

A Sustainable Cooking Show Intervention to Address Barriers Contributing to Suboptimal Diets

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Abstract

This paper will discuss barriers to a healthy diet used as an evidence base for the development of an intervention aimed to promote healthy sustainable eating behaviors across socio-economic levels. An eleven-segment cooking intervention aimed to address how to source, store and prepare inexpensive nutrient-dense sustainable food with the goal to decrease suboptimal diets while supporting change at the farming level through purchasing power influence. A 31.7% response rate was obtained from a volunteer sample from three different communities in Southern California. After receiving the intervention, shopping, planning and consumption patterns shifted toward healthier habits. The significant change in participants' understanding of the meaning of sustainable food was accompanied by changes in where they shop as well as their shopping frequency. The videos provide an engaging format to deliver the information and suggest that relevant TV cooking programs can impact barriers to cooking and provide access to health information.

Keywords: Suboptimal diets; Sustainable diet; Culinary behavior; Cooking show

Introduction

Most Americans consume a suboptimal diet [1]; the Centers for Disease Control and Prevention [2] is calling for interventions at national, state, and community levels to increase consumption of fruit and vegetables. The lack of reasonably priced food and adequate nutrition in food is contributing to improperly balanced diets [3]. An expert panel of national nutrition experts found that cooking and eating meals at home saves money making it more affordable to eat nutrient-dense foods [4]. The barriers to a healthy diet include one or more of the following: declining nutrients in food; lack of knowledge; limited access; affordability of nutrient-dense foods; time constraints; taste preferences; pervasiveness of highly palatable, energy dense, nutrient poor foods; and the decline in culinary skills [5-7]. Contributors to suboptimal eating habits are multifaceted and call for shifts in farming, policy, education, food availability, culinary behaviors and diet. Interventions are needed to help improve these suboptimal eating habits. One approach is to teach individuals to source and prepare nutrient-dense foods using motivational tools that reach across economic and socio-cultural status. Television (TV) cooking shows are one of these tools that can be used to address barriers to cooking and consuming a healthy diet. Episodes teach cooking skills, increase confidence and introduce a variety of ingredients and sourcing sustainable food [8,9]. This paper will discuss barriers to a healthy diet used as an evidence base for the development of an intervention aimed to promote healthy eating behaviors across socio-economic levels. A summary of the intervention and data from the pilot implementation will then be presented. Affordably sourced food with adequate nutrients starts at the farm and continues all the way through to consumption. Teaching consumers to source and prepare nutrient-dense food can contribute to a decrease in suboptimal diets while supporting change at the farm level through purchasing power influence.

Background

Example of purchasing power influence

The growth in organic sales demonstrates the impact of purchasing power on the type of food produced. Consumer demand for organic

foods has grown by double-digits since the 1990s leading to an increase in sales from \$ 3.6 billion in 1997 to \$ 43.3 billion in 2015 [10]. The steady growth rate of the organic industry (10.8% growth rate in 2015), which is much higher than the overall food market (3.3%), shows the impact of purchasing power on the market place. An effective way to change what is offered in the food system is by educating consumers about healthy food and how to access it in the system, thereby increasing demand and stimulating change at the production level (farm).

Industrial farming and nutrients

The industrial approach to agriculture has focused on productivity and profitability contributing to a decrease in the nutrients in food and to an increase in calorie consumption [6,11,12]. Fruits and vegetables, now considered specialty crops, have been displaced by high value staple crops, leading to higher prices for micronutrient-dense food and a decrease in the cost of carbohydrate-dense staples. As a result, overall dietary diversity has declined and consumption has increased [11]. Changes in consumption are just one contributor to nutrient loss in our diets. The methods used to grow, harvest and distribute food are also contributing to significant losses at each stage of food production. This will be delineated in the following paragraphs.

Industrial agriculture grows food in depleted or dead soil, uses chemical inputs, harvests food before it is ripe, takes 5–14 days to distribute food to consumers, and uses only one to two crop varieties [13]. Plants grown in fertile soil have more nutrients in the edible parts of the plant than those grown in infertile soil [6,14,15]. Studies have

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found that soils deficient in zinc, iron and selenium lead to deficiencies in the edible parts of the plant. For example, peas grown in fertile soil contained three times more zinc than those grown in infertile soil, and wheat contained five times more selenium [6,15,16]. Produce grown with pesticides may not develop a natural defense system which can act as beneficial phytochemicals, such as isothiocyanates, present in broccoli [17,18]. A fruit or vegetable separated from the vine or stem (the plant) before it is ripe will begin to decline before reaching its full nutrient profile. Once a fruit or vegetable is harvested, it continues to respire resulting in moisture loss, quality and nutrient degradation and potential microbial spoilage [19]. The lengthy distribution process can intensify nutrient loss before reaching the consumer. How food is grown, harvested and distributed plays a critical role in the nutrients delivered to the consumer. A report by the World Health Organization found that food today has fewer nutrients than it did 30–50 years ago with some produce containing 10–25% less nutrients [20]. Comparing food from 1951 to today, one serving of broccoli would supply a male's daily Vitamin A requirement. Today, two servings would be required. Likewise, two peaches would supply a female's daily Vitamin A requirement. Today, 53 peaches would be required [13]. One study found carotenoid levels increase with ripening [21]. Vine-ripe tomatoes have higher levels of lycopene, beta-carotene, and soluble fiber than tomatoes ripened off the vine [22]. Toxins present in food as a result of pesticide use create a myriad of health concerns for humans. In 2009, a study examined the effects of dietary exposure to six commonly used organophosphate (OP) pesticides in pregnant mice in an effort to replicate an actual agricultural scenario. Medium-dose exposure to the OP pesticide mixture resulted in significantly lower mean fetal weights and higher rates of intrauterine growth restriction [23]. A study in France found mice metabolism and the hematopoietic system are significantly affected by very low doses of commonly used pesticide mixtures [24]. Glyphosate, an active ingredient in Roundup, which is a heavily used pesticide on GMO crops, is linked to manganese depletion in plants and animals [25]. Manganese depletion for humans is associated with gut dysbiosis, autism, Alzheimer's disease (AD), depression, anxiety syndrome, Parkinson's disease (PD), and prion diseases [25-27]. The use of glyphosate has increased 100-fold since 1970 in response to the glyphosate-resistant weeds and GMO glyphosate tolerant crops. As a result of increased application, misunderstood half-life, and drift, glyphosate contamination is also found in drinking water sources, precipitation, and air especially near farming communities [28]. GMO crops are widely used for animal feed and processed foods. The glyphosate used on these crops often gets passed on to consumers through packaged foods, meats, gelatin, and stock. Glyphosate accumulates in animals' bone marrow, joints and protein, such as collagen [29,30]. Consumers eating a diet heavy in meats from conventionally raised animals are often unaware of the glyphosate intake in their diet. Of particular concern is a recent health trend to consume bone broth. The process of making bone broth calls for extracting the gelatin and collagen from the bones and skin of the animal which results in glyphosate soup unless it is made from animals given organic feed or being pasture-raised [31].

Maximizing the nutrient output of farming systems calls for a shift in the type of food that is grown as well as how it's grown, harvested and distributed. A focus on growing more nutrient-dense crops in place of the high value staple crops necessitates a shift in the current industrial farming practices [6,32]. The concept of nutrition-sensitive agriculture, described by Jaenicke and Virchow (2013), aims to "narrow the gap between available and accessible food and the food needed for a healthy and balanced diet for all people" (p.679). Research focused

on nutrition-sensitive agriculture shows how sustainable agriculture supports the goal of nutrient-dense food while assuring the stability of the system [3,6,7]. Sustainably grown food has less toxins, nitrates, and pesticides. Therefore, consumption of sustainable foods may reduce exposure to pesticide residues and antibiotic-resistant bacteria [33-35]. As described above, consuming food with toxins inhibits the body's normal functions and contributes to disease. When the body is compromised, it is not able to take in nutrients as effectively as a healthy system. Therefore, consuming food with toxins may inhibit the bioavailability of the nutrients in the food and perpetuate the cycle of suboptimal nutrition. Sustainably grown food, harvested at peak ripeness and as close to harvest as possible, can increase the density of nutrients in one's diet and enhance absorption. This calls for guidance and education to access sustainably sourced food from local farmers markets, urban farms, and home gardens to afford a sustainable diet.

Sustainable diet

Recent attention is being given to the importance of consuming a sustainable diet for the continuance of a food system and the health of humans and the planet. Some countries, such as Brazil, Sweden and the Netherlands, have adopted a sustainable diet as part of their dietary guidelines. Brazil defines a sustainable diet as one that is high in plant-based foods, lower in animal-based foods and avoids highly processed foods [36]. The United Nations Food & Agriculture Organization (FAO) defines a sustainable diet as:

Diets with low environmental impact which contribute to food and nutrition security and to a healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and the ecosystem, culturally acceptable, accessible, economically fair and affordable, nutritionally adequate, safe and healthy; while optimizing natural and human resources [37].

A sustainable diet calls for eating a nutrient-dense diet with less processed foods. Processed foods provide fewer nutrients while containing high levels of sugar, unhealthy fat, preservatives, additives and excessive salt [38,39]. Processed foods, in the form of bread made from the starches found in the roots of cattails and ferns, have been in existence even before agriculture began [40]. Shelf-stable fats began in 3,000 BC as evidenced with palm oil found in Egyptian tombs. Shelf-stable sugars have been found as far back as 500 BC with sugarcane that was processed into giant crystals in India. Over time food choices have shifted from whole food meals made from scratch to meals made or purchased from ready-prepared and processed foods [39,41]. The first foods resembling today's processed foods began with the introduction of corn flakes in 1896, Oreos® in 1912, Spam in 1926, and chicken nuggets and TV dinners in 1950 [40,42]. The use of ready-made meals grew in popularity as more women entered the workforce, time limitations and the need for convenience increased, and the cost of these meals dropped. Although processed foods have been part of food production even before agriculture, these foods were minimally processed from whole ingredients with few to no additives. Today's processed foods are high in sugars, unhealthy fats, preservatives and sodium. The rapid growth of processed foods along with changes in socioeconomic factors has led to today's increased consumption of processed foods in place of whole, nutrient-dense foods and meals cooked at home.

Decline in culinary skills

Food preparation at home significantly decreased for all socioeconomic groups between 1965 and 2008 [43]. The following

changes in sociodemographic characteristics have contributed to a decrease in cooking skills: dual income families, convenience orientation, time constraints and decreased transference of essential cooking skills [44-46]. A work week in excess of 40 hours, both parents working, and child extracurricular programs have led to time constraints for meal preparation, making it appealing to use ready prepared ingredients or meals. The purpose of cooking and the meaning of mealtime have shifted from a social connection and cultural expression to a necessity. This use of ready-prepared foods has resulted in a loss of culinary skills being taught to the next generation. Changes in today's food choices and culinary habits influence the type of food purchased and cooked at home, which in turn impacts suboptimal nutrition across income and socioeconomic sectors [2,47-51]. Research shows that meals prepared at home from sustainably grown foods are cost effective and increase fruit and vegetable consumption, proper portions, fewer calories, less fat, less salt and less sugar [4,44,52-55]. Americans generally perceive healthy cooking to be more expensive and time consuming [1]. This is largely dependent on the food and the metrics of measure used to determine cost. For all food groups and metrics there are expensive and inexpensive foods. Pre-washed, fresh cut vegetables, salad kits, and baby carrots are more expensive and potentially less nutritious than fresh whole foods that are in season. Pricing food per portion instead of the whole item cost reflects the practical price of the food while demonstrating the number of meal portions obtained from the whole food purchased. Creating meals from whole food calls for an increase in culinary skills. A systematic review of the impacts of cooking programs (1980-2015) shows a relationship between cooking skills and cooking habits [47-51]. Providing kitchen organization and management skills along with cooking skills increases a participant's ability to routinely continue the practice [43,45]. Creating change in consumption patterns, cost perceptions, diet choices and food budget allocations requires education and guidance. The knowledge, skill and motivation to make healthy food choices has to be addressed with a consideration for today's socioeconomic characteristics [5,6]. To improve whole food consumption, interventions should include where to find inexpensive whole foods combined with skill building activities to prepare that food while building convenience into the process to address today's limited time constraints [1,43,56]. Television is a familiar medium across many socioeconomic groups. Using TV cooking shows to create change in cooking and eating behavior has shown inconsistent results. TV cooking shows are categorized as educational or "edutainment." "Educational" focuses on the transfer of cooking knowledge and skills, while "edutainment" focuses on entertaining their viewers [57]. When comparing educational TV shows to edutainment, De Backer and Hudders found men of all ages appear to cook more often if they watch an educational cooking show. Men above 38 years of age tend to cook more often if they watch an edutainment TV show. In another study, Good Grubbin—four 15-minute educational cooking programs—were shown to upper division college students. This resulted in a change in nutrition knowledge but not in cooking behaviors or consumption [58]. The authors of Good Grubbin suggested testing the impact of an extended cooking and nutrition TV series on a larger sample. Another nationwide study measured viewer change in two intervals—3 days and 5½ months after watching a TV program called Eat Smart. Significant changes in cooking and eating behaviors resulted [59]. A study by Caraher, Lang, & Dixon [60] used data from a Health and Lifestyles Survey in England among 5,553 participants of working class, middle class and young professionals. Nineteen percent of participants reported learning cooking from TV cooking

programs. Focus group interviews were used with a subset of the survey respondents. Respondents reported a desire for health advice and the ability to learn from cooking shows but did not feel like shows offered useful or applicable information [60]. If presented correctly, TV cooking programs could be used as a viable intervention medium. Although outcomes in behavior change varied, all studies reported audiences liked watching cooking shows and reported a gain in knowledge. The results of the various studies suggest that for the shows to be an effective intervention, the information, preparation methods and delivery method need to be applicable to the audience and should include information about health. To date none of the TV programs created a series that combines entertainment and education with a focus on sustainable cooking and eating habits. Therefore, the goal of this research project was to develop an intervention that addresses how to source, store and prepare inexpensive, nutrient-dense, sustainable food to make weekly meals with built-in convenience. The intervention consisted of an eleven-segment pre-recorded cooking series using a television format. Each episode was limited to 15 minutes to accommodate the average attention span, increase audience appeal and provide the option to use the segment as part of a cooking class. Various studies have found the average attention span is 10–20 minutes [61-63]. The series was intended to build confidence and inspire participants to buy, cook and eat whole, sustainable foods while gaining insight into setting up a kitchen to easily make weekly meals from whole ingredients. The videos focused on a sustainable diet and included shopping excursions to the farmers market and a local health food store.

Materials and Methods

Intervention description

The overarching concept of the eleven-video intervention package is to address the suboptimal diet impacting many Americans by providing immediate (diet change) and long term (purchasing power influence) solutions to the many issues discussed above. The episodes are designed to address the loss of nutrients in food; lack of dietary diversity; pervasiveness of highly palatable, energy dense, nutrient poor foods and the decline in culinary skills. Sustainable foods were an essential focus of these videos since they addressed the decline in nutrients in food caused by depleted soils or increased toxins in food. Information will be provided to help participants understand sustainable food, how to source it, the health benefits gained and simple preparation methods. To provide a more affordable method of sourcing sustainable food, shopping at farmers markets and buying whole foods were a key focus that also emphasized a variety of foods and types of meals/snacks, See Table 1 for a list and description of each episode.

Participant recruitment

Male and female participants from three different sociodemographic market segments in Long Beach, California were used to test the wide appeal of the cooking intervention. A volunteer sample was used from the following communities: Century Villages at Cabrillo (CVC), Osher Life Long Learning Institute (OLLI), and California State University, Long Beach (CSULB) Hospitality Management (HM) Students. CVC is a 27-acre campus community geared toward a vision of breaking the cycle of homelessness. OLLI is a "senior university" program that offers lifelong learning programs for adults fifty years of age or older throughout the United States. Hospitality Management (HM) students were part of a required course for the major titled "Exploring a Sustainable Food System."

Episode title	Focus
Episode 1: Farm to Table Freshness	Farmers market vendor interviews demonstrating how to source nutrient-dense, sustainable produce including questions pertaining to harvesting and growing practices How to clean, store and prepare weekly meals from the produce
Episode 2: Grains and Beans	Cost and convenience associated with purchasing dried, canned or bulk whole grains and beans Proper storage to preserve nutrients Cooking method providing the most nutrients Diverse variety of whole grains and beans
Episode 3: Fats and Spices	Healthy and unhealthy fats/oils Cooking fats/oils Working with spices to enhance flavor and health benefits
Episode 4: Working with Poultry	Understanding the different labels in the market for poultry (organic, pasture-raised, conventional, air-chilled) Cost effectiveness of cooking whole chickens Bone broth
Episode 5: Herbs and Sauces	Using herbs to add nutrients and flavor Most cost-effective source is growing them. Simple nutrient-dense sauces, and dressing from whole foods (tomatoes, coconuts, yogurt) and bone broth
Episode 6: Repurposing Leftovers	Food waste Simple ways to turn leftover food into new meals with added nutrients Understanding the different labels in the market for eggs (cage-free, free-range, pasture-raised)
Episode 7: Soups and Crackers	Simple nutrient-dense soups as whole meals or meal additions Simple alternatives to processed foods made from fresh ingredients
Episode 8: Fun Fresh Snacks	More on processed food replacements Nutrient-dense snacks from whole foods Himalayan salt, sea salt, and table salt
Episode 9: Sweet Snacks	More on processed food replacements Nutrient-dense snacks from whole foods Processed sugars and natural sugars
Episode 10: Meat & Seafood	Understanding meat—conventional, organic, grass-fed and pasture raised Understanding seafood—sustainable, wild-caught and farm-raised
Episode 11: The Rainbow Game	Rainbow Game—simplify and create fun to learn balanced eating Diversified diet of fruits and vegetables Proper portion size

Table 1: Intervention topics: episodes 1-11.

Intervention

The cooking videos were administered as part of a class. The length of the intervention and the support provided during class was customized to the needs of each group. For CVC, during a 10-week cooking program, the residents would watch the cooking video then participate in a cooking class utilizing one of the techniques from the video. Also provided during the class were the recipes, cost per portion of each recipe and possible places to source the ingredients. At OLLI, the videos were shown as part of a 6-week course called *Buy, Cook, and Eat Sustainable Food*. During class, a trained student intern showed the videos and led discussions about the different topics. HM students watched one video during class and were given the option to participate in the study by watching the remaining videos at home. The OLLI and college student group did not receive a cooking component as part of the class. All participants were provided a written informed consent form and the study was approved by California State University, Long Beach Institutional Review Board.

Data collection

A pre/post questionnaire was administered to determine change in knowledge about sustainable foods, weekly fruit and vegetable consumption, meal preparation habits and shopping frequency. The questionnaires were distributed during class time. The surveys remained anonymous and a 5-digit number was used to match pre- and post-test responses. A 5-point Likert scale was used to ask participants about familiarity with sustainable food. Ordinal data categories were used to determine fruit and vegetable intake, meal preparation habits and shopping frequency. Participants were also asked to report typical shopping locations. The post-test also included open-ended questions

to gain insight pertaining to the impact of the intervention on the participants.

Data analysis

A qualitative approach allowed for themes and categories to emerge naturally from the participants' responses to the open-ended questions. These questions focused on likes and dislikes related to the intervention as well as suggestions for improvement in the overall course. See (Table 2) for the survey questions. Nonparametric tests on the pre- and post-intervention data were used to assess changes in participants' knowledge of sustainable foods, weekly fruit and vegetable consumption, meal preparation habits and shopping frequency. Thematic analysis was used for the qualitative data on the post survey. Six steps of thematic analysis as outlined by Braun and Clarke were used to analyze the qualitative data. These steps include familiarization with data, generating initial codes, searching for themes, reviewing themes, developing a codebook, and producing the report [64]. Two researchers (LG and VG) reviewed the transcripts separately, moving back and forth between steps as needed, to develop the codebook (including codes and definitions) and then met to resolve differences. Then each researcher independently applied the codes to the transcripts. Based on respondents likes, dislikes and areas of improvement, six categories emerged.

Results

The overall response rate among the three groups of volunteers was 31.7%, with largest number of responses from students and the highest percentage of response from the OLLI group. Please see Table 3 for the response rates.

Quantitative (Pre/Post)							
1. I am not familiar with sustainable food.							
Strongly Disagree	1	2	3	4	5	6	7 Strongly Agree
2. How often do you include fresh vegetables with meals?							
Daily			1 <input type="checkbox"/>		Once a week		4 <input type="checkbox"/>
4-6 times a week			2 <input type="checkbox"/>		Less than once a week		5 <input type="checkbox"/>
2-3 times a week			3 <input type="checkbox"/>		Never		6 <input type="checkbox"/>
3. How often do you include fresh fruit with meals?							
Daily			1 <input type="checkbox"/>		Once a week		4 <input type="checkbox"/>
4-6 times a week			2 <input type="checkbox"/>		Less than once a week		5 <input type="checkbox"/>
2-3 times a week			3 <input type="checkbox"/>		Never		6 <input type="checkbox"/>
4. How often do you shop for food to be prepared at home?							
Daily			1 <input type="checkbox"/>	Every 2 weeks			4 <input type="checkbox"/>
Twice a week			2 <input type="checkbox"/>	Once a month			5 <input type="checkbox"/>
Once a week			3 <input type="checkbox"/>	Other			6 <input type="checkbox"/>
5. Where do you typically shop for food?							
Examples are provided in parenthesis. Check all that apply.							
Traditional Grocery Store (Vons...)			1 <input type="checkbox"/>	Farmers Market/Stand			5 <input type="checkbox"/>
Health food store (Whole Foods)			2 <input type="checkbox"/>	Food Bank			6 <input type="checkbox"/>
Garden			3 <input type="checkbox"/>	Specialty Grocery Store (Trader Joe's)			7 <input type="checkbox"/>
I eat out			4 <input type="checkbox"/>	Other _____			8 <input type="checkbox"/>
6. How far in advance do you plan meals?							
At meal time			1 <input type="checkbox"/>	Every 2 weeks			4 <input type="checkbox"/>
Daily			2 <input type="checkbox"/>	Never			5 <input type="checkbox"/>
Weekly			3 <input type="checkbox"/>	Other _____			6 <input type="checkbox"/>
Qualitative (Post)							
What did you like about the cooking videos?							
What did you dislike about the cooking videos?							
Is there anything that you feel should be improved if the course is run again?							

Table 2: Quantitative and qualitative survey question.

Demographics

A total of 27 respondents completed the pre/post survey. Forty eight percent were under 25 years of age, 11% were between 25 and 45 years of age and the remaining 41% were over 45 years of age. The overall study consisted of 85% female participants. Approximately 70% of the respondents were Non-Hispanic White or Euro-American, 15% East Asian or Asian American, 11% Latino or Hispanic American, and 4% Middle Eastern or Arab American. Eighty five percent of the participants lived in households with 2 or more members, with 89% of the household member over the age of 16. Sixty three percent of the respondents had a college degree, 26% had some college education and 11% completed high school. Forty Eight percent of the respondents in this study fall below the median income in California, which is \$ 64,500 [65]. The income level of 44% of the respondents was over \$ 50,000. Twenty six percent of the respondents were below \$ 25,000, and 22% were between \$ 25,000–\$ 49,000 (Table 4).

Quantitative results

Comparison of responses from the pre-and post-intervention revealed a significant change in familiarity with sustainable foods ($p=0.012$) and fruit consumption ($p=0.012$). Although not statistically significant, there were improvements in vegetable consumption, frequency of shopping and frequency of meal planning from pre- to post-intervention (Table 5). Survey items related to shopping practices included location of food sourcing (e.g., stores, markets, gardens) and the frequency of shopping. Participants were asked to mark all the places they obtain their food. Three categories—health food store, garden and specialty store showed an increase in use after the intervention. Specialty stores showed a significant increase ($p=0.008$). Although there were no significant changes in shopping frequency, there was an increase in the number of participants who reported more frequent shopping at post-intervention (such as a shift from shopping every two weeks to shopping twice a week). Before the intervention, the most frequent food shopping pattern was once a week, with twice a week and once every two weeks as the next choices, respectively. After the intervention, the most frequent category was twice a week with some shifting to daily shopping. It is interesting to note that both shopping once a week and every two weeks decreased. Meal planning habits also showed some notable shifts. The number of participants that never plan meals dropped to zero. Daily planning decreased, and weekly planning increased. Both meal preparation habits and shopping frequency shifts toward healthier consumption but should be tested on a larger sample. The intervention resulted in a significant increase in participants' frequency of including fruits with meals ($p=0.021$). Participants in the categories of eating fruits 2–3 times a week and once a week both showed a decrease as they shifted to categories that consumed fruit more often. The number of respondents eating fruits daily increased from 29.6% to 44.4%. Respondents eating fruits 4–6 times a week more than doubled with an increase from 11.1% to 25.9%. Data related to vegetable intake also showed a shift towards greater frequency of consumption. There was a substantial decrease in the category of respondents eating vegetables only once a week, from 18.5% to 3.7%. Most of those respondents shifted to categories that included vegetables daily in their diet, from 40.7% to 55.6%. Although the changes in vegetable consumption were not significant, the shift towards more frequent consumption in a small sample warrants further testing with a larger sample.

Qualitative results

The six themes that emerged from the open-ended questions about

Market	Number	Percentage
OLLI	8/22	36.4%
HM	17/50	34%
CVC	2/13	15.3 %
All Groups	27/85	31.7%

Table 3: Response rate.

Category	n	%
Age		
Under 25	13	48.1
25–45	3	11.1
46–65	5	18.5
66 and over	6	22.2
Gender		
Male	4	14.8
Female	23	85.2
Ethnicity		
Non-Hispanic White or Euro-American	19	70.3
Black, Afro-Caribbean, or African American	0	
Latino or Hispanic American	3	11.1
East Asian or Asian American	4	14.8
Middle Eastern or Arab American	1	3.7
Education		
High School Graduate	3	11.1
Some College, No degree	7	25.9
Associate's Degree	10	37
Bachelor's Degree	2	7.4
Graduate Degree	5	18.5
Income		
Less than \$25,000	7	25.9
\$25,000–\$49,999	6	22.2
\$50,000–\$74,999	4	14.8
\$75,000–\$99,999	4	14.8
\$100,000–\$149,999	2	7.4
More than \$150,000	2	7.4
No response	2	7.4

Table 4: Demographics of participants.

the cooking show are: comprehension, usability, engaging, informative, video format and suggestions for improvement. Subthemes were used to organize repeated aspects of each category. See Table 6 for themes, definitions, subthemes and a sample of the participants responses. Comprehension refers to the ability to understand the information. Respondents liked that the recipes were easy to follow and simple to make. Communicating each step and the timing for preparation, cooking and serving the recipe was a well-liked aspect of the program. Seeing the procedures made it easier to understand. Usability refers to the ability and desire to apply the information and use the recipes. Respondents indicated simple, easy recipes and ingredients increased the ability and desire to make the recipes. The fact that the recipes did not take too much time and used simple ingredients increased the appeal to make fresh healthy meals with unfamiliar food. The applicability of new information and use of unfamiliar foods was enhanced by the demonstration of many different dishes from the same ingredients. However, for a few respondents the unfamiliar foods were

Category	Pre-test (n)	Pre-test (%)	Post-test (n)	Post-test (%)
Frequency of including fresh vegetables with meals				
Daily	11	40.7	15	55.6
4–6 times a week	4	14.8	4	14.8
2–3 times a week	6	22.2	7	25.9
Once a week	0	0	0	0
Less than once a week	5	18.5	1	3.7
Never	1	3.7	0	0
Frequency of including fresh fruit with meals				
Daily	8	29.6	12	44.4
4–6 times a week	3	11.1	7	25.9
2–3 times a week	8	29.6	5	18.5
Once a week	4	11.1	2	7.4
Less than once a week	3	3.7	1	3.7
Never	1	0	0	0
Food shopping frequency				
Daily	0	0	2	7.4
Twice a week	8	29.6	9	33.3
Once a week	10	37.0	8	29.6
Every two weeks	7	25.9	6	22.2
Once a month	1	3.7	1	3.7
Meal planning frequency				
At meal time	7	25.9	7	25.9
Daily	12	44.4	10	37.0
Weekly	7	25.9	9	33.3
Every two weeks	0	0	0	0
Never	1	3.7	0	0

Table 5: Fruit and vegetable consumption, shopping practices and meal preparation habits at pre- and post-intervention.

uncomfortable and inhibited their desire to use the recipes.

Engaging refers to the information being interesting and being delivered in a manner that was fun or enjoyable to watch. Participants reported that the colorful and appetizing food was visually appealing and enticed them to try the recipes. The respondents found the videos engaging. The participants liked being able to use the information to make healthy and easy meals. The new information, how it was presented, the interesting recipes, and professionalism of the videos were also well received. The informative category pertained to information about the sourcing, preparation and nutrition of food. The participants liked learning how to source food from vendors or employees at the markets. They also valued learning the nutritional benefits of various foods, healthy preparation methods and new ideas for meals. The participants liked that the videos were factual, to the point and full of new information. The video format category collected feedback relating to the video content, video length and camera work. There was a mix of responses about the length of the videos, with an equal number of participants expressing that the video was just right (2) or too long (2). The largest number of participants commenting on the video length thought the video was too short (4). A few suggestions pertaining to better lighting, audio and camera angles were shared. Suggestions for improvement gathered recommendations on the content and/or its delivery. To appeal to a wider audience, using different assistants on each episode, or providing alternatives to the products was suggested. For some, seeing the assistant actually making the recipes would have helped them believe the recipes were more accessible. To reinforce the information, there was a desire to see the information in multiple

formats. Suggestions included showing recipes and definitions on-screen, providing a resource manual and distributing printed copies of recipes. Overall the participants liked that the information, ingredients and recipes in the videos were simple, clear, engaging and usable. The information that appealed to the respondents related to health, sourcing, simple ingredients and preparation methods. Real time shopping examples, such as going to the local farmers market or grocery store, were enticing additions to the cooking show. Feedback to improve the impact of the videos included the addition of a cooking manual and local customization of ingredients and sourcing.

Discussion

To date, there are several research papers, policy discussions and dietary guidelines with a focus on access to sustainable diets as critical components to the health of future generations, the environment and food security [66-69]. However, to the best of our knowledge this is the first study to focus on teaching sustainable food habits through an educational and entertaining cooking intervention. As seen in the literature review, sustainable diets are often perceived to be in conflict with affordability. Affordability is reliant on changes in the farming system, policy and at-home meal consumption [3,4,7,70]. The immediate focus of this intervention was to increase at-home meal consumption and knowledge of sustainable food. The long-term goal was to create a shift in purchasing habits and thereby influence change in the marketplace and farming methods. Overall the data analysis from this intervention suggests that after receiving the intervention, shopping, planning and consumption patterns shifted toward healthier habits. The significant change in participants' understanding of the meaning of sustainable food was accompanied by changes in where they shop as well as their shopping frequency. The significant increase in shopping at specialty stores and the overall increase in shopping at health food stores coincide with seeking healthy food options. Since fresh produce is perishable, including it in the diet requires more frequent visits to food stores or markets. Changes in shopping patterns support the increase in participants' weekly fruit and vegetable consumption. As shopping patterns shift toward sustainable choices, the change in demand helps influence the type of goods in the marketplace. Shifts in shopping frequency provide evidence that some participants began to seek fresher food. Changes in meal planning habits suggest an increase in planning meals in advance. Meal planning helps assure the purchase of food needed to prepare healthy meals, and having the necessary ingredients on hand helps increase the possibility of cooking and consuming healthy meals. The questions used to obtain qualitative data allowed participants' input to naturally emerge by simply asking what they liked and disliked about the program. Consistent with the previous research on TV cooking programs, participants liked the content in the videos and the manner in which it was delivered [58-60]. Participants liked that the information was simple, accessible, healthy and nutritious. The participants enjoyed the engaging, entertaining and repeatable delivery of the information. The cooking show format for learning about sustainable cooking was well-received and suggests the value of using entertainment to support learning. An unexpected outcome was the desire for longer segments. This is surprising with today's time restraints and short attention span. The videos did a good job of keeping participant interest and may suggest that participants are seeking this information. Consideration of participant feedback can help format future interventions. Participants were engaged in video segments of local markets and requested more videos of this nature. Three of the eleven episodes visited local markets. This could pose a challenge for creating a universal intervention to be used in

Theme	Sample Response
Comprehension: <i>ability to understand the information</i> Subthemes: a. Easy to follow	The clear explanation of how to prep, cook and serve, especially clear explanation of the timing. They were easy to understand. I learned a lot. The step by step instructions made it easy to follow along.
b. Simple and clear	Seeing the procedures and tools in living color makes it easier to understand.
Usability: <i>the ability and desire to apply the information and use the recipes</i> Subthemes:	I've learned that from simple ingredients I can turn them into something really good and healthy. I like how all the foods are made easy with fresh ingredients. They seemed simple and attainable for anyone.
a. Simple/easy recipes/ingredients b. Applicable	I enjoyed how every type of vegetable/produce can be made into multiple dishes. I will continue to access the video and try recipes. Getting ideas for healthy meals
	I liked that they were very easy to follow and did not take too much effort or time, More food that is more common to cook
Engaging: <i>the information was interesting and delivered in a manner that was fun or enjoyable to watch</i>	Pleasantly happy to watch and interesting visually pleasing. Loved the emphasis on colors I don't think there is something that I dislike in the videos. It is all fun and interesting.
Subthemes: a. Enjoyment/fun b. Health c. Appeal	I honestly loved all parts of the videos. They were very engaging and straight to the point. I really like the new information. Meeting the farmers and seeing how passionate they were about their product.
Informative: <i>pertained to the information about sourcing, preparation and nutrition of sustainable foods</i> Subthemes:	They (videos) answered a lot of simple questions I had. As well as the different nutrients and health benefits the different foods being used provide New info and new methods, I tried new oils
a. Sourcing b. Healthy c. Preparation	Because I am not the biggest cook, I learned a lot of new recipes and methods of what to do with leftover food. Interviews with farmers and grocery staff
Video Format: <i>the length, format, quality and delivery of the information</i>	Manageable viewing time Right length
Subthemes: a. Video length b. Video suggestions: Content, filming & delivery	Some were a little long but ok Wanted longer Sometimes they went a little too fast regarding instructions. Maybe more hands on from the assistant in the video.
Suggestions for Improvement: <i>refers to content or delivery of the information</i>	Maybe different students in each episode to get a feel for different culture and different perspective.

Subthemes: a. Expanded perspective	More alternatives to the products used in case individuals do not have access to the products and ingredients the cooking show uses. Add definition and description of unique ingredients on the bottom of the screen so the audience can see what it is. The assistant never tasted anything, neither did the chef.
b. Support	I want to see more market videos.

Table 6: Themes emerging from responses to open-ended questions about cooking shows.

different locations. One solution would be to develop curriculum to accompany the universal intervention. The curriculum could help the facilitator identify local sustainable markets and supplemental classes or material to customize it to the specific target group. Since participants liked seeing familiar shopping locations, it might be beneficial to provide facilitators with a guide to develop locally-made video shopping supplements. Another engaging aspect of the videos was the food presentation aesthetic of colorful ingredients and appetizing final products. This visual appeal was reported to increase desire to repeat the recipes. Colorful and aesthetically appealing food presentation may be a useful approach to encouraging more diversified diets. Consistent with Caraher et al. [60] a key factor to learning about food and cooking is the desire for simple, easy and applicable recipes and health information. Several positive comments about learning how to make simple, healthy meals and snacks suggest a desire to adopt healthier habits. The participants liked the nutrition and health benefits taught in each episode. There were requests for even more nutrition and health information. A couple of comments about watching the videos again and continuing to use them suggest a repeatable medium could enhance interventions. Some of the things that the participants did not like included use of unfamiliar ingredients or cooking methods. In addition, there were suggestions to increase audience appeal by using assistants from different cultures, adding more hands-on participation from assistants and providing alternate ingredients. All of these suggestions could be used to increase appeal across various socioeconomic or demographic groups. Seeing someone with whom viewers relate might increase perceived accessibility and desire to use the information. Showing how more familiar ingredients can be used in place of the new ones introduced in the video might help ease the transition to new ingredients. A group of respondents desired to see more support, whether on the videos or as supplemental materials. This is interesting considering there is a blog that provides another format to revisit the information in the videos. The blog is mentioned during each video but was not widely used or accessed. The blog may not appeal to this group of respondents or needs more effort to engage participant use of the medium. Easy access to the blog with live links included in each video episode could increase traffic to the site and should be explored more critically. This may indicate that for some, the videos alone are not enough to create change and need to be accompanied with a course format and supplemental materials.

Limitations

This exploratory study used a small convenience sample so generalizations to the population cannot be made. Since participants volunteered for the study, they may have had some interest in the topic of health, cooking or sustainability. The study focused on three

different groups: residents 50 years and older, residents of a low-income housing shelter and college students. The small sample size did not allow for changes in the three groups to be investigated separately. The large number of female respondents and the highly educated sample may have influenced the outcome. The shifts toward healthier consumption and favorable culinary habits are limited to the sample in the study. Therefore, it is important to replicate the study on a larger sample. The information concerning participants' understanding of sustainable foods was self-reported and may not measure actual change in knowledge. Finally, for the OLLI and CVC participants, the outcome was measured on the last day of class while the information and practices were fresh in their minds. A follow-up study would be helpful in elucidating lasting behavior changes and/or continued growth.

Conclusion

The results of this exploratory study suggest that participants are interested in seeking healthy meal options. Participant feedback suggests a focus on cooking information that is simple, easy and applicable to today's sociodemographic characteristics. The videos provide an engaging format to deliver the information and suggest that relevant TV cooking programs can impact barriers to cooking and provide access to health information. For some groups, a supporting curriculum is needed to customize the delivery to meet the specific needs of different market segments. Curriculum customization might include additional handouts, instructions, hands-on components and/or local market information. Further research into the specific needs of each market is needed to develop curriculum tailored to different socio-economic or demographic groups. The solution to better health and nutritional patterns requires changes throughout the food system regarding agriculture, distribution, processing and consumption. It begins at the farm by implementing nutrition-sensitive agriculture practices. Food must be harvested, distributed and processed in a manner that assures peak nutritional value. Food consumption habits need to be guided toward optimal nutrition. The cooking intervention in this study addresses the loss of nutrients in food; lack of dietary diversity; pervasiveness of highly palatable, energy dense, nutrient-poor foods; and the decline in culinary skills. Addressing at-home consumption habits will have a ripple effect on the food system as consumers' purchasing habits change and influence the product demand in the market place.

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