A FRUIT AND VEGETABLE NUTRITION EDUCATION INTERVENTION IN NORTHEAST GEORGIA OLDER AMERICANS ACT NUTRITION PROGRAMS IMPROVES INTAKE, KNOWLEDGE, AND BARRIERS RELATED TO CONSUMPTION

By

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(Under the direction of JOAN G. FISCHER, PhD)

ABSTRACT

The purpose was to improve fruit and vegetable intake in older adults participating in Title III congregate meal programs. Older adults in northeast Georgia completed the pre-test (n=54), nutrition education series, post-test (n=47), and sensory test (n=41). At baseline, 40% of participants reported inadequate income to spend on fruits and vegetables, and 15-20% reported other barriers, including taste and preparation difficulty. Intakes of several fruit and vegetable items improved after the intervention ($p<0.05$), including mean intakes of total fruit and vegetable items (from 22.8 $\pm$ 1.5 to 25.2 $\pm$ 2.0 servings/week) and total fruit items (from 9.0 $\pm$ 0.9 to 10.9 $\pm$ 1.3 servings/week). Additionally, more participants reported knowledge of the Five a Day recommendation. In conclusion, this intervention improved consumption of selected fruits and vegetables, identified barriers, and improved behaviors, attitudes, and knowledge related to fruit and vegetable intake. The curriculum is available for download at www.arches.uga.edu/~noahnet.

INDEX WORDS: Older Americans Act Nutrition program, congregate meal program, senior center, older adults, fruit, vegetable, nutrition education, nutrition intervention

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CHAPTER I

INTRODUCTION

The older adult population in the United States is growing rapidly, and is projected to more than double to 70 million by the year 2030 (CDC, 2001). Roughly 1 in 5 persons will be aged 65 or older. Georgia has the fourth fastest-growing elderly population in the United States (GA DHR, 2002). Chronic disease, increasingly prevalent with age, often translates into functional limitations, disability and overall compromised health and nutritional status in the older adult population (Drewnowski & Evans, 2001). For example, 81% of heart disease and 71% of cancer victims are 65 and older. However, disease and disability are not inevitable consequences of aging, even though the likelihood clearly increases with age (Chernoff, 2001). Effective prevention strategies for chronic disease and associated risk factors have been established through research, epidemiology, and surveillance. Poor diet is a significant risk factor for many chronic diseases associated with aging, but is modifiable, unlike genetic predisposition (Steinmetz & Potter, 1996). Numerous epidemiological studies have shown that diets low in fat, high in fiber, and high in fruits and vegetables may reduce the risk of many chronic diseases, including cancer, heart disease, diabetes, osteoporosis, arthritis, cataract, and age-related macular degeneration (Steinmetz & Potter, 1996; Joshipura et al., 2001; Johnston et al., 2000). The Older Americans Act Nutrition Program (OANP) it is the largest U.S. community nutrition program for adults aged 60 years and older and their spouses (AoA, 2001). The OANP serves over 3 million lunch meals daily across

the U.S.; over 38,000 meals are served daily in Georgia (GA DHR, 2002). This nutrient-dense meal, served five days a week in community senior centers or delivered to home-bound clients, meets over one-third of a senior's daily nutritional need. The OANP sponsors nutrition education and other health-related services for all participating older adults. These preventive nutrition services are vital to improving overall health and quality of life of a population with a broad scope of significant health problems.

Previous research in the Department of Foods and Nutrition at the University of Georgia has shown similar compromised health and nutrition status in Georgia OANP participants. Studies suggested that more than 50 percent of participants are at nutritional risk as measured by Nutrition Screening Initiative (NSI) scores, more than 30 percent have self-reported diabetes and/or poor glucose control, more than 30 percent are obese, and many have difficulty performing one or more ADLs (Accettura 2000; Aspinwall 2001; Brackett 1999). Over two-thirds had low intakes (less than five a day) of fruits and vegetables, particularly of brightly-colored, high-phytochemical fruits and vegetables associated with reduced chronic disease risk, in a study by Aspinwall (2001). Data from these studies in Georgia, as well as national OANP evaluation data, strongly indicate the high nutritional risk and overall poor health of this population.

Health care professionals at the community level must strive to promote optimal health and functioning in OANP clients (AoA, 2001). Focused nutrition interventions are needed to target particular behavior changes, such as increasing consumption of specific fruits and vegetables, to maximize benefits in nutritional status, overall health, and quality of life (Aspinwall 2001; McCamey et al., 2003). An intervention was designed to increase consumption of fruits and vegetables consumed in particularly low amounts in

this population. These fruits and vegetables were selected based on serum carotenoid analyses and food intake data showing low consumption when compared to national data (Aspinwall, 2001), as well as similar findings of other studies (Johnston et al., 2000; Steinmetz & Potter, 1996; Joshipura et al., 2001). It was determined that intakes of citrus fruits, cruciferous and dark green leafy vegetables, and tomatoes and tomato products need to be promoted within this population; these fruits and vegetables have been most closely associated with reduced risk of chronic disease.

This study evaluated the ability of a focused nutrition education intervention to improve fruit and vegetable intake, knowledge related to benefits of fruit and vegetable consumption, and barriers to consumption in an underserved elderly population. Ten educational modules were developed for this intervention and were delivered over a seven month period in the five participating counties. The curriculum consisted of: 1. Cruciferous Vegetables, 2. Citrus Fruits, 3. Berries, 4. Onions and Garlic, 5. Leafy Greens, 6. Beans, 7. Canned and Frozen Produce, 8. Squash, Zucchini, and Pumpkin, 9. Tomatoes and Tomato Products, and 10. (Supplemental) Medication Interactions and Fruit and Vegetable Intake. Several significant barriers to fruit and vegetable consumption were identified at baseline. Forty percent reported not having enough money to spend on fruits and vegetables, and 15-20% did not like the taste of most vegetables, had difficulty using kitchen tools in vegetable preparation, and did not plan or cook their own meals. Following the nutrition education intervention, mean intakes of total fruit and vegetable items (from 22.8 $\pm$ 1.5 to 25.2 $\pm$ 2.0 servings/week) and total fruit items (from 9.0 $\pm$ 0.9 to 10.9 $\pm$ 1.3 servings/week) increased significantly from Time 1 to Time 2 ($p<0.05$). Knowledge of the recommendation to eat five fruits and

vegetables daily and of the relationship of high fruit and vegetable consumption to reduced risk of heart disease and cancer also improved, but these changes were not significant. However, the percentage of African American participants who responded correctly that 5 fruits and vegetables are recommended daily increased from 13% at baseline to 41% post-intervention. An additional finding was that participants who took $\geq$ 4 medications per day or were identified as supertasters were more likely to have significantly lower mean intakes of several fruits and vegetables, especially those high in vitamin C.

CHAPTER II

LITERATURE REVIEW

Older Adult Population

The elderly population is growing larger, both globally and nationally. Currently, the number of older adults (those aged 65 and older) in the United States is 33.9 million (CDC, 2001). That number is projected to more than double to 70 million by the year 2030; 20% of the total population will be aged 65 or older. By comparison, older Americans living in 1900 numbered a mere three million. The oldest old (those aged 85 and older) is the fastest growing age group in the U.S. and in all developed countries. Georgia has the fourth fastest-growing elderly population in the United States (GA DHR, 2002). Georgia's elderly population increased by 20 % from 1990 to 2000, and the current population of older adults in Georgia is 12% higher than the United States total (AoA, 2002).

Growth of the elderly population will lead to increased demands on health care systems (WHO, 2001). Chronic disease, particularly taxing on health care systems, is more prevalent with age. Of the top ten leading causes of death in the United States for all populations, heart disease and cancer hold the number one and number two positions, respectively, and together account for 50% of all deaths (CDC, 2001). Eighty-four percent of heart disease and 71% of cancer victims are 65 and older. Chronic disease sometimes translates into functional limitations, disability and need for assistance (Drewnowski & Evans, 2001). In 1997, over 4.5 million elderly (14%) experienced difficulty performing activities of daily living (ADLs), including bathing, dressing,

eating, and moving around their home (AoA, 2002). Further, 6.9 million (22%) reported difficulties with instrumental activities of daily living (IADLs), including meal preparation, shopping, and taking medication. Disease and disability are not inevitable consequences of aging, even though the likelihood clearly increases with age (Chernoff, 2001). Effective prevention strategies for chronic disease and associated risk factors have been established through research, epidemiology, and surveillance.

Poor diet is a significant risk factor for many chronic diseases associated with aging, but is modifiable, unlike genetic predisposition (Steinmetz & Potter, 1996). Numerous epidemiological studies have shown that diets low in fat, high in fiber, and high in fruits and vegetables may reduce the risk of many chronic diseases, including cancer, heart disease, diabetes, osteoporosis, arthritis, cataract, and age-related macular degeneration (Steinmetz & Potter, 1996; Joshipura et al., 2001; Johnston et al., 2000). Research has also shown that individuals seeking healthy lifestyles, such as engaging in regular physical activity, avoiding tobacco, and following a healthy diet, have red

uced risk of chronic disease and cut their chances of disability by one-half, regardless of genetic predisposition (CDC, 2001). Benefits of seeking a healthy lifestyle can be seen at any age. Unfortunately, these prevention strategies, as well as others such as screening and surveillance, have not been widely applied in the health care arena with the older adult population.

Recognizing that nutrition is a major modifiable risk factor for chronic disease and related complications in an older population, the U.S. Department of Health and Human Services, Administration on Aging developed the Older Americans Act Nutrition Program (OANP) in 1972 (Millen et al., 2002; Ponza et al., 1996). Also known as the

Title III Nutrition Program, it is the largest U.S. community nutrition program for adults aged 60 years and older and their spouses (AoA, 2001). The OANP serves over 3 million lunch meals daily across the U.S.; over 38,000 meals are served daily in Georgia (GA DHR, 2002). This nutrient-dense meal, served five days a week in community senior centers or delivered to home-bound clients, meets over one-third of a senior's daily nutritional need. Congregate daily meals provide community-dwelling, ambulatory seniors the opportunity to participate in activities, socialize, and receive education programs. Although the program's purpose is to offer preventive nutrition and health-related services to all elderly persons, due to funding limitations, OANP projects are placed primarily in communities where elderly people are at increased nutritional risk (Millen et al., 2002). Characteristics of these communities include poor, minority, rural, and frail elderly. An Executive Summary of the OANP reported significant health and health-related problems in program participants, including an average of two to three diagnosed chronic health conditions per participant (Ponza et al., 1996). Both community and home-based preventive nutrition services are vital to improving overall health and quality of life of a population with a broad scope of significant health problems.

Nutritional Risk Factors and Nutrient Intakes of OANP Participants

Preventive nutrition services are an essential component of home and community-based services for elders. The elderly are at increased nutritional risk because of vulnerability to chronic disease and other health problems, and physical and cognitive limitations. A national evaluation of the OANP provides the most recent and comprehensive profiles of participants (Ponza et al., 1996). Eighty to 90 percent of

OANP participants have incomes below 200% of the DHHS poverty level – twice as many compared to the overall U.S. elderly population (Ponza et al., 1996). In the Southern U.S., those aged 65 and older have the highest poverty rates of all elderly Americans (U.S. Census Bureau, 2000). Ponza et al. (1996) also reported that 10 % of OANP participants experienced food insecurity. Participants are also twice as likely as older adult non-participant counterparts to live alone and have functional limitations that interfere with performance of everyday tasks. Two-thirds are either under- or overweight, further increasing their risk for nutrition and health problems.

Other common nutritional risk factors in this population include lower educational attainment, higher incidence of chronic disease, more than three prescribed medications, and older age (four to six years on average; Millen et al., 2002; Ponza et al., 1996). These factors tend to co-exist in multiple combinations and severely elevate the nutritional risk and overall poor health of this population.

Elderly residents of Southern states are more likely than their Northeast counterparts to consume less calories, protein, vitamin C, vitamin B-6, phosphorus, and magnesium (Weimer 1998). Research conducted by Accettura (2000), Aspinwall (2001), Brackett (1999), and McCamey et al. (2003), Department of Foods and Nutrition, University of Georgia, mirror those of other regional and national OANP evaluations. Several nutrient deficiencies were identified, including vitamin D, vitamin B6, and vitamin B12; common nutritional risk factors included obesity, use of multiple prescription medications, and physical and functional limitations. Low intakes of fruits, vegetables and dairy products associated with reduced chronic disease risk were also reflective of national data.

Participants who receive daily meals, both congregate and home-delivered, are more likely to have higher intakes of key nutrients than non-participants (Ponza et al., 1996). OANP meals provide 40 to 50 percent of daily requirements for most nutrients. However, over one-third of participants save part of their meal to eat as a full or partial second meal or a snack, which may reflect some level of food insecurity.

Benefits of Fruit and Vegetable Intake

Epidemiologic evidence supports the relationship between high fruit and vegetable intake and reduced risk for many chronic diseases. The evidence is particularly strong for cardiovascular disease and cancer, the leading causes of death in the elderly. In a 2001 epidemiological study of cardiovascular disease risk and fruit and vegetable intake, subjects ranged in age from 34 to 75 and were free of cardiovascular disease, cancer, and diabetes at baseline (n= 84,251 females, 42,148 males; Joshipura et al., 2001). After an 8 to 14 year follow-up period, and adjustment for standard cardiovascular risk factors, total fruit intake and total vegetable intake were both associated with decreased risk for cardiovascular disease. The lowest risks were observed in individuals with high intakes of cruciferous and green leafy vegetables and vitamin C–rich vegetables and fruits. A prospective study of female health professionals by Liu et al. (2000) also suggested an inverse relationship between fruit and vegetable intake and cardiovascular disease.

Several studies have acknowledged that 35% of cancer may be attributed to unhealthy diets (Steinmetz and Potter, 1996; Havas et al., 1998). Epidemiological studies examining cancer and fruit and vegetable consumption concur that an inverse relationship exists and that the same fruits and vegetables are responsible for the protective effect –

cruciferous and dark green vegetables, tomatoes, and citrus fruits (Johnston et al., 2000). A review of vegetables, fruit, and cancer prevention by Steinmetz and Potter (1996) highlighted fruits and vegetables most often found (in 70% or more studies) to have an inverse association with cancer at any anatomical site. These included allium vegetables and carrots in addition to those previously mentioned. Block et al. (1992) reported that persons consuming one or less servings of fruits and vegetables a day had twice the risk of cancer compared with persons consuming at least four servings a day.

As a result of the research supporting high fruit and vegetable consumption and reduced risk of heart disease, cancer, and other health conditions, several large government agencies have promoted this relationship through publications and campaigns. *Healthy People 2010* included separate objectives for the consumption of five or more fruits and vegetables daily and, within the vegetable category, added a specific aim for dark green and deep yellow vegetables (US DHHS, 2000; Krebs-Smith and Kantor, 2001). A massive health promotion campaign, *Five a Day for Better Health*, was launched in 1991 by the National Cancer Institute in conjunction with the Produce for Better Health Foundation (NCI, 2000) to increase awareness; the *Dietary Guidelines for Americans* (2000) also recommend at least five servings a day of fruits and vegetables (Krebs-Smith and Kantor, 2001).

National surveillance and epidemiological studies have been useful in assessing the frequency and types of fruits and vegetables consumed by Americans. According to BRFSS 2000 prevalence data, only 23 percent of Americans consumed the recommended five or more servings per day. Although this was an improvement from the 19 percent reported in 1990, it has changed little since 1994 (Liu et al., 2000), despite the massive

public health campaign launched by Five a Day. This percentage was even lower in the Five a Day research trials, where adults aged 18 and older consumed an overall mean of 3.6 servings a day; only 17 percent consumed the recommended number of servings (Thompson et al., 1999). In a study examining baseline and follow-up results of the *Five a Day for Better Health Program*, the slight increase in total consumption was due to higher fruit, not vegetable, consumption (Stables et al., 2002). According to *Continuing Survey of Food Intakes by Individuals* (CSFII) 1994–1996 surveillance, white potatoes alone accounted for one-third of vegetables consumed. Based on data collected from two nonconsecutive 24-hour dietary recalls, U.S. adults aged 25-75 years consumed over three times as many white potatoes and starchy vegetables as dark green and deep yellow vegetables, and fewer than one in five adults surveyed consumed a cruciferous vegetable in either recall interview (Johnston et al., 2000).

Knowledge of the relationship of fruit and vegetable consumption to chronic disease risk and of current dietary recommendations may serve as one explanation for low consumption patterns of some fruits and vegetables. Although a modest number of individuals are aware of the diet and cancer relationship, they may lack the knowledge of fruits and vegetables that decrease cancer risk (Harnack et al., 1998). Only 20 percent of all Americans and 16 percent of those aged 65 and older are currently aware of current recommendations to eat five or more servings of fruits and vegetables a day for better health (NCI, 2000; Stables et al., 2002).

Adults aged 65 and older tend to consume more servings per day of fruits and vegetables than other age groups, as indicated by BRFSS 2000 national data. Mean fruit and vegetable intakes for adults aged 50 and older were reported at 3.7 servings per day,

0.1 servings higher than all adults combined (Thompson et al., 1999). However, BRFSS 2000 data indicates that 30 percent of elderly Georgians average 5 or more servings a day, as compared with 31.7 percent of elderly Americans nationwide. Even though older adults are more likely to consume more fruits and vegetables than the general population, these percentages are still low and there is much need for improvement. This task is especially important in a growing elderly population riddled with chronic disease, overall poor health, functional limitations, and other health conditions and risks that may benefit from dietary modification, namely increasing fruit and vegetable intakes to meet or exceed recommendations.

Barriers to Fruit and Vegetable Consumption

Barriers often relate more closely than benefits to nutrition behaviors, therefore identification and reduction of barriers is necessary to improve fruit and vegetable intake (Dittus et al., 1995). A review of 22 fruit and vegetable behavioral intervention studies observed that underserved and minority elderly populations are often at greatest risk for chronic disease and health problems and tend to experience more obstacles to adopting dietary change; encouragingly, interventions targeted at individuals with elevated disease risk were found to be most effective (Ammerman et al., 2002).

Lack of knowledge and negative attitudes and beliefs related to fruit and vegetable consumption are barriers that have the potential for improvement through nutrition intervention (Shumaker et al.; See Figure 1). These are considered to be modifiable barriers. However, several static barriers, or those that are unmodifiable through nutrition invervention, are closely associated with fruit and vegetable consumption in older adult populations, and must be identified and considered in

program development. For example, Donkin et al. (1998) measured fruit and vegetable consumption using a food frequency questionnaire and dietary diary, and identified male gender and living alone as static variables related to fruit and vegetable consumption in community-dwelling older adults. Older males living alone consumed fruits and vegetables much less frequently and had poorer nutrient status compared to the rest of the sample. Additional static barriers included lower consumption of vegetables with increasing age and less education, and lower consumption of fruit by those who had a lower socioeconomic status. The baseline survey of the Five a Day program (Subar et al., 1994) reported several predictors of fruit and vegetable intake. Respondents were 2,811 U.S. adults interviewed with a phone survey in 1991, with over-sampling of African Americans and Hispanics to improve ethnicity subgroup analyses. Respondents were asked about consumption patterns of fruits and vegetables listed on the Block Food Frequency Questionnaire and those listed as top-selling by the produce industry, for a total of 33 items. Portion size was not asked. Seasonal consumption of seven items from the Block FFQ, including peaches, melons, berries, oranges, and, string beans/peas/corn and tomatoes was also determined. Gender, ethnicity, age group, level of education, and low socioeconomic status were identified as important predictors of fruit and vegetable intake. Total mean fruit and vegetable intake was highest for African Americans compared with Caucasians and Hispanics in both the youngest and the oldest age groups, largely because of higher intakes of fruit and fruit juice. Fruit and vegetable intake increased with education and decreased with socioeconomic status. Females had higher median intakes than males, and those over age 65 had higher intakes than any other age group (approximately 4.1 servings per day).

Male gender, older age, minority, low income, living alone, and less than 13 years of formal education are static variables that have consistently been associated with low fruit and vegetable consumption in these studies, as well as other surveys and intervention studies (Laforge et al., 1994; Donkin et al., 1998; Johnson et al., 1998). Additionally, geographic location has been associated with low fruit and vegetable consumption. Johnson et al. (1998) found that 51 percent of rural elderly did not meet fruit and vegetable recommendations, compared with 37 percent of their urban counterparts.

Observational studies and reports on modifiable barriers to fruit and vegetable consumption, including knowledge, beliefs, attitudes, and self-efficacy, are discussed in the following section. In a Five a Day national program evaluation report, investigators found that the strongest predictors of dietary change were knowledge that 5 servings of fruits and vegetables are recommended daily, taste preferences, and self-efficacy (NCI, 2000). Johnson et al. (1998) examined fruit and vegetable consumption patterns in 445 older adults, along with barriers to consumption. Subjects completed food frequency questionnaires, four-day dietary diaries, and an interview examining influences on food choices and nutrition knowledge. A major finding was lower consumption of vegetables in older respondents; possible explanations were lowered taste acuity and being physically unable to prepare vegetables. Further, Donkin et al. (1998) observed that consumption of all foods decreases in individuals aged 75 and older, due in part to lowered taste acuity. Harnack et al. (1998) used data collected for the 1992 National Health Interview Survey Cancer Epidemiology Supplement to assess cancer prevention-related knowledge, beliefs, and attitudes. The sample consisted of 12,005 adults aged 18 and older; African Americans and Hispanics were oversampled to achieve adequate

representation. Men were more likely than women to have lower knowledge levels regarding diet and cancer, knowledge of dietary recommendations, and the current Five a Day recommendation for fruits and vegetables, and African Americans and Hispanics were more likely to have lower knowledge levels of these three relationships than Caucasians. Men were more likely to report taste, ease of eating a healthy diet, and confusion over dietary advice as attitudinal barriers to a healthy diet. Those aged 65 and older were also more likely to report confusion over dietary advice. African American or Hispanic subjects were more likely to report food taste, cost, and confusion over dietary advice as barriers to consumption of a healthy diet; the same attitudes were observed in subjects with lower socioeconomic status and lower educational attainment. One study assessed barriers to fruit and vegetable consumption in African American public housing residents by conducting focus groups (Shankar & Klassen, 2001). Cost was cited as the primary barrier to fruit and vegetable consumption. Focus group participants reported beliefs and attitudes that vegetables are less filling and more costly than other meal components, are on sale rarely or never, and take too much time to prepare. In a multiethnic worksite study, availability, taste preferences, and preparation time were important predictors of fruit and vegetable intake; low education and low income were significantly associated with perception of these barriers (Cohen et al., 1998). Only 23 percent of the population consumed the recommended number of servings daily, and consumption of cruciferous vegetables and fruits and vegetables rich in vitamins A and C were especially low in African Americans and persons with low education.

The relationship of static barriers, modifiable barriers, and fruit and vegetable intake is complex. Overall findings of these studies strongly indicate the need to target

nutrition interventions to low-income, less educated, minority, and elderly populations, and to tailor interventions so that modifiable barriers, including attitudes, beliefs, and knowledge are addressed. Barriers to fruit and vegetable consumption in the context of fruit and vegetable nutrition intervention programs are discussed in the next section.

Fruit and Vegetable Intervention Studies

Few fruit and vegetable intervention studies have specifically targeted older adults. One home based program for community-dwelling elders in Boston (Bernstein et al., 2002) featured a tailored intervention to increase fruit and vegetable and dairy intakes to meet current recommendations. Seventy men and women aged 70 and older received either a nutrition education intervention or an exercise intervention (control group). The design was pre-and post-test. The 6-month nutrition education curriculum consisted of an education booklet that promoted 5 servings of fruits and vegetables and 3 servings of calcium-rich foods a day, home visits, phone contacts, letters, goal-setting, food journals, and games. Nutrition topics included in the curriculum were the importance of good nutrition at any age, health benefits of fruits and vegetables, grocery shopping tips, recipes, serving sizes, and osteoporosis. The exercise control group received a 6-month intervention to improve strength and balance, but no nutrition intervention. Both groups were required to keep monthly progress logs in an effort to increase adherence to the curriculum and were given program-related rewards for doing so. The nutrition intervention was considered to be successful, improving intakes of both fruits/vegetables and dairy products by one additional serving per day. Specifically, the nutrition intervention group reported eating more citrus fruit, orange vegetables, tomatoes, and other vegetables than the exercise control group. Increases in serum concentrations of

alpha-carotene, beta-carotene, beta-cryptoxanthin, and total carotenoids were observed in the nutrition intervention group, which supported these findings. Implications of the study were that dietary recommendations should be individualized to fit each person's lifestyle and preferences, and that record-keeping and positive reinforcement are useful techniques in adherence and facilitation of behavior change. However, because 68 of the 70 subjects were Caucasian, and because the intervention was conducted in an individual vs. group setting, findings may not be applicable to Georgia OANP participants.

Another fruit and vegetable intervention study used the unique approach of nutrition education through gardening to facilitate dietary behavior change in 141 adults aged 55 and older (Hackman & Wagner, 1990). The 5-month intervention consisted of bi-weekly home visits to participants, bi-monthly group sessions on gardening, and bi-monthly group sessions on nutrition. The intervention took place in three different locations, one of which was a large, urban senior center. The curriculum focused on seven nutritional areas for improvement: dairy products, vitamin C-rich foods, iron-rich foods, dark green leafy vegetables, fiber from fruits and vegetables, fiber from beans and whole grains, and water. Goal-setting, Nutrition Bingo with pictures of targeted foods, a large-print nutrition workbook, and raised garden boxes for growing fruits and vegetables were used to facilitate behavior change. There were significant improvements ($p<0.01$) in mean intakes of vitamin C-rich foods and fiber intake from fruits and vegetables, as well as in most of the other five nutrition categories. Improved nutrition attitudes were also observed, including increased confidence in the ability to structure a healthy diet. One limitation noted in the study is the seasonality of fruits and vegetables; mean intakes may have been higher during late summer garden harvesting. However, some dietary

changes seemed to be independent of seasonality. This study demonstrates the importance of creating a socially supportive environment for seniors in which they can increase self-efficacy and physiological well-being by actively participating in an intervention.

Another fruit and vegetable intervention targeted members of 50 black churches in 10 North Carolina rural counties (2519 subjects, mean age=54, 98% African American, 73% female; Campbell et al., 1999). The population had higher rates of cancer morbidity and mortality than the state average. At baseline, a 15-item food frequency questionnaire was used to measure fruit and vegetable consumption in an intervention and a control group, as well as knowledge of the Five a Day recommendation and self-efficacy for eating 5 servings a day. Fruit and vegetable items included in the questionnaire were 100% orange or grapefruit juice, other 100% juice, fruit, salad, fried potatoes, other potatoes, and other vegetables. For 20 months, the intervention group received messages on barriers to consumption, monthly packets of handouts, educational sessions, recipe tasting sessions, and were encouraged to serve more fruit and vegetable dishes at church events. At baseline, only 23% of total participants consumed five or more servings of fruits and vegetables a day; after a 2-year follow-up; in the intervention group, this figure increased to 33% vs. a decrease to 21% in the control group. The largest increases in consumption were observed in participants aged 66 and older and with education beyond high school. Knowledge also increased significantly from baseline in the intervention group; 36% of participants knew the five a day recommendation compared with only 10% at baseline. In summary, fruit and

vegetable interventions in older adult populations, while few, demonstrate innovative approaches and promising outcomes.

Because low socioeconomic status is prevalent among rural, underserved elderly, it is also important to review studies in low-income populations. Treiman et al. (1996) conducted formative research to identify fruit and vegetable consumption barriers in low-income women for a future intervention study for Maryland WIC participants. The most frequently cited barriers identified in focus group discussions were the dislike of specific fruits and vegetables, preferring other foods over fruits and vegetables, time and difficulty involved in preparation, perishability, and cost. This study suggests that interventions may be more successful when specific behaviors are promoted, such as having 100% fruit juice or fruit with breakfast, rather than general information about ways to increase consumption. Five specific behaviors were identified as having the most potential for increasing fruit and vegetable consumption: having 100% juice or fruit in the morning, having fruit for a snack, eating a salad or other vegetables at lunch, eating two vegetables for dinner, and eating fruit for dessert.

Havas et al. (1998) reported the final results of the Maryland WIC Five a Day promotion program. The primary goal was increased consumption of fruits and vegetables by at least 0.5 serving each, based on a report that this increase, if maintained, could result in an 8% lower incidence of cancer. A multifaceted intervention program was conducted over two years at 16 WIC sites, with surveys occurring at baseline, 2 months post-intervention, and 1 year later. Survey questions asked about barriers, knowledge, attitudes, and behaviors related to fruit and vegetable intake; 7 summary questions were used to assess fruit and vegetable consumption. Each participant received

an illustrated fruit and vegetable program book for goal setting, identifying barriers to increasing consumption, choosing behavioral strategies to reach goals, and recording thoughts about fruits and vegetables. Participants were guided through the program book exercises in 4 sessions by peer educators at each WIC site. Other materials used to create an environment conducive to change included a book of recipes submitted by participants, colorful posters at intervention sites, and educational extenders such as refrigerator magnets and videos. Participants also received four letters, tip sheets, and cue cards in the mail over six months, which were tailored to their individual barriers and goals. Post-intervention data revealed significant increases in mean daily fruit and vegetable intakes among intervention participants when compared to controls (0.56 ± 0.11 per day vs. 0.13 ± 0.17 per day). There was also a linear trend among increased consumption of fruits and vegetables and attendance. It should be noted that 46% of participants attended 0 sessions, which may have diluted the positive changes observed in attendees. Knowledge of Five a Day increased from 46% to 57% in the intervention group, and other positive changes in knowledge, efficacy, and attitudes were observed. Perceived barriers, however, did not change significantly. One year after completion of the initial post-intervention survey, mean consumption of fruits and vegetables had further increased by approximately 0.27 servings per day in both intervention and control groups. Significantly higher increases in consumption were observed in white women who were under 30 years old and high school graduates, demonstrating that interventions designed to motivate African American and low-income women to increase fruit and vegetable intake are needed. This study, while successful, demonstrates the numerous

and complex factors associated with increasing fruit and vegetable intake in low-income, ethnically diverse populations.

Anderson et al. (2001) examined the effectiveness of using farmers' market coupons in combination with education to improve intake in a low-income community of 564 female WIC participants (43% African American, 49% Caucasian, mean age=30). Participants were assigned to four groups: coupons and education, education only, coupons only, and control (no intervention). Self-administered pre-and post-test questionnaires assessed fruit and vegetable intakes, attitudes and beliefs related to intake, and knowledge of the Five a Day recommendation. A follow-up was conducted after two months. Taste of fruit, taste of vegetables, preparation knowledge, family response, and importance for health were highly correlated with fruit and vegetable intake; while cost, availability, preparation difficulty, and importance of increasing intakes were less correlated with fruit and vegetable intake. Participants in the two groups receiving education were more likely to have heard the Five a Day recommendation, and participants in the two groups receiving coupons were more likely to visit local farmers' markets. However, there were no significant increases in increased intake of specific types of fruits and vegetables among groups. Overall, this study was successful in increasing fruit and vegetable consumption by conducting a focused intervention targeted at specific barriers, such as cost and health benefits, and providing solutions through knowledge facilitation and coupon distribution. Life experiences of exposure to new fruits and vegetables also helped facilitate change.

Cox et al. (1996) reported the impact of a previously published cancer intervention on diet-related cardiovascular disease risk of 150 low-income EFNEP clients

(69% African American, 31% Caucasian). Three day random diet recalls were collected pre- and post-intervention. The program consisted of an intervention group that received education on diet-related prevention of cancer and CVD, and a control group that received money management education but no nutrition or health information. The nine intervention lessons were based on the Health Belief Model and covered such topics as Cancer Prevention I and II; Diet and Cancer Overview; Fruits; Vegetables; Vitamin A, Carotenoids, and Health; Vitamin C – Know the Facts; and Putting It All Together. Participants in the control group received 13 lessons on money management, which did not include specific information on food, nutrition, health, or disease prevention. Both groups received bi-weekly sessions for six months. Baseline measures revealed that 75% of all participants had below-recommended intakes of fruits and vegetables. The experimental group increased intake of fruit and vegetable servings significantly more than the control group ($p<0.05$), although mean intake of vegetables was still inadequate. Possible explanations include low personal preference for vegetables, and low seasonal availability and higher cost of vegetables at the time of post data collection (late winter months). Although this study did not conduct a delayed post-test to assess whether or not dietary changes were sustained, past EFNEP studies have found evidence of sustained change at 12 to 20 months post-intervention.

Ciliska et al. (2000) conducted a review of the effectiveness of community-based fruit and vegetable interventions in all populations over the age of four. Only six papers in adult populations were rated as "moderate" or "strong" by reviewers and were examined in this paper. Overall findings indicated that fruit and vegetable interventions are most effective when they are developed from a theoretical base, take place over a

longer time period involving multiple sessions, contain specific and focused fruit and vegetable messages, and are directed at changing behaviors and attitudes. Although fruit and vegetable intervention studies in the literature are few in number, fruit and vegetable interventions in low income, low literacy populations have the potential for success when barriers are identified, self-efficacy is increased, knowledge and awareness of health benefits is increased, and practical solutions for increasing intake are provided.

Fruit and Vegetable Studies in Georgia OANPs

Focused nutrition education programs with specific recommendations and practical solutions must be implemented more frequently in underserved communities. A study of northeast Georgia OANP participants recently found that only 25 to 33 percent were meeting fruit and vegetable recommendations (Aspinwall, 2001). This study identified the need for a reliable means of assessing fruit and vegetable intake, and the need to promote consumption of green vegetables, tomato products, and citrus fruits in this population. McCamey et al. (2003) acknowledged the need for future interventions in Georgia OANP populations to facilitate behavior changes related to diet, and, more specifically, to target and address the perceived barriers to fruit and vegetable intake in this population. Participants in this region have much room for improvement and could greatly benefit from a fruit and vegetable intervention program.

Sensory Changes in Older Adults

Numerous studies have shown that sensory losses are common, but modest, in normal, healthy aging (Schiffman & Finkelstein, 1999). The degree of olfactory loss is often greater than that of taste. In addition to small losses as a result of the normal aging process, changes in sensory function are determined by certain disease states, especially

Alzheimer's disease; environmental exposure; and surgery or treatment of health conditions, such as the use of chemotherapy, radiation, or medications. Specifically, over 250 prescription medications have been reported to alter the sense of taste. This phenomenon may be problematic in the elderly population, since the average community-dwelling older adult over age 65 takes 2.9 to 3.7 medications per day (Schiffman & Finkelstein, 1999). Medications are secreted into saliva, where by several mechanisms they produce adverse tastes most commonly described as bitter, metallic, and medicinal. Cardiovascular drugs, NSAIDS, and psychotropic agents appear to be most responsible for taste and smell deficits, which may be due in part to their high prescription rate (Schiffman & Zervakis, 2002). Taste and smell deficits in the elderly may lead to poor appetite, reduced nutrient intake, inappropriate food choices, and impaired nutritional and immune status. Chemosensory changes are thought to become apparent after age 60 and more severe after age 70. However, many older adults are unaware of taste and smell losses; they simply believe that food just doesn't taste as good as when they were younger.

A review of studies examining age-related sensory loss and food choices reported a host of variables that may determine food choices and predict taste and smell loss, including depression, loneliness, social isolation, socioeconomic status or income, medication, and disease (Drewnowski 1997). However, separating the effects of sensory function on dietary habits from those of education, socioeconomic status, and disease is difficult. One study examining olfactory dysfunction and related nutritional risk in free-living elderly women found that nearly 50% of subjects demonstrated losses in either taste or smell (Duffy et al., 1995). This group reported increased food intake to

compensate for sensory loss, lower interest in food-related activities such as preparation, higher intakes of sweets, and increased cardiac risk as indicated by nutrient profiles. The most common reason for dislike of a particular food is perceived bitterness (Drewnowski et al., 2001). Subjects with altered sensory function also had lower intakes and preferences for foods with either a strong sour taste, especially citrus fruits, or foods with a strong bitter taste, especially cruciferous and leafy green vegetables. When sensory loss occurs in older adults, these factors may impair their ability to follow a diet rich in fruits and vegetables to prevent or control chronic disease.

Sensitivity to the substance 6-n-propylthioluracil (PROP) is an inherited trait. PROP tastes bitter to some people, while others cannot detect a taste (Drewnowski et al., 2001). Rejection of some bitter compounds, most commonly phytochemicals found in raw cruciferous vegetables, has been linked with the ability to taste PROP. Recent studies recognize three taster categories for ability to detect PROP: non-tasters, medium tasters, and super-tasters. Approximately 25% of American women are classified as super-tasters, while 50% are medium tasters; females are more sensitive than males to the bitter compound. Both medium tasters and super-tasters may report lower consumption of fruits and vegetables that are rich in bitter but beneficial phytochemicals. Several studies, using PROP-impregnated filter paper strips, have shown that PROP detection thresholds increased with age and that older participants rated the compound as less bitter than younger participants (Drewnowski et al., 2001). However, there are few studies that examine PROP taster status exclusively in the elderly, and many confounding factors, including illness, genetics, medications, socioeconomic status, and cancer therapy, may complicate the assessment of linking PROP detection directly to avoidance of fruits and

vegetables high in phytochemicals (Drewnowski et al., 2001, Schiffman & Zervakis, 2002). The relationship of PROP taster status to fruit and vegetable consumption patterns in low-income older adult populations is not fully understood and needs to be further studied.

Health Belief Model

The Health Belief Model (HBM) served as the theoretical basis for this study (see Figure 1). The HBM was first developed in the1950's by psychologists at the U.S. Public Health Service, and was used to understand and explain failure of individuals to pursue available preventive measures for disease, such as the tuberculosis vaccine, and to provide the foundation for learning new skills and knowledge to achieve change (Caserta 1995; Coulston et al., 2001; Glanz et al., 1990; Shumaker et al., 1998). It has been used more recently to explain dietary patterns and other health-related behaviors. The HBM postulates that for behavior change to occur, individuals must 1) feel that their current behavior patterns are conducive to a feared disease, condition, or specific action, 2) believe that behavior change will be beneficial in reducing or eliminating the health threat, and 3) believe that behavior change is attainable and feel confident in their ability to implement change (self-efficacy; Glanz et al., 1990). These three tenets of the HBM assume that health is a major concern for most people, and that a given health action will result in the desired goal of eliminating or reducing the perceived serious consequences of a health condition (Coulston et al., 2001; Shumaker et al., 1998). Behavior change also depends heavily on existing barriers to adopting a specific health behavior, and may be demographic, cultural, personal, physical, social, or psychological in nature (Shumaker et al., 1998). The HBM is of limited use in primary prevention of chronic

disease, such as cardiovascular disease and cancer; instead, it has been shown to be most effective for symptomatic individuals and is widely applicable in individuals with nutrition-related risk factors for chronic disease (Coulston et al., 2001). In low-income, rural older adult populations, a high number of participants are either diagnosed or at risk for several chronic conditions, including high blood pressure, overweight and obesity, high cholesterol, and diabetes, any of which may lead to further development of more advanced conditions, such as cardiovascular disease. Dittus et al. (1995) explored the relationship between benefits and barriers of fruit and vegetable intake to attitudes and consumption using the HBM as the theoretical framework. Major findings were that there were a significantly higher number of barriers in individuals with low income and low education. Barriers were more closely related to fruit and vegetable intake than benefits, suggesting intervention programs should focus first on identification of barriers to change and facilitation of barrier reduction.

Rationale, Specific Aims, and Hypotheses

Effective nutrition interventions are crucial in low income, rural older adult populations for improvement of nutrient profiles and overall health and facilitation of independent living in the community (Ponza et al., 1996). Increased consumption of fruits and vegetables, in particular those containing high levels of phytochemicals, have consistently been shown to reduce risk of various health conditions and associated risk factors in epidemiological studies and reviews (Johnston et al., 2000; Joshipura et al., 2001; Liu et al., 2000; Steinmetz & Potter, 1996). These studies all cite particularly low consumption of dark green and cruciferous vegetables, tomatoes, and citrus fruits in older adults, and stress the need for increased consumption of these phytochemical-rich fruits

and vegetables. Studies in our own laboratory have observed similar consumption patterns in OANP participants in Georgia (Aspinwall, 2001; Brackett, 1999; McCamey et al., 2003).

In the literature, there are few focused fruit and vegetable interventions that target low-income populations, and fewer interventions implemented exclusively in older adults (Johnston et al., 2000). Intervention programs that focus on increasing the knowledge and awareness of health benefits and disease prevention, reducing perceived and actual barriers to adopting new behavior patterns, and providing practical, tangible solutions are most successful at facilitating increased fruit and vegetable intake (Havas et al., 1998). This study was implemented using the Health Belief Model to explain behavior change, and aimed to identify consumption patterns of fruits and vegetables associated with chronic disease risk, to identify and reduce barriers to increasing consumption, and to promote increased consumption of fruits and vegetables.

The specific aims of this study were:

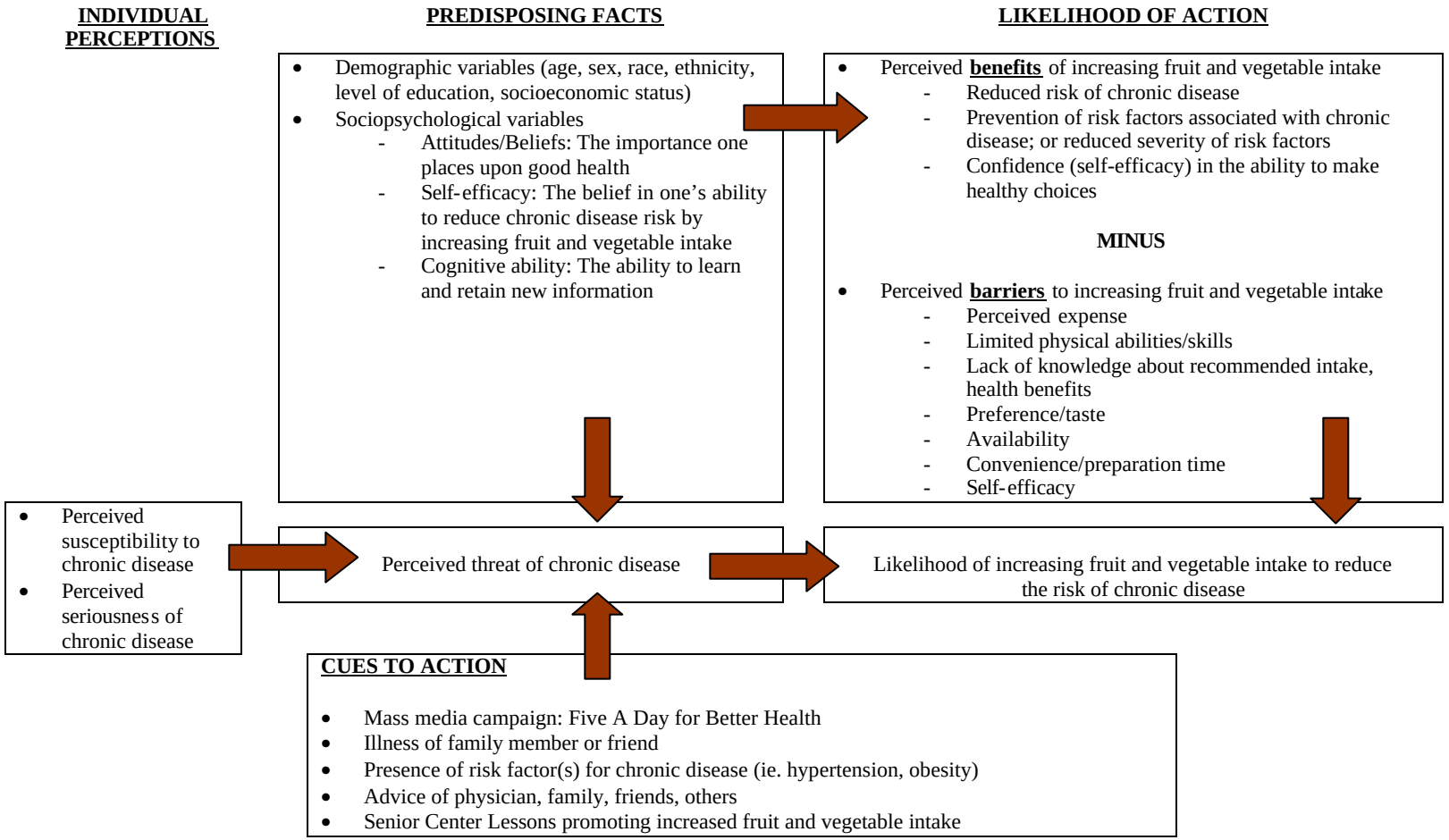
1. To determine baseline consumption patterns of selected fruit and vegetables.
2. To identify perceived and actual barriers to fruit and vegetable consumption, and improve behaviors, attitudes, and knowledge related to fruit and vegetable intake through disease prevention awareness, emphasis of the overall health benefits of fruits and vegetables, increased self-efficacy, and providing practical ways to increase intake.
3. To identify the relationship of fruit and vegetable consumption to medication use and supertaster status.

4. To determine the effectiveness of a nutrition intervention program that is designed for a low income, low literacy older adult population by assessing change in intakes of selected fruits and vegetables.

The hypotheses of this study were:

1. Participants will increase mean intakes of $\geq$ 3 of the 31 fruit and vegetable items assessed in the intervention.
2. After completion of the curriculum, knowledge and self-efficacy related to fruit and vegetable consumption will increase.

Figure 1. The Health Belief Model



Adapted from Shumaker SA, Schron EB, Ockene JK, McBee WL, eds. (1998) *The Handbook of Health Behavior Change, 2nd ed*., pp 9, Spronger Publishing, New York NY 10012-3955.

CHAPTER III:

A FRUIT AND VEGETABLE NUTRITION EDUCATION INTERVENTION IN NORTHEAST GEORGIA OLDER AMERICANS ACT NUTRITION PROGRAMS IMPROVES INTAKE, KNOWLEDGE, AND BARRIERS RELATED TO CONSUMPTION

Introduction

Chronic disease, including heart disease and cancer, and associated risk factors are major health threats to adults aged 65 and older, often translating into functional limitations, disability, and overall poor health and nutrition status (Drewnowski and Evans, 2001). However, chronic disease and disability are not inevitable consequences of aging. Effective prevention strategies have been established, including establishment of the recommendation to consume a diet low in fat, high in fiber, and plentiful in fruits and vegetables (Steinmetz and Potter, 1996; Joshipura et al., 2001; Johnston et al., 2000).

The Older Americans Act Nutrition Program (OANP) is the largest U.S. community nutrition program for adults aged 60 and older (AoA, 2001). The OANP is usually housed in community or senior centers, serves a nutrient-dense meal five days a week to participants, and is often used as a forum to provide nutrition education and other health-related services. It has been estimated that more than 50% of OANP participants in Georgia are at nutritional risk and are considered to have overall poor health (Accettura 2000; Aspinwall 2001; Brackett 1999). Because Georgia has the fourth

fastest-growing elderly population in the United States (GA DHR, 2002), older adults in Georgia would especially benefit from efforts to reduce chronic disease risk. Previous research in our laboratory has shown that over two-thirds OANP participants in Georgia senior centers consumed less than five servings of fruits and vegetables daily; especially low were intakes of brightly-colored, high-phytochemical fruits and vegetables associated with reduced chronic disease risk (Aspinwall, 2001).

Based on a review of the literature, few fruit and vegetable nutrition education intervention programs designed to increase consumption have been conducted in low-income, older adult populations. It has been reported that only 25 to 33 percent of Georgia OANP participants are currently meeting fruit and vegetable recommendations (Aspinwall, 2001). In order to promote increased intake of fruits and vegetables in Georgia OANP participants, it has been suggested that an education program emphasize increased consumption of the colorful fruits and vegetables associated with reduced chronic disease risk (especially green vegetables, tomato products, and citrus fruits), and identify perceived barriers to fruit and vegetable intake in this population (Aspinwall, 2001; McCamey et al., 2003). Thus, the focus of this study was to promote increased intake of selected fruits and vegetables in OANP participants through a fruit and vegetable nutrition education program.

The Department of Foods and Nutrition at the University of Georgia was funded by the Georgia Department of Human Resources and Northeast Georgia Regional Development Center and Area Agency on Aging to develop, implement, and evaluate a fruit and vegetable nutrition intervention program for use in Georgia OANP programs. The Health Belief Model was used in this study as a framework for understanding

barriers and attitudes that affect fruit and vegetable intake. The HBM postulates that for behavior change to occur, individuals must feel that their current behavior patterns are conducive to a feared disease or condition, believe that behavior change will be beneficial in reducing or eliminating the health threat, believe that behavior change is attainable, and feel confident in their ability to implement change (self-efficacy; Glanz et al., 1990). This model assumes that health is a major concern for most people, and that a given health action will result in the desired goal of eliminating or reducing the perceived serious consequences of a health condition (Coulston et al., 2001; Shumaker et al., 1998). We evaluated the outcomes of a focused nutrition education intervention designed to improve fruit and vegetable intake, increase knowledge, and reduce barriers to consumption in an underserved elderly population. Fruits and vegetables selected for this study are commonly consumed in low amounts, as documented in studies completed within OANP's in Georgia (Aspinwall, 2001; McCamey at al., 2003), and as reported in epidemiological studies and reviews (Joshipura et al., 2001; Liu et al., 2000; Steinmetz and Potter, 1996). Ten educational modules were developed for this intervention and were delivered over a seven month period in five participating counties. The curriculum consisted of: 1. Cruciferous Vegetables, 2. Citrus Fruits, 3. Berries, 4. Onions and Garlic, 5. Leafy Greens, 6. Beans, 7. Canned and Frozen Produce, 8. Squash, Zucchini, and Pumpkin, 9. Tomatoes and Tomato Products, and 10. (Supplemental) Medication Interactions and Fruit and Vegetable Intake. The study was conducted in 2001 and 2002 and was piloted in five rural senior centers in Northeast Georgia located in Elbert, Greene, Morgan, Oglethorpe, and Oconee Counties. The program is currently being conducted in other senior centers in Northeast and Northwest Georgia, with future plans

to implement the program statewide. The program curriculum is available for download at www.arches.uga.edu/~noahnet.

The objectives of this study were to: (1) determine baseline consumption patterns of selected fruit and vegetables, (2) identify barriers to fruit and vegetable consumption, and improve behaviors, attitudes, and knowledge related to fruit and vegetable intake through disease prevention awareness, emphasis of the overall health benefits of fruits and vegetables, increased self-efficacy, and providing practical ways to increase intake, (3) identify the relationship of fruit and vegetable consumption to medication use and supertaster status, and (4) determine the effectiveness of a nutrition intervention program that is designed for a low income, low literacy older adult population by assessing change in intakes of selected fruits and vegetables.

The hypotheses of this study were: (1) participants will increase mean intakes of $\geq$ 3 of the 31 fruit and vegetable items assessed in the intervention, and (2) after completion of the curriculum, knowledge and self-efficacy related to fruit and vegetable consumption will increase.

Methods

Research Participants

A convenience sample of 7 men and 47 women, aged 60–97 was recruited. All subjects were community dwelling and congregate meal participants at senior centers in Northeast Georgia. Participants needed to be cognitively able to comply with testing procedures. The following five counties participated in this study based on their interest in the project and the availability of their senior centers at the time of the intervention program: Elbert, Greene, Morgan, Oconee, and Oglethorpe. Our sample size was limited

due to the small, rural nature of participating senior centers. Participants and non-participants attending the senior center were invited to take part in the study, as part of Title III-C Nutrition Services and Title III-F Disease Prevention and Health Promotion Services. The purpose, procedures, content, and benefits of participation were explained, and all subjects gave individual written informed consent. Participants were informed that they could withdraw at any time from the study with no adverse effects on their participation in the congregate meal program. All procedures were approved by the University of Georgia and the Georgia Department of Human Resources Institutional Review Board on Human Subjects. All questionnaires and consent forms are in the Appendix.

All questionnaires and instructional materials were developed and reviewed by expert faculty and staff in the Department of Foods and Nutrition at the University of Georgia; educational extenders were developed by a graphic artist within the University. The Health Belief Model served as the theoretical base for program development. Staff from the Department of Foods and Nutrition at the University of Georgia were trained on correct use of all survey tools in this study as well as administration of the intervention program.

The Intervention Program

The first phase of the study consisted of staff training, senior center and participant recruitment, obtaining signed consent (see Appendix A), and pre–test administration. The second phase was a six-month fruit and vegetable education program comprised of 10 teaching modules. The last phase consisted of administration of the post–test, a brief sensory evaluation, and sensory tests that screened for taste acuity; this

phase lasted for two months. All questionnaires were read aloud individually to each participant by trained staff, who recorded their responses.

At baseline, questionnaires were administered that collected information on selected fruit and vegetable consumption patterns and barriers to consumption (see Appendix B). Demographic information - age, gender, ethnicity, and county - was recorded in the first section of the pre-test. The second section was a food frequency questionnaire that contained 31 questions about consumption patterns of specific fruits and vegetables (fresh, frozen, and canned). Fruits and vegetables selected had high phytochemical content (USDA Nutrient Database, 1998; see Appendix F), have been associated with disease risk reduction in epidemiological studies, and/or were consumed in low amounts in previous studies in this population (Aspinwall, 2001; McCamey et al., 2003). Frequency categories used in the questionnaire included: less than 1 serving per week, 1 per week, 2 per week, 3 per week, 4 per week, 5 per week, 6 per week, 1 per day, 2 per day, and missing/don't know. The third section inquired about potential barriers to fruit and vegetable consumption in this population. Barriers were selected based on the findings of previous intervention studies. Yes/no questions were used to assess knowledge, physical limitations, attitudes, socioeconomic status, and preferences. The final section of the questionnaire contained five questions about current or past disease conditions. After collecting baseline data on all participants, the fruit and vegetable education intervention was implemented.

Ten educational modules were developed for this intervention and were delivered over a seven month period in the five participating counties. A written script lasting no more than 30 minutes served as the guide for each lesson. Fruits and vegetables in each

module were grouped by similar nutrient content and characteristics. The curriculum consisted of: 1. Cruciferous Vegetables, 2. Citrus Fruits, 3. Berries, 4. Onions and Garlic, 5. Leafy Greens, 6. Beans, 7. Canned and Frozen Produce, 8. Squash, Zucchini, and Pumpkin, 9. Tomatoes and Tomato Products, and 10. (Supplemental) Medication Interactions and Fruit and Vegetable Intake. The program curriculum is available for download at the Nutrition for Older Adults' Health (NOAHnet) website: http://www.fcs.uga.edu/~noahnet.

At each session, participants received a packet consisting of three to four handouts and three to four recipes. The handouts were brief, in size 14 font, and contained bulleted main points covered in each session, including health benefits (particularly protection against chronic disease), innovative ideas to increase consumption, easy preparation methods, and selection and storage tips. Fresh, frozen, and canned fruits and vegetables were promoted equally because fresh produce is often perceived as more expensive and may not be available year-round in rural communities. Recipes generally contained five or fewer ingredients and had short preparation times. Fruit and vegetable cartoon characters were used as educational extenders and were displayed at each lesson. Each lesson ended with taste-testing of a recipe included in the corresponding lesson packet that was prepared beforehand by the instructor. All sessions were informal, audience interaction was encouraged, and key concepts were repeated during recipe tasting. Attendance was recorded at each session, and number of sessions attended by each participant was totaled.

After completion of the curriculum in all participating senior centers, post-test questionnaires were administered to assess change in fruit and vegetable consumption,

change in knowledge and attitudes, and program satisfaction. Eleven open-ended questions were added to the post-test to allow participants to further describe changes in consumption and knowledge since baseline (see Appendix C).

A brief sensory questionnaire, developed by staff in the Department of Foods and Nutrition at the University of Georgia, and a taste and smell test to screen for sensory loss were also administered in conjunction with the post-test (The Pocket Smell Test™, Sensonics Inc., PO Box 112, Haddon Heights, NJ 08035, phone 856-547-7702). A separate consent form was used for the sensory component, and individual written informed consent was obtained (see Appendix D). The sensory questionnaire was administered, followed by taste and smell screening tests (see Appendix E). Taste tests were administered using two litmus paper strips placed in the participant's mouth for 15 seconds. The first was a control strip with no detectable taste, and the second was a 6-n propylthioluracil (PROP)-impregnated test strip. Detection of this chemical produces a bitter sensation that mimics the response of the taste buds to certain fruits and vegetables that contain high levels of bitter phytochemicals. It has been theorized that individuals who are able to detect this bitter taste (called supertasters) may avoid fruits and vegetables that produce a similar sensory response, including cruciferous vegetables and fruits and vegetables high in vitamin C. Because over 250 prescription medications may affect taste perception (Schiffman & Finkelstein, 1999), the number of daily prescription medications taken by participants was recorded on the sensory questionnaire. Protocol for the taste test is described in further detail in the Appendix. Due to time limitations of this study, only taste acuity test results and the sensory questionnaire item inquiring about medication use were included in analyses.

Statistical Analysis

The data were analyzed using the Statistical Analysis System, Version 6.1 (SAS Institute, Cary, NC). Only one person coded all questionnaires and entered all data to ensure consistency. Data files were checked twice for accuracy by the investigator and a staff member before the analyses were performed. In order to generate summary scores by nutrient content of fruit and vegetable items, cut-off values were assigned: $\geq$ 777 IU vitamin A, $\geq$ 25 mg vitamin C (both values are approximately one-third of the Recommended Dietary Allowance for females $\geq$ 19 years), and $\geq$ 4000 µg carotenoids (USDA Nutrient Database, 1998; see Appendix F, G). Descriptive statistics, including frequencies, means and standard errors were generated at Time 1 (pre-test) and Time 2 (post-test). Data from pre- and post-tests were compared using paired T-tests and Chi-Square Analyses to identify changes that were either statistically significant (p value < 0.05) or trends (p value= 0.05 – 0.15). Analyses were conducted by ethnicity (Caucasian and African American participants), and age (participants < 80 years old and participants $\geq$ 80 years old). Open-ended questions at Time 2 provided qualitative and quantitative information used to assess participants' self-reported changes and satisfaction with the program. Correlation analyses were used to identify possible predictors of change in fruit and vegetable consumption.

Results

Of the 59 participants who enrolled in the study, 54 completed pre-test measures, 47 completed post-test measures, and 41 completed the taste acuity questionnaire and test. Questionnaires were not completed for the following reasons: cognitive inability to answer all questions (n=5), died (n=1), did not attend the Senior Center for any post-test

sessions (n=2), no longer attended the Senior Center due to personal or health reasons (n=10). When appropriate, participants who were unable to attend the Senior Center were interviewed over the telephone (n=6) to obtain post-test responses.

Participant characteristics at baseline are shown in **Table 1**. The mean age was 77.9 $\pm$ 1.2 years in participants who completed baseline measures (n=54). The sample was predominantly female (87%) and African American (57%). The following health conditions were self-reported: hypertension (57%), high cholesterol (46%), diabetes (35%), heart disease or heart attack (19%), and cancer (17%).

Participant responses on the pre-test questionnaire are shown in **Table 2**. Baseline frequency analyses of fruit and vegetable intake revealed low consumption patterns for several variables. The following were reported as being consumed once a week or less by $\geq$ 50% of the population: 100% cranberry, apple, or purple grape juice (58%), berries (79%), nectarines, peaches, or apricots (54%), cruciferous vegetables (50%), cantaloupe or honeydew (74%), corn (67%), tomato products (56%), squash or zucchini (78%), spinach (80%), sweet potatoes or yams (64%), carrots (60%), beans (66%), vegetables eaten as a snack (80%), and frozen or canned vegetables (50%). African American participants' average intakes of orange juice, leafy green vegetables, and spinach were at least twice as high as those of Caucasian participants. African American participants also consumed more spaghetti or lasagna and sweet potatoes, but fewer servings of onions per week than Caucasian participants. Age had little effect on consumption patterns, although those aged 60-79 ate corn more frequently than those aged 80 and older. Summary score means also showed that African American participants consumed, on average, 6.5 more servings per week of all fruit and vegetables

included in the questionnaire; 6.4 more servings per week of items high in vitamin C; 5 more servings per week of all fruit items; and 3 more servings per week of items high in vitamin A and carotenoids than Caucasian participants.

Approximately 70% of participants thought that increasing fruit and vegetable intake would reduce their risk of both heart disease and cancer, but only 24% knew that five fruits and vegetables are recommended daily. However, Caucasian participants were more likely than African American participants (39% vs. 13%) to know that five servings of fruits and vegetables are recommended daily ($p=0.11$) at baseline. Forty percent reported not having enough money to spend on fruits and vegetables, and 15-20% did not like the taste of most vegetables, had difficulty using kitchen tools in vegetable preparation, and did not plan or cook their own meals. Older participants were more likely to report several perceived and actual barriers to consumption, including having less interest in learning new preparation methods for vegetables and in receiving healthy recipe handouts, and being less likely to shop for their own groceries or plan their meals. See Appendix H for a completed table of barriers associated with fruit and vegetable consumption frequency at Time 1.

Frequencies and mean intakes of targeted fruits and vegetables and behavioral and knowledge questions for the post-test questionnaire are shown in **Table 3**. The following were reported as being consumed once a week or less by $\geq$ 50% of the population at Time 2: 100% cranberry, apple, or purple grape juice (52%), berries (71%), cruciferous vegetables (50%), cantaloupe or honeydew (61%), corn (66%), tomato products (5%), squash or zucchini (72%), spinach (76%), sweet potatoes or yams (65%), carrots (50%),

beans (55%), fruit as dessert (61%), vegetables eaten as a snack (67%), and frozen vegetables (60%).

Pre- and post-test comparisons of mean fruit and vegetable intake are shown in **Table 4.** Of the 31 variables of fruit and vegetable intake, mean intakes of 5 items increased significantly from Time 1 to Time 2, including cranberry, apple, or purple grape juice; peaches, nectarines, and apricots; beans; vegetables consumed as a snack; and canned vegetables. Mean intakes of summary score variables that increased significantly included total fruit and vegetable items (from 22.8 + 1.5 to 25.2 + 2.0 servings/week) and total fruit items (from 9.0 $\pm$ 0.9 to 10.9 $\pm$ 1.3 servings/week). Trends toward increased mean intakes were found for squash or zucchini, and carrots.

Changes in mean intakes from Time 1 to Time 2 were affected by age and ethnicity (**Table 5**). For example, compared with Caucasians, African American participants had greater mean increases in consumption of cranberry, apple, or purple grape juice; berries; and frozen vegetables, even though at baseline the mean weekly intake of these items by African American participants was about the same or higher than Caucasian participants. Caucasian participants had greater mean increases in consumption of carrots, even though their mean weekly intake was slightly higher at baseline than African Americans. Participants aged 80 and older reported greater increases in consumption of fresh vegetables than participants under age 80, even though they consumed an average of 1.2 servings more per week at baseline than their younger counterparts. Trends towards increased consumption by age and ethnicity may be viewed in **Table 5**.

Responses to five items assessing barriers to fruit and vegetable consumption were included on both pre- and post-test questionnaires (**Table 4**). Three items pertained to knowledge, one to availability of fruits and vegetables, and one to self-efficacy. There was a trend for increased knowledge that high fruit and vegetable intake is protective against cancer (from 70% to 83% of participants). The percentage of participants who responded correctly that 5 fruits and vegetables are recommended daily increased from only 34% to 38% from Time 1 to Time 2. However, when Time 2 responses were compared with Time 1 responses for the population, the percentage of African Americans who responded correctly increased from 13% to 41%, while the percentage of Caucasians who responded correctly decreased from 39% to 35%.

Responses to open-ended questions at Time 2 provided further details of self-reported change (**Table 6**; data on individual responses not shown; see Appendix J). Sixty-six percent reported increased overall consumption of fruit or fruit juice, while 53% reported increased overall vegetable intake. African American participants were more likely to respond that they had increased intakes of these items. The most common responses to increased fruit or fruit juice intake were: cranberry, apple, or grape juice, 100 percent orange juice, peaches, berries, apples, and bananas. The most common responses to increased vegetable intake were: cabbage, collard or turnip greens, beans, peas, and corn. Twenty-eight percent reported trying a fruit or vegetable that they never liked before, including spinach, beans, and broccoli; 54% reported increased consumption of dark green vegetables since baseline, including collards and turnips, cabbage, spinach, and broccoli, with Caucasians being more likely to report this change. Forty-eight percent reported using different methods to prepare vegetables, including

cooking with butter or margarine instead of fatback; steaming, baking, or boiling more and frying less; eating more raw vegetables; and using less salt as seasoning. Fifty-five percent were able to name disease risks that may be lowered by a diet high in fruits and vegetables, including cancer, heart disease, high blood pressure, and diabetes. Participants were asked if they had increased their fruit and vegetable consumption due to perceived health benefits; 80% responded yes. Seventy-eight percent responded that, since the intervention, they felt more strongly about the health benefits of fruits and vegetables; 63% have tried to follow a healthier diet by eating more fruits and vegetables and eating fewer sweets and high-fat foods. Several responses were significantly affected by ethnicity ($p<0.05$). African American participants reported overall increases in consumption of fruit or fruit juice (85% vs. 40% Caucasian), vegetables (70% vs. 30% Caucasian), and dark green vegetables (67% vs. 37% Caucasian).

Additional barriers were identified at Time 2 (**Table 6**). Fifty-six percent of all participants reported taking $\geq$ 4 medications per day (self-reported). Eighty percent of Caucasian participants reported taking $\geq$ 4 medications every day, compared with 42% of African American participants ($p=0.04$). Fifty-one percent of participants were identified as super-tasters, and there were no significant differences in super-taster status when ethnicity and age were examined. **Table 7** depicts how medication and sensory barriers (taking $\geq$ 4 medications daily and being classified as a super-taster) negatively affected mean intakes of specific fruits and vegetables at Time 2. Taking $\geq$ 4 medications daily was associated with lower consumption of leafy greens, frozen fruit, and total items high in vitamin C. In addition, participants who tested positively for heightened taste acuity (supertaster) ate more fresh vegetables, but there were trends ($p=0.05$-0.15) towards

lower consumption of cruciferous vegetables, tomato products, and total items high in vitamin C.

There was a relationship between mean change in fruit and vegetable intake and some Time 2 barriers (**Table 8**). Participants with the knowledge that five servings of fruits and vegetables are recommended daily consumed approximately five additional servings of fruit per week than participants without knowledge of the recommendation ($p=0.09$). Knowledge of the recommendation was also associated with increases in consumption of 100 % orange juice ($p=0.11$), cantaloupe ($p=0.047$), and frozen vegetables ($p=0.05$). Participants who felt that improved eating habits would not improve their health reported mean decreases in several variables, including fresh vegetables (-3.2 ± 1.6), frozen vegetables (-0.4 ± 0.4), and onions (-0.9 ± 0.9); participants who felt that improving eating habits would result in better health reported small increases (fewer than 1 serving per week). Participants who took 0 to 3 medications per day reported higher increases in mean intake of several items than participants taking ≥ 4 medications daily, including total fruit and vegetable items (8.3 ± 3.5 vs. 3.3 ± 2.5) and total items high in vitamin C (3.6 ± 2.3 vs. -0.4 ± 1.3), although these increases were not significant. Non-supertaster participants also reported higher increases in mean intake of several items than supertasters, including total fruit and vegetable items (8.8 ± 3.3 vs. 1.9 ± 2.5, $p=0.11$) and total items high in vitamin C (3.6 ± 1.6 vs. $-1.4 + 1.4$, $p<0.05$), as well as peaches, nectarines, and apricots; tomato products; and canned fruit ($p<0.05$). Attendance was significantly associated with increased mean intake of two items: vegetables consumed as a snack and fresh fruit consumption. Changes in mean intakes were also examined by barriers to fruit and vegetable

consumption reported at time 1. Participants who had difficulty using a can opener were less likely to increase mean intake of total vegetable items per week, and participants who did not shop for their own groceries were less likely to increase mean intake of vegetables as a snack and frozen vegetables per week. Participants who reported cardiovascular disease were more likely to increase mean intakes of cranberry, apple or grape juice and total fruit and vegetable items per week. Reported lack of money to spend on fruits and vegetables was not significantly associated with fruit and vegetable intake at time 1 or change in fruit and vegetable consumption from time 1 to time 2.

Correlations among fruit and vegetable intake and Time 1 barriers are shown in **Table 9**. Reported lack of money to spend on fruits and vegetables was not significantly correlated with any single fruit and vegetable item or summary score. Knowledge of the relationship between high fruit and vegetable intake and reduced risk of cancer was significantly correlated with intake of cantaloupe or honeydew ($p<0.05$); knowledge of the relationship between high fruit and vegetable intake and reduced risk of heart disease was significantly correlated with fresh fruit intake ($p<0.05$). Knowledge of the Five a Day recommendation was significantly correlated with intake of broccoli, cabbage, and cauliflower ($p<0.05$). Correlations among fruit and vegetable intake and Time 2 barriers are shown in **Table 10**. Knowledge of the relationship of either heart disease or cancer risk and fruit and vegetable intake was not significantly correlated with any single fruit and vegetable item or summary score. Knowledge of the Five a Day recommendation was significantly correlated with intake of 100% orange juice, cantaloupe or honeydew, and fresh vegetables ($p<0.05$). Eating more fruits and vegetables due to perceived health benefits (open-ended question) was significantly correlated with intake of beans, fruit as

a snack, and fresh fruit. Feeling that canned and frozen fruits and vegetables are just as good as their fresh counterparts was significantly correlated with consumption of frozen vegetables ($p<0.05$). Reported increases in overall fruit consumption were significantly correlated with total fruit and vegetable items, total fruit items, and total items high in vitamin C, while reported increases in overall vegetable consumption were significantly correlated with total items high in lutein and zeaxanthin ($p<0.05$).

Discussion

Programs and facilities that support Older Americans Nutrition Act Programs are recognized as ideal settings for delivery of nutrition and other health promotion programs, particularly for low-income, minority, and frail elderly (Millen et al., 2002). However, few evaluations of fruit and vegetable intervention programs provided in OANP frameworks have been reported in the literature. Thus, this evaluation is important for promotion of overall health in older adults and for investigators who wish to provide focused nutrition intervention programs to OANP clients. This nutrition intervention was unique in its exploration of intakes of a number of fruits and vegetables recognized for their potential in chronic disease risk reduction, barriers to fruit and vegetable consumption in a low-income older adult population, and in its examination of the effect of both taste acuity and number of prescribed medications on changes in fruit and vegetable intake. Major outcomes were 1) significantly increased mean intakes of 5 of the 31 fruit and vegetable items studied, total fruits and vegetables, and total fruit, 2) improved behaviors, attitudes, and knowledge related to fruit and vegetable consumption, and 3) identification of chemosensory barriers to increasing fruit and vegetable intake.

One major finding was that at baseline, over 50% of the total population reported intakes of $\leq$ 1 serving per week for approximately half of all fruits and vegetables assessed (14 of 31), including cruciferous vegetables, carrots, leafy greens, tomato products, and vitamin C-rich fruits and vegetables. This finding is consistent with the findings of a previous study conducted by this laboratory (Aspinwall, 2001), and those of epidemiological studies examining fruit and vegetable intake and chronic disease risk (Steinmetz & Potter, 1996; Joshipura et al., 2001; Johnston et al., 2000). Also at baseline, only 13% of participants reported eating $\geq$ 5 servings per day of the fruits and vegetables assessed in the intervention. Other studies have reported that 23-26% of subjects consumed the recommended number of servings per day at baseline (Campbell et al., 1999; Cohen et al., 1998). However, both studies used a common 7-item fruit and vegetable screener that included two questions about consumption of fried potatoes and baked, boiled, or mashed potatoes, and two general questions on consumption frequency of all fruits and all vegetables. The FFQ used in this study asked about intake of sweet potatoes but not white potatoes, as well as intake of specific fruits and vegetables. This may explain why fewer participants in the current study appeared to consume $\geq$ 5 servings of fruits and vegetables daily when compared with the results of Campbell et al. (1999) and Cohen et al. (1998). After the intervention, increases in mean intake of total fruit items accounted for most of the observed change in this population (consumption of total fruit items increased by 3 servings/week, while consumption of total fruit and vegetable items together increased by 3.9 servings/week). Possible reasons for larger increases in fruit intake include the ready-to-eat convenience of fruit and wider appeal of fruit to personal tastes and preferences. Cohen et al. (1998) reported that taste

preferences and preparation time were important predictors of fruit and vegetable intake in an adult multiethnic worksite population, and that intakes of cruciferous vegetables and vegetables rich in vitamins A and C were particularly low.

The two most frequent barriers to consumption reported by participants at baseline were lack of knowledge that five fruits and vegetables are recommended daily (76%), and inadequate income to spend on fruits and vegetables (40%). Similarly, in an observational study of African American public housing residents (Shankar & Klassen, 2001), cost was cited as the primary barrier to fruit and vegetable consumption. However, in our study, inadequate income did not significantly affect intake of any fruits and vegetable items at Time 1 or change in fruit and vegetable consumption from Time 1 to Time 2. Cohen et al. (1998) also found no association among the expense barrier and fruit and vegetable intake in an adult multiethnic worksite population, even though cost is often highlighted as a barrier to fruit and vegetable consumption in other studies.

Since the cost barrier was reported by almost half of the population we studied, fresh, frozen, and canned vegetables were promoted equally throughout the series and were discussed exclusively in one lesson. It has been reported that canned and frozen vegetables, often less expensive than fresh, offer similar health benefits, although consumers tend to think that health benefits of fresh produce greatly outweigh those of their canned and frozen counterparts (NCI, 2000). We also asked participants to consider the many health benefits of fruits and vegetables relative to cost. A past study reported that the distribution of coupons improved the affordability of fruits and vegetables in low-income women (Cohen et al., 1998). Since the intervention, our staff has helped

facilitate food stamp application in OANP participants and encouraged participants to use awards to purchase fruits and vegetables.

Harnack et al. (1998) and Shankar & Klassen (2001) observed that perceived high cost of fruits and vegetables was more frequent in African Americans than in Caucasians. In the current study, while African American participants (48%) were also more likely to report inadequate income than Caucasian participants, they made more positive changes in mean total fruit and vegetable intake than Caucasian participants from Time 1 to Time 2. In addition to increasing total fruit and vegetable intake, African American participants reported significantly ($p<0.05$) higher mean intakes of 100% orange juice; 100% cranberry, apple, or grape juice; cruciferous vegetables, leafy greens, spinach, total fruit and vegetable items, total fruit items; and total vitamin C-rich fruits and vegetables at Time 2 than Caucasians.

Another barrier that may have influenced intake was lack of knowledge that five servings of fruits and vegetables are recommended daily. Knowledge of the recommendation was low in the total population, and was not related to fruit and vegetable intake. Further, African American participants in this study tended to be even less likely than Caucasian participants to report knowledge of the Five a Day recommendation. Harnack et al. (1998) also reported lower knowledge in African Americans about the health benefits of fruits and vegetables than Caucasians in a study of the cancer prevention-related nutrition knowledge, beliefs, and attitudes of U.S. adults. Correct responses to knowledge of the Five a Day recommendation only increased from 34% to 38% in the total population, but improvement was different among Caucasian and African American participants. The percentage of African Americans who responded

correctly increased from 13% at baseline to 41% post-intervention, while the percentage of correct responses by Caucasian participants decreased slightly. Because baseline knowledge of the Five a Day recommendation was lower in African Americans than Caucasians (13% vs. 39%), African Americans may have been more likely to absorb and retain new concepts taught in the intervention. A larger overall change in knowledge of the recommendation may not have been observed due to the lack of short, repetitive messages in all lessons that link five servings of fruits and vegetables a day directly to increased health benefits. To further increase knowledge of this recommendation, clear, concise, and repetitive Five a Day messages have been incorporated into every lesson.

Our findings that African American participants reported a higher frequency of barriers at baseline, and reported a lower frequency of barriers and higher increases in mean intakes of fruits and vegetables post-intervention than Caucasian participants are supported by Ammerman et al. (2002). They reported that minority older adult populations are often at greatest risk for chronic disease and health problems and tend to experience more obstacles to adopting dietary change. However, interventions targeted at individuals with elevated disease risk and a higher prevalence of barriers were reported to be more effective at achieving goals set forth in dietary interventions than those with fewer obstacles.

Participants aged 80 and older were more likely than their younger counterparts to report barriers to fruit and vegetable consumption, including less interest in learning new vegetable preparation methods and receiving recipe handouts, less belief that improving eating habits would improve health, less likely to shop for their own groceries, less likely to plan their meals ($p<0.05$); and less likely to like the taste of most vegetables, less

likely to prepare their own meals, more limitations with kitchen appliances and cookware, and more likely to have high blood pressure (p=0.05-0.15). It was expected that older participants would experience more barriers to fruit and vegetable intake. Several studies have acknowledged a decrease in functional ability and increase in health problems with age (Drewnowski et al., 2001; Millen et al., 2002; Ponza et al., 1996). In the current study, at baseline, participants aged 80 and older reported lower mean intakes of several fruit and vegetable items, did not have significantly higher mean intakes of any fruit or vegetable item, and reported a greater number of barriers to consumption than participants younger than 80. However, participants aged 80 and older reported higher mean increases in four fruit and vegetable items from Time 1 to Time 2 compared to younger participants, even though most increases were nutritionally small. A possible explanation is that older participants who experienced more barriers, health problems, or felt more at risk for health conditions, were more motivated to change behavior (Coulston et al., 2001; Dittus et al., 1995). This explanation supports the *perceived susceptibility* and *perceived severity* tenets of the Health Belief Model in predicting behavior change.

There were few observed differences in intake among participants who had any of the five self-reported health conditions, but participants with self-reported heart disease or heart attacks were more likely to increase intakes of cranberry, apple, or purple grape juice; and total fruit and vegetable items from Time 1 to Time 2. Perhaps participants who had experienced heart attacks - an outward, physical, and often frightening manifestation of a health condition - were more receptive to the health benefits of fruits and vegetables. This possible phenomenon further supports the *perceived severity* tenet of the HBM.

The number of medications taken daily had a significant impact on intakes of several fruit and vegetable measures and summary scores at Time 2, especially fruits and vegetables high in vitamin C. Studies have shown that over 250 medications negatively alter the taste of fruits and vegetables (Finkelstein & Schiffman, 1999). In addition, older adults taking multiple medications often have extensive health problems that may cognitively and functionally limit their ability to purchase and prepare fruits and vegetables.

Fifty-one percent of participants were identified as supertasters, and supertasters reported fewer changes in fruit and vegetable consumption following the intervention. The percentage of supertasters (51%) seen in this population is approximately twice as high as estimates of supertaster prevalence in the elderly reported in other studies (Finkelstein & Schiffman, 1999). Alteration of sensory function is common in the elderly, and it is unclear to what degree these changes are caused by the normal aging process, medications, disease states (especially Alzheimer's), cognitive status, and other environmental factors (Finkelstein & Schiffman, 1999). Further research is needed to determine the biochemical mechanisms of and reasons for altered taste acuity in older adults, which may cause aversion to fruits and vegetables with high amounts of bitter-tasting phytochemicals.

After the intervention, there was an increase in consumption of total fruit and vegetable items by 3.9 servings per week, as well as consumption of five of the 31 fruit and vegetable items assessed: cranberry, apple, or purple grape juice; peaches, nectarines, and apricots; beans; vegetables consumed as a snack; and canned vegetables. Additionally, the percentage of participants who reported consuming $\geq$ 5 servings a day

of fruits and vegetables assessed in the intervention increased from 13% to 21%. Havas et al. (1998) reported that increased consumption of fruits and vegetables by at least 0.5 serving each per day, if maintained, could result in an 8% lower incidence of cancer. Our results show similar gains, therefore the observed positive increases in intake hold both promise and challenge for future fruit and vegetable intervention studies in this population.

There were several limitations in this study. First, the questionnaire used in this intervention was not validated, although it was adapted from the Block food frequency questionnaire, a widely used assessment tool. However, other similar FFQs have been assessed for validity. The Health Habits and History questionnaire, a 36-item FFQ similar to the Block FFQ, was assessed for validity by Resnicow et al. (2001). Subjects were 1,000 African American adults from 15 churches in Atlanta. The 36-item FFQ was found to correlate more closely with serum levels of lycopene, lutein, zeaxanthin, cryptoxanthin, alpha-carotene, and beta-carotene than a seven-item and two-item instrument previously used in the population, suggesting that it has merit in fruit and vegetable interventions. In contrast, the baseline Five a Day survey researchers reported that their assessment tool, a 33-item fruit and vegetable questionnaire, appeared to generate inflated estimates of intake (Subar et al., 1994). Possible overestimation is attributed to cognitive difficulties in recalling consumption frequencies for a lengthy list of fruits and vegetables. This effect could be amplified or reversed in our population, where cognitive abilities vary. The second limitation was that attendance was encouraged but not mandatory. Although participants who were absent received handouts, they missed hearing important information and key messages on the health

benefits of specific fruits and vegetables, which may have negatively impacted change in intake and behavior. Third, participant responses were self-reported. Studies have shown that people tend to misreport the amount of fruits and vegetables they are consuming, so fruit and vegetable intake may have actually been higher or lower than reported (Thompson et al., 1999; Subar et al., 1994). Fourth, cognitive abilities were not formally examined in this study. Folstein's Mini-Mental State Examination or a comparable assessment would have been useful in determining the prevalence of cognitive disabilities for data analysis and for curriculum development. All education materials were evaluated and modified prior to the intervention to account for possible differences in cognitive abilities. Education level was not assessed; however, the curriculum was designed using an eighth grade reading level as the mean education level based on a report by Bracket (1999). Fifth, seasonality may have affected the results of this study (Ciliska et al., 2001). Although this pilot study was useful in establishing information about general fruit and vegetable intake patterns, future studies should address seasonal variation in reported intake. Sixth, the sample size was small and was composed primarily of women and African Americans. Our findings may not be applicable to OANP participants with different cultural, ethnic, gender, or age characteristics. However, our findings can serve as a general guide for future interventions and evaluations in low-income, low-literacy older adult populations.

Our goal was to facilitate the ability of older Americans to live independently in the community through dietary practices that will support adequate nutrition and increase overall health. This study was successful in helping to achieve that goal. Ninety-one percent of participants rated the program as good, very good, or excellent, supporting the

continuation and expansion of this project. It is encouraging that African Americans and adults aged 80 and older demonstrated increased self-efficacy by making positive changes in fruit and vegetable intake and behaviors, given that these are identified as high-risk groups within the older adult population (Millen et al., 2002; Ponza et al., 1996), and that these groups reported more barriers to fruit and vegetable intake at Time 1 than their Caucasian and younger counterparts. Future studies are needed to explore the long-term impact of fruit and vegetable educational interventions in the elderly, and to explore cultural and generation norms in older adults to determine differences in behaviors and attitudes that may further explain fruit and vegetable consumption patterns. Also unclear is the extent to which age-related changes in chemosensory function caused by prescription medications, changes in taste acuity, and other factors interact with individual barriers, health beliefs, and knowledge to determine fruit and vegetable intake.

The fruit and vegetable nutrition education curriculum is available to other educators at our website, Nutrition for Older Adults' Health or NOAHnet: www.arches.uga.edu/~noahnet. Lesson handouts for participants, scripts for educators, assessment questionnaires, fruit and vegetable references, and educational extenders (fruit and vegetable characters) are included in the online curriculum.

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Table 1. Participant Characteristics at Time 1 (n=54)

	n	**%**
Age		
60s	14	26
70s	12	22
80s	23	43
90s	5	9
Mean age	77.9 ± 1.2	
Gender		
Male	7	13
Female	47	87
Ethnicity		
Caucasian	23	43
African American	31	57
A52 – A56. Do you have or have you had any of the following diseases or conditions? (% yes)		
Cancer	9	17
Heart disease/ heart attack	10	19
Diabetes	19	35
High cholesterol	25	46
Hypertension	31	57

Table 2. Participant Responses on Pre-Test Questionnaires (n=54)

Variable Name & Description		**Total (%)**		**By Race (%)**		**P value**	**By Age Group (%)**		**P value**
				Caucasian (C)	**African American (AA)**		**60 – 79 (< 80)**	**80 – 97 (≥ 80)**	
A7[a]	100% orange juice								
	0 – 1 servings per week	46		61	35	0.05* AA > C	58	36	0.23
	2 – 3 servings per week	13		17	10		8	18	
	4 or more servings per week	41		22	55		34	46	
	Mean ± S.D.	3.6 ± 0.5		1.7 ± 0.5	4.9 ± 0.8	0.01* AA > C	3.2 ± 0.7	4.0 ± 0.8	0.45
	n	54		23	31		26	28	
A8[a]	100% cranberry, apple, or purple grape juice								
	0 – 1 servings per week	58		61	55	0.88	62	54	0.68
	2 – 3 servings per week	22		22	23		23	21	
	4 or more servings per week	20		17	22		15	25	
	Mean ± S.D.	2.0 ± 0.4		1.5 ± 0.5	2.4 ± 0.6	0.25	1.8 ± 0.6	2.1 ± 0.5	0.68
	n	54		23	31		26	28	
A9[a]	Berries such as strawberries, blueberries, or blackberries								
	0 – 1 servings per week	79		83	78	0.82	88	71	0.21
	2 – 3 servings per week	17		13	19		12	21	
	4 or more servings per week	4		4	3		-	8	
	Mean ± S.D.	0.8 ± 0.2		0.8 ± 0.3	0.8 ± 0.2	0.98	0.5 ± 0.2	1.1 ± 0.3	0.09[†]
	n	54		23	31		26	28	
A10[a]	Nectarines, peaches, or apricots								
	0 – 1 servings per week	54		69	42	0.08[†]	42	64	0.25
	2 – 3 servings per week	39		22	52		50	29	
	4 or more servings per week	7		9	6		8	7	

	Mean ± S.D.	1.5 ± 0.2		1.3 ± 0.4	1.6 ± 0.3	0.56	1.7± 0.3	1.3 ± 0.3	0.42
	n	54		23	31		26	28	
A11 [a]	Broccoli, cabbage, or Cauliflower								
	0 – 1 servings per week	50		56	45	0.01* AA > C	46	54	0.25
	2 – 3 servings per week	41		22	55		50	32	
	4 or more servings per week	9		22	-		4	14	
	Mean ± S.D.	1.9 ± 0.2		2.1± 0.4	1.7 ± 0.2	0.33	1.8 ± 0.2	1.9 ± 0.3	0.68
	n	54		23	31		26	28	
A12 [a]	Cantaloupe or honeydew								
	0 – 1 servings per week	74		82	68	0.45	84	64	0.22
	2 – 3 servings per week	15		9	19		8	22	
	4 or more servings per week	11		9	13		8	14	
	Mean ± S.D.	1.2 ± 0.3		0.9 ± 0.4	1.5 ± 0.4	0.27	0.8 ± 0.4	1.5 ± 0.4	0.20
	n	54		23	31		26	28	
A13 [a]	Leafy greens such as mustard, turnip, collard greens								
	0 – 1 servings per week	39		61	23	0.01* AA > C	31	47	0.30
	2 – 3 servings per week	48		35	58		50	46	
	4 or more servings per week	13		4	19		19	7	
	Mean ± S.D.	2.1 ± 0.2		1.3 ± 0.2	2.7 ± 0.3	0.001* AA > C	2.6 ± 0.4	1.6 ± 0.2	0.06† 60–79 > 80–97
	n	54		23	31		26	28	
A14 [a]	Corn								
	0 – 1 servings per week	67		70	66	0.74	52	83	0.02* 60–79 > 80–97
	2 – 3 servings per week	33		30	34		48	17	
	4 or more servings per week	-		-	-		-	-	
	Mean ± S.D.	1.4 ± 0.2		1.6 ± 0.3	1.3 ± 0.3	0.45	1.5 ± 0.3	1.3 ± 0.3	0.60
	n	49		20	29		25	24	

A15 [a]	Cooked or stewed tomatoes								
	0 – 1 servings per week	56		61	52	0.39	50	61	0.71
	2 – 3 servings per week	33		35	32		38	28	
	4 or more servings per week	11		4	16		12	11	
	Mean ± S.D.	1.7 ± 0.2		1.5 ± 0.3	1.8 ± 0.4	0.48	1.9 ± 0.4	1.5 ± 0.3	0.38
	n	54		23	31		26	28	
A16 [a]	Spaghetti or lasagna								
	0 – 1 servings per week	85		96	77	0.06† AA > C	77	93	0.10†
	2 – 3 servings per week	15		4	23		23	7	
	4 or more servings per week	-		-	-		-	-	
	Mean ± S.D.	0.6 ± 0.1		0.3 ± 0.1	0.8 ± 0.2	0.01* AA > C	0.7 ± 0.2	0.5 ± 0.1	0.25
	n	54		23	31		26	28	
A17 [a]	Onions								
	0 – 1 servings per week	41		26	52	0.09†	31	50	0.26
	2 – 3 servings per week	33		35	32		35	32	
	4 or more servings per week	26		39	16		34	18	
	Mean ± S.D.	2.7 ± 0.3		3.5 ± 0.6	2.0 ± 0.4	0.03* C > AA	3.1 ± 0.5	2.3 ± 0.4	0.20
	n	54		23	31		26	28	
A18 [a]	Squash or zucchini								
	0 – 1 servings per week	78		82	74	0.09†	77	79	0.99
	2 – 3 servings per week	18		9	26		19	18	
	4 or more servings per week	4		9	-		4	3	
	Mean ± S.D.	0.9 ± 0.2		1.1 ± 0.3	0.8 ± 0.2	0.42	0.9 ± 0.2	0.9 ± 0.3	0.90
	n	54		23	31		26	28	
A19 [a]	Spinach								
	0 – 1 servings per week	80		96	68	0.03* AA > C	73	86	0.24
	2 – 3 servings per week	15		-	26		23	7	

	4 or more servings per week	5		4	6		4	7	
	Mean ± S.D.	0.9 ± 0.2		0.4 ± 0.2	1.2 ± 0.3	0.02* AA > C	0.9 ± 0.2	0.9 ± 0.3	0.94
	n	54		23	31		26	28	
A20 [a]	Sweet potatoes or yams								
	0 – 1 servings per week	64		82	52	0.053† AA > C	62	67	0.27
	2 – 3 servings per week	32		14	45		38	26	
	4 or more servings per week	4		4	3		-	7	
	Mean ± S.D.	1.3 ± 0.2		1.0 ± 0.2	1.5 ± 0.2	0.07†	1.2 ± 0.2	1.4 ± 0.2	0.56
	n	53		22	31		26	27	
A21 [a]	Carrots								
	0 – 1 servings per week	60		56	61	0.92	58	61	0.97
	2 – 3 servings per week	33		35	32		34	32	
	4 or more servings per week	7		9	7		8	7	
	Mean ± S.D.	1.6 ± 0.2		1.7 ± 0.3	1.5 ± 0.3	0.70	1.5 ± 0.3	1.6 ± 0.3	0.67
	n	54		23	31		26	28	
A22 [a]	Baked beans, pintos, black-eyed peas, other beans								
	0 – 1 servings per week	66		61	71	0.74	69	64	0.38
	2 – 3 servings per week	30		35	26		31	29	
	4 or more servings per week	4		4	3		-	7	
	Mean ± S.D.	1.3 ± 0.2		1.5 ± 0.3	1.1 ± 0.2	0.23	1.2 ± 0.2	1.3 ± 0.3	0.71
	n	54		23	31		26	28	
A23 [a]	How often do you eat fruit as a snack?								
	0 – 1 servings per week	20		26	16	0.61	15	25	0.60
	2 – 3 servings per week	30		30	29		35	25	
	4 or more servings per week	50		43	55		50	50	
	Mean ± S.D.	4.3 ± 0.5		4.0 ± 0.7	4.5 ± 0.6	0.59	4.7 ± 0.7	4.0 ± 0.6	0.51
	n	54		23	31		26	28	

A24 [a]	How often do you eat fruit as dessert?								
	0 – 1 servings per week	57		63	52	0.63	54	59	0.30
	2 – 3 servings per week	24		23	26		19	30	
	4 or more servings per week	19		14	22		27	11	
	Mean ± S.D.	2.1 ± 0.3		1.6 ± 0.4	2.4 ± 0.5	0.23	2.4 ± 0.5	1.7 ± 0.4	0.29
	n	53		22	31		26	27	
A25 [a]	How often do you eat vegetables as a snack?								
	0 – 1 servings per week	80		83	77	0.12[†]	81	79	0.36
	2 – 3 servings per week	17		9	23		19	14	
	4 or more servings per week	4		9	-		-	7	
	Mean ± S.D.	0.7 ± 0.2		0.8 ± 0.4	0.7 ± 0.1	0.74	0.5 ± 0.2	1.0 ± 0.4	0.24
	n	54		23	31		26	28	
A26 [a]	When you are at home, how often do you eat fresh fruit?								
	0 – 1 servings per week	18		9	26	0.27	19	18	0.97
	2 – 3 servings per week	26		30	22		27	25	
	4 or more servings per week	56		61	52		54	57	
	Mean ± S.D.	4.6 ± 0.4		5.3 ± 0.6	4.1 ± 0.5	0.17	4.5 ± 0.6	4.7 ± 0.5	0.87
	n	54		23	31		26	28	
A27 [a]	When you are at home, how often do you eat frozen fruit?								
	0 – 1 servings per week	93		91	94	0.48	96	89	0.53
	2 – 3 servings per week	5		4	6		4	7	
	4 or more servings per week	2		4	-		-	4	
	Mean ± S.D.	0.4 ± 0.1		0.5 ± 0.3	0.3 ± 0.1	0.57	0.2 ± 0.1	0.5 ± 0.3	0.35
	n	54		23	31		26	28	

A28 [a]	When you are at home, how often do you eat canned fruit?								
	0 – 1 servings per week	55		68	45	0.12[†]	54	56	0.17
	2 – 3 servings per week	34		18	45		42	26	
	4 or more servings per week	11		14	10		4	18	
	Mean ± S.D.	1.6 ± 0.2		1.5 ± 0.4	1.6 ± 0.3	0.75	1.5 ± 0.3	1.6 ± 0.3	0.84
	n	53		22	31		26	27	
A29 [a]	When you are at home, how often do you eat fresh vegetables?								
	0 – 1 servings per week	20		30	13	0.06[†] AA > C	19	22	0.56
	2 – 3 servings per week	39		22	52		46	32	
	4 or more servings per week	41		48	35		35	46	
	Mean ± S.D.	3.9 ± 0.4		3.7 ± 0.6	4.2 ± 0.6	0.55	3.3 ± 0.4	4.5 ± 0.7	0.15[†]
	n	54		23	31		26	28	
A30 [a]	When you are at home, how often do you eat frozen vegetables?								
	0 – 1 servings per week	59		55	63	0.81	62	58	0.10[†]
	2 – 3 servings per week	33		36	30		38	27	
	4 or more servings per week	8		9	7		-	15	
	Mean ± S.D.	1.4 ± 0.2		1.7 ± 0.4	1.1 ± 0.3	0.30	1.1 ± 0.2	1.7 ± 0.5	0.25
	n	52		22	30		26	26	
A31 [a]	When you are at home, how often do you eat canned vegetables?								
	0 – 1 servings per week	59		57	60	0.73	58	59	0.87
	2 – 3 servings per week	32		30	33		31	33	
	4 or more servings per week	9		13	7		11	8	
	Mean ± S.D.	1.5 ± 0.2		1.7 ± 0.4	1.4 ± 0.3	0.58	1.6 ± 0.4	1.5 ± 0.3	0.77

	n	53		23	30		26	27	
All FV[b]	Summary Score for total fruit and vegetable items, excluding A16. Spaghetti or lasagna and A22. Beans								
	0 – 13 servings per week	23		31	16	0.30	19	26	0.92
	14 – 20 servings per week	21		28	16		23	18	
	21 – 27 servings per week	30		28	32		34	26	
	28 – 34 servings per week	13		4	20		12	15	
	≥ 35 servings per week	13		9	16		12	15	
	Mean ± S.D.	22.8 ± 1.5		19.0 ± 2.1	25.6 ± 2.0	0.03* AA > C	23.2 ± 2.1	22.5 ± 2.2	0.81
	n	53		22	31		26	27	
AllFr[b]	Summary Score for total fruit items: A7-A10, A12								
	0 – 6 servings per week	37		52	26	0.10[†] AA > C	46	29	0.26
	7 – 13 servings per week	39		35	42		39	39	
	≥ 14 servings per week	24		13	32		15	32	
	Mean ± S.D.	9.0 ± 0.9		6.2 ± 1.1	11.1± 1.2	0.01* AA > C	7.9 ± 1.3	10.0± 1.2	0.26
	n	54		23	31		26	28	
All Veg[b]	Summary Score for total vegetable items: A11, A13-15, A17-21								
	0 – 6 servings per week	11		14	10	0.96	8	15	0.03* 60–79 > 80–97
	7 – 13 servings per week	40		41	39		27	52	
	14 – 20 servings per week	34		32	35		54	15	
	≥ 21 servings per week	15		13	16		11	18	
	Mean ± S.D.	14.0 ± 0.9		13.2 ± 1.3	14.5 ± 1.2	0.47	15.3 ± 1.2	12.7 ± 1.3	0.14
	n	53		22	31		26	27	

Hi VitA Car	Summary Score for total items high in vitamin A and/or carotenoids: A13, A19, A20, A21								
	0 – 6 servings per week	68		91	52	0.001* AA > C	62	74	0.33
	≥ 7 servings per week	32		9	48		38	26	
	Mean ± S.D.	5.7 ± 0.5		4.0 ± 0.6	6.9 ± 0.6	0.001* AA > C	6.1 ± 0.7	5.3 ± 0.7	0.43
	n	53		22	31		26	27	
HVit ACar Cru	Summary Score for total items high in vitamin A/carotenoids and cruciferous vegetables:A13, A19, A20, A21, A11								
	0 – 6 servings per week	55		68	45	0.10†	46	63	0.22
	≥ 7 servings per week	45		32	55		54	37	
	Mean ± S.D.	7.5 ± 0.6		6.0 ± 0.9	8.6 ± 0.7	0.03* AA > C	7.9 ± 0.8	7.1 ± 0.8	0.53
	n	53		22	31		26	27	
Hi VitC	Summary Score for total fruit and vegetable items high in vitamin C: A7, A9, A11-13, A15, A20								
	0 – 6 servings per week	26		45	13	0.01* AA > C	23	30	0.59
	≥ 7 servings per week	74		55	87		77	70	
	Mean ± S.D.	12.2 ± 1.0		8.5 ± 1.3	14.9 ± 1.2	0.001* AA > C	11.9 ± 1.3	12.6 ± 1.4	0.72
	n	53		22	31		26	27	
HiLut Zea	Summary Score for total items high in lutein and zeaxanthin: A13, A19								
	≤ 2 servings per week	54		74	39	0.001*	50	57	0.60

	≥ 3 servings per week	46		26	61	AA > C	50	43	
	Mean ± S.D.	3.0 ± 0.3		1.7 ± 0.3	3.9 ± 0.5	0.0001* AA > C	3.5 ± 0.6	2.5 ± 0.4	0.17
	n	54		23	31		26	28	
HiLycop	Summary Score for total items high in lycopene: A15, A16								
	≤ 2 servings per week	63		74	55	0.15†	54	71	0.18
	≥ 3 servings per week	37		26	45		46	29	
	Mean ± S.D.	2.3 ± 0.3		1.7 ± 0.4	2.6 ± 0.4	0.11†	2.6 ± 0.4	1.9 ± 0.4	0.25
	n	54		23	31		26	28	
A32	Do you think that eating more fruits and vegetables will help reduce your risk of cancer?								
	Yes	70		65	74	0.45	77	64	0.44
	No	11		18	7		11	11	
	Don't Know	19		17	19		12	25	
	n	54		23	31		26	28	
A33	Do you think that eating more fruits and vegetables will help reduce your risk of heart disease?								
	Yes	68		65	71	0.17	77	61	0.18
	No	6		-	10		-	11	
	Don't Know	26		35	19		23	28	
	n	54		23	31		26	28	
A34	Do you think if you improved the way you eat, that you would be a much healthier person?								
	Yes	83		78	87	0.66	96	71	0.04* 60–79 >
	No	9		13	6		-	18	

	Don't Know	8		9	7		4	11	80–97
	n	54		23	31		26	28	
A35	Do you think that your grocery store has a wide selection of fruits and vegetables?								
	Yes	92		91	94	0.48	92	93	0.51
	No	6		9	3		8	3	
	Don't Know	2		-	3		-	4	
	n	53		23	30		25	28	
A36	How many fruits and vegetables should people eat each day?								
	1 per day	7		9	6	0.11†	8	7	0.69
	2 per day	17		9	23	C > AA	15	18	
	3 per day	26		17	32		19	32	
	4 per day	15		9	19		11	18	
	5 or more per day	**24**		**39**	**13**		**31**	**18**	
	Don't Know	11		17	7		16	7	
	n	54		23	31		26	28	
A37	Do you like the way most vegetables taste?								
	Yes	80		87	74	0.25	88	71	0.12†
	No	20		13	26		12	29	
	n	54		23	31		26	28	
A38	Do you have tooth or mouth problems that make you usually eat easy-to-chew fruits and vegetables?								
	Yes	26		13	35	0.06†	19	32	0.28
	No	74		87	65	AA > C	81	68	
	n	54		23	31		26	28	

A39	Do you have enough money to spend on fruits and vegetables?								
	Yes	60		70	52	0.19	56	63	0.61
	No	40		30	48		44	37	
	n	52		23	29		25	27	
A40	Would you like to know more about which fruits and vegetables are good for your health?								
	Yes	91		91	90	0.90	92	89	0.70
	No	9		9	10		8	11	
	n	54		23	31		26	28	
A41	Would you like to know more about different ways to cook vegetables?								
	Yes	74		57	87	0.01* AA > C	88	61	0.02* 60–79 > 80–97
	No	26		43	13		12	39	
	n	54		23	31		26	28	
A42	Would you like a handout with healthy menus to take home?								
	Yes	85		83	86	0.72	96	73	0.02* 60–79 > 80–97
	No	15		17	14		4	27	
	n	52		23	29		26	26	
Which of these kitchen tools can you easily use to cook vegetables at home?									
A43	Sharp knife?								
	Yes	85		83	87	0.64	88	82	0.51
	No	15		17	13		12	18	

	n	54		23	31		26	28	
A44	Can opener?								
	Yes	83		83	84	0.90	92	75	0.09†
	No	17		17	16		8	25	
	n	54		23	31		26	28	
A45	Pot of hot water?								
	Yes	80		74	87	0.37	88	71	0.12†
	No	20		26	16		12	29	
	n	54		23	31		26	28	
A46	Do you shop for your own groceries?								
	Yes	74		74	73	0.96	96	54	0.001* 60–79 > 80–97
	No	26		26	27		4	46	
	n	53		23	30		25	28	
A47	If you answered no, then who shops for you?								
	Spouse	2		4	-	N/A	-	3	N/A
	Other family	20		22	20		4	36	
	Friend	-		-	-		-	-	
	Other	4		-	7			7	
	n	14		6	8		1	13	
A48	Do you plan the meals you eat?								
	Yes	80		78	81	0.83	96	64	0.001* 60–79 > 80–97
	No	20		22	19		4	36	
	n	54		23	31		26	28	
A49	Do you cook the meals you eat?								

	Yes	83		78	87	0.39	92	75	0.09†
	No	17		22	13		8	25	
	n	54		23	31		26	28	
A50	Do you use a microwave at home?								
	Yes	70		83	61	0.09†	69	71	0.86
	No	30		17	39		31	29	
	n	54		23	31		26	28	
A51	Do you use a stove at home?								
	Yes	91		91	90	0.90	96	86	0.19
	No	9		9	10		4	14	
	n	54		23	31		26	28	
Do you have or have you ever had any of the following?									
A52	Diabetes								
	Yes	35		22	45	0.07† AA > C	42	29	0.29
	No	65		78	55		58	71	
	n	54		23	31		26	28	
A53	Cancer								
	Yes	17		30	6	0.02* C > AA	19	14	0.63
	No	83		70	94		81	86	
	n	54		23	31		26	28	
A54	Heart disease or heart attack								
	Yes	19		22	16	0.60	15	21	0.57
	No	81		78	84		85	79	
	n	54		23	31		26	28	
A55	High blood cholesterol								
	Yes	46		48	45	0.85	50	43	0.60
	No	54		52	55		50	57	
	n	54		23	31		26	28	

A56	High blood pressure or hypertension								
	Yes	57		48	65	0.22	46	68	0.11†
	No	43		52	35		54	32	
	n	54		23	31		26	28	

†*P values 0.05 – 0.15 were considered trends.*

**P values < 0.05 were considered significant.*

[a] *For frequency measures by ethnicity and age, a > direction indicated for significant and trend p-values indicates which group (African American vs.Caucasian or 60-79 vs. 80-97) was more likely to consume more than 1 serving per week.*

[b] *For summary score frequency measures by ethnicity and age, a > direction indicated for significant and trend p-values indicates which group (African American vs. Caucasian or 60-79 vs. 80-97) was more likely to consume ≥ than 3 servings per day(AllFV), ≥ than 2 servings per day(AllVeg), or ≥ than 1 serving per day(AllFr) .*

Table 3. Participant Responses on Post-Test Questionnaires (n = 47)

Variable Name	Description of Variable	Total Population (%)		By Race (%)		P value	By Age Group (%)		P value
				Caucasian (C)	African American (AA)		60 – 79 (< 80)	80 – 97 (≥ 80)	
B7rc[a]	100% orange juice								
	0 – 1 servings per week	32		55	15	0.01*	29	35	0.30
	2 – 3 servings per week	27		28	27		38	17	
	4 or more servings per week	41		17	58		33	48	
	Mean ± S.D.	3.5 ± 0.4		1.8 ± 0.6	4.7 ± 0.5	0.001* AA > C	3.4 ± 0.6	3.6 ± 0.7	0.80
	n	44		18	26		21	23	
B8rc[a]	100% cranberry, apple, or purple grape juice								
	0 – 1 servings per week	52		69	41	0.04* AA > C	52	52	0.10[†] 80-97 > 60-79
	2 – 3 servings per week	24		26	22		35	13	
	4 or more servings per week	24		5	37		13	35	
	Mean ± S.D.	3.0 ± 0.6		1.1 ± 0.4	4.4 ± 0.9	0.001* AA > C	2.2 ± 0.7	3.8 ± 1.0	0.19
	n	46		19	27		23	23	
B9rc[a]	Berries such as strawberries, blueberries, or blackberries								
	0 – 1 servings per week	71		80	64	0.24	86	58	0.09[†] 80-97 > 60-79
	2 – 3 servings per week	22		20	24		14	29	
	4 or more servings per week	7		-	12		-	13	

	Mean ± S.D.	1.1 ± 0.3		0.6 ± 0.2	1.6 ± 0.4	0.04* AA > C	0.6 ± 0.2	1.5 ± 0.4	0.08† 80-97 > 60-79
	n	45		20	25		21	24	
B10rc[a]	Nectarines, peaches, or apricots								
	0 – 1 servings per week	42		58	31	0.18	36	48	0.71
	2 – 3 servings per week	40		32	46		46	35	
	4 or more servings per week	18		10	23		18	17	
	Mean ± S.D.	2.2 ± 0.3		1.6 ± 0.4	2.7 ± 0.5	0.08† AA > C	2.1 ± 0.4	2.3 ± 0.5	0.80
	n	45		19	26		22	23	
B11rc[a]	Broccoli, cabbage, or Cauliflower								
	0 – 1 servings per week	50		70	35	0.06† AA > C	44	57	0.12† 60-79 > 80-97
	2 – 3 servings per week	39		25	50		52	26	
	4 or more servings per week	11		5	15		4	17	
	Mean ± S.D.	1.8 ± 0.2		1.3 ± 0.2	2.2 ± 0.4	0.04* AA > C	1.7 ± 0.2	1.9 ± 0.4	0.64
	n	46		20	26		23	23	
B12rc[a]	Cantaloupe or honeydew								
	0 – 1 servings per week	61		65	58	0.72	65	57	0.32
	2 – 3 servings per week	30		30	31		22	39	
	4 or more servings per week	9		5	11		13	4	
	Mean ± S.D.	1.6 ± 0.3		1.4 ± 0.4	1.8 ± 0.4	0.46	1.8 ± 0.5	1.3 ± 0.3	0.41
	n	46		20	26		23	23	

B13rc[a]	Leafy greens such as mustard, turnip, collard greens								
	0 – 1 servings per week	50		63	41	0.21	36	63	0.20
	2 – 3 servings per week	46		37	52		59	33	
	4 or more servings per week	4		-	7		5	4	
	Mean ± S.D.	1.7 ± 0.2		1.1 ± 0.2	2.0 ± 0.3	0.02* AA > C	2.0 ± 0.3	1.4 ± 0.3	0.19
	n	46		19	27		22	24	
B14rc[a]	Corn								
	0 – 1 servings per week	66		65	59	0.69	61	62	0.91
	2 – 3 servings per week	34		35	41		39	38	
	4 or more servings per week	-		-	-		-	-	
	Mean ± S.D.	1.4 ± 0.2		1.4 ± 0.4	1.4 ± 0.3	0.99	1.4 ± 0.3	1.4 ± 0.3	0.90
	n	47		20	27		23	24	
B15rc[a]	Cooked or stewed tomatoes								
	0 – 1 servings per week	52		60	46	0.64	45	58	0.66
	2 – 3 servings per week	35		30	39		41	29	
	4 or more servings per week	13		10	15		14	13	
	Mean ± S.D.	1.9 ± 0.3		1.5 ± 0.3	2.2 ± 0.5	0.18	1.9 ± 0.4	1.9 ± 0.4	0.98
	n	46		20	26		22	24	
B16rc[a]	Spaghetti or lasagna								
	0 – 1 servings per week	73		90	58	0.02* AA > C	76	70	0.62
	2 – 3 servings per week	27		10	42		24	30	
	4 or more servings per week	-		-	-		-	-	
	Mean ± S.D.	0.7 ± 0.1		0.4 ± 0.2	0.9 ± 0.2	0.09† AA > C	0.6 ± 0.2	0.7 ± 0.2	0.56

	n	44		20	24		21	23	
B17rc[a]	Onions								
	0 – 1 servings per week	34		25	41	0.46	22	46	0.20
	2 – 3 servings per week	38		40	37		48	29	
	4 or more servings per week	28		35	22		30	25	
	Mean ± S.D.	2.9 ± 0.4		3.4 ± 0.6	2.6 ± 0.5	0.25	3.2 ± 0.5	2.6 ± 0.5	0.41
	n	47		20	27		23	24	
B18rc[a]	Squash or zucchini								
	0 – 1 servings per week	72		70	73	0.85	69	74	0.83
	2 – 3 servings per week	22		25	19		22	22	
	4 or more servings per week	6		5	8		9	4	
	Mean ± S.D.	1.3 ± 0.2		1.3 ± 0.3	1.3 ± 0.4	0.99	1.4 ± 0.4	1.2 ± 0.3	0.73
	n	46		20	26		23	23	
B19rc[a]	Spinach								
	0 – 1 servings per week	76		88	65	0.051[†] AA > C	80	71	0.37
	2 – 3 servings per week	22		6	35		15	29	
	4 or more servings per week	2		6	-		5	-	
	Mean ± S.D.	0.8 ± 0.2		0.6 ± 0.3	1.0 ± 0.4	0.33	0.7 ± 0.3	0.9 ± 0.2	0.56
	n	41		18	23		20	21	
B20rc[a]	Sweet potatoes or yams								
	0 – 1 servings per week	65		75	58	0.38	70	61	0.55
	2 – 3 servings per week	33		25	38		30	35	
	4 or more servings per week	2		-	4		-	4	
	Mean ± S.D.	1.2 ± 0.2		1.0 ± 0.2	1.4 ± 0.3	0.27	1.0 ± 0.2	1.5 ± 0.3	0.24
	n	46		20	26		23	23	

B21rc[a]	Carrots								
	0 – 1 servings per week	50		35	62	0.03* C > AA	61	39	0.08[†] 80-97 > 60-79
	2 – 3 servings per week	41		45	38		39	44	
	4 or more servings per week	9		20	-		-	17	
	Mean ± S.D.	1.8 ± 0.3		2.7 ± 0.5	1.1 ± 0.2	0.01* C > AA	1.2 ± 0.2	2.4 ± 0.5	0.03* 80-97 > 60-79
	n	46		20	26		23	23	
B22rc[a]	Baked beans, pintos, black-eyed peas, other beans								
	0 – 1 servings per week	55		65	48	0.31	61	50	0.34
	2 – 3 servings per week	41		35	44		39	42	
	4 or more servings per week	4		-	7		-	8	
	Mean ± S.D.	1.5 ± 0.2		1.3 ± 0.2	1.7 ± 0.3	0.30	1.3 ± 0.2	1.8 ± 0.3	0.19
	n	47		20	27		23	24	
B23rc[a]	How often do you eat fruit as a snack?								
	0 – 1 servings per week	23		35	15	0.21	22	25	0.90
	2 – 3 servings per week	24		15	30		26	21	
	4 or more servings per week	53		50	55		52	54	
	Mean ± S.D.	4.4 ± 0.5		3.9 ± 0.7	4.8 ± 0.6	0.35	4.4 ± 0.7	4.4 ± 0.6	0.99
	n	47		20	27		23	24	
B24rc[a]	How often do you eat fruit as dessert?								
	0 – 1 servings per week	61		74	52	0.25	57	65	0.33
	2 – 3 servings per week	22		10	30		30	13	

	4 or more servings per week	17		16	18		13	22	
	Mean ± S.D.	1.8 ± 0.3		1.4 ± 0.5	2.1 ± 0.4	0.27	1.8 ± 0.5	1.8 ± 0.5	1.0
	n	46		19	27		23	23	
B25rc[a]	How often do you eat vegetables as a snack?								
	0 – 1 servings per week	67		83	56	0.16	67	68	0.55
	2 – 3 servings per week	19		11	24		24	14	
	4 or more servings per week	14		6	20		9	18	
	Mean ± S.D.	1.4 ± 0.3		0.7 ± 0.4	2.0 ± 0.5	0.052[†] AA > C	1.2 ± 0.4	1.6 ± 0.6	0.62
	n	43		18	25		21	22	
B26rc[a]	When you are at home, how often do you eat fresh fruit?								
	0 – 1 servings per week	19		25	15	0.65	22	17	0.83
	2 – 3 servings per week	30		30	30		26	33	
	4 or more servings per week	51		45	55		52	50	
	Mean ± S.D.	4.3 ± 0.4		3.8 ± 0.6	4.7 ± 0.6	0.27	3.9 ± 0.5	4.7 ± 0.7	0.39
	n	47		20	27		23	24	
B27rc[a]	When you are at home, how often do you eat frozen fruit?								
	0 – 1 servings per week	81		94	71	0.15[†] AA > C	90	74	0.12[†] 80-97 > 60-79
	2 – 3 servings per week	17		6	25		5	26	
	4 or more servings per week	2		-	4		5	-	
	Mean ± S.D.	0.7 ± 0.2		0.4 ± 0.1	1.0 ± 0.3	0.11[†] AA > C	0.7 ± 0.4	0.8 ± 0.2	0.83
	n	42		18	24		19	23	

B28rc[a]	When you are at home, how often do you eat canned fruit?								
	0 – 1 servings per week	42		55	33	0.14[†] AA > C	39	46	0.26
	2 – 3 servings per week	47		30	59		57	37	
	4 or more servings per week	11		15	8		4	17	
	Mean ± S.D.	2.0 ± 0.4		1.8 ± 0.5	2.2 ± 0.5	0.55	1.6 ± 0.2	2.5 ± 0.6	0.23
	n	47		20	27		23	24	
B29rc[a]	When you are at home, how often do you eat fresh vegetables?								
	0 – 1 servings per week	26		40	15	0.14[†] AA > C	22	29	0.41
	2 – 3 servings per week	40		35	44		35	46	
	4 or more servings per week	34		25	41		43	25	
	Mean ± S.D.	3.7 ± 0.5		2.9 ± 0.6	4.3 ± 0.7	0.12[†] AA > C	4.6 ± 0.8	2.8 ± 0.5	0.07
	n	47		20	27		23	24	
B30rc[a]	When you are at home, how often do you eat frozen vegetables?								
	0 – 1 servings per week	60		67	55	0.76	55	65	0.31
	2 – 3 servings per week	27		22	30		36	17	
	4 or more servings per week	13		11	15		9	18	
	Mean ± S.D.	1.8 ± 0.3		1.4 ± 0.5	2.0 ± 0.5	0.47	1.8 ± 0.4	1.7 ± 0.5	0.96
	n	45		18	27		22	23	
B31rc[a]	When you are at home, how often do you eat canned vegetables?								

	0 – 1 servings per week	33		30	36	0.53	30	36	0.88
	2 – 3 servings per week	45		40	48		48	41	
	4 or more servings per week	22		30	16		22	23	
	Mean ± S.D.	2.6 ± 0.3		3.0 ± 0.5	2.3 ± 0.4	0.28	2.4 ± 0.4	2.8 ± 0.5	0.60
	n	45		20	25		23	22	
All FV rc[b]	Summary Score for total fruit and vegetable items, excluding B16 & B22								
	0 – 13 servings per week	16		25	9	0.03* AA > C	18	14	0.88
	14 – 20 servings per week	24		44	9		17	29	
	21 – 27 servings per week	29		19	36		35	24	
	28 – 34 servings per week	10		6	14		12	9	
	≥ 35 servings per week	21		6	32		18	24	
	Mean ± S.D.	25.2 ± 2.0		19.2 ± 2.2	29.6 ± 2.6	0.01* AA > C	23.5 ± 2.6	26.6 ± 2.9	0.42
	n	38		16	22		17	21	
All Frrc[b]	Summary Score for total fruit items: B7-B10, B12								
	0 – 6 servings per week	34		61	13	0.0001* AA > C	37	32	0.74
	7 – 13 servings per week	39		39	39		42	36	
	≥ 14 servings per week	27		-	48		21	32	
	Mean ± S.D.	10.9 ± 1.3		5.9 ± 0.8	14.7 ± 1.8	0.0001* AA > C	9.2 ± 1.4	12.3 ± 2.0	0.22
	n	41		18	23		19	22	
All Veg rc[b]	Summary Score for total vegetable items: B11, B3-15, B17-21								
	0 – 6 servings per week	7		6	9	0.39	10	5	0.91
	7 – 13 servings per week	40		53	30		37	43	
	14 – 20 servings per week	38		35	39		37	38	

	≥ 21 servings per week	15		6	22		16	14	
	Mean ± S.D.	14.4 ± 1.0		13.8 ± 1.6	14.9 ± 1.4	0.61	14.6 ± 1.6	14.2 ± 1.4	0.84
	n	40		17	23		19	21	
Hi VitACarrc[b]	Summary Score for total items high in vitamin A/carotenoids: B13, B19, B20, B21								
	0 – 6 servings per week	67		71	65	0.72	79	57	0.14[†] 80-97 > 60-79
	≥ 7 servings per week	33		29	35		21	43	
	Mean ± S.D.	5.4 ± 0.5		5.4 ± 0.8	5.5 ± 0.6	0.90	4.6 ± 0.7	6.1 ± 0.6	0.12[†] 80-97 > 60-79
	n	40		17	23		19	21	
HVitACarCrurc[b]	Summary Score for total items high in vitamin A/carotenoids and cruciferous vegetables:B13, B19, B20, B21, B11								
	0 – 6 servings per week	45		53	39	0.39	42	48	0.73
	≥ 7 servings per week	55		47	61		58	52	
	Mean ± S.D.	7.3 ± 0.6		6.4 ± 0.8	7.9 ± 0.9	0.22	6.4 ± 0.8	8.0 ± 0.9	0.17
	n	40		17	23		19	21	
HiVitC rc[b]	Summary Score for total items high in vitamin C: B7, B9, B11-13, B15, B20								
	0 – 6 servings per week	26		53	5	0.001* AA > C	22	29	0.65
	≥ 7 servings per week	74		47	95		78	71	
	Mean ± S.D.	12.2 ± 1.1		7.8 ± 1.0	15.6 ± 1.3	<0.0001 * AA > C	11.4 ± 1.3	12.8 ± 1.6	0.52
	n	39		17	22		18	21	

HiLutZearc[b]	Summary Score for total items high in lutein and zeaxanthin: B13, B19								
	0 – 2 servings per week	57		71	48	0.15[†] AA > C	53	62	0.55
	≥ 3 servings per week	43		29	52		47	38	
	Mean ± S.D.	2.4 ± 0.3		1.6 ± 0.4	2.9 ± 0.3	0.02* AA > C	2.4 ± 0.4	2.4 ± 0.4	0.98
	n	40		17	23		19	21	
HiLycop rc[b]	Summary Score for total items high in lycopene: B15, B16								
	≤ 2 servings per week	56		70	43	0.08[†]	50	61	0.47
	≥ 3 servings per week	44		30	56		50	39	
	Mean ± S.D.	2.4 ± 0.3		1.9 ± 0.3	2.9 ± 0.5	0.07[†] AA > C	2.5 ± 0.4	2.4 ± 0.4	0.92
	n	43		20	23		20	23	
B32[a]	Do you think that eating more fruits and vegetables will help reduce your risk of cancer?								
	Yes	83		75	89	0.33	96	71	0.07[†] 60-79 > 80-97
	No	2		5	-		4	29	
	Don't Know	15		20	11				
	n	47		20	27		23	24	
B33[a]	Do you think that eating more fruits and vegetables will help reduce your risk of heart disease?								
	Yes	79		75	81	0.24	91	67	0.10[†] 60-79 > 80-97
	No	4		-	8		-	8	
	Don't Know	17		25	11		9	25	
	n	47		20	27		23	24	

B34[a]	Do you think if you improved the way you eat, that you would be a much healthier person?								
	Yes	77		70	82	0.45	87	67	0.07[†] 60-79 > 80-97
	No	17		25	11		4	29	
	Don't Know	6		5	7		9	4	
	n	47		20	27		23	24	
B35[a]	Do you think that your grocery store has a wide selection of fruits and vegetables?								
	Yes	85		80	89	0.38	96	75	0.11[†] 60-79 > 80-97
	No	9		15	4		4	12	
	Don't Know	6		5	7		-	13	
	n	47		20	27		23	24	
B36[a]	How many fruits and vegetables should people eat each day?								
	1 per day	4		5	4	0.99	9	-	0.08[†] 60-79 > 80-97
	2 per day	17		20	15		17	17	
	3 per day	26		25	26		13	37	
	4 per day	9		10	7		9	8	
	5 or more per day	38		35	41		52	25	
	Don't Know	6		5	7		-	13	
	n	47		20	27		23	24	

[†]*P values 0.05 – 0.15 were considered trends.*

**P values < 0.05 were considered significant.*

[a]*For frequency measures by ethnicity and age, a > direction indicated for significant and trend p-values indicates which group (African American vs. Caucasian or 60-79 vs. 80-97) was more likely to consume more than 1 serving per week.*

[b]*For summary score frequency measures by ethnicity and age, a > direction indicated for significant and trend p-values indicates which group (African American vs. Caucasian or 60-79 vs. 80-97) was more likely to consume ≥ than 3 servings per day(AllFV), ≥ than 2 servings per day(AllVeg), or ≥ than 1 serving per day(AllFr) .*

Table 4. Time 1, Time 2, and Mean Change in Fruit and Vegetable Intake (servings/wk), and Change in Barrier Items 32-36 by Time

	Time 1	Time 2	Mean Change	
Variable Name & Description	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**	**P value**
Diff 7. 100% orange juice	3.6 ± 0.5	3.5 ± 0.4	0.30 ± 0.48	0.54
n	54	44	44	
Diff 8. Cranberry, apple, or purple grape juice	2.0 ± 0.4	3.0 ± 0.6	1.4 ± 0.58	0.02*
n	54	46	46	
Diff 9. Berries	0.8 ± 0.2	1.1 ± 0.3	0.44 ± 0.31	0.16
n	54	45	45	
Diff 10. Peaches, nectarines, apricots	1.5 ± 0.2	2.2 ± 0.3	0.84± 0.33	0.01*
n	54	45	45	
Diff 11. Broccoli, cabbage, cauliflower	1.9 ± 0.2	1.8 ± 0.2	0.02 ± 0.30	0.94
n	54	46	46	
Diff 12. Cantaloupe, honeydew	1.2 ± 0.3	1.6 ± 0.3	0.54 ± 0.39	0.17
n	54	46	46	
Diff 13. Leafy greens	2.1 ± 0.2	1.7 ± 0.2	-0.43 ± 0.28	0.12†
n	54	46	46	
Diff 14. Corn	1.4 ± 0.2	1.4 ± 0.2	0.17 ± 0.27	0.54
n	49	47	47	
Diff 15. Tomato products	1.7 ± 0.2	1.9 ± 0.3	0.30 ± 0.41	0.47
n	54	46	46	
Diff 16. Spaghetti or lasagna	0.6 ± 0.1	0.7 ± 0.1	0.18 ± 0.12	0.15†
n	54	44	44	
Diff 17. Onions	2.7 ± 0.3	2.9 ± 0.4	0.23 ± 0.33	0.48
n	54	47	47	
Diff 18. Squash, zucchini	0.9 ± 0.2	1.3 ± 0.2	0.48 ± 0.29	0.11†
n	54	46	46	
Diff 19. Spinach	0.9 ± 0.2	0.8 ± 0.2	-0.12 ± 0.23	0.60
n	54	41	41	
Diff 20. Sweet potatoes	1.3 ± 0.2	1.2 ± 0.2	0.07 ± 0.22	0.77
n	53	46	46	
Diff 21. Carrots	1.6 ± 0.2	1.8 ± 0.3	0.46 ± 0.27	0.10†
n	54	46	46	
Diff 22. Beans	1.3 ± 0.2	1.5 ± 0.2	0.49 ± 0.19	0.01*

n	54	47		
Diff 23. Fruit as snack	4.3 ± 0.5	4.4 ± 0.5	0.19 ± 0.56	0.73
n	54	47	47	
Diff 24. Fruit as dessert	2.1 ± 0.3	1.8 ± 0.3	-0.38 ± 0.53	0.48
n	53	46	45	
Diff 25. Vegetables as snack	0.7 ± 0.2	1.4 ± 0.3	0.79 ± 0.34	0.02*
n	54	43	43	
Diff 26. Fruit, fresh	4.6 ± 0.4	4.3 ± 0.4	-0.04 ± 0.52	0.94
n	54	47	47	
Diff 27. Fruit, frozen	0.4 ± 0.1	0.7 ± 0.2	0.33 ± 0.27	0.22
n	54	42	42	
Diff 28. Fruit, canned	1.6 ± 0.2	2.0 ± 0.4	0.50 ± 0.35	0.16
n	53	47	46	
Diff 29. Vegetables, fresh	3.9 ± 0.4	3.7 ± 0.5	-0.21 ± 0.62	0.73
n	54	47	47	
Diff 30. Vegetables, frozen	1.4 ± 0.2	1.8 ± 0.3	0.34 ± 0.31	0.28
n	52	45	44	
Diff 31. Vegetables, canned	1.5 ± 0.2	2.6 ± 0.3	0.98 ± 0.39	0.02*
n	53	45	45	
Diff Total Fruit and Vegetable Items, excluding diff16 & diff22	22.8 ± 1.5	25.2 ± 2.0	3.9 ± 1.8	0.04*
n	53	38	38	
Diff Total Fruit Items	9.0 ± 0.9	10.9 ± 1.3	3.0 ± 1.2	0.02*
n	54	41	41	
Diff Total Vegetable Items	14.0 ± 0.9	14.4 ± 1.0	0.75 ± 1.2	0.52
n	53	40	40	
Diff Total Items High in Vitamin A/Carotenoids	5.7 ± 0.5	5.4 ± 0.5	-0.08 ± 0.67	0.91
n	53	40	40	
Diff Total Items High in Vitamin C	12.2 ± 1.0	12.2 ± 1.1	0.82 ± 0.97	0.40
n	53	39	39	

Barrier	Time 1 (%)	Time 2 (%)	P value
32. Do you think that eating more fruits and vegetables will help reduce your risk of cancer?			0.14†
Yes	70	83	
No or Don't Know	30	17	
n	47	47	
33. Do you think that eating more fruits and vegetables will help reduce your risk of heart disease?			0.24
Yes	68	79	
No or Don't Know	32	21	
n	47	47	
34. Do you think if you improved the way you eat, that you would be a much healthier person?			0.44
Yes	83	77	
No or Don't Know	17	23	
n	47	47	
35. Do you think that your grocery store has a wide selection of fruits and vegetables?			0.19
Yes	93	85	
No or Don't Know	7	15	
n	47	47	
36. How many fruits and vegetables should people eat each day?			0.29
5 per day or more	34	45	
1-4 per day or Don't Know	66	55	
n	47	47	

†*P values 0.05 – 0.15 were considered trends.*
**P values < 0.05 were considered significant.*

Table 5. Significant Mean Changes in Fruit and Vegetable Intake from Time 1 to Time 2 by Ethnicity and Age Group (Servings/week)

	Total Population		**By Ethnicity**			**By Age Group**		
Variable Name & Description of Variable			**Caucasian (C)**	**African American (AA)**		**60 – 79**	**80 - 97**	
	Mean Change ± SD	**P value**	**Mean Change ± SD**	**Mean Change ± SD**	**P value**	**Mean Change ± SD**	**Mean Change ± SD**	**P value**
Diff 7. 100% orange juice	0.30 ± 0.48	0.54	0.11 ± 0.56	0.42 ± 0.43		0.81 ± 0.77	-0.17 ± 0.60	
n	44		18	26		21	23	
Diff 8. Cranberry, apple, or purple grape juice	1.4 ± 0.58	0.02*	0.05 ± 0.34	2.4 ± 0.93	0.03* AA > C	0.78 ± 0.82	2.04 ± 0.83	
n	46		19	27		23	23	
Diff 9. Berries	0.44 ± 0.31	0.16	-0.20 ± 0.31	0.96 ± 0.47	0.05* AA > C	0.29 ± 0.14	0.58 ± 0.57	
n	45		20	25		21	24	
Diff 10. Peaches, nectarines, apricots	0.84± 0.33	0.012*	0.47 ± 0.22	1.11 ± 0.53		0.45 ± 0.44	1.22 ± 0.46	
n	45		19	26		22	23	
Diff 11. Broccoli, cabbage, cauliflower	0.02 ± 0.30	0.94	-0.65 ± 0.44	0.54 ± 0.38	0.04* AA > C	-0.13 ± 0.31	0.17 ± 0.51	
n	46		20	26		23	23	
Diff 12. Cantaloupe, honeydew	0.54 ± 0.39	0.17	0.75 ± 0.52	0.38 ± 0.57		0.91 ± 0.55	0.17± 0.56	
n	46		20	26		23	23	
Diff 13. Leafy greens (collards, turnips, etc)	-0.43 ± 0.28	0.12†	0 ± 0.23	-0.74 ± 0.44		-0.82 ± 0.41	-0.08 ± 0.37	
n	46		19	27		22	24	
Diff 14. Corn	0.17 ± 0.27	0.54	0.10 ± 0.38	0.22 ± 0.39		-0.04 ± 0.35	0.38 ± 0.42	
n	47		20	27		23	24	

Diff 15. Tomato products	0.30 ± 0.41	0.47	0.30 ± 0.31	0.31 ± 0.70		-0.05 ± 0.58	0.63 ± 0.59	
n	46		20	26		22	24	
Diff 16. Spaghetti or lasagna	0.18 ± 0.12	0.15†	0.30 ± 0.15	0.08 ± 0.19		-0.05 ± 0.15	0.39± 0.19	0.07† 80-97 > 60-79
n	44		20	24		21	23	
Diff 17. Onions	0.23 ± 0.33	0.48	0.10 ± 0.55	0.33 ± 0.41		0.17 ± 0.29	0.29 ± 0.59	
n	47		20	27		23	24	
Diff 18. Squash, zucchini	0.48 ± 0.29	0.11†	0.25 ± 0.50	0.65 ± 0.35		0.48 ± 0.48	0.48 ± 0.35	
n	46		20	26		23	23	
Diff 19. Spinach	-0.12 ± 0.23	0.60	0.33 ± 0.28	-0.48 ± 0.33	0.07† AA > C	-0.15 ± 0.37	-0.10 ± 0.28	
n	41		18	23		20	21	
Diff 20. Sweet potatoes	0.07 ± 0.22	0.77	0.20 ± 0.28	-0.04 ± 0.33		-0.09 ± 0.21	0.22 ± 0.39	
n	46		20	26		23	23	
Diff 21. Carrots	0.46 ± 0.27	0.10†	1.15 ± 0.52	-0.08 ± 0.21	0.04* C > AA	-0.17 ± 0.23	1.09 ± 0.45	0.02* 80-97 > 60-79
n	46		20	26		23	23	
Diff 22. Beans	0.49 ± 0.19	0.01*	0.15 ± 0.22	0.74 ± 0.28		0.17 ± 0.21	0.79 ± 0.29	0.10† 80-97 > 60-79
n	47		20	27		23	24	
Diff 23. Fruit as snack	0.19 ± 0.56	0.73	-0.05 ± 0.84	0.37 ± 0.75		0.09 ± 0.82	0.29 ± 0.77	
n	47		20	27		23	24	
Diff 24. Fruit as dessert	-0.38 ± 0.53	0.48	-0.33 ± 0.70	-0.41 ± 0.75		-0.87 ± 0.70	0.14± 0.79	
n	45		18	27		23	22	

Diff 25. Veg as snack	0.79 ± 0.34	0.02*	0.11 ± 0.21	1.28 ± 0.54	0.054† AA > C	0.71 ± 0.45	0.86 ± 0.51	
n	43		18	25		21	22	
Diff 26. Fruit, fresh	-0.04 ± 0.52	0.94	-1.45 ± 0.74	1.0 ± 0.67	0.02* AA > C	-0.52 ± 0.70	0.42 ± 0 .78	
n	47		20	27		23	24	
Diff 27. Fruit, frozen	0.33 ± 0.27	0.22	-0.06 ± 0.37	0.63 ± 0.37		0.37 ± 0.43	0.30 ± 0.34	
n	42		18	24		19	23	
Diff 28. Fruit, canned	0.50 ± 0.35	0.16	0.32 ± 0.38	0.63 ± 0.53		0.17 ± 0.31	0.83 ± 0.62	
n	46		19	27		23	23	
Diff 29. Vegetables, fresh	-0.21 ± 0.62	0.73	-0.85 ± 0.63	0.26 ± 0.97		1.35 ± 0.78	-1.71 ± 0.85	0.01* 60-79 > 80-97
n	47		20	27		23	24	
Diff 30. Vegetables, frozen	0.34 ± 0.31	0.28	-0.41 ± 0.32	0.81 ± 0.45	0.03* AA > C	0.77 ± 0.46	-0.09 ± 0.41	
n	44		17	27		22	22	
Diff 31. Vegetables, canned	0.98 ± 0.39	0.02*	1.3 ±0.56	0.72 ± 0.55		0.78 ±0.53	1.18 ± 0.59	
n	45		20	25		23	22	
Diff All Fruit and Vegetable Items (excluding diff16 & diff22)	3.9 ± 1.8	0.04*	1.63 ± 2.0	5.6 ± 2.7		2.1 ± 2.0	5.4 ± 2.9	
n	38		16	22		17	21	
Diff All Fruit Items	3.0 ± 1.2	0.02*	0 ± 0.93	5.3 ± 1.9	0.02* AA > C	2.5 ± 1.5	3.4 1.9	
n	41		18	23		19	22	
Diff All Vegetable Items	0.75 ± 1.2	0.52	1.53 ± 1.5	0.17 ± 1.7		-0.6 ± 1.5	2.0 ± 1.7	
n	40		17	23		19	21	

Diff All Vegetable Items High in Vitamin A & Carotenoids	-0.08 ± 0.67	0.91	1.82 ± 0.76	-1.5 ± 0.93	0.01* C > AA	-1.4 ± 0.99	1.1 ± 0.86	0.07† 80-97 > 60-79
n	40		17	23		19	21	
Diff All Fruit and Vegetable Items High in Vitamin C	0.82 ± 0.97	0.40	0.06 ± 1.3	1.4 ± 1.4		0.3 ± 1.0	1.2 ± 1.6	
n	39		17	22		18	21	

†*P values 0.05 – 0.15 were considered trends.*

**P values < 0.05 were considered significant.*

Table 6. Participant Responses Open-Ended Questions, Number of Prescription Medications, and Sensory Test at Time 2

Variable Name	Description of Variable	Total (%)		By Race (%)		P value	By Age Group (%)		P value
				Caucasian (C)	African American (AA)		< 80 (60–79)	≥ 80 (80–97)	
Open-Ended Behavior and Knowledge Questions Related to Fruit and Vegetable Intake (n = 47)									
B57	Have you increased your overall consumption of fruit or fruit juice (fresh, frozen, and canned)?								
	Yes	66		40	85	0.001*	70	63	0.61†
	No	34		60	15		30	37	
	n	47		20	27		23	24	
B58	Have you increased your overall consumption of vegetables (fresh, frozen, and canned)?								
	Yes	53		30	70	0.01*	61	46	0.30
	No	47		70	30		39	54	
	n	47		20	27		23	34	
B59	Can you name some diseases or conditions that might be decreased by a diet high in fruits and vegetables?								
	Yes	55		55	56	0.97	69	42	0.08†
	No/ Don't know	45		45	44		31	58	
	n	47		20	27		23	24	
B60	Tried different ways of preparing fruits and vegetables?								
	Yes	48		28	62	0.03*	59	36	0.13†
	No	52		72	38		41	64	
	n	44		18	26		22	22	
B61	Tried a fruit or vegetable that you didn't like before, but now like?								
	Yes	28		16	37	0.18	26	30	0.58
	No	72		84	63		74	70	
	n	46		19	27		23	23	

B62	Eat more fruits and vegetables because you think they are good for you?								
	Yes	80		70	88	0.23	83	78	0.60
	No	20		30	12		17	22	
	n	46		20	26		23	23	
B63	Feel more strongly than before that eating fruits and vegetables will reduce the risk of disease?								
	Yes	78		79	78	0.44	91	65	0.06†
	No	22		21	22		9	35	
	n	46		19	27		23	23	
B64	Feel that canned and frozen fruits and vegetables are just as good for you as fresh fruits and vegetables?								
	Yes	28		20	33	0.53	35	21	0.16
	No/ Don't know	72		80	67		65	79	
	n	47		20	27		23	24	
B65	Tried to follow a healthier diet?								
	Yes	63		20	33	0.54	78	48	0.03*
	No	37		80	66		22	52	
	n	46		19	27		23	23	
B66	Eat more dark green vegetables than before?								
	Yes	54		37	67	0.05*	52	57	0.77
	No	46		63	33		48	43	
	n	46		19	27		23	23	
B67	Made a recipe from one of the lessons?								
	Yes	22		16	26	0.19	17	26	0.68
	No	78		84	74		83	74	
	n	46		19	27		23	23	
B68	What was your overall level of satisfaction with this fruit and vegetable nutrition education program?								
	Poor	2		-	4	0.72	-	4	0.06†
	Fair	7		10	4		-	13	
	Good	47		45	48		45	48	
	Very Good	29		25	32		46	13	

	Excellent	15		20	12		9	22	
	n	45		20	25		23	23	
B69	How many sessions of the fruit and vegetable nutrition education program did the participant attend?								
	0	4		5	4	0.16	-	9	0.06†
	1	4		5	4		9	-	
	2	8		20	-		13	4	
	3	11		15	7		17	4	
	4	11		5	15		13	8	
	0 – 4 sessions	**38**		**50**	**30**		**52**	**25**	
	5	4		5	4		-	8	
	6	13		5	18		8	17	
	7	8		5	11		9	8	
	8	13		20	7		9	17	
	9	13		10	15		13	12	
	10	11		5	15		9	13	
	5 – 10 sessions	**62**		**50**	**70**		**48**	**75**	
	n	47		20	27		23	24	
Selected Sensory Variables (n = 41)									
B71rc	How many medications do you routinely take each day?								
	0 – 1 per day	12		-	19	0.04*	15	10	0.86
	2 – 3 per day	32		20	39		30	33	
	4 or more per day	56		80	42		55	57	
	n	41		15	26		20	21	
B72rc	(Taste test using PTC–Impregnated Strip) Are you able to detect a taste? Intensity?								
	No	22		33	15	0.47	25	19	0.71
	Yes; Don't know or slight‡	12		13	12		10	14	
	Yes; moderate	15		7	19		20	10	
	Yes; strong	51		47	54		45	57	
	n	41		15	26		20	21	

†*P values 0.05 – 0.15 were considered trends.*

**P values < 0.05 were considered significant.*

‡*Participants who were unsure of the intensity were grouped with "slight".*

Table 7. Medication and Sensory Barriers to Fruit and Vegetable Consumption at Time 2

Barrier Variable Name & Description	**Fruit/Vegetable Variable Name & Description**	**Barrier Response Categories**		**P value**
B71rc. How many prescription medications do you take every day?		**0-3 meds/day=0 (%)**	**≥ 4 meds/day=1 (%)**	
	B13rc. Leafy greens			0.08†
	0 – 1 servings per week	42	57	
	2 – 3 servings per week	42	43	
	4 or more servings per week	17	-	
	Mean ± SD	2.3 ± 0.7	1.4 ± 0.2	0.18
	n	12	28	
	B27rc. Fruit, frozen			0.052†
	0 – 1 servings per week	56	89	
	2 – 3 servings per week	33	11	
	4 or more servings per week	11	-	
	Mean ± SD	1.8 ± 1.4	0.6 ± 0.2	0.18
	n	9	27	
	Vit C. Total fruit and vegetable items high in vitamin C			0.28
	0 – 6 servings per week	11	29	
	≥ 7 servings per week	89	71	
	Mean ± S.D.	15.7 ± 2.1	11.3 ± 1.4	0.10†
	n	9	24	
B72rc. (*Taste test using PTC–Impregnated Strip*) Are you able to detect a taste? Intensity?		**No taste, slight or moderate taste=0**	**Strong taste /Supertaster=1**	
	B11rc. Cruciferous vegetables			0.16
	0 – 1 servings per week	35	65	
	2 – 3 servings per week	50	25	
	4 or more servings per week	15	10	
	Mean ± SD	2.4 ± 0.4	1.4 ± 0.3	0.06†
	n	20	20	
	B15rc. Tomato products			0.42
	0 – 1 servings per week	40	60	
	2 – 3 servings per week	40	30	
	4 or more servings per week	20	10	
	Mean ± SD	2.5 ± 0.5	1.5 ± 0.4	0.11†
	n	20	20	
	B29rc. Vegetables, fresh**			
	0 – 1 servings per week	45	9	0.04*
	2 – 3 servings per week	30	48	
	4 or more servings per week	25	43	
	Mean ± SD	3.0 ± 0.8	4.5 ± 0.7	0.16
	n	20	21	
	Vit C. Total fruit and vegetable items high in vitamin C			0.75
	0 – 6 servings per week	21	26	
	≥ 7 servings per week	79	74	
	Mean ± S.D.	14.7 ± 2.1	10.8 ± 1.3	0.14†
	n	14	19	

	Lycop. Total vegetable items high in lycopene			0.25
	0 – 2 servings per week	41	60	
	≥ 3 servings per week	59	40	
	Mean ± S.D.	3.1 ± 0.5	2.1 ± 0.5	0.14[†]
	n	17	20	

[‡]*Participants who were unsure of the intensity were grouped with "slight".*
[†]*P values 0.05 – 0.15 were considered trends.*
**P values < 0.05 were considered significant.*
***Participants who were identified as super-tasters were more likely to consume fresh vegetables than participants who were not identified as super-tasters.*

Table 8. Barriers to Increasing Mean Fruit and Vegetable Intake (Servings/week)

Barrier Name & Description	Fruit or Vegetable Item	Mean Change ± SD by Response to Barrier		P value
The following barrier responses were recorded at Time 2.				
B32rc. Do you think that eating more fruits and vegetables will help reduce your risk of cancer?		**No or Don't Know**	**Yes**	
	Diff 9. Berries	-0.7 ± 0.6	0.8 ± 0.4	0.054†
	n	6	33	
	Diff 26. Fruit, fresh	-1.7 ± 0.8	0.3 ± 0.6	0.08†
		6	35	
B34rc. Do you think if you improved the way you eat, that you would be a much healthier person?		**No or Don't Know**	**Yes**	
	Diff 17. Onions	-0.9 ± 0.9	0.7 ± 0.4	0.07†
	n	9	32	
	Diff 29. Vegetables, fresh	-3.2 ± 1.6	0.4 ± 0.7	0.06†
	n	9	32	
	Diff 30. Vegetables, frozen	-0.4 ± 0.4	0.7 ± 0.4	0.08†
	n	9	29	
B36rc. How many fruits and vegetables should people eat every day?		**0 – 4 per day or Don't know**	**5 or more per day**	
	Diff 7. 100% orange juice	-0.3 ± 0.6	1.6 ± 0.9	0.11†
	n	24	14	
	Diff 12. Cantaloupe, honeydew	-0.2 ± 0.6	1.6 ± 0.6	0.05*
	n	24	16	
	Diff 30. Vegetables, frozen	-0.2 ± 0.4	1.3 ± 0.6	0.054†
	n	22	16	
	Diff AllFr. Total Fruit Items	1.9 ± 1.6	6.8 ± 2.3	0.09†
	n	22	13	
B69rc. How many sessions of the fruit and vegetable nutrition education program did the participant attend?		**0 – 3 sessions**	**4 – 10 sessions**	
	Diff 10. Peaches, nectarines, apricots	0 ± 0.5	1.2 ± 0.4	0.08†
	n	9	30	
	Diff 25. Vegetables as snack	-0.1 ± 0.3	1.0 ± 0.5	0.05*
	n	8	29	

	Diff 26. Fruit, fresh	-2.1 ± 0.8	0.7 ± 0.7	0.01*
	n	10	31	
Note: The following two sensory questions had a possible n of 41.				
B71rc. How many medications do you take every day?		**0 - 3 meds per day**	**≥ 4 meds per day**	
	Diff 7. 100% orange juice	1.7 ± 1.2	-0.1 ± 0.65	0.21
	n	11	27	
	Diff 23. Fruit as snack	1.8 ± 1.1	0.1 ± 0.7	0.20
	n	12	29	
	Diff TimeFVs. Total Fruit and Vegetable Items (excluding diff16 & diff22)	8.3 ± 3.5	3.3 ± 2.5	0.26
	n	9	23	
	Diff AllFr. Total Fruit Items	5.8 ± 2.5	3.0 ± 1.4	0.34
	n	10	25	
	Diff AllVeg. Total Vegetable Items	2.2 ± 2.9	0.2 ± 1.5	0.55
	n	9	25	
	Diff VitC. Total Fruit and Vegetable Items High in Vitamin C	3.6 ± 2.3	-0.4 ± 1.3	0.15†
	n	9	24	
B72rc. Can you detect a taste *(using the PTC – impregnated taste strip)*?		**No taste detected, Slight taste, or Moderate taste**	**Strong taste detected (Supertaster)**	
	Diff 10. Peaches, nectarines, apricots	1.7 ± 0.6	0.2 ± 0.4	0.04*
	n	19	20	
	Diff 15. Tomato products	1.3 ± 0.6	-0.8 ± 0.7	0.02*
	n	20	20	
	Diff 28. Fruit, canned	1.4 ± 0.6	-0.5 ± 0.4	0.02*
	n	19	21	
	Diff TimeFVs. Total Fruit and Vegetable Items (excluding diff 16 & diff22)	8.8 ± 3.3	1.9 ± 2.5	0.11†
	n	13	19	
	Diff AllFr. Total Fruit Items	6.7 ± 2.1	1.3 ± 1.6	0.06†
	n	16	19	
	Diff VitC. Total Fruit and Vegetable Items High in Vitamin C	3.6 ± 1.6	-1.4 ± 1.4	0.03*
	n	14	19	

The following barrier responses were recorded at Time 1.				
A39rc. Do you have enough money to spend on fruits and vegetables?		**No or Don't Know**	**Yes**	
	Diff 23. Fruit as snack	-1.0 ± 0.8	1.0 ± 0.8	0.07†
	n	19	26	
	Diff 31. Vegetables, canned	0.2 ± 0.6	1.6 ± 0.5	0.08†
	n	19	24	
Are you able to easily use the following kitchen tools to cook vegetables at home?				
A43rc. Sharp knife?		**No or Don't Know**	**Yes**	
	Diff 20. Sweet potatoes	-0.8 ± 0.5	0.2 ± 0.2	0.09†
	n	6	40	
A44rc. Can opener?		**No or Don't Know**	**Yes**	
	Diff AllVeg. Total Vegetable Items	-4.7 ± 3.6	1.7 ± 1.1	0.14†
	n	6	34	
46. Do you shop for your own groceries?		**No or Don't Know**	**Yes**	
	Diff 25. Vegetables as snack	-0.6 ± 0.3	1.2 ± 0.4	0.001*
	n	10	32	
	Diff 30. Vegetables, frozen	-0.3 ± 0.3	0.5 ± 0.4	0.10†
	n	9	34	
Do you have or have you ever had any of the following diseases / conditions?				
53. Cancer		**No**	**Yes**	
	Diff 16. Spaghetti or lasagna	0.1 ± 0.1	0.8 ± 0.3	0.07†
	n	36	8	
	Diff 17. Onions	-0.1 ± 0.3	1.8 ± 0.8	0.07†
	n	39	8	
54. Heart disease or heart attack		**No**	**Yes**	
	Diff 8. Cranberry, apple, or purple grape juice	0.8 ± 0.6	4.3 ± 1.6	0.07†
	n	38	8	
	Diff TimeFVs. Total Fruit and Vegetable Items	2.5 ± 2.0	9.1 ± 3.8	0.17
	n	31	7	
55. High cholesterol		**No**	**Yes**	
	Diff 19. Spinach	-0.5 ± 0.4	0.2 ± 0.2	0.11†
	n	20	21	
†*P values 0.05 – 0.15 were considered trends; *P values < 0.05 were considered significant.*				

Table 9. Spearman Correlations among Fruit and Vegetable Intake and Time 1 Barriers

TIME 1 BARRIERS	7. 100% orange juice	8. 100% cran, app, purple grape juice	9. Berries	10. Peaches, nectarines, or apricots	11. Broccoli, cabbage, oauliflower	12. Cantaloupe, honeydew	13. Leafy greens	14. Corn	15. Cooked or stewed tomatoes	16. Spaghetti or lasagna
32. Do you think that eating more fruits and vegetables will help reduce your risk of cancer? 0=no or don't know, 1=yes	-0.05 0.7279	-0.03 0.8266	0.16 0.2484	0.20 0.1445	0.11 0.4297	0.32 0.0177*	0.13 0.3589	0.17 0.2308	-0.12 0.3903	0.16 0.2484
33. Do you think that eating more fruits and vegetables will help reduce your risk of heart disease? 0=no or don't know, 1=yes	0.23 0.0920	-0.07 0.5897	-0.08 0.5507	0.04 0.7955	0.22 0.1060	-0.03 0.8553	0.19 0.1663	0.15 0.2712	0.08 0.5699	-0.01 0.9344
34. Do you think if you improved the way you eat, that you would be a much healthier person? 0=no or don't know, 1=yes	0.18 0.2018	-0.13 0.3518	0.15 0.2863	0.26 0.0544	-0.04 0.7477	-0.06 0.6767	0.24 0.0787	0.28 0.0422*	0.08 0.5315	0.04 0.7947
35. Do you think that your grocery store has a wide selection of fruits and vegetables? 0=no or don't know, 1=yes	0.02 0.8635	-0.13 0.3537	0.04 0.7741	0.01 0.9171	0.14 0.3046	0.07 0.6316	0.07 0.6324	0.15 0.2834	-0.03 0.8108	0.03 0.8194
36. How many fruits and vegetables should people eat each day? 0= 1, 2, 3, 4 a day or don't know, 1= 5 or more	-0.21 0.1359	0.003 0.9830	-0.22 0.1090	-0.21 0.1185	0.32 0.0196*	-0.12 0.3768	-0.12 0.3751	-0.01 0.9855	-0.05 0.7345	-0.12 0.3998
37. Do you like the way most vegetables taste? 0=no, 1=yes	-0.16 0.2563	-0.09 0.5117	0.08 0.5804	0.15 0.2705	0.13 0.3355	0.05 0.7258	0.07 0.6532	0.22 0.1024	0.14 0.2977	0.09 0.4993
38. Do you have tooth or mouth problems that make you usually eat easy-to-chew fruits and vegetables? 0=yes, 1=no	-0.14 0.3167	-0.01 0.9669	0.11 0.4220	-0.14 0.3166	0.06 0.6482	0.08 0.5834	-0.06 0.6517	0.26 0.0564	0.07 0.6230	-0.08 0.5495
39. Do you have enough money to spend on fruits and vegetables? 0=no, 1=yes	-0.17 0.2308	-0.10 0.4760	-0.11 0.4219	-0.10 0.4830	-0.10 0.4965	0.02 0.9031	-0.05 0.7040	-0.003 0.9848	-0.13 0.3424	0.08 0.5636

TIME 1 BARRIERS	7. 100% orange juice	8. 100% cran, app, purple grape juice	9. Berries	10. Peaches, nectarines, or apricots	11. Broccoli, cabbage, oauliflower	12. Cantaloupe, honeydew	13. Leafy greens	14. Corn	15. Cooked or stewed tomatoes	16. Spaghetti or lasagna
40. Would you like to know more about which fruits and vegetables are good for your health? 0=no, 1=yes	-0.17 0.2320	-0.11 0.4132	-0.09 0.5053	0.13 0.3306	0.22 0.1068	-0.05 0.7087	0.19 0.1736	-0.02 0.8909	0.13 0.3534	0.10 0.4606
41. Would you like to know more about different ways to cook vegetables? 0=no, 1=yes	0.23 0.09	0.06 0.6627	0.10 0.4695	-0.07 0.6107	-0.01 0.9193	-0.13 0.3652	0.18 0.1821	0.11 0.4423	0.10 0.4633	0.06 0.6739
42. Would you like a handout with healthy menus to take home? 0=no, 1=yes	0.13 0.3509	-0.13 0.3557	-0.07 0.6152	0.04 0.7728	-0.09 0.5320	-0.17 0.2207	0.36 0.0091*	-0.06 0.6972	0.04 0.7669	0.10 0.4607
Which of these kitchen tools can you easily use to cook vegetables at home?										
43. Sharp knife? 0=no, 1=yes	-0.05 0.7373	-0.11 0.4412	-0.21 0.1362	-0.13 0.3579	-0.15 0.2856	-0.04 0.7808	-0.11 0.4274	0.08 0.5583	-0.06 0.6831	-0.02 0.9131
44. Can opener? 0=no, 1=yes	-0.14 0.3178	-0.11 0.4408	-0.26 0.0536	0.05 0.6929	-0.29 0.0321	-0.07 0.6400	0.07 0.6036	0.01 0.9339	-0.04 0.7954	0.03 0.8555
45. Pot of hot water? 0=no, 1=yes	-0.10 0.4619	-0.08 0.5796	-0.20 0.1402	-0.04 0.7735	-0.08 0.5887	-0.05 0.7346	0.24 0.0823	-0.15 0.2847	0.13 0.3578	0.02 0.8851
46. Do you shop for your own groceries? 0=no, 1=yes	-0.17 0.2208	-0.17 0.2135	-0.11 0.4277	-0.06 0.6355	-0.03 0.8357	-0.25 0.0728	0.01 0.9511	0.04 0.7649	-0.12 0.3880	-0.01 0.9274
48. Do you plan the meals you eat? 0=no, 1=yes	-0.03 0.8266	-0.13 0.3408	-0.12 0.3957	-0.14 0.3225	-0.23 0.0831	-0.27 0.0495	-0.06 0.6545	-0.06 0.6447	-0.12 0.3753	-0.18 0.1899
49. Do you cook the meals you eat? (no)	-0.03 0.8405	0.05 0.7233	-0.15 0.2802	-0.03 0.8017	-0.11 0.4446	-0.11 0.4103	-0.04 0.7863	-0.04 0.7851	0.03 0.8412	-0.19 0.1639
50. Do you use a microwave at home? 0=no, 1=yes	0.07 0.6150	-0.01 0.9207	-0.02 0.8967	-0.13 0.3318	-0.49 0.0002	-0.14 0.3202	-0.24 0.0841	-0.06 0.6701	-0.05 0.7218	-0.11 0.4433
51. Do you use a stove at home? 0=no, 1=yes	0.09 0.5022	0.02 0.8877	-0.02 0.8780	-0.17 0.2153	-0.15 0.2742	-0.10 0.4841	-0.05 0.7046	0.01 0.9150	0.05 0.7047	-0.24 0.0835

TIME 1 BARRIERS	7. 100% orange juice	8. 100% cran, app, purple grape juice	9. Berries	10. Peaches, nectarines, or apricots	11. Broccoli, cabbage, oauliflower	12. Cantaloupe, honeydew	13. Leafy greens	14. Corn	15. Cooked or stewed tomatoes	16. Spaghetti or lasagna
Do you have or have you ever had any of the following?										
52.Diabetes? 0=yes, 1=no	-0.15 0.2813	0.02 0.8714	-0.16 0.2565	-0.04 0.7580	0.14 0.3086	0.04 0.7826	-0.18 0.1910	0.05 0.7460	-0.08 0.5493	0.01 0.9191
53. Cancer? 0=yes, 1=no	0.05 0.7313	0.10 0.4935	-0.13 0.3377	0.02 0.9048	-0.21 0.1115	0.04 0.7618	0.03 0.8045	-0.24 0.0855	0.02 0.8969	0.11 0.4337
54. Heart disease or heart attack? 0=yes, 1=no	0.04 0.7939	-0.08 0.5817	-0.09 0.5075	0.07 0.6214	0.22 0.1131	-0.05 0.6981	0.05 0.7089	0.23 0.0970	-0.04 0.7687	0.03 0.8417
55. High blood cholesterol? 0=yes, 1=no	0.01 0.9577	0.43 0.0013*	0.03 0.8043	0.07 0.6354	0.04 0.7757	0.14 0.3241	0.03 0.8394	0.02 0.8733	-0.07 0.6340	0.16 0.2564
56. High blood pressure or hypertension? 0=yes, 1=no	-0.39 0.0038	0.13 0.3656	-0.21 0.1323	-0.06 0.6455	-0.04 0.7601	-0.09 0.5106	-0.21 0.1222	-0.18 0.1978	-0.23 0.0959	-0.11 0.4431

TIME 1 BARRIERS	17. Onions	18. Squash or zucchini	19. Spinach	20. Sweet potatoes or yams	21. Carrots	22. Baked beans, pintos,other dried beans	23. Fruit as a snack?	24. Fruit as dessert?	25. Vegetables as a snack?
32. Do you think that eating more fruits and vegetables will help reduce your risk of cancer? 0=no or don't know, 1=yes	-0.18 0.2032	0.15 0.2830	0.13 0.3389	0.22 0.1132	-0.05 0.7394	-0.09 0.5058	0.15 0.2797	0.12 0.3803	-0.03 0.8087
33. Do you think that eating more fruits and vegetables will help reduce your risk of heart disease? 0=no or don't know, 1=yes	0.02 0.8813	0.16 0.2602	0.21 0.1251	-0.11 0.4258	0.19 0.1592	0.06 0.6446	0.00 1.0000	0.17 0.2161	0.02 0.8796
34. Do you think if you improved the way you eat, that you would be a much healthier person? 0=no or don't know, 1=yes	0.22 0.1262	0.18 0.2046	0.15 0.2671	-0.05 0.7054	0.08 0.5727	0.03 0.8388	0.13 0.3466	0.07 0.6229	0.05 0.7359
35. Do you think that your grocery store has a wide selection of fruits and vegetables? 0=no or don't know, 1=yes	-0.06 0.6606	-0.15 0.2897	0.25 0.0741	-0.01 0.9436	0.05 0.7279	0.06 0.6637	0.05 0.5689	0.10 0.4740	-0.11 0.4125
36. How many fruits and vegetables should people eat each day? 0= 1, 2, 3, 4 a day or don't know, 1= 5 or more	-0.06 0.6406	0.08 0.5607	0.14 0.3175	-0.08 0.5470	0.16 0.2563	0.04 0.7782	-0.04 0.7721	0.18 0.1864	0.01 0.9625
37. Do you like the way most vegetables taste? 0=no, 1=yes	0.00 1.0000	0.01 0.9272	0.12 0.3835	-0.04 0.7692	-0.18 0.1947	-0.04 0.7649	-0.01 0.9300	-0.13 0.3541	0.18 0.1823
38. Do you have tooth or mouth problems that make you usually eat easy-to-chew fruits and vegetables? 0=yes, 1=no	0.05 0.7068	-0.02 0.8666	0.08 0.5597	-0.22 0.1102	0.15 0.2773	0.07 0.6177	-0.11 0.4299	0.001 0.9918	-0.09 0.5351
39. Do you have enough money to spend on fruits and vegetables? 0=no, 1=yes	-0.03 0.8226	-0.08 0.5711	0.00 1.0000	-0.15 0.2833	0.06 0.6648	0.04 0.7654	-0.04 0.7606	-0.10 0.4896	-0.19 0.1806
40. Would you like to know more about which fruits and vegetables are good for your health? 0=no, 1=yes	-0.16 0.2464	0.13 0.3471	0.17 0.2058	0.16 0.2635	-0.02 0.9141	0.26 0.0541	0.01 0.9635	0.03 0.8050	0.23 0.0951
41. Would you like to know more about different ways to cook vegetables? 0=no, 1=yes	0.03 0.8046	-0.08 0.5632	0.15 0.2638	0.15 0.2730	0.004 0.9756	0.23 0.0927	0.15 0.2686	0.29 0.0339*	0.22 0.1173
42. Would you like a handout with healthy menus to take home? 0=no, 1=yes	0.16 0.2498	0.13 0.3544	-0.05 0.7415	-0.02 0.9149	-0.01 0.9165	0.08 0.5809	0.21 0.1373	0.20 0.1559	0.13 0.3729

TIME 1 BARRIERS	17. Onions	18. Squash or zucchini	19. Spinach	20. Sweet potatoes or yams	21. Carrots	22. Baked beans, pintos,other dried beans	23. Fruit as a snack?	24. Fruit as dessert?	25. Vegetables as a snack?
Which of these kitchen tools can you easily use to cook vegetables at home?									
43. Sharp knife? 0=no, 1=yes	-0.17 0.2190	0.05 0.7265	0.08 0.5843	0.05 0.7456	-0.05 0.7247	-0.002 0.9900	-0.01 0.9603	-0.09 0.5132	-0.02 0.8764
44. Can opener? 0=no, 1=yes	0.15 0.2872	0.16 0.2532	-0.04 0.7513	-0.10 0.4972	-0.08 0.5645	-0.06 0.6751	0.03 0.8309	-0.14 0.3051	-0.17 0.2269
45. Pot of hot water? 0=no, 1=yes	-0.16 0.2332	0.17 0.2098	0.04 0.7513	0.01 0.9255	0.06 0.6814	0.09 0.5272	0.13 0.3430	0.12 0.3986	0.11 0.4305
46. Do you shop for your own groceries? 0=no, 1=yes	-0.04 0.7616	0.03 0.8057	0.16 0.2553	-0.17 0.2279	-0.09 0.5450	0.03 0.8269	0.08 0.5765	0.08 0.5767	-0.20 0.1443
48. Do you plan the meals you eat? 0=no, 1=yes	0.14 0.3197	0.06 0.6475	0.04 0.7513	-0.06 0.6480	-0.03 0.8331	-0.13 0.3333	0.26 0.0623	0.08 0.5717	-0.22 0.1058
49. Do you cook the meals you eat? 0=no, 1=yes	0.00 1.0000	-0.03 0.8434	0.17 0.2058	0.01 0.9287	0.06 0.6572	-0.11 0.4213	0.19 0.1762	-0.06 0.6682	-0.02 0.9034
50. Do you use a microwave at home? 0=no, 1=yes	0.24 0.0795	-0.04 0.7547	-0.28 0.0438	-0.15 0.2790	0.18 0.1930	0.12 0.3994	0.06 0.6487	-0.07 0.6093	-0.10 0.4734
51. Do you use a stove at home? 0=no, 1=yes	0.18 0.2055	-0.02 0.8739	0.17 0.2058	-0.02 0.78633	0.14 0.3142	0.14 0.3142	0.14 0.3043	-0.11 0.4209	-0.06 0.6645
Do you have or have you ever had any of the following?									
52.Diabetes? 0=yes, 1=no	0.10 0.4835	-0.02 0.8624	-0.22 0.1112	-0.20 0.1482	-0.04 0.7862	0.17 0.2074	-0.16 0.2402	-0.12 0.3853	-0.24 0.0780
53. Cancer? 0=yes, 1=no	-0.13 0.3321	0.09 0.5365	-0.05 0.6940	-0.21 0.1272	-0.07 0.5975	-0.23 0.0942	0.07 0.6263	-0.16 0.2434	0.08 0.5892
54. Heart disease or heart attack? 0=yes, 1=no	-0.22 0.1138	0.01 0.9151	0.16 0.2549	0.12 0.3916	-0.29 0.0324	0.25 0.0652	0.06 0.6734	-0.05 0.7468	0.16 0.2575
55. High blood cholesterol? 0=yes, 1=no	-0.11 0.4224	-0.05 0.7051	-0.02 0.8795	0.13 0.2513	0.07 0.5905	0.19 0.1617	0.09 0.5399	-0.12 0.3891	-0.01 0.9357
56. High blood pressure or hypertension? 0=yes, 1=no	0.09 0.5043	-0.12 0.3751	-0.22 0.0977	-0.06 0.6912	-0.03 0.8425	0.06 0.6453	-0.05 0.6938	-0.16 0.2574	-0.20 0.1420

TIME 1 BARRIERS	26. Fresh fruit	27. Frozen fruit	28. Canned fruit	29. Fresh vegetables	30. Frozen vegetables	31. Canned vegetables
32. Do you think that eating more fruits and vegetables will help reduce your risk of cancer? 0=no or don't know, 1=yes	0.19 0.1688	0.11 0.4081	0.19 0.1831	0.08 0.5615	-0.13 0.3504	-0.01 0.9215
33. Do you think that eating more fruits and vegetables will help reduce your risk of heart disease? 0=no or don't know, 1=yes	0.28 0.0407*	0.13 0.3377	-0.04 0.7676	0.06 0.6468	0.15 0.2798	0.06 0.6694
34. Do you think if you improved the way you eat, that you would be a much healthier person? 0=no or don't know, 1=yes	0.18 0.1948	0.08 0.5678	0.10 0.4705	0.10 0.4693	-0.17 0.2416	0.03 0.8282
35. Do you think that your grocery store has a wide selection of fruits and vegetables? 0=no or don't know, 1=yes	-0.10 0.4617	0.14 0.3279	0.02 0.8752	0.02 0.8791	0.08 0.5739	0.01 0.9522
36. How many fruits and vegetables should people eat each day? 0= 1, 2, 3, 4 a day or don't know, 1= 5 or more	0.21 0.1192	0.16 0.2468	-0.11 0.4170	0.02 0.8710	0.14 0.3247	-0.20 0.1453
37. Do you like the way most vegetables taste? 0=no, 1=yes	-0.07 0.6321	0.25 0.0636	0.04 0.7633	-0.004 0.9742	0.20 0.1527	0.22 0.1112
38. Do you have tooth or mouth problems that make you usually eat easy-to-chew fruits and vegetables? 0=yes, 1=no	0.15 0.2668	-0.11 0.4364	-0.02 0.8777	0.10 0.4873	-0.06 0.6591	-0.06 0.6736
39. Do you have enough money to spend on fruits and vegetables? 0=no, 1=yes	0.20 0.1577	0.06 0.8466	0.01 0.9226	0.04 0.8007	0.01 0.9425	-0.14 0.3342
40. Would you like to know more about which fruits and vegetables are good for your health? 0=no, 1=yes	-0.01 0.9261	0.16 0.2461	0.19 0.1796	0.06 0.6639	0.21 0.1281	0.16 0.2424
41. Would you like to know more about different ways to cook vegetables? 0=no, 1=yes	0.14 0.3192	0.20 0.1454	-0.02 0.8997	0.07 0.6062	-0.18 0.1900	-0.01 0.9264
42. Would you like a handout with healthy menus to take home? 0=no, 1=yes	0.18 0.1857	-0.05 0.6994	0.07 0.6157	0.02 0.9090	0.06 0.6996	-0.13 0.3508
Which of these kitchen tools can you easily use to cook vegetables at home?						
43. Sharp knife? 0=no, 1=yes	0.08 0.5613	-0.05 0.7067	0.12 0.3837	-0.15 0.2635	0.04 0.7799	-0.10 0.4622
44. Can opener? 0=no, 1=yes	0.02 0.8758	-0.14 0.3179	0.04 0.7908	-0.17 0.2182	0.12 0.3813	0.12 0.3971

TIME 1 BARRIERS	26. Fresh fruit	27. Frozen fruit	28. Canned fruit	29. Fresh vegetables	30. Frozen vegetables	31. Canned vegetables
45. Pot of hot water? 0=no, 1=yes	0.20 0.1505	0.02 0.8682	0.20 0.1545	0.01 0.9570	0.25 0.0747	0.11 0.4267
46. Do you shop for your own groceries? 0=no, 1=yes	-0.08 0.5928	-0.15 0.2776	0.10 0.4910	-0.16 0.2537	0.05 0.7119	-0.003 0.9828
48. Do you plan the meals you eat? 0=no, 1=yes	0.08 0.5700	-0.21 0.1312	0.02 0.8715	-0.03 0.8462	-0.11 0.4407	-0.21 0.1253
49. Do you cook the meals you eat? 0=no, 1=yes	0.03 0.8287	-0.05 0.7321	0.04 0.7617	-0.10 0.4765	-0.08 0.5662	-0.19 0.1763
50. Do you use a microwave at home? 0=no, 1=yes	0.29 0.0363*	-0.09 0.5224	-0.05 0.7177	0.06 0.6896	-0.17 0.2169	-0.22 0.1198
51. Do you use a stove at home? 0=no, 1=yes	0.21 0.1256	-0.01 0.9166	-0.17 0.2209	-0.004 0.9761	-0.22 0.1257	-0.19 0.1832
Do you have or have you ever had any of the following?						
52.Diabetes? 0=yes, 1=no	-0.20 0.1445	-0.002 0.9899	0.03 0.8578	-0.19 0.1577	0.07 0.6131	-0.05 0.7127
53. Cancer? 0=yes, 1=no	0.02 0.9139	-0.02 0.8577	0.14 0.3286	-0.14 0.3201	-0.01 0.9684	0.20 0.1616
54. Heart disease or heart attack? 0=yes, 1=no	-0.23 0.0995	0.24 0.0810	0.07 0.5946	-0.18 0.1838	-0.12 0.3886	0.07 0.6432
55. High blood cholesterol? 0=yes, 1=no	-0.12 0.3868	0.01 0.9514	0.18 0.2045	0.02 0.8618	0.15 0.2912	-0.14 0.3118
56. High blood pressure or hypertension? 0=yes, 1=no	-0.08 0.5863	-0.15 0.2716	-0.20 0.1508	-0.20 0.1411	0.13 0.3471	0.11 0.4417

TIME 1 BARRIERS	SUMMARY SCORES						
	AllFV	**AllFr**	**AllVeg**	**HiVitACar**	**HiVitC**	**HiLutZea**	**HiLycop**
32. Do you think that eating more fruits and vegetables will help reduce your risk of cancer? 0=no or don't know, 1=yes	0.10 0.4722	0.11 0.4471	0.04 0.7888	0.16 0.2534	0.13 0.3464	0.15 0.2654	-0.07 0.5944
33. Do you think that eating more fruits and vegetables will help reduce your risk of heart disease? 0=no or don't know, 1=yes	0.13 0.3498	0.07 0.6253	0.17 0.2144	0.20 0.1436	0.16 0.2440	0.26 0.0610	0.05 0.7437
34. Do you think if you improved the way you eat, that you would be a much healthier person? 0=no or don't know, 1=yes	0.28 0.0401*	0.12 0.3816	0.28 0.0401*	0.17 0.2224	0.17 0.2160	0.26 0.0625	0.08 0.5680
35. Do you think that your grocery store has a wide selection of fruits and vegetables? 0=no or don't know, 1=yes	0.08 0.5525	0.07 0.5940	0.05 0.7346	0.13 0.3736	0.19 0.5186	0.17 0.2361	-0.03 0.8526
36. How many fruits and vegetables should people eat each day? 0= 1, 2, 3, 4 a day or don't know, 1= 5 or more	-0.24 0.0887	-0.27 0.0505	-0.08 0.5705	-0.07 0.7919	-0.22 0.1086	-0.07 0.6272	-0.10 0.4830
37. Do you like the way most vegetables taste? 0=no, 1=yes	-0.02 0.8795	-0.10 0.4760	0.06 0.6726	-0.10 0.4713	-0.03 0.8201	0.09 0.5260	0.18 0.1853
38. Do you have tooth or mouth problems that make you usually eat easy-to-chew fruits and vegetables? 0=yes, 1=no	-0.03 0.8266	-0.15 0.2941	0.11 0.4360	-0.01 0.9361	-0.10 0.5100	-0.01 0.9215	0.04 0.7665
39. Do you have enough money to spend on fruits and vegetables? 0=no, 1=yes	-0.22 0.1169	-0.22 0.1064	-0.15 0.3053	-0.08 0.5616	-0.24 0.0899	-0.02 0.8741	-0.06 0.6945
40. Would you like to know more about which fruits and vegetables are good for your health? 0=no, 1=yes	-0.17 0.2322	-0.22 0.1172	0.01 0.9641	0.04 0.7510	-0.12 0.3736	0.22 0.1063	0.17 0.2223
41. Would you like to know more about different ways to cook vegetables? 0=no, 1=yes	0.11 0.4243	0.06 0.6604	0.07 0.6394	0.17 0.2222	0.16 0.2448	0.20 0.1575	0.10 0.4751
Which of these kitchen tools can you easily use to cook vegetables at home?							
43. Sharp knife? 0=no, 1=yes	-0.04 0.7754	-0.12 0.3913	-0.02 0.8763	-0.004 0.9792	-0.03 0.8154	-0.08 0.5836	-0.11 0.4190
44. Can opener? 0=no, 1=yes	-0.01 0.9707	-0.13 0.3569	0.09 0.5390	-0.01 0.9508	-0.09 0.5308	0.01 0.9538	-0.05 0.7182
45. Pot of hot water? 0=no, 1=yes	-0.04 0.7448	-0.18 0.1881	0.11 0.4509	0.20 0.1576	0.02 0.9106	0.19 0.1796	0.08 0.5899

TIME 1 BARRIERS	SUMMARY SCORES						
	AllFV	**AllFr**	**AllVeg**	**HiVitACar**	**HiVitC**	**HiLutZea**	**HiLycop**
46. Do you shop for your own groceries? 0=no, 1=yes	-0.07 0.6017	-0.22 0.1131	0.02 0.8675	-0.01 0.9415	-0.12 0.4143	0.04 0.7548	-0.12 0.3936
48. Do you plan the meals you eat? 0=no, 1=yes	-0.005 0.9732	-0.17 0.2070	0.06 0.6778	0.02 0.8656	-0.07 0.6210	-0.06 0.6676	-0.18 0.2004
49. Do you cook the meals you eat? 0=no, 1=yes	0.06 0.6497	-0.08 0.5502	0.14 0.3243	0.14 0.3094	0.02 0.8636	0.06 0.6677	-0.04 0.7889
50. Do you use a microwave at home? 0=no, 1=yes	-0.17 0.2363	-0.16 0.2624	-0.13 0.3617	-0.20 0.1504	-0.23 0.0993	-0.28 0.0427	-0.06 0.6758
51. Do you use a stove at home? 0=no, 1=yes	0.07 0.5987	-0.04 0.7567	0.09 0.5373	0.08 0.5860	0.04 0.7523	0.04 0.7884	-0.04 0.7533
Do you have or have you ever had any of the following?							
52.Diabetes? 0=yes, 1=no	-0.21 0.1363	-0.13 0.3406	-0.09 0.5089	-0.26 0.0624	-0.25 0.0681	-0.23 0.0879	-0.04 0.7783
53. Cancer? 0=yes, 1=no	-0.01 0.9219	0.05 0.6964	-0.13 0.3688	-0.07 0.5954	0.01 0.9511	0.01 0.9169	0.07 0.6082
54. Heart disease or heart attack? 0=yes, 1=no	0.00 1.0000	0.02 0.9037	-0.04 0.7876	-0.03 0.8039	0.03 0.8136	0.10 0.4617	-0.03 0.8146
55. High blood cholesterol? 0=yes, 1=no	0.14 0.3254	0.17 0.2169	0.10 0.4739	0.19 0.1736	0.08 0.5538	0.06 0.6583	0.03 0.8551
56. High blood pressure or hypertension? 0=yes, 1=no	-0.21 0.1255	-0.26 0.0551	-0.08 0.5582	-0.13 0.3616	-0.30 0.0268	-0.25 0.0647	-0.22 0.1121

Correlation Color Key	Correlation & p-value
BLUE	Positive; $p < 0.05$
PINK	Positive; p=0.05-0.19
GREEN	Negative; $p < 0.05$ & p=0.05-0.19

Table 10. Spearman Correlations among Fruit and Vegetable Intake and Time 2 Barriers

TIME 2 BARRIERS	7. 100% orange juice	8. 100% cran, app, purple grape juice	9. Berries	10. Peaches, nectarines, or apricots	11. Broccoli, cabbage, oauliflower	12. Cantaloupe, honeydew	13. Leafy greens	14. Corn	15. Cooked or stewed tomatoes	16. Spaghetti or lasagna
32. Do you think that eating more fruits and vegetables will help reduce your risk of cancer? 0=no or don't know, 1=yes	-0.05 0.7431	-0.06 0.7317	0.19 0.2421	0.29 0.0684	0.22 0.1630	-0.02 0.9081	-0.03 0.8614	-0.07 0.6518	-0.08 0.6326	0.17 0.2961
33. Do you think that eating more fruits and vegetables will help reduce your risk of heart disease? 0=no or don't know, 1=yes	0.14 0.3871	-0.29 0.0726	-0.12 0.4769	0.05 0.7660	0.08 0.6443	0.05 0.7572	0.13 0.4240	-0.03 0.8348	-0.06 0.7315	0.03 0.8588
34. Do you think if you improved the way you eat, that you would be a much healthier person? 0=no or don't know, 1=yes	-0.12 0.4699	0.11 0.4930	0.07 0.6573	-0.10 0.5339	-0.16 0.3315	-0.13 0.4184	-0.19 0.2346	0.01 0.9489	0.14 0.3936	-0.06 0.7367
35. Do you think that your grocery store has a wide selection of fruits and vegetables? 0=no or don't know, 1=yes	0.26 0.1124	0.25 0.1271	0.10 0.5454	0.11 0.4944	0.26 0.1076	0.07 0.6510	0.21 0.1842	0.41 0.0079*	0.04 0.8295	0.17 0.2961
36. How many fruits and vegetables should people eat each day? 0= 1, 2, 3, 4 a day or don't know, 1= 5 or more	0.33 0.0449*	0.18 0.2755	-0.06 0.7009	0.05 0.7603	-0.02 0.9112	0.32 0.0423*	0.25 0.1271	-0.13 0.4201	-0.17 0.2938	0.18 0.2748
57. Have you increased your overall consumption of fruit or fruit juice (fresh, frozen, and canned)? 0=no or don't know, 1=yes	0.48 0.0026*	0.27 0.0935	0.20 0.2202	0.08 0.6148	0.27 0.0888	-0.09 0.5993	0.15 0.3538	0.17 0.2766	0.29 0.0704	0.36 0.0275*
58. Have you increased your overall consumption of vegetables (fresh, frozen, and canned)? 0=no or don't know, 1=yes	0.21 0.1988	0.25 0.1134	0.41 0.0088*	0.17 0.2881	0.26 0.0990	-0.30 0.0644	0.16 0.3167	0.38 0.0144*	0.26 0.1058	0.12 0.4658

TIME 2 BARRIERS	7. 100% orange juice	8. 100% cran, app, purple grape juice	9. Berries	10. Peaches, nectarines, or apricots	11. Broccoli, cabbage, oauliflower	12. Cantaloupe, honeydew	13. Leafy greens	14. Corn	15. Cooked or stewed tomatoes	16. Spaghetti or lasagna
59. Can you think of some diseases or conditions that might be decreased by a diet high in fruits and vegetables? 0=no or don't know, 1=yes	0.09 0.6111	-0.08 0.6237	-0.13 0.4178	-0.08 0.6303	0.17 0.2887	-0.10 0.5535	-0.11 0.4960	-0.01 0.9471	0.08 0.6420	0.02 0.8929
60. Tried different ways of preparing fruits and vegetables? 0=no or don't know, 1=yes	0.30 0.0727	0.01 0.9300	0.00 1.0000	-0.01 0.9512	0.10 0.5651	0.13 0.4307	0.29 0.0761	-0.17 0.2873	0.08 0.6483	0.14 0.4275
61. Tried a fruit or vegetable that you didn't like before, but now like? 0=no or don't know, 1=yes	-0.14 0.4105	0.18 0.2727	0.04 0.8082	0.01 0.9284	0.00 1.0000	-0.40 0.0096*	0.13 0.4226	-0.25 0.1211	0.05 0.7546	-0.03 0.8385
62. Eat more fruits and vegetables because you think they are good for you? 0=no or don't know, 1=yes	0.08 0.6490	0.08 0.6113	0.11 0.5260	0.05 0.7760	0.12 0.4486	-0.04 .8321	0.25 0.1293	0.13 0.4260	0.34 0.0358*	0.10 0.5467
63. Feel more strongly than before that eating fruits and vegetables will reduce the risk of disease? 0=no or don't know, 1=yes	-0.02 0.9161	0.04 0.8071	0.13 0.4231	-0.18 0.2644	0.09 0.5774	0.04 0.8051	0.20 0.2214	0.27 0.0831	0.29 0.0663	-0.02 0.9179
64. Feel that canned and frozen fruits and vegetables are just as good for you as fresh fruits and vegetables? 0=no or don't know, 1=yes	0.06 0.7236	0.12 0.4477	-0.01 0.9603	-0.09 0.5914	0.19 0.2407	0.002 0.9880	0.08 0.6081	0.08 0.6401	0.32 0.0437*	0.09 0.6033
65. Tried to follow a healthier diet? 0=no or don't know, 1=yes	0.01 0.9373	0.08 0.6316	-0.02 0.8992	0.07 0.6903	-0.002 0.9881	0.35 0.0247*	0.21 0.1881	-0.03 0.8641	0.25 0.1204	0.08 0.6509
66. Eat more dark green vegetables than before? 0=no or don't know, 1=yes	0.19 0.2524	0.38 0.0145*	0.04 0.8212	0.02 0.8980	0.10 0.5266	0.12 0.4714	0.29 0.0667	0.10 0.5285	0.15 0.3455	-0.16 0.4250
67. Made a recipe from one of the lessons? 0=no or don't know, 1=yes	0.12 0.4699	0.18 0.2751	0.03 0.8374	-0.03 0.8715	-0.05 0.7523	0.07 0.6682	0.01 0.9735	-0.17 0.2755	0.14 0.3841	0.10 0.5523

TIME 2 BARRIERS	7. 100% orange juice	8. 100% cran, app, purple grape juice	9. Berries	10. Peaches, nectarines, or apricots	11. Broccoli, cabbage, oauliflower	12. Cantaloupe, honeydew	13. Leafy greens	14. Corn	15. Cooked or stewed tomatoes	16. Spaghetti or lasagna
69. How many sessions of the fruit and vegetable nutrition education program did the participant attend? 0= 0-4 sessions, 1= 5-10 sessions	0.10 0.5478	-0.13 0.4224	0.01 0.9667	0.06 0.7034	0.13 0.4269	-0.07 0.6550	-0.04 0.8209	0.01 0.9732	-0.22 0.1747	0.25 0.1269
71. How many prescription medications do you take every day? 0= $\geq$ 4 meds per day, 1= 0-3 meds per day	0.18 0.2883	0.15 0.3474	0.23 0.1628	0.04 0.8303	-0.09 0.5703	0.04 0.7989	0.17 0.2865	-0.14 0.3953	0.03 0.8426	0.05 0.7600
72. Are you able to detect a taste (using the PTC-impregnated strip)? What is the intensity of the taste? 0= Strong taste (supertaster) ; 1= No taste, slight taste, or moderate taste	0.23 0.1661	0.13 0.4121	0.06 0.7085	0.07 0.6712	0.31 0.0533	-0.22 0.1822	0.03 0.8352	0.09 0.5854	0.32 0.0422*	0.10 0.5647

TIME 2 BARRIERS	17. Onions	18. Squash or zucchini	19. Spinach	20. Sweet potatoes or yams	21. Carrots	22. Baked beans, pintos,other dried beans	23. Fruit as a snack?	24. Fruit as dessert?	25. Vegetables as a snack?
32. Do you think that eating more fruits and vegetables will help reduce your risk of cancer? 0=no or don't know, 1=yes	0.09 0.9558	-0.10 0.5415	0.02 0.8904	0.03 0.8458	-0.08 0.6179	0.17 0.2874	-0.04 0.7821	0.07 0.6754	0.16 0.3414
33. Do you think that eating more fruits and vegetables will help reduce your risk of heart disease? 0=no or don't know, 1=yes	-0.10 0.5371	-0.12 0.4706	0.06 0.7414	-0.27 0.0901	0.08 0.6074	0.28 0.0731	0.08 0.6005	0.13 0.4347	-0.06 0.7433
34. Do you think if you improved the way you eat, that you would be a much healthier person? 0=no or don't know, 1=yes	0.22 0.1745	-0.18 0.2563	-0.07 0.7104	0.07 0.6651	-0.21 0.1965	0.22 0.1709	-0.23 0.1512	-0.37 0.0177*	0.24 0.1532
35. Do you think that your grocery store has a wide selection of fruits and vegetables? 0=no or don't know, 1=yes	0.16 0.3191	0.06 0.7117	0.04 0.8183	0.09 0.5719	0.19 0.2304	0.07 0.6833	0.33 0.0376*	0.35 0.0265*	0.25 0.1328
36. How many fruits and vegetables should people eat each day? 0= 1, 2, 3, 4 a day or don't know, 1= 5 or more	0.19 0.2342	0.07 0.6776	-0.24 0.1733	0.08 0.6092	0.03 0.8669	-0.10 0.5285	0.12 0.4553	0.10 0.5334	-0.01 0.9455
57. Have you increased your overall consumption of fruit or fruit juice (fresh, frozen, and canned)? 0=no or don't know, 1=yes	0.21 0.1913	-0.05 0.7594	0.33 0.0552	0.13 0.4377	0.05 0.7425	0.24 0.1372	0.17 0.3007	0.19 0.2224	0.25 0.1344
58. Have you increased your overall consumption of vegetables (fresh, frozen, and canned)? 0=no or don't know, 1=yes	-0.01 0.9266	-0.16 0.3347	0.36 0.0329*	0.07 0.6853	-0.05 0.7413	0.34 0.0308*	0.14 0.3809	0.13 0.4315	0.05 0.7476
59. Can you think of some diseases or conditions that might be decreased by a diet high in fruits and vegetables? 0=no or don't know, 1=yes	-0.05 0.7635	-0.19 0.2393	-0.28 0.0990	0.08 0.6067	-0.30 0.0644	0.09 0.5838	0.06 0.7268	-0.03 0.8680	0.20 0.2287
60. Tried different ways of preparing fruits and vegetables? 0=no or don't know, 1=yes	0.09 0.5821	-0.04 0.8092	0.003 0.9850	-0.18 0.2849	-0.06 0.7001	0.05 0.7417	0.10 0.5314	0.07 0.6961	0.32 0.0569

TIME 2 BARRIERS	17. Onions	18. Squash or zucchini	19. Spinach	20. Sweet potatoes or yams	21. Carrots	22. Baked beans, pintos,other dried beans	23. Fruit as a snack?	24. Fruit as dessert?	25. Vegetables as a snack?
61. Tried a fruit or vegetable that you didn't like before, but now like? 0=no or don't know, 1=yes	-0.29 0.0619	0.16 0.3272	0.15 0.3754	0.01 0.9275	-0.19 0.2506	0.08 0.6054	-0.05 0.7413	0.24 0.1300	0.22 0.2002
62. Eat more fruits and vegetables because you think they are good for you? 0=no or don't know, 1=yes	0.27 0.0947	-0.12 0.4702	0.02 0.9149	-0.08 0.6285	0.10 0.5257	0.40 0.0105*	0.40 0.0089*	0.28 0.0837	0.20 0.2381
63. Feel more strongly than before that eating fruits and vegetables will reduce the risk of disease? 0=no or don't know, 1=yes	0.34 0.0279*	-0.12 0.4686	0.06 0.7414	0.15 0.3640	0.07 0.6699	0.28 0.0817	0.30 0.0601	0.12 0.4646	0.09 0.6099
64. Feel that canned and frozen fruits and vegetables are just as good for you as fresh fruits and vegetables? 0=no or don't know, 1=yes	0.04 0.8182	0.18 0.2598	0.05 0.7844	0.15 0.3605	-0.02 0.9050	0.02 0.9067	-0.24 0.1310	-0.04 0.8283	0.13 0.4500
65. Tried to follow a healthier diet? 0=no or don't know, 1=yes	0.36 0.0226*	0.05 0.7594	-0.01 0.9554	-0.17 0.3066	0.22 0.1739	0.13 0.4289	0.12 0.4426	-0.03 0.8593	-0.04 0.8297
66. Eat more dark green vegetables than before? 0=no or don't know, 1=yes	0.11 0.4756	-0.06 0.7137	0.24 0.1733	0.05 0.7678	0.08 0.6201	0.09 0.5811	0.25 0.1093	0.07 0.6763	0.30 0.0762
67. Made a recipe from one of the lessons? 0=no or don't know, 1=yes	0.02 0.8790	-0.05 0.7581	0.00 1.0000	0.08 0.6185	-0.03 0.8497	0.28 0.0733	-0.14 0.3777	-0.07 0.8230	0.05 0.7543
69. How many sessions of the fruit and vegetable nutrition education program did the participant attend? 0= 0-4 sessions, 1= 5-10 sessions	-0.35 0.0235*	-0.03 0.8763	-0.13 0.4629	-0.31 0.0503	-0.04 0.7942	-0.15 0.3478	-0.03 0.8507	0.07 0.6589	0.17 0.3280
71. How many prescription medications do you take every day? 0= $\geq$ 4 meds per day, 1= 0-3 meds per day	-0.19 0.2289	-0.11 0.5092	0.18 0.2899	0.01 0.9628	-0.28 0.0772	-0.005 0.9766	0.07 0.6784	0.23 0.1504	0.003 0.9849

TIME 2 BARRIERS	17. Onions	18. Squash or zucchini	19. Spinach	20. Sweet potatoes or yams	21. Carrots	22. Baked beans, pintos,other dried beans	23. Fruit as a snack?	24. Fruit as dessert?	25. Vegetables as a snack?
72. Are you able to detect a taste (using the PTC-impregnated strip)? What is the intensity of the taste? 0= Strong taste (supertaster) ; 1= No taste, slight taste, or moderate taste	-0.01 0.9687	-0.14 0.3898	0.08 0.6385	-0.22 0.1675	-0.18 0.2580	-0.12 0.4374	-0.005 0.9777	-0.19 0.2526	0.07 0.6993

TIME 2 BARRIERS	26. Fresh fruit	27. Frozen fruit	28. Canned fruit	29. Fresh vegetables	30. Frozen vegetables	31. Canned vegetables
32. Do you think that eating more fruits and vegetables will help reduce your risk of cancer? 0=no or don't know, 1=yes	0.15 0.3459	-0.01 0.9583	0.11 0.5113	0.18 0.2477	0.13 0.4247	0.15 0.3479
33. Do you think that eating more fruits and vegetables will help reduce your risk of heart disease? 0=no or don't know, 1=yes	0.05 0.7732	0.04 0.8022	0.23 0.1542	0.17 0.3016	-0.05 0.7719	0.21 0.1936
34. Do you think if you improved the way you eat, that you would be a much healthier person? 0=no or don't know, 1=yes	-0.08 0.6306	0.08 0.6321	-0.22 0.1341	0.12 0.4566	0.14 0.3917	0.12 0.4623
35. Do you think that your grocery store has a wide selection of fruits and vegetables? 0=no or don't know, 1=yes	0.24 0.1287	0.14 0.4075	0.08 0.6096	0.18 0.2478	0.16 0.3262	0.03 0.8764
36. How many fruits and vegetables should people eat each day? 0= 1, 2, 3, 4 a day or don't know, 1= 5 or more	0.28 0.0737	0.07 0.6865	-0.06 0.7242	0.32 0.0390*	0.19 0.2384	0.19 0.2558
57. Have you increased your overall consumption of fruit or fruit juice (fresh, frozen, and canned)? 0=no or don't know, 1=yes	0.26 0.1065	0.25 0.1400	0.14 0.3728	-0.17 0.2979	0.11 0.5224	0.06 0.7265
58. Have you increased your overall consumption of vegetables (fresh, frozen, and canned)? 0=no or don't know, 1=yes	0.10 0.5206	0.05 0.7710	0.18 0.2476	-0.09 0.5796	-0.002 0.9885	0.05 0.7783
59. Can you think of some diseases or conditions that might be decreased by a diet high in fruits and vegetables? 0=no or don't know, 1=yes	0.16 0.3042	0.04 0.8283	0.20 0.2190	0.15 0.3508	-0.19 0.2521	0.08 0.6129
60. Tried different ways of preparing fruits and vegetables? 0=no or don't know, 1=yes	0.23 0.1500	0.12 0.4875	-0.11 0.5017	0.12 0.4803	0.28 0.0936	0.06 0.7260
61. Tried a fruit or vegetable that you didn't like before, but now like? 0=no or don't know, 1=yes	-0.04 0.8087	-0.01 0.9531	0.42 0.0061*	-0.07 0.6630	0.04 0.8192	0.10 0.5525
62. Eat more fruits and vegetables because you think they are good for you? 0=no or don't know, 1=yes	0.39 0.0126*	0.30 0.0838	0.30 0.0609	0.25 0.1217	0.23 0.1600	0.27 0.1016

TIME 2 BARRIERS	26. Fresh fruit	27. Frozen fruit	28. Canned fruit	29. Fresh vegetables	30. Frozen vegetables	31. Canned vegetables
63. Feel more strongly than before that eating fruits and vegetables will reduce the risk of disease? 0=no or don't know, 1=yes	0.40 0.0101*	0.25 0.1452	-0.01 0.9745	0.21 0.1963	0.30 0.0644	0.24 0.1435
64. Feel that canned and frozen fruits and vegetables are just as good for you as fresh fruits and vegetables? 0=no or don't know, 1=yes	0.01 0.9652	0.25 0.1459	-0.01 0.9652	0.08 0.6249	0.07 0.6740	-0.21 0.1967
65. Tried to follow a healthier diet? 0=no or don't know, 1=yes	0.18 0.2629	0.26 0.1234	-0.14 0.3680	0.21 0.1867	0.36 0.0241*	0.19 0.2577
66. Eat more dark green vegetables than before? 0=no or don't know, 1=yes	0.05 0.7791	0.14 0.4216	0.26 0.1038	0.14 0.3682	0.13 0.4237	-0.09 0.5708
67. Made a recipe from one of the lessons? 0=no or don't know, 1=yes	0.22 0.1694	0.24 0.1560	0.01 0.9631	-0.02 0.9031	0.21 0.2085	0.08 0.6180
69. How many sessions of the fruit and vegetable nutrition education program did the participant attend? 0= 0-4 sessions, 1= 5-10 sessions	-0.27 0.0836	-0.17 0.3093	-0.09 0.5836	-0.36 0.0208*	-0.09 0.5699	-0.15 0.3758
71. How many prescription medications do you take every day? 0= $\geq$ 4 meds per day, 1= 0-3 meds per day	-0.03 0.8727	0.21 0.2294	0.22 0.1712	0.08 0.6352	0.19 0.2584	0.12 0.4622
72. Are you able to detect a taste (using the PTC-impregnated strip)? What is the intensity of the taste? 0= Strong taste (supertaster) ; 1= No taste, slight taste, or moderate taste	-0.03 0.8632	0.03 0.8700	0.07 0.6716	-0.37 0.0177*	-0.02 0.8857	-0.10 0.5267

TIME 2 BARRIERS	SUMMARY SCORES						
	AllFV	**AllFr**	**AllVeg**	**HiVitACar**	**HiVitC**	**HiLutZea**	**HiLycop**
32. Do you think that eating more fruits and vegetables will help reduce your risk of cancer? 0=no or don't know, 1=yes	-0.04 0.8319	-0.004 0.9829	-0.01 0.9470	0.004 0.9823	-0.04 0.8371	0.03 0.8573	-0.07 0.6970
33. Do you think that eating more fruits and vegetables will help reduce your risk of heart disease? 0=no or don't know, 1=yes	-0.05 0.7822	-0.02 0.9080	-0.03 0.8735	0.02 0.9204	-0.02 0.9181	0.13 0.4653	-0.10 0.5607
34. Do you think if you improved the way you eat, that you would be a much healthier person? 0=no or don't know, 1=yes	-0.16 0.3688	-0.19 0.2873	-0.07 0.7051	-0.14 0.4219	-0.14 0.4264	-0.17 0.3390	0.02 0.9159
35. Do you think that your grocery store has a wide selection of fruits and vegetables? 0=no or don't know, 1=yes	0.35 0.0515	0.27 0.1225	0.37 0.0309*	0.24 0.1760	0.22 0.2294	0.14 0.4161	0.23 0.1642
36. How many fruits and vegetables should people eat each day? 0= 1, 2, 3, 4 a day or don't know, 1= 5 or more	0.31 0.0827	0.31 0.0688	0.14 0.4323	-0.02 0.8890	0.18 0.3279	-0.06 0.7508	-0.01 0.9628
57. Have you increased your overall consumption of fruit or fruit juice (fresh, frozen, and canned)? 0=no or don't know, 1=yes	0.51 0.0030*	0.42 0.0125*	0.32 0.0667	0.21 0.2413	0.44 0.0102*	0.35 0.0451*	0.38 0.0216*
58. Have you increased your overall consumption of vegetables (fresh, frozen, and canned)? 0=no or don't know, 1=yes	0.23 0.1969	0.22 0.2056	0.11 0.5415	0.08 0.6339	0.23 0.2030	0.38 0.0270*	0.20 0.2267
59. Can you think of some diseases or conditions that might be decreased by a diet high in fruits and vegetables? 0=no or don't know, 1=yes	-0.11 0.5547	-0.08 0.6617	0.03 0.8524	-0.20 0.2504	0.04 0.8324	-0.19 0.2829	0.00 1.0000
60. Tried different ways of preparing fruits and vegetables? 0=no or don't know, 1=yes	0.25 0.1876	0.18 0.3198	0.18 0.3242	0.11 0.5519	0.27 0.1455	0.14 0.4513	0.12 0.4796
61. Tried a fruit or vegetable that you didn't like before, but now like? 0=no or don't know, 1=yes	-0.13 0.4853	-0.17 0.3169	0.02 0.9282	0.10 0.5888	-0.11 0.5512	0.19 0.2881	-0.08 0.6582
63. Feel more strongly than before that eating fruits and vegetables will reduce the risk of disease? 0=no or don't know, 1=yes	0.09 0.6395	-0.11 0.5280	0.32 0.0725	0.23 0.1812	0.02 0.9181	0.13 0.4653	0.32 0.0574
64. Feel that canned and frozen fruits and vegetables are just as good for you as fresh fruits and vegetables? 0=no or don't know, 1=yes	0.19 0.3070	0.10 0.5762	0.31 0.0758	0.09 0.6113	0.20 0.2698	0.08 0.6732	0.27 0.1101
65. Tried to follow a healthier diet? 0=no or don't know, 1=yes	0.22 0.2238	0.04 0.8379	0.30 0.0825	0.15 0.3919	0.0716 0.6944	0.05 0.7834	0.29 0.0868
66. Eat more dark green vegetables than before? 0=no or don't know, 1=yes	0.37 0.0347*	0.31 0.0731	0.33 0.0558	0.30 0.0902	0.26 0.1421	0.39 0.0228*	0.12 0.4916

TIME 2 BARRIERS	SUMMARY SCORES						
	AllFV	**AllFr**	**AllVeg**	**HiVitACar**	**HiVitC**	**HiLutZea**	**HiLycop**
67. Made a recipe from one of the lessons? 0=no or don't know, 1=yes	0.10 0.5796	0.05 0.7812	0.05 0.7958	0.04 0.8105	0.07 0.6805	-0.05 0.7772	0.19 0.2635
69. How many sessions of the fruit and vegetable nutrition education program did the participant attend? 0= 0-4 sessions, 1= 5-10 sessions	-0.09 0.6144	0.10 0.5550	-0.24 0.1804	-0.17 0.3320	0.02 0.9106	-0.09 0.6184	-0.06 0.7265
71. How many prescription medications do you take every day? 0= ≥ 4 meds per day, 1= 0-3 meds per day	0.14 0.4591	0.19 0.2703	-0.01 0.9390	0.07 0.7149	0.29 0.1015	0.23 0.1940	0.05 0.7514
72. Are you able to detect a taste (using the PTC-impregnated strip)? What is the intensity of the taste? 0= Strong taste (supertaster) ; 1= No taste, slight taste, or moderate taste	0.15 0.4178	0.17 0.3264	0.12 0.5059	-0.17 0.3445	0.25 0.1521	0.10 0.5681	0.26 0.1196

Correlation Color Key	Correlation & p-value
BLUE	Positive; $p < 0.05$
PINK	Positive; p=0.05-0.19
GREEN	Negative; $p < 0.05$ & p=0.05-0.19

CHAPTER IV

CONCLUSIONS

The overall objectives of this evaluation were to: 1) determine baseline consumption patterns of selected fruit and vegetables, 2) identify perceived and actual barriers to fruit and vegetable consumption, and to improve behaviors, attitudes, and knowledge related to fruit and vegetable consumption, 3) identify prescription medication use and its relationship to fruit and vegetable consumption and super-taster status, and 4) determine the effectiveness of a nutrition intervention program that is designed for a low income, low literacy older adult population by assessing change in intakes of selected fruits and vegetables.

Major Findings

Baseline data indicated that this convenience sample of 54 older adults had low intakes of specific fruits and vegetables associated with reduced chronic disease risk, and encountered several barriers to increasing fruit and vegetable consumption, including low knowledge of the Five a Day fruit and vegetable recommendation (24%). In addition, 51% were identified as super-tasters, and 56% took 4 or more medications daily.

The fruit and vegetable nutrition education intervention program resulted in several positive changes at post-test. The first major outcome is that mean intakes of total fruit and vegetable items (from 22.8 + 1.5 to 25.2 + 2.0 servings/week) and total fruit items (from 9.0 $\pm$ 0.9 to 10.9 $\pm$ 1.3 servings/week) significantly increased from Time 1 to Time 2 ($p<0.05$). Additionally, there were significant increases in 5 of the 31 fruit

and vegetable items assessed: cranberry, apple, or purple grape juice; peaches, nectarines, and apricots; beans; vegetables consumed as a snack; and canned vegetables. Therefore, the first hypothesis, which states that participants will increase mean intakes of $\geq$ 3 fruit and vegetable items assessed in the intervention, is true. The second finding was an improvement in knowledge of the Five a Day recommendation in African American participants. The percentage of African Americans who answered correctly increased from 13% to 41% from Time 1 to Time 2, while the percentage of Caucasians who answered correctly slightly decreased. Among all participants, there was a trend toward increased knowledge of the relationship between high fruit and vegetable consumption and reduced risk of cancer (from 70% to 83%, $p=0.14$). Therefore, the second hypothesis, which states that knowledge and self-efficacy related to fruit and vegetable consumption will increase post-intervention, is also true. The third major outcome was identification of chemosensory barriers to fruit and vegetable consumption and determining how they affected ability to increase fruit and vegetable consumption. Participants who took $\geq$ 4 medications per day or were identified as supertasters were more likely to have significantly lower intakes of several fruits and vegetables, especially those high in vitamin C.

Implications

The results of this nutrition intervention program demonstrate the ability of older adults in Georgia OANPs to respond positively to instruction on diet and disease prevention. Because ethnicity and increasing age are identified as high-risk groups within the older adult population (Millen et al., 2002; Ponza et al., 1996), these findings are especially important for African Americans and adults aged 80 and older.

Because this study and others have found larger increases in fruit intake than vegetable intake, and because barriers such as taste and preparation difficulty often relate more closely to vegetables than fruits, future interventions should consider addressing vegetable consumption separately. Trudeau et al. (1998) suggests implementing all-vegetable intervention that focuses on simple, practical information for meal planning and preparation. Further, because some older adults do not use or follow recipes when cooking, suggesting simple, one-step ways to modify home-prepared meals may be more effective than distributing recipes. This would involve collecting more extensive data on cooking or meal preparation patterns of older adults at home, and structuring an intervention program to address these findings. Conducting focus groups in senior centers prior to the fruit and vegetable intervention would be useful for collecting this type of information, and addressing these findings in the program would better meet the needs of participants.

Future interventions in this population should also assess cognitive ability using Folstein's Mini-Mental State Examination or other comparable tool in order to obtain a clearer picture of self-reported fruit and vegetable intake and behaviors. Additionally, a control group may be useful in assessing change in fruit and vegetable intake due to seasonal variation vs. change as a result of the intervention. A follow-up assessment is also needed to determine if increases in fruit and vegetable intake were permanent.

Further research is needed to determine the extent to which taste and smell defecits impact food choices, nutrition, and overall health in this population and in all older adults (Drewnowski, 1997). The use of flavor-enhancers in food needs to be explored as a means to increase palatability of fruits and vegetables. Flavor enhancers, by

intensifying the positive characteristics of food and minimizing the unpleasant taste sensations produced by prescription medications, may increase the enjoyment of meals and acceptance of fruits and vegetables with high levels of phytochemicals. Flavor enhancers may also have positive effects on improving nutrient status/food intake, food enjoyment, and increasing immune status (Schiffman & Finkelstein, 1999).

Suggested questions to add to pre-test data collection tools include: 1) Do you grow your own fruits and vegetables or do you receive fruits and vegetables from a family member or neighbor's garden? If yes, what types of fruits and vegetables do you/they grow? 2) Where do you purchase fresh fruits and vegetables? ___ local farmer's or produce market ___ local grocery store ___ other (list) 3) Do you eat more fresh fruits and vegetables when they're in season? If yes, which fruits and vegetables? 4) Do you feel that fruits and vegetables are too expensive? (in place of " Do you have enough money to spend on fruits and vegetables?"), and 5) How are the vegetables that you eat prepared? ___ fried ___steamed ___boiled ___raw ___ sautéed ___ with fatback or meat ___in a casserole ___other (add "usually", "sometimes", and "rarely or never" to each possible response). On the taste questionnaire, a question regarding tobacco use needs to be added, since tobacco use can have negative effects on taste perception. Also, the word "prescription" needs to be added to the question pertaining to daily medication use. Clarifications and additions suggested regarding the food frequency questionnaire include: "beans" should read "dried beans and legumes"; "fruit as a snack" and "fruit as dessert" should be combined to read "fruit as a snack or as dessert"; "fresh tomatoes" should be added; and "fresh oranges, tangerines, or grapefruit" should be added.

Continued use of the fruit and vegetable characters is suggested, as they are excellent visual aids in a low-literacy audience, and they served as good icebreakers throughout the lessons. Participants responded positively to the colorful, cartoon-ish characters. Also, repeated viewing of the characters may help participants remember nutrition benefits and recall key concepts repeated in each lesson. Additionally, individual goal-setting based on participants' personal barriers to increasing fruit and vegetable intake has been associated with greater outcomes (Ammerman et al., 1999). Outlining specific goals or behaviors, such as having 100% fruit juice or fruit with breakfast, having vegetables for a snack, or eating two vegetables for dinner, have been shown to have great potential for increasing fruit and vegetable intake (Treiman et al., 1996). Individual, simple goal sheets or checklists may be useful in enhancing program outcomes.

In conclusion, many factors, including environmental, social, cultural, physical, cognitive, and behavioral, are closely linked with fruit and vegetable consumption in low-income, older adult populations. Increased intake of fruits and vegetables, especially those closely associated with reduced risk of health conditions, and reduced barriers to consumption are of great importance in an older adult population where chronic disease, diabetes, obesity, and related health problems are rampant. Including these suggestions in planning and evaluation of future studies in this population may facilitate further increases in fruit and vegetable intake, reductions in barriers to increased consumption, and reductions in chronic disease risk.

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APPENDICES

Appendix A. Consent Form for Fruit and Vegetable Study FORM FV

NUTRITION AND PHYSICAL ACTIVITY CONSENT FORM

I, _____, agree to participate in the study titled "NUTRITION AND PHYSICAL ACTIVITY" conducted by Dr. Mary Ann Johnson in the Department of Foods and Nutrition at the University of Georgia. I understand that I do not have to take part if I do not want to. I can stop taking part without giving any reason and without penalty. I can ask to have all information concerning me removed from the research records, returned to me, or destroyed. My decision to participate will not affect the services that I receive at the Senior Center.

The benefits of this study are to help me improve my eating habits and physical activity habits. This study will also help the investigators learn more about good ways to help older adults improve their eating and increase their physical activity. This study will be conducted at my local Senior Center. If I volunteer to take part in this study, I will be asked to do the following things:

1) Answer questions about my health, food intake, and nutrition status.
2) Attend up to 10 nutrition, health, and fitness programs that will last about 30 to 60 minutes each.
3) Take part in a physical activity program to improve my strength and balance.
4) Attend two sessions for collecting information about my health, fitness, food, and nutrition habits. Each session will last up to 60 minutes.
5) Someone from the study may contact me to clarify my information.

The instructor will provide food to taste. Mild to no risk is expected by tasting food. However, I will not taste foods that I should not eat because of swallowing difficulties, allergic reactions, dietary restrictions, or other food-related problems.

No risk is expected, but I may experience some discomfort or stress when the researchers ask me questions about my food intake, nutrition status, and health. The leaders will advise me to stop exercising if I experience any discomfort or chest pains. No information concerning myself or provided by myself during this study will be shared with others without my written permission, unless law requires it. I may choose not to answer any question or questions that may make me uncomfortable. I will be assigned an identifying number and this number will be used on all of the questionnaires I fill out. Data will be stored in locked file cabinets under the supervision of Dr. Mary Ann Johnson at the University of Georgia; only the staff involved in the study will have access to these data and only for the purpose of data analyses and interpretation of results. The data will be destroyed by January 1, 2012.

I will allow the staff to take my picture, videotape, or record me on audiotape while participating in the study. I can verbally refuse at anytime, and my wishes will be upheld. My pictures will only be used to promote this nutrition and physical activity program.

I will allow my picture/video/audio recordings to be used for promotional purposes.
Circle one: YES / NO. Initial _____
I will allow the staff to take my picture.
Circle one: YES / NO. Initial _____.
I will allow the staff to videotape me.
Circle one: YES / NO. Initial _____.
I will allow the staff to record me on audiotape.
Circle one: YES / NO. Initial _____.

If I have any further questions about the study, now or during the course of the project I can call Ms. Susan Stone 706-542-4838 or Dr. Mary Ann Johnson 706-542-2292.

I will sign two copies of this form. I understand that I am agreeing by my signature on this form to take part in this project. I will receive a signed copy of this consent form for my records.

_____	_____	_____
Signature of Participant	Participant's Printed Name	Date

_____
Participant Address and Phone

_____	Mary Ann Johnson	_____
Signature of Investigator	Printed Name of Investigator	Date

Questions or problems regarding your rights as a participant should be addressed to Dr. Christina Joseph; Institutional Review Board; Office of V.P. for Research; The University of Georgia; 604A Graduate Studies Research Center; Athens, GA 30602-7411; Telephone 706-542-6514.

UGA project number: H2000-10489-3 *DHR project number: 990102*
11/27/01

Appendix B. Pre-Test Questionnaire

PRE-TEST: Fruit and Vegetable Intake

Administer this questionnaire before doing any nutrition and health education activities

Name (ID): 1-4	**2. County:** 5-7	**3. Date (M/D/Y):** 8-13	***Line 1***

4. Age: 14-16	**5. Male(0) Female(1)** 17	**6. White(1) Black(2) Hispanic(3) Other(4)** 18	

How often do you eat or drink these fruits and vegetables? ***Think about fresh, frozen, and canned fruits and vegetables***	Less than 1 per wk **0**	1 per wk **1**	2 per wk **2**	3 per wk **3**	4 per wk **4**	5 per wk **5**	6 per wk **6**	1 per day **7**	2 per day **8**	Missing/ Don't Know **9**	***Line 2***
7. 100% orange juice	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	7
8. 100% cranberry, apple, or purple grape juice	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	8
9. Berries such as strawberries, blueberries, or blackberries	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	9
10. Nectarines, peaches, or apricots	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	10
11. Broccoli, cabbage, or cauliflower	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	11
12. Cantaloupe or honeydew melon	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	12
13. Leafy greens such as mustard, turnip or collard greens	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	13
14. Corn	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	14
15. Cooked or stewed tomatoes such as in vegetable soup or rice and tomato gravy	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	15
16. Spaghetti or lasagna	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	16
17. Onions	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	17
18. Squash or zucchini	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	18
19. Spinach	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	19

20. Sweet potatoes or yams	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	20
21. Carrots	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	21
22. Baked beans, pintos, black-eyed peas, other beans	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	22
23. How often do you eat fruit as a snack?	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	23
24. How often do you eat fruit as dessert?	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	24
25. How often do you eat vegetables as a snack?	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	25
26. When you are at home, how often do you eat <u>fresh fruit</u>?	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	26
27. When you are at home, how often do you eat <u>frozen fruit</u>?	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	27
28. When you are at home, how often do you eat <u>canned fruit</u>?	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	28
29. When you are at home, how often do you eat <u>fresh vegetables</u>?	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	29
30. When you are at home, how often do you eat <u>frozen vegetables</u>?	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	30
31. When you are at home, how often do you eat <u>canned vegetables</u>?	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	31

Please answer "yes" or "no" to these next questions.	**0**	**1**	**8**	**9**	
32. Do you think that eating more fruits and vegetables will help reduce your risk of <u>cancer</u>?	No	Yes	Don't know	Missing	32
33. Do you think that eating more fruits and vegetables will help reduce your risk of <u>heart disease</u>?	No	Yes	Don't know	Missing	33
34. Do you think if you improved the way you eat, that you would be a much healthier person?	No	Yes	Don't know	Missing	34
35. Do you think that your grocery store has a wide selection of fruits and vegetables?	No	Yes	Don't know	Missing	35
36. How many fruits and vegetables should people eat each day? *Circle one: 1 2 3 4 5 or more*			Don't know	Missing	36

PRE-TEST ONLY			
	0	**1**	
37. Do you like the way most vegetables taste?	No	Yes	37
38. Do you have tooth or mouth problems that make you usually eat easy-to-chew fruits and vegetables?	No	Yes	38

39. Do you have enough money to spend on fruits and vegetables?	No	Yes	39
40. Would you like to know more about which fruits and vegetables are good for your health?	No	Yes	40
41. Would you like to know more about different ways to cook vegetables?	No	Yes	41
42. Would you like a handout with healthy menus to take home?	No	Yes	42
Which of these kitchen tools can you easily use to cook vegetables at home?			
43. Sharp knife?	No	Yes	43
44. Can opener?	No	Yes	44
45. Pot of hot water?	No	Yes	45
46. Do you shop for your own groceries? 47. If you answered no, then who shops for you? 8=not applicable; 1=spouse, 2=other family, 3=friend, 4=other, describe: _____	No	Yes	46 47
48. Do you plan the meals you eat?	No	Yes	48
49. Do you cook the meals you eat?	No	Yes	49
50. Do you use a microwave at home?	No	Yes	50
51. Do you use a stove at home?	No	Yes	51
Do you have or have you ever had any of the following?			
52. Diabetes	No	Yes	52
53. Cancer	No	Yes	53
54. Heart disease or heart attack	No	Yes	54
55. High blood cholesterol	No	Yes	55
56. High blood pressure or hypertension	No	Yes	56

Appendix C. Post-Test Questionnaire

POST-TEST: Fruit and Vegetable Intake

Administer this questionnaire after doing all nutrition and health education activities

Name (ID): 1-4	**2. County:** 5-7	**3. Date (M/D/Y):** 8-13	***Line 1***
4. Age: 14-16	**5. Male(0) Female(1)** 17	**6. White(1) Black(2) Hispanic(3) Other(4)** 18	

How often do you eat or drink these fruits and vegetables? Think about fresh, frozen, and canned fruits and vegetables	Less than 1 per wk **0**	1 per wk **1**	2 per wk **2**	3 per wk **3**	4 per wk **4**	5 per wk **5**	6 per wk **6**	1 per day **7**	2 per day **8**	Missing/ Don't Know **9**	***Line 2***
7. 100% orange juice	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	7
8. 100% cranberry, apple, or purple grape juice	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	8
9. Berries such as strawberries, blueberries, or blackberries	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	9
10. Nectarines, peaches, or apricots	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	10
11. Broccoli, cabbage, or cauliflower	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	11
12. Cantaloupe or honeydew melon	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	12
13. Leafy greens such as mustard, turnip or collard greens	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	13
14. Corn	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	14
15. Cooked or stewed tomatoes such as in vegetable soup or rice and tomato gravy	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	15
16. Spaghetti or lasagna	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	16
17. Onions	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	17
18. Squash or zucchini	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	18
19. Spinach	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	19

20. Sweet potatoes or yams	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	20
21. Carrots	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	21
22. Baked beans, pintos, black-eyed peas, other beans	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	22
23. How often do you eat fruit as a snack?	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	23
24. How often do you eat fruit as dessert?	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	24
25. How often do you eat vegetables as a snack?	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	25
26. When you are at home, how often do you eat <u>fresh fruit?</u>	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	26
27. When you are at home, how often do you eat <u>frozen fruit?</u>	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	27
28. When you are at home, how often do you eat <u>canned fruit?</u>	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	28
29. When you are at home, how often do you eat <u>fresh vegetables?</u>	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	29
30. When you are at home, how often do you eat <u>frozen vegetables?</u>	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	30
31. When you are at home, how often do you eat <u>canned vegetables?</u>	<1/wk	1/wk	2/wk	3/wk	4/wk	5/wk	6/wk	1/dy	2/dy	M/DK	31

Please answer "yes" or "no" to these next questions.	0	1	**8**	**9**	
32. Do you think that eating more fruits and vegetables will help reduce your risk of <u>cancer</u>?	No	Yes	Don't know	Missing	32
33. Do you think that eating more fruits and vegetables will help reduce your risk of <u>heart disease</u>?	No	Yes	Don't know	Missing	33
34. Do you think if you improved the way you eat, that you would be a much healthier person?	No	Yes	Don't know	Missing	34
35. Do you think that your grocery store has a wide selection of fruits and vegetables?	No	Yes	Don't know	Missing	35
36. How many fruits and vegetables should people eat each day? *Circle one: 1 2 3 4 5 or more*			Don't know	Missing	36

OPEN-ENDED BEHAVIOR AND KNOWLEDGE QUESTIONS RELATED TO FRUIT AND VEGETABLE INTAKE					***Line 3***
57. Have you increased your overall consumption of fruit or fruit juice (fresh, frozen, and canned)? Please list fruits: Total # per week:___	No	Yes	Don't know	Missing	57

58. Have you increased your overall consumption of vegetables (fresh, frozen, and canned)? Please list vegetables: Total # per week:___	No	Yes	Don't know	Missing	58
59. Can you think of some diseases or conditions that might be decreased by a diet high in fruits and vegetables? List:	No	Yes	Don't know	Missing	59
(Questions 40-47) Because of the information that you learned in the lessons, have you or do you: *(Record additional responses below.)*					
60. Tried different ways of preparing fruits and vegetables?	No	Yes	Don't know	Missing	60
61. Tried a fruit or vegetable that you didn't like before, but now like?	No	Yes	Don't know	Missing	61
62. Eat more fruits and vegetables because you think they are good for you?	No	Yes	Don't know	Missing	62
63. Feel more strongly than before that eating fruits and vegetables will reduce the risk of disease?	No	Yes	Don't know	Missing	63
64. Feel that canned and frozen fruits and vegetables are just as good for you as fresh fruits and vegetables?	No	Yes	Don't know	Missing	64
65. Tried to follow a healthier diet?	No	Yes	Don't know	Missing	65
66. Eat more dark green vegetables than before?	No	Yes	Don't know	Missing	66
67. Made a recipe from one of the lessons?	No	Yes	Don't know	Missing	67
POST-TEST ONLY *Line 4*					
68. What was your overall level of satisfaction with this fruit and vegetable nutrition education program? Circle one: *1-Poor, 2-Fair, 3-Good, 4-Very Good, 5-Excellent*					68
69. How many sessions of the fruit and vegetable nutrition education program did the participant attend? *Staff should document with attendance records.*					69

Appendix D. Consent Form for Sensory Testing FORM FV-S&T

NUTRITION AND PHYSICAL ACTIVITY CONSENT FORM

I, _____, agree to participate in a taste and smell test that is part of the study titled "NUTRITION AND PHYSICAL ACTIVITY" conducted by Dr. Mary Ann Johnson in the Department of Foods and Nutrition at the University of Georgia. I understand that I do not have to take part in the taste and smell test if I do not want to. I can stop taking part without giving any reason and without penalty. I can ask to have all information concerning me removed from the research records, returned to me, or destroyed. My decision to participate will not effect the services that I receive at the Senior Center.

The benefits of this study are to help me improve my eating habits. This study will also help the investigators learn more about good ways to help older adults improve their eating. This study will be conducted at my local Senior Center. If I volunteer to take part in this study, I will be asked to participate in tests to access my smell and taste acuity.

No risk is expected from participation in the smell and taste acuity tests. Both are commonly used by medical and health professionals to help people improve the taste of the foods they eat. I may experience some discomfort or stress if the odors or tastes presented are unpleasant to me. I will be shown how to clear odors from my nose and will be provided a choice of foods and water to clear my taste buds. I will not taste foods that I should not eat because of swallowing difficulties, allergic reactions, dietary restrictions, or other food-related problems.

No information concerning myself or provided by myself during this study will be shared with others without my written permission, unless law requires it. I may choose not to answer any question or questions that may make me uncomfortable. I will be assigned an identifying number and this number will be used on all of the questionnaires I fill out. Data will be stored in locked file cabinets under the supervision of Dr. Mary Ann Johnson at the University of Georgia; only the staff involved in the study will have access to these data and only for the purpose of data analyses and interpretation of results. The data will be destroyed by January 1, 2012.

If I have any further questions about the study, now or during the course of the project I can call Ms. Susan Stone 706-542-4838 or Dr. Ruthann Swanson 706-542-4834 or Dr. Mary Ann Johnson 706-542-2292.

I will sign two copies of this form. I understand that I am agreeing by my signature on this form to take part in this project. I will receive a signed copy of this consent form for my records.

_____	_____	_____
Signature of Participant	Participant's Printed Name	Date

_____

Participant Address and Phone

_____	Mary Ann Johnson	_____
Signature of Investigator	Printed Name of Investigator	Date

Questions or problems regarding your rights as a participant should be addressed to Dr. Christina Joseph; Institutional Review Board; Office of V.P. for Research; The University of Georgia; 604A Graduate Studies Research Center; Athens, GA 30602-7411; Telephone 706-542-6514.

UGA project number: H2000-10489-3 *DHR project number: 990102*

Appendix E. Taste & Smell Test Forms

Taste & Smell Test Questions

We would like to know if you **disagree**, **somewhat agree** or **strongly agree** with these statements about the foods you eat...

	Disagree	**Somewhat Agree**	**Strongly Agree**
1. Foods that I used to enjoy eating just don't taste right anymore.			
2. I no longer eat at least one food that I used to enjoy eating because it just doesn't taste right.			
If response is agree, probe..... **What food is that?** _____ **Any others?** _____ _____ _____ _____ _____			
3. My food has little taste.			
4. My mouth is often dry.			
6. I often have an unpleasant taste in my mouth.			
If response is agree, probe... How would you describe that taste?_____ ***Possible response categories : bitter, metallic, decayed, other***			
How many medications do you routinely take each day? _____0 _____1 _____2 _____3 _____4 _____5 or more			

Taste Test

The same food often tastes different to different people. For example, you might think the ____ you ate today were salty, but the person sitting next to you complained that the cooks forgot to add the salt again. The same food tasted different to the two of you. I have two little strips of paper. I want to see if you can taste anything on the papers and if so, how strong that taste is. (Demonstrate with a control strip, because do not want participant to chew and/or swallow strip.) First, take a sip of water.

Paper 1(Control Strip)

Ask:
Is a taste present? _____yes _____no

If yes, then ask:
Would you describe that taste as slight, moderate or strong?
_____slight
_____moderate
_____strong

If strong, then ask:
Would you describe the taste as strong or very strong?
_____strong
_____very strong

Take another sip of water.

Paper 2 (Impregnated Strip)

Ask:
Is a taste present? _____yes _____no

If yes, then ask:
Would you describe that taste as slight, moderate or strong?
_____slight
_____moderate
_____strong

If strong, then ask:
Would you describe the taste as strong or very strong?
_____strong
_____very strong

You can have another sip of water, a bite of cracker or apple slice if you'd like to clean your mouth. Thanks for your help. Please don't talk with anyone else about these questions until after you leave today. Again, thanks.

Appendix F. Vitamin C, Vitamin A, and Carotenoid Content of Selected Foods

Vitamin C content (mg) of selected foods, USDA Nutrient Database 1998

Description	Common Measure	Content per Measure
Orange juice, chilled, includes from concentrate	8 fl oz	81.9
Broccoli, raw, boiled	1/2 cup	58.2
Strawberries, raw	½ cup	47.1
Cranberry juice cocktail, bottled	8 fl oz	89.6
Broccoli, frozen, chopped, boiled	½ cup	36.9
Broccoli, raw	½ cup	41.0
Brussels sprouts, frozen, boiled,	½ cup	35.4
Oranges, raw, all commercial varieties	1 medium	69.7
Sweet potato, baked in skin	1 medium	35.9
Cantaloupe, raw	½ cup	33.8
Soup, tomato, canned, prepared with water	1 cup	66.4
Cauliflower, frozen, boiled	½ cup	28.2
Cauliflower, raw, boiled	½ cup	27.5
Kale, raw, boiled	½ cup	26.7
Tangerines (mandarin oranges), canned, in light syrup	½ cup	25.0
Cauliflower, raw	½ cup	23.2
Collards, frozen, boiled	½ cup	22.5
Tomato juice, canned	1 cup	44.5
Honeydew, raw	½ cup	39.7
Raspberries, frozen	½ cup	20.7
Cabbage, red, raw	½ cup	20.0
Turnip greens, raw, boiled	½ cup	20.0
Coleslaw, home prepared	½ cup	19.6
Turnip greens, frozen, boiled	½ cup	17.9
Mustard greens, raw, boiled	½ cup	17.7
Collards, raw, boiled	½ cup	17.3
Cabbage, raw, boiled	½ cup	15.1
Tomatoes, canned, stewed	½ cup	14.6

*RDA for Vitamin C for males is 90 mg/day; for females, 75 mg/day.
*30% of the RDA for females = 25 mg/day.

Vitamin A content (IU) of selected foods, USDA Nutrient Database 1998

Description	Common Measure	Content per Measure
Pumpkin, canned	½ cup	27019
Carrots, raw, cooked	½ cup	19152
Sweet potato, baked in skin	1 medium	31860
Carrots, raw	½ cup	15471
Carrots, frozen, cooked	½ cup	12923
Carrots, canned	½ cup	10055
Spinach, canned	½ cup	9391
Spinach, frozen, cooked	½ cup	7395
Spinach, raw, cooked	½ cup	7371
Sweet potato, canned in syrup	½ cup	7014
Turnip greens, frozen cooked	½ cup	6540
Pie, pumpkin, prepared from recipe	1/8 pie	6216
Collards, frozen, cooked	½ cup	5084
Kale, raw, cooked	½ cup	4810
Kale, frozen, cooked	½ cup	4130
Squash, winter, all varieties, raw, cooked	½ cup	3646
Cantaloupe, raw	½ cup	2579
Mustard greens, raw, cooked	½ cup	2122
Apricots, canned in juice	½ cup	2063
Broccoli, frozen, chopped, cooked	½ cup	1741
Tomato products, canned, puree	½ cup	1594
Tomato products, canned, sauce	½ cup	1200
Tangerines (mandarin oranges), canned, light syrup	½ cup	1059
Spinach, raw	½ cup	1008
Lettuce, cos or romaine, raw	1 cup	1456
Tomatoes, canned, whole	½ cup	714
Tomatoes, canned, stewed	½ cup	690
Broccoli, raw	½ cup	679
Tomato juice, canned	8 fl oz	1351
Peas, green, canned	½ cup	653
Brussels sprouts, raw, cooked	½ cup	561
Lettuce, looseleaf, raw	1 cup	1064
Nectarines, raw	1 medium	1001
Peaches, canned in juice	½ cup	473
Sauce, spaghetti	½ cup	469
Apricots, raw	1 medium	914
Peaches, raw	1 medium	524
Tangerines, raw	1 medium	773

Cabbage, raw	½ cup	350
Soup, tomato, canned, prepared with water	1 cup	688
Squash, summer, all varieties, cooked	½ cup	259
Fruit cocktail, canned in syrup	½ cup	254

*RDA for Vitamin A for men aged 19+ is 3000 IU, and for women aged 19+ is 2330 IU.
* 30% of the RDA for females = 777 IU.

Carotenoid content (µg/100g edible portion) of selected foods, USDA Nutrient Database 1998

Description	Beta-carotene	Beta-cryptoxanthin	Lutein + Zeaxanthin	Lycopene
Apricots, canned, heavy syrup	6640			65
Apricots, raw		2554		5
Beans, baked, canned	408			
Blueberries, raw	35			
Broccoli, cooked, boiled	1042		2226	
Broccoli, frozen, cooked	1000		830	
Broccoli, raw	779		2445	
Brussels sprouts, cooked	465		1290	
Cabbage, cooked	90			
Cabbage, raw	65		310	
Carrots, baby, raw	7275		358	
Carrots, cooked	8015			
Carrots, canned	5776			
Carrots, frozen, cooked	12272			
Carrots, raw	8836			
Collards, cooked	4418	20	8091	
Fruit cocktail, canned, heavy syrup	138	52	112	
Kale, cooked	6202		15798	
Lasagna with meat & tomato sauce	170		97	7750
Lettuce, cos or romaine, raw	1272		2635	
Lettuce, iceberg	192		352	
Melons, cantaloupe	1595		40	
Nectarines, raw	101	59		
Onions, spring, raw	391			
Orange juice, frozen, diluted with water	24	99	138	
Oranges, raw	51	122	187	
Peaches, canned, heavy syrup	334	141	33	
Peaches, raw	97	24	57	
Peas, green, canned	320		1350	

Peas, green, frozen	320			
Pumpkin, canned	6490			
Raspberries, raw	8			
Sauce, pasta, spaghetti/marinara	440		160	15990
Soup, tomato, canned	235		90	10920
Spinach, cooked	5242		7043	
Spinach, canned	4820			
Spinach, raw	5597		11938	
Squash, summer, crookneck & straight, raw	90		290	
Squash, summer, zucchini, raw	410		2125	
Squash, winter, acorn, cooked	490		66	
Squash, winter, butternut, cooked	4570			
Sweet potato, cooked with skin	9488			
Sweet potato, canned	8314			

Appendix G. Summary Score Categories Defined

	Fruit and Vegetable Items Included
Total Fruit Items	A7. 100 % orange juice A8. Cranberry, apple, purple grape juice A9. Berries A10. Peaches, nectarines, apricots A12. Cantaloupe, honeydew
Total Vegetable Items	A11. Broccoli, cabbage, cauliflower A13. Leafy greens A14. Corn A15. Tomato Products A17. Onions A18. Squash, zucchini A19. Spinach A20. Sweet potatoes, yams A21. Carrots
Total Fruit & Vegetable Items	All items except A16. Spaghetti or Lasagna & A22. Beans
Cruciferous Vegetables	A11. Broccoli, cabbage, cauliflower
Total Vegetables High in Carotenoids + Cruciferous Vegetables	A11. Broccoli, cabbage, cauliflower A13. Leafy greens A19. Spinach A20. Sweet potatoes, yams A21. Carrots
Total Vegetable Items High in Carotenoids & Vitamin A	A13. Leafy greens A19. Spinach A20. Sweet potatoes, yams A21. Carrots
Total Items High in Lutein & Zeaxanthin	A13. Leafy greens A19. Spinach
Total Items High in Lycopene	A15. Tomato products A16. Spaghetti, lasagna
Total Fruit & Vegetable Items High in Vitamin C	A7. 100 % orange juice A9. Berries A11. Broccoli, cabbage, cauliflower A12. Cantaloupe, honeydew A13. Leafy greens A15. Tomato Products A20. Sweet potatoes, yams

Appendix H. Barriers Associated with Fruit and Vegetable Consumption Frequency at Time 1 (n = 54)					
Barrier Variable Name & Description	**Fruit/Vegetable Variable Name & Description**	**No or Don't Know (%)**	**Yes (%)**	**P value**	**** Barriers reported by participants who were less likely to consume ≥ 1 serving/week**
A32. Do you think that eating more fruits and vegetables will help reduce your risk of cancer?					
	A12rc. Cantaloupe or honeydew			0.02*	**
	0 – 1 servings per week	100	63		
	2 – 3 servings per week	-	21		
	4 or more servings per week	-	16		
	n	16	38		
	A30rc. (At home) How often do you eat frozen vegetables?			0.01*	**
	0 – 1 servings per week	38	69		
	2 – 3 servings per week	62	19		
	4 or more servings per week	-	11		
	n	16	36		
A33. Do you think that eating more fruits and vegetables will help reduce your risk of heart disease?					
	A7rc. 100% Orange juice			0.01*	
	0 – 1 servings per week	53	43		
	2 – 3 servings per week	29	6		
	4 or more servings per week	18	51		
	n	17	37		
A34. Do you think if you improved the way you eat, that you would be a much healthier person?					
	A13rc. Leafy greens			0.03*	**
	0 – 1 servings per week	78	31		
	2 – 3 servings per week	11	56		
	4 or more servings per week	11	13		
	n	9	45		
	A14rc. Corn			0.02*	**
	0 – 1 servings per week	100	60		
	2 – 3 servings per week	-	40		

	4 or more servings per week	-	-		
	n	9	40		
	AllFrrc. All fruit items			0.02*	
	0 – 6 servings per week	33	38		
	7 – 13 servings per week	67	33		
	14 or more servings per week	-	29		
	n	9	45		
A37. Do you like the way most vegetables taste?					
	A29rc. (At home) How often do you eat fresh vegetables?			0.02*	
	0 – 1 servings per week	-	26		
	2 – 3 servings per week	73	30		
	4 or more servings per week	27	44		
	n	11	43		
A41. Would you like to know more about different ways to cook vegetables?					
	A24rc. How often do you eat fruit for dessert?			0.04*	**
	0 – 1 servings per week	85	48		
	2 – 3 servings per week	15	27		
	4 or more servings per week	-	25		
	n	13	40		
A42. Would you like a handout with healthy menus to take home?					
	A9rc. Berries			0.001*	
	0 – 1 servings per week	75	82		
	2 – 3 servings per week	-	18		
	4 or more servings per week	25	-		
	n	8	44		
	A13rc. Leafy greens			0.01*	**
	0 – 1 servings per week	88	32		
	2 – 3 servings per week	12	52		
	4 or more servings per week	-	16		
	n	8	44		
	A27rc. (At home) how often do you eat frozen fruit?			0.05*	

149	0 – 1 servings per week	88	93		
	2 – 3 servings per week	-	7		
	4 or more servings per week	12	-		
	n	8	44		
Which of these kitchen tools can you easily use to cook vegetables at home?					
A43. Sharp knife?					
	A14rc. Corn			0.05*	**
	0 – 1 servings per week	100	62		
	2 – 3 servings per week	-	38		
	4 or more servings per week	-	-		
	n	7	42		
	A19rc. Spinach			0.02*	
	0 – 1 servings per week	75	80		
	2 – 3 servings per week	-	17		
	4 or more servings per week	25	2		
	n	8	46		
A44. Can opener					
	A11rc. Cruciferous vegetables			0.03*	
	0 – 1 servings per week	11	58		
	2 – 3 servings per week	37	35		
	4 or more servings per week	22	7		
	n	9	45		
	A19rc. Spinach			0.03*	
	0 – 1 servings per week	78	80		
	2 – 3 servings per week	-	18		
	4 or more servings per week	22	2		
	n	9	45		
	A24rc. (At home) How often do you eat fruit for dessert?			0.02*	
	0 – 1 servings per week	25	62		
	2 – 3 servings per week	63	18		
	4 or more servings per week	12	20		
	n	8	45		

A45. Pot of hot water					
	A19rc. Spinach			0.05*	
	0 – 1 servings per week	82	79		
	2 – 3 servings per week	-	19		
	4 or more servings per week	18	2		
	n	11	43		
A46. Do you shop for your own groceries?					
	A15rc. Cooked tomato products			0.05*	
	0 – 1 servings per week	50	59		
	2 – 3 servings per week	21	36		
	4 or more servings per week	29	5		
	n	14	39		
	A20rc. Sweet potatoes or yams			0.04*	
	0 – 1 servings per week	62	67		
	2 – 3 servings per week	23	33		
	4 or more servings per week	15	-		
	n	13	39		
	A22rc. Beans			0.05*	
	0 – 1 servings per week	64	69		
	2 – 3 servings per week	21	31		
	4 or more servings per week	14	-		
	n	14	39		
A48. Do you plan the meals you eat?					
	A11rc. Cruciferous vegetables			0.05*	
	0 – 1 servings per week	18	58		
	2 – 3 servings per week	64	35		
	4 or more servings per week	18	7		
	n	11	43		
	A19rc. Spinach			0.05*	
	0 – 1 servings per week	82	79		
	2 – 3 servings per week	-	19		
	4 or more servings per week	18	2		
	n	11	43		
	A20rc. Sweet potatoes or yams			0.01*	

	0 – 1 servings per week	60	65		
	2 – 3 servings per week	20	35		
	4 or more servings per week	20	-		
	n	10	43		
	A22rc. Beans			0.02*	
	0 – 1 servings per week	55	70		
	2 – 3 servings per week	27	30		
	4 or more servings per week	18	-		
	n	11	43		
A50. Do you use a microwave at home?					
	A11rc. Cruciferous vegetables			< 0.0001*	
	0 – 1 servings per week	6	68		
	2 – 3 servings per week	88	21		
	4 or more servings per week	6	11		
	n	16	38		
	HiCarCrurrc. All Vegetable Items High in Vitamin A/Carotenoids + Cruciferous Vegetables			0.02*	
	0 – 6 servings per week	31	65		
	≥ 7 servings per week	68	35		
	n	16	37		
Do you have or have you ever had any of the following?					
A52. Diabetes					
	A19rc. Spinach			0.002*	**
	0 – 1 servings per week	89	63		
	2 – 3 servings per week	3	37		
	4 or more servings per week	8	-		
	n	35	19		
A55. High blood cholesterol					
	A8rc. 100% cranberry, apple, purple grape juice			0.01*	
	0 – 1 servings per week	41	76		
	2 – 3 servings per week	24	20		
	4 or more servings per week	35	4		
	n	29	25		
A56. High blood pressure or hypertension					

	A7. 100% Orange juice			0.04*	**
	0 – 1 servings per week	65	32		
	2 – 3 servings per week	13	13		
	4 or more servings per week	22	55		
	n	23	31		
A36. How many fruits and vegetables should people eat each day?		**1 – 4 per servings day or Don't Know**	**5 or more servings per day**		
	A11rc. Cruciferous vegetables			0.01*	**
	0 – 1 servings per week	56	31		
	2 – 3 servings per week	42	38		
	4 or more servings per week	2	31		
	n	41	13		
	A17rc. Onions			0.04*	**
	0 – 1 servings per week	44	31		
	2 – 3 servings per week	24	61		
	4 or more servings per week	32	8		
	n	41	13		
	AllFVrc. Total Fruit and Vegetable Items (excluding A16 & A22)			0.03*	
	0 – 13 servings per week	22	25		
	14 – 20 servings per week	12	50		
	21 – 27 servings per week	37	8		
	28 – 34 servings per week	12	17		
	≥ 35 servings per week	17	-		
	n	41	12		
** P values < 0.05 were considered significant.*					

Appendix J. Responses to Open-Ended Questions at Time 2

Not all participants who answered "yes" provided further responses. The most common answers to questions which received two or more responses are included below.

Responses to open-ended questions provided further insight into participants' behaviors by allowing them to state, in their own words, how their behavior has changed since pre-test. Sixty-six percent (n=31) reported that they increased their overall consumption of fruit or fruit juice, while 53 percent (n=25) reported increasing their overall vegetable intake. The most common responses to increased fruit or fruit juice intake were: cranberry, apple, or grape juice (n=9), 100 percent orange juice (n=8), peaches (n=7), berries (6), apples (n=6), and bananas (n=5). The most common responses to increased vegetable intake were: cabbage (n=7), collard or turnip greens (n=7), beans (n=6), peas (n=6), and corn (n=4). Twenty-eight (n=13) reported trying a fruit or vegetable that they never liked before but now like. Responses included spinach (n=3), beans, (n=3), and broccoli (n=2). Fifty-four percent state that they now eat more dark green fruits and vegetables, including collards and turnips (n=1), cabbage, (n=1), spinach (n=1), and broccoli (n=1). Only 28 percent of participants felt that canned and frozen fruits and vegetables are just as good as fresh; two stated that they still preferred fresh even though they felt canned and frozen were equally good.

Forty-eight percent (n=21) of participants reported using different methods to prepare vegetables and fruit. These methods included cooking vegetables with butter or margarine instead of fatback (n=2); steaming, baking, or boiling vegetables more and frying less (n=5); eating more raw vegetables (n=1); using less salt to season vegetables (n=1); and sweetening fruit with artificial sweetener (n=1). Twenty-two percent (n=10)

made a recipe from one of the handouts given at each session, but only one person was able to name the recipe.

Fifty-five percent (n=26) were able to name disease risks that may be lowered by a diet high in fruits and vegetables, including cancer (n=16), heart disease (n=12), high blood pressure (n=6), and diabetes (n=3). When participants were asked if they have increased their fruit and vegetable consumption due to perceived health benefits, 80 percent (n=37) responded yes. Seventy-eight percent (n=36) responded that, since the intervention, they feel more strongly about the health benefits of fruits and vegetables; 63 percent have tried to follow a healthier diet by eating more fruits and vegetables (n=2), and eating less sweets and high-fat foods (n=2).