Healthier Diets for Older Adults: Impact of a Brief Intervention

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Running Headline: HEALTHIER DIETS OF OLDER ADULTS

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Abstract

A typical American diet is high in saturated fats, calories, and sodium, and inadequate in nutrients and fiber. As we age, a healthier diet becomes even more important for maintaining health and independence.

This research evaluated the effectiveness of a 2-hour video-based educational workshop in improving the diets of 164 older adults who live in elder housing and prepare some of their own meals. Paired housing sites were randomized; half received the intervention and half served as controls (and received the intervention afterwards). Interviews collected data on diet, intentions, physical activity, and knowledge of nutrition at baseline, and at follow-up six weeks after the intervention.

Comparing the groups, intervention participants increased consumption of fruits and vegetables while controls did not; neither group reduced saturated fat or sodium. Intervention effects were not mediated by any advancement in knowledge or stage of dietary change. Diabetes seems to promote healthier diets. Gender differences raised interesting questions.

Key words: older adults, diet, nutrition, behavior change

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Nutritional Health of Older Adults

Epidemiological and experimental evidence have linked low consumption of fruits and vegetables (F&V), and excessive consumption of fat and sodium to chronic diseases, including certain cancers, heart disease and hypertension (DHHS, 1988; Krauss et al., 1996; NRC, 1989; Rimm et al., 1996). An estimated 35% or more of cancer deaths are linked to diet (Doll & Peto, 1981). A diet rich in fruits, vegetables, and low-fat dairy foods and with reduced saturated and total fat can help to maintain optimal blood pressure (Appel et al., 1997) and reduce one's risk of cardiovascular disease (Krauss et al., 2000). Changes in dietary habits of older adults can improve health and increase life expectancy (Chernoff, 2001). Thus, to the extent that elders can prepare healthy meals for themselves, they will enhance their ability to maintain health and functional independence.

Nutrients and Fiber. National guidelines recommend consumption of between five and nine F&V a day, and 25 to 35 grams of dietary fiber a day (NRC, 1989; USDA, 1992). However, survey data indicate that adults consume about 3.12 servings F&V a day, and 77% fall short of the 5-A-Day guideline (Patterson, Block, Rosenberger, Pee, & Kahle, 1990). Although population-based estimates of F&V intakes in older adults have not been reported, the nutrient intake of elders has been described in a number of recent studies. In a study of 1740 healthy adults age 51 to 85 in Southwest United States, (a) only 49% of females and 40% of males consumed the recommended amount of vegetables, (b) 53% of women and 48% of men consumed the recommended amount of fruit (c) 60% of respondents' intakes of vitamin D, vitamin E, folate, and calcium were below recommended requirements, and (d) fewer than 10% consumed recommended amounts of dairy and grains (Foote, Giuliano, & Harris, 2000). In a

study of 2,655 adults aged 65 to 85 that used the probability approach to assess adequacy of nutrient intake, zinc deficiency had the highest estimated prevalence, followed by calcium, vitamin E and vitamin B-6 (Cid-Ruzafa, Caulfield, Barron, & West, 1999). In a Canadian study of 82 adults aged 65 to 89, more than one-quarter had inadequate intakes of folate, vitamin D, calcium, magnesium or zinc (Patterson, Block, Rosenberger, Pee, & Kahle, 1990). A pilot study of 40 older adults found that they had inadequate intakes of calcium and folate, and low dietary fiber intake (18.5 g/day) (Gilbride, Amella, Breines, Mariano, & Mezey, 1998). Many older adults are failing to meet nutrient requirements for calcium, found primarily in dairy products, and zinc, found in meat and cereals (Subar, Krebs-Smith, Cook, & Kahle, 1998).

Dietary Fat. National guidelines recommend 30% or less of energy from total fat, 8-10% of energy from saturated fat, and less than 300 mg of cholesterol a day (Krauss et al., 2000; Schaefer et al., 1995). Analyses of NHANES III data indicated that, on average, adults aged 55 to 70 consumed 33.2% of calories from fat and 11.2% of calories from saturated fat (NCHS, 1994). In the recent study by Cid- Ruzafa et al. (1999), the average intake of energy from fat ranged from 34% in Caucasian women to 37% in African American men; in the Canadian study fat was 33% of energy intake, and saturated fat consumption comprised 12% of energy (Payette & Gray-Donald, 1991). In sum, fat intake among older adults is often higher than recommended.

Energy Intake. Obesity is one of the most important risk factors for the development of cardiovascular disease in older adults (Kohrt, 1998), and is is a risk factor for type II diabetes, stroke, and several forms of cancer (Rogers, Shirey, & Summers, 2003). The prevalence of obesity in Americans between ages 55 and 70 is 30% to 35% (NCHS, 1994). Obesity is of particular concern in older African American women, as more than one-half are classified as obese (NCHS, 1994). To avoid obesity, it is important that older adults limit their intake of

energy-dense foods -- optimally, in conjunction with a regular pattern of physical activity.

Sodium. Kidney function also decreases with age and sodium re-absorption becomes less efficient (Fliser et al., 1997; Gold & Fishman, 1995). Although it appears doubtful that sodium causes hypertension in general (Midgley, Matthew, Greenwood, & Logan, 1996), excessive sodium intakes may cause hypertension in an older population (Whelton et al., 1998). A "No Salt Added" diet (3-4 grams of sodium/day) is recommended (Massachusetts Executive Office of Elder Affairs, 1998).

Factors Affecting the Nutritional Health of Older Adults

Physiological, environmental and social changes that occur during the aging process may influence diet and nutritional well-being.

Taste and smell acuity becomes impaired with age. Taste and olfactory thresholds for sweet, sour, salty and bitter compounds, as well as amino acids are higher in older adults (Schiffman, 1983). Compared to younger adults, older individuals are less able to identify mixed or pureed foods (Schiffman & Warwick, 1989). These sensory changes may be exacerbated by chronic disease, including cancer, or neurological, endocrine disorders and nutrient deficiencies. Furthermore, medications that are frequently used by older persons may also alter their sense of taste and smell (Schiffman & Warwick, 1989). In a sample of 120 older women, those with lower olfactory perceptions were less interested in food (less likely to look for new recipes, enjoy cooking, and eat different kinds of foods), reported lower preference scores for F&V, especially F&V rich in vitamins A and C, were less likely to consume F&V (i.e., strawberries, grapefruit, cauliflower, Brussels sprouts and raw spinach), and more likely to consume high fat desserts (i.e., pie, ice cream and cookies) (Duffy, Backstrand, & Ferris, 1995). Problems with gums, teeth, and jaw occur more frequently in older adults and can affect diet (Coutts, 2001).

Energy regulation and nutrient absorption. Although many nutritional needs stay the same throughout adulthood, changes in energy metabolism that occur with age result in increased body fat stores, hypertriglyeridemia and lower levels of high-density lipoproteins (Russell & Suter, 1993). Furthermore, age-related changes in body composition, namely, loss of muscle mass and decreased bone density, alter body composition, and thereby decrease basal energy requirements (Blumberg, 1997). Therefore, a diet lower in energy is required (Coutts, 2001).

Declines in the homeostatic capabilities of older adults to regulate their energy intake may also affect their food choices and nutrient intake. Experimental research demonstrated that compared to younger men, older men were less able to regulate their energy intake after consuming either high- or low-energy yogurts (Rolls, Dimeo, & Shide, 1995). The older men consistently overate by 10-30% of their baseline intake. Furthermore, concordant decreases in energy expenditure further reduce energy requirements. Thus, when energy dense foods are selected, older individuals may consume calories in excess of their energy needs.

Aging is also associated with increased gastric pH and decreased gastric motility, and decreased nutrient absorption. Consequently, older adults require more vitamin B12, folate, calcium, iron, zinc and vitamin D, and fewer calories per unit body weight than younger adults (Blumberg, 1997; Russell & Suter, 1993). Therefore, to consume adequate intakes of vitamins and minerals and maintain body weight, it is important for older adults to select nutrient dense foods. Dietary guidelines that suggest limiting high calorie foods including desserts, snack foods and high fat meat and dairy products are especially prudent for this age group.

Social and environmental changes that occur with age such as poverty, bereavement and attitudes towards health may affect nutritional well-being (Horwath, 1991; Rosenbloom & Whittington, 1993). Survey research has revealed statistically significant relationships between

social support, nutrition knowledge, and dietary quality in older men and women (Matheson, Woolcott, Martin-Matthews, & Roth, 1991; Rosenbloom & Whittington, 1993). Older individuals who are married or who have adequate social support are more likely to enjoy meals, and be concerned about their health and nutritional well-being. Older women who are concerned about their health have diets that are lower in fat and higher in key nutrients, including fiber, calcium, and vitamin A (Lahmann & Kumanyika, 1999).

Nutrition Guidance. Recently, Russell, Rasmussen, and Lichtenstein (1999) modified the USDA Food Guide Pyramid to meet dietary recommendations for people over the age of 70. The Modified Food Guide Pyramid is similar to the original Food Guide Pyramid with the addition of a flag on the top that suggests nutrient supplements of vitamin D, vitamin B-12, and calcium. In addition, symbols are included within each food group to promote fiber intake. Nutrient dense food choices within each food group are also recommended. For example, whole grain, or fortified breads, cereals and rice products are suggested to provide ample fiber, B vitamins and folate. Likewise, cruciferous vegetables, dark colored fruits and vegetables, and fresh or frozen fruits and vegetables, rather than juices, are recommended for their nutrient density, high fiber and low sodium content. Low-fat meat and dairy products are suggested as sources of key nutrients that are not excessively high in calories. Finally, adequate fluid intake is emphasized by symbols on the base of the pyramid.

Facilitating Dietary Change

Overall, older individuals are capable of and interested in nutrition and motivated to improve or maintain their health (Chernoff, 2001; Lahmann & Kumanyika, 1999). However, there has been a scarcity of nutritional education for older adults. A recent review of group nutrition education classes published between 1993-2003 (Higgins & Barkley, 2004) found nine

interventions ranging from four to 16 classes. The majority of these interventions focused on weight loss, several worked specifically with older adults with diabetes, and one focused on reducing the risk of malnutrition. Most interventions included workshop sessions, which usually involved several components, such as lecture, discussion, goal setting, exercise, food demonstrations, recipes, and in-class and take-home activities; one intervention (Elshaw, Young, Saunders, McGurn, & Lopez, 1994) included the use of videos. No single outcome was measured by all nine interventions, and no consistent pattern was found across studies. Three of the interventions had statistically significant findings in nutrition knowledge, and one intervention (Hermann, Brown, & Heintz, 2000) had significant improvement in food and nutrition behaviors, including intake of breads, vegetables, and dairy.

Another recently published review of 21 studies between 1990 and 2003 (Sahyoun, Pratt, & Anderson, 2004) reports on all types of nutrition education interventions for older adults – ranging from telephone advice with mailings to education through gardening. Significant outcomes were as varied as the intervention formats, and included increase in calcium, dairy, vitamin D, whole grains and water intake; decrease in fat and sodium intake, weight, blood glucose levels, and cholesterol levels. Six of the studies reported significant improvements in knowledge, and six studies reported significant increase in fruit and vegetable consumption.

These reviews indicate that it is important to further develop and test nutritional interventions for this population in order to improve health in older adults. They also provide promising evidence that, although dietary change is especially difficult for any person to make, nutritional interventions can help even very old populations to improve their diet. However, there is no single approach to intervention that is a recognized "gold standard." Nutrition interventions that target specific subgroups of this population, and are sensitive to age-related

physical and social changes, have been especially successful in this population. Those that address food preparation skills and behavior change have been more successful than programs focused on knowledge acquisition (Contento et al., 1995). Also, older adults are more receptive to and motivated by programs that address their current health concerns. The Senior HealthTrac program, using lifestyle questionnaires, serial risk reports, individualized recommendation letters, newsletters and self management books, has been evaluated with over 30,000 retired men and women, and has shown significant changes in dietary fat intake (Fries, Bloch, Harrington, Richardson, & Beck, 1993; Fries, Harrington, Edwards, Kent, & Richardson, 1994). Therefore, needs assessments are critical to developing programs that are relevant for the intended audience.

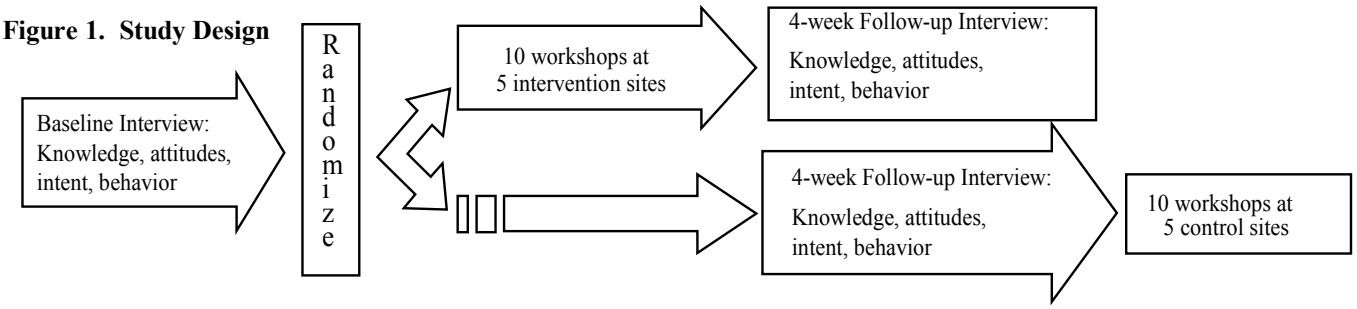
Many interventions are costly, complex to implement, and require a fairly high level of expertise. Therefore, we determined to develop and evaluate a brief, easily administered, and low-cost intervention to help improve the diets of older adults. The intervention stressed the value of making small, incremental changes in participants' dietary habits. The Modified Food Guide Pyramid was used as the basis for nutrition recommendations in the program.

Method

Sample, Recruitment, and Procedures

The objective of the workshop was to prompt seniors to adopt a diet that includes more fruits and vegetables, is higher in fiber, and lower in saturated fat, sugar, and sodium. To test this, a randomized controlled trial was conducted (See Figure 1) with 164 participants recruited through ten senior housing sites. For randomization, the sites were matched in pairs by type of setting (residential vs. non-residential), location (urban vs. non-urban), and percent minority. One site of each pair was randomly assigned to the intervention group and the other to the control group.

Figure 1. Study Design



Unlike random assignment of individuals, which assigns persons from the same site to either the intervention or control group, this procedure minimizes the potential for contamination of the control subjects by intervention subjects residing in the same housing project. Dates were then set for the baseline and follow-up interviews (eight weeks apart) and workshops (two weeks after the baseline interviews for intervention sites; to facilitate site cooperation and recruitment, the workshop was also provided to control group subjects two weeks after the follow-up interview).

Recruitment was conducted with the assistance of residential site staff, by posting and distributing notices at cooperating sites where the workshops were to take place. Interviewers contacted 198 potential participants by telephone to explain the research, obtain verbal consent for screening, and screen for eligibility. Eligibility criteria were: (1) age 60 or older, (2) speak and understand English, (3) usually prepare at least one meal a day, (4) able to see and hear television, and (5) available on the scheduled dates for the workshop and follow-up interview.

Field interviewers met with eligible participants in person at the site to explain the research, obtain informed consent, and conduct a baseline interview. For logistical purposes, we determined that it was more important to confirm availability on pre-selected dates than to keep interviewers blind as to the participants' group. Field interviewers conducted follow-up interviews at the site eight weeks later.

Participation involved a 1-hour baseline in-person interview conducted at the recruitment

site, attendance at a 2-hour workshop either two weeks after baseline (intervention group) or two weeks after follow-up (control group), and a 1-hour follow-up interview in person at the site six weeks after the date of the intervention workshop. Interviews covered background information, food frequency/consumption in the preceding month (Willett et al., 1985) to estimate nutritional intake, shopping and meal preparation practices, knowledge of nutrition, behavioral intent, and reactions to the workshop (intervention group only). After the follow-up interviews, workshops were held at all control sites.

Intervention

The goal of the intervention was to increase consumption of foods that are dense in nutrients and fiber, and decrease consumption of foods that are dense in calories (saturated fat, sugar) or high in sodium. The intervention consisted of the structured 2-hour educational workshop, including (a) a 25-minute video, (b) printed materials for participants, and (c) group discussion and exercises. Video was used because it is a highly effective medium for illustrating successful strategies for behavior change. It is cost-effective, standardized, and accessible to individuals with limited education or literacy barriers. The video and printed materials were grounded in extensive preliminary data obtained from older adults who prepare most of their own meals. They indicated that dietary changes promoted in such interventions need to be: (1) Practical, i.e., economical, easy and quick – for example, portraying ways to reduce cost and preparation time; (2) Tasty and flavorful – for example, acquainting participants with substitutes for salt, and lower-fat foods that can give the same or better "mouth feel"; and (3) Fun – for example, emphasizing social aspects to meal planning, preparation, and dining. Moreover, any video should be entertaining, and printed materials be not only legible, but also colorful, visually appealing, and "user-friendly." All components of the workshop were critiqued and pilot tested

by older research participants and expert reviewers.

The workshop was implemented in small group settings at each intervention site by the project interventionist and an assistant. Because the intervention was intended to be widely applicable for a diverse audience of older adults, the interventionist was chosen for good communication skills and an appreciation for older adults, rather than an advanced degree or previous experience implementing nutritional programs. To insure intervention fidelity, the leaders followed a detailed manual developed by the project team, and after each workshop both completed a checklist of key workshop elements.

Measures

Behavioral Outcomes

Food consumption. The primary outcomes assessed for this study were consumption of fruits and vegetables (F&V), intake of fiber, saturated fat, sodium and calories. These were assessed at baseline and follow-up using the Diet Assessment (Willett et al., 1985) diet recall instrument. a The instrument asks respondents how often they consumed items from a comprehensive list of foods during the month prior to administration. Consumption of each F&V was converted to number per day. For example, if a respondent reported eating 2-4 bananas per week, then it was counted as 3/7 of a banana per day. These were then summed over the choices of F&V listed on the dietary assessment. Total intake of fiber (grams/day), fat (grams/day), sodium (milligrams/day), and calories (kilocalories/day) were calculated based on known quantities in food items reported. Because the assessment may not be comprehensive, these amounts may not represent accurately daily intake in absolute terms; however, the accuracy is sufficient for comparing the intake between groups of respondents completing the same survey.

Physical activity was a secondary behavioral outcome. Respondents were asked “During

an average or normal day, how much time [hours and minutes] do you spend … in vigorous physical activity or exercise – hard activities such as jogging, aerobics, swimming, tennis and biking? … in moderate physical activity or exercise – activities such as walking, gardening (raking leaves, shoveling snow), and heavy housecleaning (scrubbing floors)?" Answers were converted to hours and summed.

Mediators

Mediators – knowledge and stage of change (reflecting a combination of behavior and intentions) – were included both as outcomes that might be affected by the intervention and other covariates, and as predictors that might facilitate change in the target behaviors.

Knowledge. A knowledge test was designed for use in this study, consisting of ten true-false questions relating to ten major points conveyed in the intervention video. Items included "Fiber helps with digestion and fights constipation" and "All fats are bad for you." Scores were calculated based on the number of correct answers; the range of potential scores was 0 to 10.

Stage of change. To determine stage of change, respondents were asked a series of four questions: (1) "In general, would you say your usual diet is… very unhealthy, somewhat unhealthy, not really healthy nor unhealthy, somewhat healthy, or very healthy?" (2) "For how long have you followed a [pervious answer] diet? Would you say … less than 1 month, 1-6 months, 6 months to 1 year, or 1 year or more?" (3) "Do you have any interest in learning how to improve your diet (yes/no)? (4) How motivated are you to make healthy changes in your diet during the next 3 months? Are you… very motivated, somewhat motivated, a little motivated, not really motivated, not at all motivated?"

Five stages of change were defined following an algorithm modeled after Greene, Rossi, Rossi, et al, (1999). Action and Maintenance were based on behavior: Usual diet characterized as

"very healthy" for a period of 6 months or longer (Maintenance) or up to 6 months (Action). Because 95% of those who characterized their diet as "very healthy" reported having followed that diet for 6 months or longer, the stages of Action and Maintenance were collapsed. Respondents whose diets were not "very healthy" were staged based on their intentions: Preparation was defined as having an interest in learning how to improve their diet, and being "very motivated" to make healthy changes in the next three months. Contemplation was defined as being interested and "somewhat" or "a little" motivated. Precontemplation meant either no interest or "not really motivated" or "not at all motivated."

Demographics

At baseline, respondents reported the following demographic information: age, gender, marital status (recoded to currently married or not), Hispanic/Latino ethnicity, race (recoded to African American, white, or other; dichotomized for multivariate analyses, with African American as the referent group), level of education (recoded to less than high school, high school grad, some college, or college graduate), employment status. They also reported whether they usually ate alone, sometimes lack enough money for food (interpreted as a proxy for poverty), and whether they received "Meals on Wheels."

Health information collected at both time points included height and weight measured by the interviewer, self-assessed general physical and mental health (from 1= "excellent" to 5= "poor"), and whether or not a health care provider had ever told the respondent they had diabetes, high blood pressure, high cholesterol, kidney disease, or heart disease. Body Mass Index (BMI) was calculated as weight in kilograms divided by (height in meters, squared).

Process Data

Participants in the intervention answered additional questions about the video, printed

materials, and workshop.

Analyses

Preliminary bivariate analyses were conducted to test for group differences at baseline. We used t-tests for age, height, weight, and BMI, and chi-square tests for gender and other sociodemographic and health background characteristics.

The primary hypothesis was that the intervention influenced the response variables. If the workshop were effective, we would expect to find a significant interaction of treatment with time. Specifically, we would see a greater intake of fruits and vegetables and fiber, and intake of less saturated fat, sodium, and calories among participants at intervention sites than at control sites. We would also expect greater nutritional knowledge, and a more advanced stage of change for adopting a healthier diet. We tested the hypothesis, for each outcome, using repeated measures mixed-effects models, with two (repeated) time points, and random effects of site and pair of sites. This method allows for estimation of treatment effects over time while simultaneously adjusting for the possibility that responses from participants within a site (or pair of sites) are correlated. The models were estimated using the method of restricted maximum likelihood. The residuals were examined to detect influential outliers and to determine whether or not the model assumptions of normal errors and homoscedasticity were met. All analyses were conducted in SAS (SAS Institute Inc., Version 9.1, Cary, NC 1999)

Models including demographic and other covariates (as fixed effects, both continuous and discrete) were also fit to examine predictors of the same outcomes. Knowledge and stage of change were examined not only as predictors of the behavioral outcomes, but also as outcomes.

Results

Characteristics of the participants are displayed in Table 1. The only statistically

significant difference between treatment groups was gender: 79% of the intervention group and 96% of the control group were female (p=0.0021).

In the analysis of group differences (Table 2), there was a significant interaction of treatment group and time in the number of fruits and vegetables consumed, and in intake of fiber: Participants in the intervention group increased the number of fruits and vegetables they consumed (p=0.04); those in the control group did not (p=0.34). Participants in the intervention group increased their intake of fiber slightly, but the change was not statistically significant (p=0.20), while those in the control group marginally decreased intake of fiber (p=0.10). There were no other significant effects of the intervention.

In the multivariate analyses (Table 3), the intervention was the only significant predictor of greater consumption of fruits and vegetables. Men consumed more fiber than women (21g vs. 17g), as well as more saturated fat (29g vs. 17g), sodium (1866 mg vs. 1138 mg), and calories (2132 vs. 1416) (note that means reported in this section are adjusted for other variables in the model). Gender was the only significant predictor of sodium intake.

Intake of saturated fat and calories were related not only to gender, but also to poverty and health conditions. Participants without adequate money for food consumed more saturated fat (27g vs. 20g) and more calories (1924 vs. 1624) than those with adequate money; they also were more physically active (2.6 vs. 1.3 hours/day). Participants with diabetes consumed less saturated fat (21g vs. 25g) and fewer calories (1605 vs. 1943); they also were less physically active (1.7 vs. 2.3 hours/day). Those with high cholesterol consumed more calories (1858 vs. 1690).

As an outcome, knowledge scores were higher among whites and other races (8.7 vs. 7.8 points for African American), those with greater education (0.2 point increase for each category), and those with adequate money for food (8.6 vs. 7.9). African Americans were more physically

active than whites and other races (2.3 vs. 1.7 hours/day), as were those at a more advanced stage of change (0.2 hours increase for each stage progressed).

The intervention workshop was well received by both intervention and control groups. Many of the participants claimed to have made changes based on the nutritional facts and advice given in the workshop. In one of the sites, participants convened on their own time and talked more in depth about the topic. Many felt it was a useful experience and gained new tips for eating healthier. Some even shared their newfound tips with others who were not involved with the project. As a whole, participants were excited about the option to hear and learn about the tips for successful dietary changes.

Discussion

The workshop had a modest, limited effect on specific food intakes that were especially emphasized in the video and printed materials – fruits and vegetables. Fruits and vegetables, of course, are a major source of fiber, so one would expect these two outcomes to follow similar patterns. The change in fiber intake, however, cannot fairly be attributed to the intervention. In light of the limited 2-hour duration of the workshop, it is heartening to see behavioral change at six weeks. A more extensive intervention – for example, with a booster session – might hold out a promise of more extensive change. Whether change might be greater at an earlier or later time point could be determined in future studies with multiple follow-up measurements.

Knowledge scores seem to reflect sociodemographic characteristics, and were unaffected by the intervention. Given that the intervention did not improve knowledge scores or advance participants' stage of change, the modest intervention effects on consumption were not mediated by knowledge or stage of change; thus, the direct effect may be attributed to the direct messages contained in the workshop, video and materials.

Stage of change for a healthier diet was also associated with greater physical activity (also promoted in the video but not emphasized in the workshop). This suggests that readiness to adopt healthier eating habits may be part of a larger proclivity to adopt healthier behaviors, but dietary changes may lag behind changes in physical activity. Because we did not measure stage of change for physical activity, further research would be required to interpret this connection.

A large percentage of the participants (83%) had some type of medical condition. Those with diabetes are apparently making healthier food choices (less saturated fat and fewer calories). This is heartening, given current trends of increasing incidence and earlier onset of diabetes. One would hope that participants with high cholesterol would do the same, but such was not the case. Instead, they consumed more calories than those without high cholesterol. We could not attribute this to food industry practices of substituting high calorie ingredients when reducing the fat in foods because, according to *post hoc* analyses, these participants had not lowered their intake of saturated fat or total fat. We also considered whether they might be at an earlier stage of change than others and/or than those with diabetes; however, *post hoc* tests revealed no such significant difference. Given that weight, *per se,* is a risk factor for high cholesterol, possibly their higher calorie consumption contributed to their higher cholesterol.

Some participants indicated that they would have related more to the workshop if it were geared toward people living with a specific medical condition (e.g., diabetes). The interventionist, while able to answer many questions, could not give the advice of a nutritionist or a doctor. Older adults may be more motivated to change their diets when the change is prescribed by a doctor. Further study could assess what types of interventions may be more or less successful for older adults with specific medical conditions and prescriptions.

Gender differences present some intriguing inconsistencies, and merit further exploration.

The men ate more food overall, with greater intake of saturated fat, fiber, sodium, and calories. Nevertheless, they did not eat more fruits and vegetables. Heavier people require more calories to maintain a stable body weight. However, *post hoc* t-test comparisons revealed that the men in this study, although taller than the women (66.6 vs. 61.3, $p<0.0001$), weighed only marginally more (175.3 vs. 163.2, $p=0.15$), and had lower BMI than the women (27.96 vs. 30.10, $p=0.01$). The men might have expended more calories, but gender was not a significant predictor of physical activity. Gender effects could have been moderated by other predictors in the model. It was unfortunate that so few men took part in this study. This was largely a function of demographics, i.e., fewer men in the target age group, and fewer who met the eligibility criteria, which involved preparing more than one meal a day (given typical gender socialization). The rates of eligible candidates declining to participate were comparable across genders. Consequently, there is insufficient power to fully explore gender differences and interactions of gender with other predictors. Also, the genders were not evenly distributed between intervention conditions, so gender and intervention condition are confounded in this study. Therefore, further study is warranted in which a larger number of men take part, perhaps with randomization stratified by gender. Another caveat is that the number of analyses conducted increased the likelihood of at least one significant finding.

Nutritional health of older adults is a topic of increasing importance, as the number of older adults will increase in the coming years. Changing their dietary habits to conform to national guidelines will help to sustain their independence and enhance their quality of life. Many older adults are receptive to nutritional interventions, and this intervention was received positively. Moreover, the statistically significant changes evident in the number of fruits and vegetables consumed indicate that older adults do have the ability to make important

modifications in their diets in order to live a healthier and stronger life.

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Table 1. *Background Characteristics* (N=164)

Variable		%	(n)
Age > 75 years		52	(85)
Sex = Female		87	(142)
Marital Status = Married		14	(23)
Ethnicity = Hispanic/Latino		3	(5)
Race:			
White		62	(101)
African-American/Black		36	(59)
Other		2	(4)
Education:			
Less then high school degree		26	(43)
High school degree		34	(56)
Some college/associate degree		26	(43)
College degree or more		13	(21)
Employment:			
Employed		4	(6)
Disabled		7	(12)
Homemaker		4	(6)
Retired		79	(129)
Other		7	(11)
Have enough money for food		79	(129)
Receive "Meals on Wheels"		13	(21)
Usually eat alone		82	(135)
	Range	Mean	(SD)
Age	60 - 93	75.4	(7.3)
Height	53 - 72	62.5	(3.2)
Weight	97 -278	164.9	(36.5)
BMI	16 - 54	29.8	(6.5)
General physical health	1-5*	3.0	(1.0)
General mental health	1-5*	2.4	(1.1)
		%	(n)
Any health condition		83	(136)
Diabetes		21	(34)
High blood pressure		61	(100)
High cholesterol		48	(79)
Kidney disease		6	(10)
Heart disease		26	(43)
Stage of change:			
Action/maintenance		30	(49)
Preparation		18	(30)
Contemplation		45	(73)
Precontemplation		7	(12)

* 1=excellent 2=very good 3=good 4=fair 5=poor

Table 2. *Outcomes at Follow-Up, by Time x Group*

	Intervention (n=92)		Control (n=72)		
	Baseline	Endpoint	Baseline	Endpoint	
Outcome	Adj Mean (SD)	Adj Mean (SD)	Adj Mean (SD)	Adj Mean (SD)	p (F)
Consumption:					
Fruits & vegetables (servings/day)	4.50 (2.25)	4.90 (2.28)	4.64 (2.11)	4.43 (1.93)	0.04*
Fiber (grams/day)	17.0 (7.95)	17.9 (7.87)	17.0 (7.37)	15.8 (6.44)	0.04*
Saturated fat (grams/day)	20.7 (13.6)	19.5 (12.3)	18.2 (10.2)	16.3 (7.5)	0.68
Sodium (milligrams/day)	1346 (758)	1347 (694)	1218 (528)	1146 (486)	0.41
Calories (kilocalories/day)	1657 (722)	1641 (758)	1502 (616)	1398 (473)	0.35
Exercise (hours/day)	1.51 (2.00)	1.57 (2.06)	1.41 (1.67)	1.35 (1.15)	0.55
Knowledge score (0-10 correct)	8.54 (1.34)	8.57 (1.39)	8.80 (1.12)	8.76 (0.84)	0.42
Stage of change (1=precontemplation – 4= action/maintenance)	2.65 (1.08)	2.56 (1.18)	2.64 (1.01)	2.44 (1.01)	0.60

*** p<.05**

Table 3. *Predictors of Outcomes & Mediators at Endpoint – p(F)*

		F&V	Fiber	Saturated Fat	Sodium	Calories	Exercise (hrs/day)	Knowledge Score	Stage of Change
Sociodemographics	Age	0.46	0.16	0.28	0.47	0.59	0.41	0.12	0.93
	Gender	0.43	0.02	<0.0001	<0.0001	<0.0001	0.46	0.91	0.39
	Race	0.24	0.96	0.69	0.76	0.74	0.03	<0.0001	0.57
	Marital status	0.42	0.14	0.64	0.40	0.37	0.89	0.88	0.57
	Education	0.42	0.96	0.25	0.09	0.49	0.44	0.02	0.20
	Poverty	0.83	0.77	0.0003	0.08	0.005	<0.0001	0.001	0.79
Health conditions	High blood pressure	0.99	0.60	0.20	0.41	0.24	0.06	0.73	0.07
	High cholesterol	0.91	0.36	0.21	0.10	0.05	0.67	0.68	0.48
	Heart disease	0.71	0.82	0.50	0.80	0.58	0.90	0.21	0.97
	Diabetes	0.79	0.15	0.03	0.13	0.003	0.03	0.50	0.80
Mediators	Knowledge score	0.35	0.75	0.07	0.08	0.17	0.33	–	0.47
	Stage of change	0.06	0.06	0.27	0.80	0.70	0.03	0.50	–
Intervention over time		0.04	0.02	0.28	0.26	0.12	0.16	0.79	0.51