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Increased Fruit and Vegetable Intake among Older Adults Participating in Kentucky's Congregate Meal Site Program

Dawn Brewer, PhD, RD, LD, Emily Dickens, MS, RD, LD, Alyson Humphrey, BS, and Tammy Stephenson, PhD

Department of Dietetics and Human Nutrition, University of Kentucky, Lexington, Kentucky 40506

Abstract

The purpose of this study was to determine if the amount and variety of fruits and vegetables consumed increased among community-dwelling older adults participating in Kentucky's congregate meal site program following a series of five nutrition education lessons. A convenience sample of older adults attending senior centers ($n=35$), two intervention ($n=19$) and two control ($n=16$) centers, participated in this quasi-experimental pilot study. Following the intervention there was a significant increase in actual fruit and vegetable intake in the intervention group ($p<0.05$) as assessed by plate waste measurements of the congregate lunch meal. In addition, from pre- to post-intervention, a trend towards increased self-reported intake in the variety of fruit and vegetables was observed among the intervention group. As well, a significant increase in the number of days intervention participants self-reported consuming at least 4.5 cups of fruits and vegetables in the last seven days (2.44 ± 2.09 days to 4.28 ± 1.99 days ($p=0.004$)) was observed; and knowledge pertaining to phytochemicals increased ($p<0.05$). The phytochemical index (PI) score of the lunch meal, taking into account that the older adults consumption of meal components, including phytochemical-rich foods, was 26.9. Overall, study results indicated that a short theory-based nutrition education program offered to community-dwelling older adults was linked to an increase in fruit and vegetable consumption and phytochemical knowledge.

Keywords

Fruits and vegetables; older adults; plate waste; phytochemicals

Introduction

The older adult population is considered one of the fastest growing segments of the population within the United States (US) and is projected to reach approximately 71 million by the year 2030 (Center for Disease Control (CDC), 2015). Moreover, the average life expectancy of persons who have reached age 65 years has increased by an additional 19.2 years (US Department of Health and Human Services Administration on Aging, 2015). With this increasing lifespan comes the elevated risk of the development or progression of multiple chronic diseases (Fisher, 2007). An estimated 80% of adults over the age of 65 have

at least one chronic disease, while an estimated 50% have two or more chronic diseases (Fontana, 2009). Consequently, healthcare costs associated with caring for older adults, particularly those with chronic diseases, will continue to rise. Educating older adults about key nutrition-related behaviors is one method to encourage behavior changes that promote chronic disease prevention and management, as well as prolonging independence.

Research has demonstrated that increasing fruit and vegetable consumption promotes healthy aging by delaying the onset or severity of a variety of chronic conditions (Hendrix et al., 2008; Nicklett & Kadell, 2013). The subsequent increased consumption of phytochemicals associated with a diet rich in fruits and vegetables is a component thought to be associated with the observed health benefits (Si & Liu, 2014). Phytochemicals are non-essential, non-nutritive compounds (Si & Liu, 2014) derived from various plant-based foods that include fruits, vegetables, legumes, nuts, and whole grains (McCarty, 2004). They are known to be beneficial in protecting against several chronic diseases (Heneman & Zidenberg-Cherr, 2008; Zhang et al., 2015) by lowering oxidative stress and inflammation (Vincent, Bourguignon, & Taylor, 2010). The *2015-2020 Dietary Guidelines for Americans* recommends that adults over the age of 51 consume between 1.5-2.0 cups of fruits and 2.5-3.0 cups of vegetables each day. The guidelines place an emphasis on consuming a variety of fruits and vegetables. (US Department of Health and Human Services and US Department of Agriculture, December 2015). However, despite these recommendations, the mean consumption of fruit and vegetables among adults nationwide is only 1.1 and 1.6 servings per day of fruit and vegetables, respectively (Center for Disease Control (CDC), 2013). Low consumption of fruits and vegetables among older adults has been linked to barriers such as poor access, lack of nutrition knowledge, health problems, and geographically or physically isolated environments (Nicklett & Kadell, 2013).

The services provided by the Older Americans Act Elderly Nutrition Program (OAAENP) promote healthy aging by addressing some of these barriers through the provision of nutritious meals and social programs. Title IIIC of the Act authorizes access to healthy meals, nutrition education, and nutrition counseling free of charge to adults 60 years or older while specifically targeting those with the greatest social and economic need (US Department of Health and Human Services Administration on Aging, 2015). To maintain operations, senior centers, which are a type of community center, obtain funding from government sources, public and private grants, businesses, fundraising, participant contributions, in-kind donations and volunteers. Each state is divided into planning and service areas that include designated Area Agencies on Aging (AAA), which develop and implement programs and services for older adults at the local level, including the nutrition services. The healthy meal component is provided as congregate or home-delivered meals. The congregate meals are served in group settings at a community center, typically a senior center. All meals served through the OAAENP are required to fulfill the recommendations of the *Dietary Guidelines for Americans* and provide a minimum of one-third of the Dietary Reference Intakes (DRI) for certain nutrients. Furthermore, congregate lunch meals are required to offer at least 1 serving each of a fruit, vegetable, and a whole grain without a specific requirement for phytochemicals. These three meal components are, however, considered to be phytochemical-rich foods that contribute to the phytochemical index (PI) score. The PI score is a ratio calculation derived from the energy of high phytochemical-rich

food in kilocalories (kcal) to the overall daily energy intake (kcal). Several studies have found PI scores ranging from 28.6 to 48.1 to be associated with positive health benefits such as weight loss, reduced risk of breast cancer, and improvement in triglyceride levels (Bahadoran, Karimi, Houshiar-rad, Mirzayi, & Rashidkhani, 2013; Golzarand, Mirmiran, Bahadoran, Alamdari, & Azizi, 2014; Vincent et al., 2010).

The effectiveness of dietary interventions administered to older adults has been studied multiple times particularly within the OAAENP. Several studies from both short- and long-term interventions have found moderate increases in fruit and vegetable intake among retirement age participants (Lara et al., 2014). However, additional studies have shown that more nutritional guidance is still needed among older adults (Foote, Giuliano, & Harris, 2000) to raise awareness, enhance self-efficacy and improve perception of the health benefits of fruits and vegetables (Salehi et al., 2010). Providing nutrition education at senior centers is one avenue of improving nutrition knowledge (Rosenbloom, Kicklighter, Patacca, & Deshpande, 2004) and lifestyle behaviors among older adults, particularly in promoting increased fruit and vegetable consumption (Hersey et al., 2015). Senior centers are also an environment that lends itself to conducting plate waste measurements. The meal components are portioned out into a tray using standard portion sizes and then given to participants. By collecting the tray from participants once they have finished their meal, the actual consumption of meal components can be assessed by visually evaluating the remaining meal components left on the tray. As well, having access to the senior center lunch menus allows for the assessment of the average PI score of the lunch meals. Moreover, in combination with the plate waste measurements, the average PI score based on actual consumption of phytochemical-rich foods can be measured.

The purpose of this pilot study was to determine if the amount and variety of self-reported fruits and vegetables consumed increased among community-dwelling older adults participating in Kentucky's congregate meal site program following a series of five nutrition education lessons; to ascertain if actual fruit and vegetable intake increased; to calculate the average meal PI score of a set of 2014-2015 congregate lunch menus for a particular Area Agency on Aging (AAA); and to calculate the average meal PI score based on participant intake of phytochemical-rich foods as assessed by plate waste measurements.

Materials and methods

Participants and setting

The University of Kentucky's Office of Research Integrity Institutional Review Board approved all questionnaires and procedures for the study. The pilot study took place at four senior centers within the Bluegrass AAA located in the Central Kentucky region. This quasi-experimental study included a voluntary convenience sample of community-dwelling, non-institutionalized older adults aged 60 years or older that attended their local senior center. Participants were recruited through advertisements in the monthly senior center newsletter, posting flyers and table tents in each center, and from the encouragement of each senior center director. Two of the four senior centers served as control and two as the intervention group. Participants were excluded if they were homebound or cognitively impaired, as determined by senior center directors. Study personnel obtained written informed consent

from interested seniors, yielding 64 participants. The study took place May 2015 through August 2015.

Data collection

Plate waste measurement—Anonymous plate waste measurements and lunch quality questionnaires were conducted at all four centers to evaluate fruit and vegetable intake. Plate waste measurements were modeled after the methods of Hanks, Wansink, and Just (Hanks, Wansink, & Just, 2014). Each pre- and post-measurement were done on the same day of the week and time for each center. A total of four plate waste assessments were completed for each center during the study. The initial measurements were completed at the pre-intervention time point and then within one week following the intervention. In brief, lunch items were portioned into Styrofoam plates and/or bowls that were placed onto a plastic tray that contained a participant code and the lunch tray questionnaire that was handed to the senior. Research personnel were present in the dining room to encourage the participants to complete the questionnaire and to provide assistance with completing the questionnaire. Once the participants completed their lunch they were directed by the researchers to place their tray on a designated table rather than throwing items into the trash. Measurements of required meal components served in the congregate lunch meal were then taken. The meal components included some form of bread, fruits, vegetables, meat, desserts, and butter as a condiment. These measurements were based on the quarter-visual waste method (0%, 25%, 50%, or 100%) and the digital imaging method. Three individual raters were involved in the process of assessing the plate waste. The first rater recorded the quarter increment measurements on a data sheet and placed it in an envelope as soon as the numbers were recorded for a particular tray. The second rater randomly chose half of the participants' meal trays to rate independently of the first rater and recorded their measurements on a separate data sheet. Digital pictures of an untouched reference tray along with each participants' tray were taken and evaluated by a third rater using the quarter-visual increments six weeks following the initial plate waste measurement at the senior center (Connors & Rozell, 2004; Hanks et al., 2014). An average of the measurements by the three raters was determined and the intraclass correlation two-way mixed method (ICC (2)) was conducted to assess reliability (Hallgren, 2012). An ICC(2) score below 0.70 suggests internal inconsistency, between 0.70 and 0.79 is fair clinical significance, between 0.80 and 0.89 is good clinical significance, and 0.90 or greater is excellent (Cicchetti, 1994).

The anonymous lunch questionnaire were collected when lunch trays were collected by research personnel during the plate waste measurements. There were 125 questionnaires distributed before and after the intervention (77 from intervention and 48 from control). One hundred seventeen questionnaires were returned at the pre-plate waste time point (72 from intervention and 46 from control) and 83 were returned at the post-plate waste time point (48 from intervention and 35 from control). These questionnaires included meal satisfaction questions to assess participant satisfaction with the taste, texture, and portion sizes of the meal, as well as if they would eat that particular meal again. Additionally, two questions pertaining to whether they usually consumed the particular fruit or vegetable served in the meal were included.

Pre- and post-intervention questionnaires—The pre- and post-questionnaires were reviewed by nutrition experts from the University of Kentucky. The self-reported health questions were derived from the Behavioral Risk Factor Surveillance System Survey Questionnaire (BRFSS) (Centers for Disease Control and Prevention (CDC), 2014). The questions pertaining to fruit and vegetable intake and demographics were taken directly from the “Live Healthy Georgia Seniors Taking Charge: Serving up Fruits and Vegetables Everyday” community intervention questionnaire (Department of Foods and Nutrition; The University of Georgia & Resources, 2005; Hendrix et al., 2008). Questions regarding phytochemical knowledge and intervention satisfaction were developed by the research team.

The pre- and post-questionnaires were administered by research personnel who read the questionnaires to each of the consented participants. The post-questionnaires were administered within one week of completing the final nutrition lesson in the intervention centers or after handing out educational tools at the control centers. The questionnaires included basic demographic information, perceived health, self-reported health history, phytochemical knowledge, and fruit and vegetable consumption. In addition to these questions, the post-questionnaire included questions pertaining to satisfaction with the intervention and use of intervention tools.

To assess fruit and vegetable intake and variety, the frequency of 20 individual fruits and 24 vegetables were listed in the questionnaire. These fruits and vegetables were organized into color categories similar to the Produce for Better Health Foundation's Phytochemical Information Center (Produce for Better Health Foundation). The color categories included orange/yellow, blue/purple, red, green, and white. Seven fruits and vegetables did not fall into a specific category because a color was not associated with a particular fruit or vegetable. The “other” category consisted of 100% fruit juice, dried fruits, apples, grapes, kiwi/mango/or papayas, cabbage, and beans. Serving sizes were explained and frequency for each individual fruit and vegetable was assessed by asking the participant how many times during the past month they consumed each item: 0, 1-3/month, 1/week, 2/week, 3/week, 4/week, 5/week, 1/day, 2/day, or more than 2/day. Fruit and vegetable intake was also assessed by asking participants how often they consumed fresh, frozen or canned produce as well as the number of servings of fruits and vegetables they typically incorporated into each meal (breakfast, lunch, evening meal and snacks).

To encourage participation small incentives were given to those who completed a questionnaire. Incentives included bananas and household or personal items, such as lotion, socks, body wash, toothpaste, mints, water bottles, or dish soap.

Phytochemical index score—The current study also determined the average PI meal score for the Kentucky Bluegrass AAA congregate meal 2014-2015 lunch menus. The average PI meal score was derived using nutrient information from all meals served over a one-year period. Then the average PI meal score based on actual food intake was calculated by averaging the intake of the meal components as determined by the eight plate waste measurements. To obtain the PI score the McCarty equation was used (McCarty, 2004).

$$PI = \frac{\text{dietary energy derived from phytochemical rich foods (kcal)}}{\text{total daily energy intake (kcal)}} \times 100$$

However, for the purpose of our study the equation was modified to determine the score for a particular meal rather than total daily caloric intake. Therefore, we used dietary energy derived from phytochemical-rich foods (kcal) divided by the total energy intake (kcal) from one particular meal and multiplied by 100. McCarty defined phytochemical-rich foods as foods typically high in phytochemicals: fruits, vegetables (not including potatoes, but including tubers), legumes, nuts, seeds, and whole grains (McCarty, 2004). A registered dietitian reviewed the menus and identified the phytochemical-rich foods. The caloric value of each food was determined using the Nutrition Data Systems for Research software (NDSR) (Nutrition Coordinating Center, 2014).

Color Your Plate with Fruits and Vegetables Intervention—The *Color Your Plate with Fruits and Vegetables* intervention was adapted from the University of Georgia's: Live Well Age Well, Serving Up Fruits, Vegetables, and Physical Activity Everyday (Department of Foods and Nutrition; The University of Georgia & Resources, 2005) and the *Nutrition for Older Adults Health* (NOAHnet) program: Fruit and Vegetable Series (Department of Foods and Nutrition; The University of Georgia, 2003). Differences in program implementation included the current pilot study using five nutrition lessons rather than eight to ten, focusing only on fruit and vegetable consumption, and providing specifically developed supplemental learning tools that emphasized the health benefits of phytochemicals using color categories. In this study, the intervention group received a series of five, 15-minute fruit and vegetable-themed nutrition education lessons and educational tools. The lessons taught participants the basics of which phytochemicals were associated with a particular color category and their health benefits; serving sizes of fruits and vegetables; and shopping techniques and tips to overcome common barriers typically perceived by older adults in regards to incorporating a variety of fruits and vegetables into their daily meals.

Educational tools consisted of a phytochemical guide that was given to all participants at the beginning of the study, five seasonal recipe cards and phytochemical health information cards. The laminated recipe and phytochemical cards were bound together by small binder rings and given to all participants for them to keep on a large binder ring as they obtained cards throughout the study. The laminated phytochemical guide categorized fruits and vegetables into color categories, listed specific fruits and vegetables within each color category along with the most common phytochemicals found in each fruit and vegetable and their associated health benefits. The recipe cards used were derived from the University of Kentucky's Family and Consumer Sciences Extension *Plate It Up Kentucky Proud* project, which encourages the purchase and consumption of products grown in Kentucky (University of Kentucky, 2016). Each recipe coincided with seasonal availability of produce as well as the color theme of the nutrition lesson. The phytochemical health information cards corresponded to the recipes by highlighting the potential health benefits of the produce used in the recipe according to their color category and respective phytochemicals. Participants in the intervention group were offered a small sample of the prepared recipes.

Control—The control group received the phytochemical guide, and recipe cards and phytochemical health information cards only. The cards were distributed to participants the same weeks as when the intervention group received their educational tools, recipe samples and lessons.

Statistical analysis

Data was analyzed using the Statistical Analysis System (SAS) software version 9.4. Descriptive statistics for demographics, including frequencies, means, and standard deviations were calculated. Chi-square analysis was used to compare pre- and post-questionnaire categorical variables within and between groups. Paired t-tests were used to compare pre- and post-questionnaire continuous variables within control or intervention groups and the unpaired t-test was used to compare continuous variables between groups for each time point. The change in the quantity and variety of self-reported fruit and vegetables was calculated as a score. The self-reported intakes were converted to an average weekly intake (0, 0.5, 1, 2, 3, 4, 5, 7, 14 or 21 servings/week) in which the individual fruit and vegetable weekly intakes were summed per participant to generate an overall weekly average intake score for all fruits and vegetables as well as a weekly average score for each respective color category.

The plate waste measurement analysis included averages of the participant's consumption of the total meal, meal components, and the phytochemical index score based on plate waste measurements. Participant intake of fruits and vegetables as determined by the plate waste measurements were averaged and compared by t-tests. The PI score, based on food intake, was calculated using plate waste measurements from all centers. The intake of the fruit and vegetable meal components were combined to generate the dependent variable used in the general linear model that was compared within and between groups while including the pre- and post-tray questionnaire questions “is this a fruit or vegetable you usually consume?” as independent variables in the regression model. Differences were considered statistically significant at $p \leq 0.05$.

Results

Demographics

The sample included 35 older adults that completed both the pre- and post-questionnaires. There were no significant differences in demographics between the intervention ($n=19$) and control ($n=16$) groups (Table 1). The majority of participants were white, female, non-tobacco users that had a high school education or greater and self-reported health to be at least “good” (Table 1). Despite the high dropout rate from the original 64 participants who completed the pre-questionnaire, there were no statistical differences in the baseline demographics between those included in the study and the participants that dropped out (data not shown). The high attrition rate was attributed to participants having a lack of interest in completing the post-questionnaire, absence from the center the day of the post-questionnaire assessment, hospitalization, or death.

Plate waste measurements

The plate waste average intraclass correlation two-way mixed method (ICC (2)) for the control group was 0.80 before the intervention and 0.82 afterwards. The ICC(2) was 0.86 and 0.70 for the intervention group. The plate waste data revealed that the intervention group only significantly increased their consumption of fruits and vegetables from pre- to post-intervention, $77\% \pm 31$ to $84.0\% \pm 22$ ($p=0.03$, Figure 1). After controlling for whether or not participants usually consumed a particular fruit or vegetable served in their congregate lunch meal, the significance remained. However, a significant association was detected at the pre-intervention time point between mean fruit and vegetable intake and participants reporting not typically consuming the fruit or vegetable served in the respective meals. Again, there were no significant differences in the intake of produce between the intervention and control groups at either time point. Data from the lunch tray questionnaire revealed high meal satisfaction as at least 80% of participants were pleased with meal taste, texture, and portion sizes, and reported their willingness to eat a particular meal again (Table 2).

Variety and quantity of self-reported fruit and vegetable consumption

Self-reported consumption of fruits and vegetables, as grouped by color category, did not significantly increase from pre- to post-intervention within either group or between the groups. There was, however, greater positive trends in the mean difference of consumption among the intervention group from pre- to post-intervention, compared to control (Table 3). Furthermore, the non-significant increase in the number of produce servings consumed (all produce variable that combined all fruits and vegetables) from pre- to post-intervention was greater among the intervention group compared to control; mean difference of 3.47 ± 2.38 versus 0.75 ± 13.06 servings/week for the intervention and control groups, respectively (Table 3).

In regards to incorporating more servings of fruits and vegetables into meals, the intervention group self-reported incorporating significantly more fruits and vegetables into their evening meal ($p=0.0035$) and all meals combined ($p=0.002$), from pre- to post-intervention while positive trends were observed with breakfast, lunch, and snacks. The control group demonstrated decreased trends of fruit and vegetable incorporation into each meal except for the slight increase in snacks (Table 4). Additionally, the intervention group consumed more fruits and vegetables in the evening meal compared to control both before ($p=0.03$) and after ($p=0.03$) the intervention (Table 4).

Following the intervention, participants within the intervention group self-reported significantly increasing the number of days they had eaten at least 4.5 cups of fruit and vegetables throughout one week, 2.44 ± 2.09 days to 4.28 ± 1.99 days ($p=0.004$). The control group showed a slight positive trend, 2.53 ± 1.96 to 2.80 ± 2.91 days, following the intervention (Figure 2). There were no changes in self-reported consumption of fresh, frozen, or canned fruits and vegetables between or within the two study groups following the intervention (data not shown).

Phytochemical knowledge and self-reported use of educational tools

There was a significant increase in self-reported knowledge among the intervention group on whether participants had heard of the term “phytochemicals” following the intervention, with the frequency increasing from 36.84% to 52.63% ($p=0.03$). There was no knowledge change within the intervention or control groups in regards to correctly identifying plants as the food source of phytochemicals (data not shown).

In regards to use of educational tools, significantly more participants in the intervention group compared to control, (84.21% vs 43.75%, $p=0.04$), reported sharing the health benefits of what they had learned about phytochemicals with family, friends, co-workers, or acquaintances (Table 5). Although not significant, the intervention group was more likely than control to report reading the phytochemical health information cards and be motivated by the information to take action to be healthier (Table 5).

Phytochemical index score

The plate waste measurements ($n=119$) demonstrated that participants consumed an average of $79\% \pm 19\%$ of the phytochemical-rich foods (fruits, vegetables, and whole grains) at the congregate lunch meal (Table 6). The average PI meal score from this particular congregate lunch meal menu was calculated to be 32.1. However, the actual PI score was calculated to be lower, approximately 26.9, because of participants consuming less than a 100% of their meal components.

Discussion

Following the delivery of a nutrition-focused intervention to older adults attending senior centers, those within the intervention group, consumed significantly more of the fruits and vegetables offered in their congregate lunch meal from pre- to post-intervention. Additionally, the intervention group had a significant increase in phytochemical knowledge and was more likely to self-report participation in positive behaviors associated with fruit and vegetable consumption compared to the control group. Moreover, this was the first study to calculate an average meal PI score based on a particular AAA's lunch menu as well as determining an average meal PI score based on participants' intake of their congregate lunch meal as assessed by plate waste measurements.

Increasing the consumption of a variety of fruits and vegetables has been shown to provide many favorable health benefits among older adults including the potential of delaying or improving the management of chronic diseases (Murphy et al., 2012). The phytochemicals found in fruits and vegetables are believed to have a role in providing these positive health effects. In the current pilot study, the health benefits of various phytochemicals were emphasized in nutrition lessons and the educational tools by associating the primary phytochemicals found within each color category with their related health benefits.

The concept of “eating the rainbow” and “color your plate” has been popular when teaching individuals the importance of consuming a wide variety of fruits and vegetables. Kalina & Arnold found that when providing positive messages on posters about fruits and vegetables throughout an elementary school cafeteria, the posters displaying specific messages such as,

“5-a-day” and “the color way” in concert with colorful and appealing graphics, positively impacted fruit and vegetable intake compared to traditional posters providing nutrition education about breakfast and healthy snacking (Kalina & Arnold, 2006). Furthermore, studies have found that interventions encouraging “5-a-day” by consuming a color spectrum of fruits and vegetables, increased the number of servings consumed by adults and children (Nanney, Schermbeck, & Haire-Joshu, 2007). Although there are limited studies focusing on this theme with older adults, results from studies mentioned above do resemble current study results in that the intervention group consumed significantly more fruits and vegetables served in their congregate lunch meal following the intervention. Also, positive trends of self-reported consumption of fruit and vegetable variety and quantity were observed among both intervention and control groups from pre- to post-intervention with greater increases observed among the intervention group.

An exciting finding from the plate waste measurement component of the study was that participants from both groups increased their actual fruit and vegetable intake (outcome variable) following the intervention, but only significantly in the intervention group. This significant increase remained after including the tray survey questions (independent variables) in the regression model that asked if the fruit or vegetable served in the meal was one that they typically ate. Furthermore, a significant association between the typical consumption of a fruit or vegetable during the pre-intervention and the outcome variable was detected in the regression model. Only 42% of intervention group participants reported typically consuming the produce offered in their lunch at the pre-intervention time point. Despite this, 77% of the produce offered in the pre-intervention lunch meals was consumed by the intervention group participants. This further supports our finding of participants reporting high meal satisfaction, as they were willing to consume a fruit or vegetable that they did not typically eat.

The significant increase in the self-reported incorporation of more fruits and vegetables into certain meals was consistent with other successful interventions involving community-dwelling older adults (Hendrix et al., 2008). The intervention group demonstrated increased trends of incorporating more fruits and vegetables into all of the meals (breakfast, lunch, evening meal and snacks) from pre- to post-intervention compared to control. A reason why the evening meal demonstrated a significant increase in the incorporation of fruits and vegetables may be due to larger portion sizes typically consumed with evening meals, allowing for the addition of greater portions of fruit and vegetables. The control group however, showed decreased trends of incorporating fruits and vegetables into all meals except for snacks. The positive changes observed among the intervention group is likely due to participants being exposed to specific lessons that focused on unique ways to incorporate fruits and vegetables into daily meals and snacks. Study results did not reveal any significant changes in the form in which fruits and vegetables were consumed, such as canned or frozen. Since the pre- and post-questionnaires included data from the peak of the growing season participants were able to purchase fresh produce inexpensively or grow their own, which likely influenced their consumption of fresh, frozen or canned produce.

The final purpose of the current study was to calculate the potential PI score of the 2014-2015 congregate meal site menu of a particular AAA and to determine the average PI

score based on the consumption of the phytochemical-rich foods as assessed by plate waste measurements. The average meal PI score for the particular set of menus used in this study was calculated to be 32.1 if participants consumed 100% of the phytochemical-rich foods offered in the meal. However, the results of this study demonstrated that, with participants consuming less than 100% of meal components, the average meal PI score based on consumption was 26.9. Literature has shown that greater PI scores, particularly those between 29.8 and 41.6, have favorable effects on blood triglyceride levels, blood cholesterol levels, breast cancer risk, and weight loss (Bahadoran et al., 2013; Golzarand et al., 2014). Considering that participants from our study consumed a mean PI score of 26.9 from only one of the day's meals, there is the potential of reaching the ideal PI range if participants consumed similar nutritious meals throughout the day. Therefore, greater financial support of the congregate meal site program is needed to allow senior centers to serve particular fruits and vegetables that have high concentrations of phytochemicals and appeal to seniors, such as fresh berries. Serving appealing fruits and vegetables would also increase the likelihood of participants consuming 100% of the fruits and vegetables offered, which would subsequently raise their PI score.

Overall, this pilot intervention was well received by both the intervention and control participants. Participants enjoyed receiving nutrition education materials and self-reported sharing the health benefits they had learned regarding phytochemicals as well as the importance of consuming a variety of fruits and vegetables with their doctors or health professionals, with statistically more participants in the intervention group sharing information. Additionally, 95% of intervention group participants reported being satisfied with provided recipe samples.

There were limitations to this pilot study. A small sample size likely contributed to the lack of significance observed in the self-reported intake of specific fruits and vegetables among the intervention group. Moreover, the nonsignificant changes in the consumption of a variety of produce may be a result of the limited number of fruits and vegetables listed within each color category. However, the plate waste measurements demonstrated the effectiveness of the program as the intervention group consumed significantly more fruits and vegetables from pre- to post-intervention compared to control. In general, participant bias may have been an issue in that more motivated seniors chose to participate in the intervention, but this was likely the case with seniors in the control centers who also received incentives for completing the questionnaires. Regarding the PI score, it was calculated for only one meal rather than based on participants' total daily caloric intake. Future studies are needed that use total calories and determines an ideal PI score that bestows health benefits to older adults. Additionally, repeating the study using a larger sample size would be important to assess if the benefits of the intervention remained over the use of educational tools only. Evaluating whether the dietary changes are sustained through a time series study design would also be informative. Future studies should gather information pertaining to barriers and motivators to consuming fruits and vegetables. Such information would be valuable to community leaders, including senior center directors and Family Consumer Science Extension Agents, to incorporate into programs targeting an older adult audience in order to promote sustainable behavior changes. Continued and increased funding to support senior centers is critical to expand their reach to fulfill the purpose of the OAAENP by providing

nutrition services to more older adults, particularly those with the greatest social and economic need.

Implications

In summary, the findings of the current study showed that delivering a community intervention that offered five nutrition lessons focused on the health benefits of phytochemicals to older adults regularly attending senior centers increased fruit and vegetable intake and improved phytochemical knowledge. Moreover, the educational tools used in the pilot intervention were beneficial as demonstrated by the increased trends in participant knowledge and consumption of phytochemical-rich foods among the control group, suggesting that the educational tools outside of the lessons alone were valuable. Providing community educators with this short nutrition-focused intervention and educational tools would allow for a broad audience of families, including older adults, to be educated in a simple and inexpensive manner about the health benefits of phytochemicals.

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Figure 1.

* P 0.05, significant difference in fruit and vegetable intake as measured by plate waste measurements between pre- to post-intervention was detected within the intervention group. This significant difference remained after including the following independent variable in the regression model: "Do you usually consume the fruit or vegetable served in the meal?". There were no significant differences between control or intervention groups at either time point.

**Self -Reported Intake of Consuming
≥ 4.5 Cups of Fruit and Vegetables in the Last Seven Days**

Figure 2.

* P 0.05, significant difference in self-reported intake of consuming at least 4.5 cups of fruits and vegetables in the last seven days between pre- to post-intervention within the control and intervention groups. There were no significant differences between control or intervention groups at either time point.

Table 1

Participant Characteristics *

	Control n= 16 Mean ± SD or %	Intervention n= 19 Mean ± SD or %
Age (years, range 62-93)	77.6±8.2	74.1±8.4
Race		
White	81.3	84.2
Black	18.7	15.8
Gender		
Male	12.5	21.0
Female	87.5	79.0
Education		
< High school	12.5	26.3
High school	87.5	73.7
Tobacco Use (Yes)	6.3	5.6
BMI (kg/m^2)	30.9±7.8	29.9±7.7
Perceived Health		
Excellent	6.3	0.0
Very good	18.8	36.8
Good	50.0	36.8
Fair	25.0	21.1
Poor	0.0	5.26
Self-reported health condition (Yes)		
All Types of Cancer	43.8	31.6
Angina or CAD	31.3	31.6
Arthritis	81.3	68.4
Asthma	12.5	21.1
COPD, Emphysema, Chronic Bronchitis	6.3	10.5
Diabetes	56.3	31.6
Heart Attack	18.8	10.5
Kidney Disease	12.5	15.8
Stroke	25.0	10.5

* There were no significant differences detected between the control and intervention groups.

Table 2

Meal Satisfaction Tray Questionnaire Responses from Congregate Meal Participants

Tray question	n=81 [*] % Responding “yes”
Pleased with food in meal?	82.7
Pleased with taste of meal?	82.7
Pleased with texture of meal?	80.3
Pleased with portion size of meal?	93.8
Would you eat this meal again?	81.5

^{*} The tray questionnaire results include the combined responses of control and intervention group participants.

Table 3

* Self-reported Intake of Fruits and Vegetables (servings/week) between Control and Intervention Groups

Category	Control n=16			Intervention n=19		
	Pre-intervention Mean±SD	Post-intervention Mean±SD	Difference Mean±SD	Pre-intervention Mean±SD	Post-intervention Mean±SD	Difference Mean±SD
Orange Fruit and Vegetables	3.38±3.08	4.25±4.36	0.88±3.22	3.97±3.58	3.42±4.16	0.56±2.78
Blue Fruit and Vegetables	0.14±0.32	0.36±1.08	0.15±0.34	0.18±0.32	1.47±2.79	1.32±2.75
Red Fruit and Vegetables	2.16±1.67	2.88±3.11	0.72±2.84	2.11±3.02	2.22±3.01	0.03±3.31
Green Fruit and Vegetables	3.44±2.68	2.47±2.55	-0.97±2.90	2.95±2.48	3.56±2.91	0.67±2.35
White Fruit and Vegetables	6.94±4.37	7.00±4.68	0.06±5.67	5.84±4.09	7.18±4.53	1.00±3.36
All Fruits and Vegetables**	19.34±9.21	20.09±15.40	0.75±13.06	18.42±11.73	22.06±14.73	3.47±2.38

* There were no significant differences from pre- to post-intervention within the control or intervention groups, or between the intervention and control groups at either time point.

** The “all fruits and vegetables” category includes the average of all fruit and vegetable servings consumed per week (to measure quantity).

Table 4

Self-reported Incorporation of Fruits and Vegetables into Meals (number of servings/meal) between Control and Intervention Groups

Meal	Control n=16			Intervention n=19		
	Pre-intervention Mean±SD	Post-test Mean±SD	Change Mean±SD	Pre-test Mean±SD	Post-test Mean±SD	Change Mean±SD
Breakfast	1.19±1.22	0.94±0.85	0.25±1.00	0.89±0.88	1.39±1.09	0.44±1.15
Lunch	2.69±1.08	2.56±0.51	0.13±1.02	2.37±1.11	2.78±0.94	0.39±1.24
Dinner	2.63±1.09	2.19±0.83	0.44±1.32	1.89±0.88	3.11±1.41	1.17±1.62 [*]
Snacks	1.50±1.41	1.63±1.36	0.13±1.45	1.26±1.05	1.56±1.42	0.22±1.06
All Meals ^{**}	8.00±3.16	7.31±1.85	0.69±2.77	6.42±2.50	8.83±2.96	2.22±2.84 [*]

* Indicates significant differences at p 0.05 from pre- to post-intervention within the control or intervention groups. There were no significant differences detected between the intervention and control groups at either time point.

** The all meals variable includes the average incorporation of the number of fruit and vegetable servings/meal for all meals combined, which consisted of breakfast, lunch, snacks and evening meals.

Table 5

Self-reported Knowledge and Health Behaviors between Control and Intervention Groups.

	Control (n =16) % or Mean $\pm$ SD	Intervention (n=19) % or Mean $\pm$ SD	P-value
Number of fruit and vegetable lessons attended or educational tools received	3.43 $\pm$ 1.87	4.16 $\pm$ 1.50	0.11
Shared learned health benefits with family, friends, co-workers, or acquaintances	43.75	84.21	0.04 *
Shared what they learned with a doctor or health professional	12.50	36.84	0.10
Improved their attitude concerning the consumption of more fruits and vegetables	66.67	84.21	0.23
Tried to follow a healthier diet	93.75	94.74	0.90
Read phytochemical health information cards attached to recipe cards	75.00	78.95	0.43
Phytochemical health information cards helped incorporate more fruits & vegetables into daily meals/snacks	62.50	73.68	0.49
Phytochemical health information cards motivated incorporation of a greater variety of fruits & vegetables into daily meals/snacks	56.25	68.42	0.48

* Indicates significant differences at p 0.05 between the intervention and control group at the post-intervention time point.

Table 6

Average Consumption of Congregate Lunch Meal Phytochemical-rich Foods and Meal Components.

Meal component	n=119* Mean percentage $\pm$ SD
Phytochemical-rich foods**	79 $\pm$ 0.19
Total meal	84 $\pm$ 0.11
Bread	78 $\pm$ 0.28
Fruit	88 $\pm$ 0.22
Vegetable	75 $\pm$ 0.22
Meat	85 $\pm$ 0.20
Dessert	85 $\pm$ 0.27
Condiments	82 $\pm$ 0.22

* The n of 119 plate waste measurements includes both intervention and control groups at the pre- and post-intervention time points.

** Phytochemical-rich foods included fruits, vegetables, legumes and whole grains.