in the treatment groups reported changing food-related practices. Intervention participants reported gaining knowledge in translating abstract messages, changing cooking methods and reducing fat intake.

Auld & Fulton (1995) (41)	Non-randomized controlled trial: cooking classes vs. no intervention (Assessment before and after classes and three-month follow-up)	Female clients of a life skills training program in Colorado (20 intervention participants and nine control participants)	Five sessions	FFQ to measure changes in dietary intake; food attitudes survey to assess changes in cooking attitudes (acceptable test retest reliability)	The intervention group significantly increased consumption of grains compared to control group but intakes of dairy, fruits and meats were not significantly different.
Jacoby et al. (1994) (42)	Intervention with control group: infant feeding counseling, cooking demonstration, and recipe pamphlet vs. infant feeding counseling and recipe pamphlet (Assessment at baseline, 48 hrs post-intervention and 30-day follow-up)	Mothers of a child five-15 months from one of 11 poor districts in Lima, Peru, attending the Oral Rehydration clinic. Mothers had initiated weaning, children were fully rehydrated (70 mothers in cooking demonstration group and 73 mothers in pamphlet group with pre/post data)	One session with 20-minute cooking demonstration	Interviews with recall of food preparation practices and foods given to child on previous day to assess infant food preparation practices (use of an adequate weaning food), child's health status and maternal knowledge); consistency of foods as proxy for energy density based on photographs and pretesting	Both intervention conditions significantly increased maternal knowledge and rates of using an adequate weaning food; differences between groups were negligible.
McKellar et al. (2007) (43)	Non-randomized controlled trial: Mediterranean-type diet cooking class vs. healthy eating information control group (Assessment at baseline, three and six month follow up)	Female patients in socially deprived areas with rheumatoid arthritis ages 30-70 years (n=130: 75 cooking class and 55 control), Glasgow, UK	Six two-hour weekly sessions	Change in lifestyle, disease activity and CV risk were assessed with rheumatoid arthritis clinical features (i.e., tender and swollen joint count and C reactive protein levels), cardiovascular (CV) risk assessment (ie, smoking habits, BMI, blood pressure, serum cholesterol, glutathione); FFQ (61) to assess changes in dietary intakes	The intervention group significantly increased weekly total consumption of FV and legumes and improved ratio of monounsaturated: saturated fats consumed while no changes were observed for the control group. Intervention participants significantly benefited compared to controls in patient global assessment at six months, pain score at three and six months, duration of early morning stiffness at six months, and health assessment questionnaire scores at three months. The intervention group showed a significant drop in systolic blood pressure; the control group showed no change. No intervention dependent changes were observed in BMI or CV risk factors.
Randomized Controlled Trial					
Reference	Design	Population	Intervention Duration	Measurement Tools and Measures Questionnaires, informal	Dietary and/or Health Outcomes
Condrasky et al. (2006) (44)	Randomized controlled trial: cooking classes vs. lesson materials and recipes (Assessment at baseline and post-intervention)	Parents/caregivers of preschool children, Spartanburg, SC (n=29 total, 15 intervention participants, 14 control participants)	Lessons (unknown n) in two-hour sessions	Questionnaires, informal focus group discussions to assess changes in mealtime practices, use of flavors in cooking at home, fruit and vegetable intake, parental support	Significant changes in intervention group included awareness of how to prepare simple, healthful meals using spices compared to control group. No significant changes in fruit or vegetable intake among either group.
Clifford et al. (2009) (45)	Randomized controlled trial: viewing cooking show episodes vs. episodes on sleep disorders (Assessment at pre- and post-	Upper-level college students from non-health courses (50 intervention participants and 51 control participants)	4 15-minute weekly episodes	FFQ based on the NCI Health Habits and History food frequency questionnaire (62) to assess changes in FV intake and personal factors survey to assess changes in knowledge, motivators/barrier, self-	Significant improvements in Dietary Guidelines knowledge in the intervention compared to control group. Significant pre/post improvements in cooking motivators and barriers and

intervention and 4-month follow up intervention and 4-month follow up			efficacy. (Content validity, test-retest reliability and internal consistency established for survey.)	self-efficacy in the intervention (n=50) compared to control group (n=51), but this was not maintained at follow up (n=30 in each group). No significant change in the intervention group compared to the control group for FV motivators and barriers, self-efficacy, or consumption.
Levy & Auld (2004) (46)	Randomized controlled trial: cooking class intervention vs. cooking demonstration (Assessment at baseline and one, two, and three months post intervention)	Self-selected sophomore-level students at Colorado State University spring and fall 2002 (n=65); 33 cooking class group participants, 32 demonstration group participants	Eating habits and cooking/food preparation recalls to assess changes in attitudes, knowledge and behaviors regarding cooking (Content validity, test-retest reliability, and internal consistency established for surveys.)	Cooking class participants (n=26) had more statistically significant positive shifts in attitudes including self-efficacy in using various cooking techniques compared to the demonstration group (n=26). At the three-month post-test, cooking class participants (n=26) had significantly greater levels of cooking enjoyment, self-efficacy and viewing cooking as beneficial compared to the demonstration group (n=26).
Karvetti (1981) (47)	Randomized controlled trial with two interventions and control group: nutrition education + lecture (L) vs. nutrition education + cooking demonstrations (CD) vs. usual care (Assessments at baseline, beginning of rehabilitation period, and three, six, five, 12, and 24 months post-myocardial infarction)	Adult men, 27-64 years old, who had a myocardial infarction, treated at Turku University Hospital (98 L + CD and 96 control with baseline data, 86 in the L + CD group and 78 in the control group at one year, 77 in the L + CD group and 66 in the control group at two years)	24-hour recalls and dietary history to assess changes in dietary/nutrient intakes	No significant differences between the lecture and food demonstration groups; food intake changes between the two groups were almost identical. Two years after myocardial infarction, the treatment groups combined significantly reduced high-calorie and cholesterol-containing food consumption to a greater extent than the control group; the combined treatment groups also significantly increased FV, vegetables fats and low-fat milk product consumption compared to the control group
Flesher et al. (2011) (48)	Randomized controlled trial: individual nutrition counseling + cooking and exercise classes vs. standard care; (Assessments at baseline six and 12 month follow up)	Control (n=17) and experimental (n=23) groups of chronic kidney disease patients in greater Vancouver area.	Blood tests, urine tests, blood pressure measurements to assess changes in urinary protein and sodium, blood pressure, glomerular filtration rate and total cholesterol	In the experimental group, significantly more patients (61%) improved in four of five measures while only 12% of the control group improved in four of five measures.
Carmody et al. (2008) (49)	Randomized controlled trial: cooking classes related to plant-based foods, fish, whole grains and vegetables + mindfulness training vs. usual treatment (Assessment at baseline, post-intervention and three-month follow-up)	Three cohorts of men with prostate cancer who had undergone primary treatment, a subsequent PSA level increase, and had not received other therapy within the previous six months (17 cooking class participants and 19 wait-list control participants)	Multiple pass 24-hour dietary recall (NDSR protocol) to assess addition of plant-based foods and fish and avoidance of meat, poultry and dairy products; BMI, Quality of Life (QOL)-Functional Assessment of Chronic Illness Therapy tool to assess quality of life outcome index; serum prostate-specific antigen (PSA) velocity to measure change in PSA	Intervention participants (n=10) significantly reduced consumption of saturated fat and animal proteins and increased consumption of vegetable protein and total dietary fiber compared to the control group (n=14). Intervention group showed a significant increase in QOL on the trial outcome index compared to the control group.

No significant difference was found between the two groups
No significant difference was found between the two groups
No significant difference was found between the two groups

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FV = fruit and vegetable, FFQ = food frequency questionnaire, NCI=National Cancer Institute, NDSR=Nutrient Data System for Research, WHEL=Women's Healthy Eating and Living, RCT=randomized controlled trial

Table 2

Description of the evaluation tools used to measure quantitative outcomes regarding dietary intake, cooking behaviors, knowledge and attitudes; literature sources and pilot testing information

Construct	Tool	Original source for tools/ information about pilot testing	Psychometric data (if available)
Dietary behavior change	7-d food diary (39)		
	24-hour dietary recall (27–29, 36, 47, 49)		
	FFQ (33, 41, 43, 45)	FFQ (43) from previously validated tool (61); FFQ (41) adapted from instruments used in national surveys; FFQ (45) adapted from NCI Health Habits History Questionnaire (62)	FFQ (43): significant correlations (0.27–0.75) for major nutrients estimated from the FFQ and 7-day weighed dietary records (61). FFQ (45): 80% agreement between FFQ and 3-day food record for fruit ($r=0.43$) and vegetable ($r=0.65$) intake by 77% of subjects (62) and reliability confirmed (test-retest correlations 0.60) (45)
	Index of dietary intake meeting target intake based on 24-hour dietary recalls (29)	Women's Healthy Eating and Living (WHEL) Study Adherence Score (29) also described in (58)	WHEL score (29) based on relationship between national dietary guidance and dietary recall results, relationship tested and confirmed in a feasibility study based on circulating concentrations of carotenoids (63)
	Dietary history (47)		
	FV intake (31, 44)	Pre-post questionnaire pilot-tested for reliability (31)	Reliability data not reported (31)
	Frequency of reported dietary behaviors (25–26, 28, 30, 33, 36) or number of participants reporting dietary change (40)	General and Eating Behavior Scales of Operation Frontline questionnaire (26) internal consistency established; Eating Styles Questionnaire (30) from (59)	General, Eating, Shopping Behavior Scales (26): Cronbach α 0.68; Eating Styles Questionnaire (30): Coefficient α = 0.90, significant correlations between fat and fiber intakes based on a dietary screener (64) were -0.65 and -0.40 respectively
	Eating habits survey (46)	Eating habits survey (46) reviewed for content validity and tested for reliability	Agreement between responses at time 1 and time 2 >70% with no differences in means
	Mealtime practices, use of flavors in cooking (44)		
Cooking skills, habits	Cooking skills questionnaire (32, 39), cooking survey of attitudes, behavior and knowledge (32, 46); cooking confidence/frequency questions (32, 34)	Cooking skills questionnaire (39) based on a previous nutrition knowledge questionnaire tested for reliability and internal consistency (60); Cooking survey (46) reviewed for content validity, test-retest reliability and internal consistency established	Cooking skills questionnaire (39): based on a previous questionnaire with Cronbach α 0.56 for knowledge and skills scales and significant correlations for time 1 and time 1 scores 0.381 (60); Cooking survey (46): agreement between responses at time 1 and time 2 >70% with no differences in means, attitude and knowledge scales verified with Cronbach α .
Food preparation	72-hour food preparation recall (46)		
Nutrition knowledge	Nutrition knowledge questionnaire (35, 40)	Questions (35) from existing Dining with Diabetes program; Questions (40) adapted from similar studies and reviewed for content validity	

Construct	Tool	Original source for tools/ information about pilot testing	Psychometric data (if available)
Attitudes	Eight-item attitude questionnaire (41)	Questionnaire (41) developed by experts to reflect program objectives and test retest reliability established	Test-retest correlations ranged from 0.77–0.93 for attitudes (41).
Cooking knowledge, attitudes, behaviors	Knowledge, attitudes, behavior questionnaires (27, 45)	Measures (27) selected based on previous work and pilot tested; Personal Factors Survey (45) reviewed for content validity, test-retest reliability and internal consistency established	Personal Factors Survey (45) test-retest reliability correlations (0.50) and internal consistency verified with Cronbach α
General food behaviors	Ten-item Food Behavior Checklist (28); 18-item Food and Nutrition Behavior questionnaire (36)	Food Behavior Checklist (28) designed with procedures from (65); Food and Nutrition Behavior questionnaire (36) adapted from Oklahoma EFNEP	