EVALUATION OF A FRUIT AND VEGETABLE EDUCATION INTERVENTION FOR GEORGIA'S OLDER AMERICANS ACT NUTRITION PROGRAM PARTICIPANTS

by

SARA HENDRIX

(Under the Direction of Joan G. Fischer)

ABSTRACT

Diet is a modifiable factor in preventing disease and improving health among older adults. A convenience sample of older adults in senior centers across Georgia (N = 558, mean age = 75, 83% female, 53% African American) completed a pre-test, intervention, and post-test. Eight lessons given over 16 weeks included information on current guidelines for fruit and vegetable intake, and ways to increase fruit and vegetable intake at meals and snacks. Pre- and post-tests examined self-reported intake of fruits and vegetables at breakfast, lunch, evening meal and snacks, knowledge of recommended intakes, and barriers to intake. The following showed significant improvement after the intervention ($P < 0.0001$): the number of participants reporting they eat 7 or more fruits and vegetables daily increased by 21-percentage points, and knowledge that 7 to 10 servings of fruits and vegetables are recommended daily (for 1,600 to 2,200 calories) increased from 7% to 57%. Significant decreases in three reported perceived barriers to consumption were found after the intervention ($P < 0.05$). Ninety-eight percent of participants reported that their satisfaction with the program was good, very good or excellent. In conclusion, this intervention improved knowledge and behaviors related to nutrition in older adults.

INDEX WORDS: Nutrition, Fruits, Vegetables, Elderly, Older Americans Act Nutrition Program, Health Belief Model, Nutrition Education Intervention

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DEDICATION

This thesis is dedicated to my grandmother, Nora Hendrix, and in memoriam to my grandfather, Glen Hendrix. You have been my role models ever since I can remember; I strive to be like you. Thank you for your support and encouragement throughout my life; and thank you for always believing in me. It is a blessing to have you as grandparents. I love you!

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CHAPTER 1

INTRODUCTION

The number and proportion of older Americans is rapidly growing. Currently, Americans aged 65 and older comprise just over 12% of the population (1). The combination of increased life expectancies and aging baby boomers will lead to an unprecedented proportion of older adults in this country, comprising nearly 20% of the US population by 2030 (1). The aging of Georgia's population is also significant. The population of Georgians aged 60 and older is expected to increase nearly 82% between 1990 and 2010 (2). The fastest growing age group in the US and in Georgia is those 85 and older; they are predicted to increase by almost 265% by 2010 in the state of Georgia (2). The population of older adults is concurrently becoming more ethnically diverse (3). Challenges facing an aging society include increased incidence of chronic diseases and health care costs. Chronic disease is particularly prevalent among minority status older people (3). Preserving the health of older adults is essential to helping them maintain health and functional independence, and enhance quality of life.

Diet is a major modifiable lifestyle factor in preventing, delaying or managing disease, and improving health and quality of life (4). Research has shown that diets high in fruits and vegetables are linked to decreased risk of stroke, cardiovascular disease, certain cancers, type 2 diabetes, overweight and obesity (5-12). Evidence for the health benefits of fruits and vegetables have been reflected in the 2005 Dietary Guidelines for Americans recommendation for intake which is higher than previous recommendations. The new guidelines recommend seven to ten

servings of fruits and vegetables daily for those with energy needs of 1,600 to 2,200 calories daily, which is typical for many older people (13).

Unfortunately, many older adults are not consuming the recommended servings of fruits and vegetables. Prevalence data from the 2005 Behavioral Risk Factor Surveillance System (BRFSS) (14) indicates that only 31% of older Americans and 29% of older Georgians were consuming five or more fruits and vegetables daily. A recent analysis of the 2005 BRFSS data was conducted to assess fruit and vegetable intake in 305,504 adults by state and demographic characteristics (15). Analyses by age found that approximately 46% of adults age 65 and older consumed fruit two or more times per day, and about 34% of adults aged 65 and older consumed vegetables three or more times daily. Suboptimal fruit and vegetable intake was also observed in a recent study of older Georgians, where 37% of those surveyed consumed five or more servings of fruits and vegetables daily (16).

The Older Americans Act Nutrition Program (OAANP) recognizes the importance of adequate nutrition in the elderly. This program was established in 1972 to improve dietary intakes and provide opportunities for greater social interaction of individuals age 60 and over (17). The OAANP is the largest US community nutrition program for older adults, serving over three million elderly Americans annually. In 2005, home delivered meals were served to 15,624 older Georgians, and 13,762 older Georgians received meals in senior centers (18). An executive summary of this program reported that OAANP participants are at high nutritional risk (19). Most have two to three chronic health problems on average, and approximately two-thirds are either overweight or underweight (20). Many of these health conditions, such as diabetes, obesity, cardiovascular disease, and hypertension are related to poor nutrition, therefore, participants may benefit from nutrition education interventions. Prior community interventions

conducted in OAANP participants have been successful at improving behaviors and knowledge related to nutrition (16, 21, 22), although there is still room for improvement.

Title III-D of the Older Americans Act provides federal funds to promote the prevention and management of chronic diseases among older adults and to encourage healthy lifestyles. The state of Georgia provides additional funds through home and community-based service programs to promote physical activity, health and wellness among older adults. In Northeast Georgia, monthly nutrition and physical activity programs are funded and delivered through a collaborative effort of the Georgia Division of Aging Services, the Northeast Georgia Area Agency on Aging, and The University of Georgia. Statewide, these funds aid in the delivery of similar programs to over 200 senior centers in each AAA to enhance the quality of life for older adults by helping them to preserve their health and remain in the community.

Few prevention programs to reduce chronic disease risk have been implemented in older adults; therefore, little evidence is available on the effect of nutrition interventions on improvement of health status, quality of life, and health care cost for older adults. This study evaluated the impact of a fruit and vegetable education intervention designed to improve knowledge and behaviors related to nutrition. The results of this study show that a community-based nutrition intervention can successfully increase knowledge of dietary recommendations and reported fruit and vegetable intake in a diverse group of OAANP participants. As a result of this intervention, there was a mean increase of 1.7 servings of fruits and vegetables per day ($P < 0.0001$), with significant mean increases ($P < 0.01$) reported at all meals and snacks except for vegetables at breakfast. Significant decreases in the number of participants reporting three of the barriers to fruit and vegetable intake were reported. These barriers were: too many fruits and vegetables are recommended, fruits and vegetables are too much trouble, and difficulties with

digestion. Positive predictors of changes in total fruit and vegetable intake were found to be knowledge of the 2005 Dietary Guidelines recommendations for fruit and vegetable intake, and age. Attendance at senior centers in rural areas was negatively associated with changes in intake. This evaluation will help increase awareness of the importance of preventive programs designed to benefit the aging population.

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CHAPTER 2

LITERATURE REVIEW

Aging and Chronic Disease

The older adult population, those aged 65 and older, is rapidly growing in the US and in Georgia. In 2000, there were nearly 35 million older adults in the US, and due to increased life spans and aging baby boomers, this number is projected to more than double to 71.5 million by the year 2030 (1). Georgia is expected to see a similar increase, from just over 9.5% of the population in 2004, to nearly 16% in 2030 (2). In addition to the growing number of older adults, the population has become more racially and ethnically diverse (1). In 2004, non-Hispanic whites made up about 82% of US adults over the age of 65, and by 2050 this number is projected to decrease to only 61% (1). Projections for 2050 indicate that Hispanics of all races will comprise 18% of older adults, 12% will be African American, 8% will be Asian, and all other races will make up 3% of the elderly population. With advancing age, chronic diseases such as diabetes and high blood pressure are more prevalent, particularly in minority status seniors. Older Americans utilize health care more than any other age group (1), and the cost of providing health care to older adults is three to five times higher than for those under age 65 (3). Because of these demographic shifts, by 2030, the nation's health care spending is projected to increase by 25%.

Heart disease and cancer are the two leading causes of death of Americans age 65 and older, regardless of sex or race (1). Other leading causes of death in this population include stroke and diabetes (1). According to 2005 prevalence data from the Behavioral Risk Factor

Surveillance System (BRFSS), approximately 55% of older Americans and 60% of older Georgians are known to have high blood pressure, which is a major risk factor for cardiovascular disease (4). Nearly 17% of older Americans and 21% of older Georgians have been told they have diabetes by a health care provider (4). High blood pressure and diabetes are most prevalent among African Americans. The prevalence of obesity and overweight has grown dramatically. Among adults aged 60 and older, 31% were obese and 71% were overweight in 2003-2004 (5). Obesity and overweight are associated with an increased risk of some chronic diseases including heart disease, type 2 diabetes, and some cancers (6). Approximately 80% of older adults in the U.S. have at least one chronic condition, and 50% have at least two (7).

Chronic disease negatively impacts quality of life and contributes to limitation of activity and the inability to live independently. In 1999, almost 20% of Medicare enrollees age 65 and over were chronically disabled (1). Although advancing age increases the risk of health problems and chronic disease, these conditions are not inevitable. Diet is a major modifiable lifestyle factor in preventing or delaying disease, and improving health and quality of life (8).

Malnutrition is common among Americans age 65 and older (9). The Institute of Medicine estimates that about 40% of community-dwelling older adults have inadequate nutrient intakes. Currently, about 67% of older adults need improvement in diet quality as measured by the Healthy Eating Index; which consists of 10 components and provides an overall picture of the type and quality of foods people eat (1). The percentage of older adults needing improvement in diet quality increases to 77% for those below the poverty level. Only one-third of older adults consume five or more servings of fruits and vegetables each day (4). One reason for decreased nutrient intakes in older adults is that energy intake tends to decrease with age (10). This may be due to several factors such as decreased lean body mass, lower activity levels,

physiological changes in taste and flavor sensations (11), changes in hormone secretion and responsiveness, social factors including poverty and isolation, psychological factors such as depression or dementia, and other medical and pharmacological issues (12).

Older Americans Act Nutrition Program

Recognizing the importance of adequate nutrition in the elderly, the Older Americans Act Nutrition Program (OAANP) was established in 1972 to improve dietary intakes and provide opportunities for greater social interaction of individuals age 60 and over, with priority given to those with the greatest economic and social need, in particular low-income and minority older persons (13). It is an effective program that provides congregate and home-delivered meals, as well as other nutrition services to older adults throughout the country. The OAANP reaches over three million elderly adults annually, and these participants receive from 40 to 50% of most required nutrients from provided meals (13). In 2005, home delivered meals were served to over 15,500 older Georgians, and over 13,500 older Georgians received meals in senior centers (14).

OAANP Participants

A national evaluation showed that OAANP participants are at high nutritional risk and thus an appropriate population for nutrition intervention (15). Eighty to 90% of these participants have incomes below 200% of the DHHS poverty level; this is twice the rate of the overall U.S. elderly population. The highest poverty rates for Americans aged 65 and over are in the Southern states (2). Twenty to 25% of all OAANP participants nationwide are minority elderly compared with 14% of non-participants. Overall, participants tend to be less educated than non-participants. Participants have on average two to three chronic health problems, and approximately two-thirds are either overweight or underweight (16).

Benefits of Fruit and Vegetable Intake

The 2005 Dietary Guidelines for Americans recommends seven to ten servings (3.5 to 5 cups) of fruits and vegetables daily for those with energy needs of 1,600 to 2,200 calories daily, which is typical for many older adults (17). High intakes of fruits and vegetables are associated with reduced risk of stroke, cardiovascular disease, certain cancers, type 2 diabetes, overweight and obesity (18-25). Clinical trials have shown that increased intakes of fruits and vegetables can lower blood pressure, which in turn is associated with reduced risk of stroke and other cardiovascular diseases (19, 26). In the Dietary Approaches to Stop Hypertension (DASH) randomized controlled trial, a dietary pattern high in fruits and vegetables significantly lowered blood pressures of subjects with and without hypertension. The intervention diet consisting of eight to ten servings fruits and vegetables per day reduced systolic blood pressure by 2.8 mmHg more ($P < 0.001$), and diastolic blood pressure by 1.1 mmHg more ($P < 0.07$), than the control diet (19). Furthermore, reductions in blood pressure were seen within two weeks of adopting the intervention diet. Fruit and vegetable consumption is also inversely associated with LDL-cholesterol (27). A cross-sectional study of 4,466 men and women in the National Heart, Lung, and Blood Institute Family Heart Study found that subjects who consumed more than four servings of fruits and vegetables daily had LDL concentrations that were 6-7% lower than those in the lowest fruit and vegetable intake groups.

A follow-up study of participants in the first National Health and Nutrition Examination Survey (NHANES I) supports the inverse association between fruit and vegetable intake and risk of stroke and cardiovascular disease (28). Consumption of at least three servings of fruits and vegetables daily compared with less than one serving daily was associated with a 27% lower stroke incidence and CVD mortality in this study. A recent meta-analysis of eight prospective

studies support recommendations for increased intakes of fruits and vegetables to reduce the risk for stroke (29). This study included nine cohorts, consisting of 257,551 individuals (4,917 stroke events) with an average of 13 years follow-up. Subjects who consumed more than five servings of fruits and vegetables per day had a combined relative risk of 0.74 (95 CI, 0.69-0.79) compared with those who had less than three servings per day. The relationship between fruits and vegetables and CVD was further supported in a study of almost 110,000 men and women enrolled in the Health Professionals' Follow-up Study and the Nurses' Health Study, in which health and dietary habits were followed for 14 years (30). Participants who consumed eight or more servings of fruits and vegetables daily had a 30% lower risk of CVD than participants eating less than 1.5 serving per day. An increment of one serving of fruits and vegetables per day was associated with a 4% lower risk of CVD. Green leafy vegetables appear to be most strongly associated with a reduction in cardiovascular health; an 11% lower risk in CVD was seen with each one-serving increment.

A panel of experts from the World Cancer Research Fund in association with the American Institute for Cancer Research conducted an evidence-based review and concluded that diets with generous amounts and varied fruits and vegetables will prevent 20% or more of all cancers cases world wide (31). The evidence is most convincing for high fruit and vegetable intake and reduced risk for cancers of the mouth and pharynx, esophagus, lung, stomach, colon and rectum, larynx, pancreas, breast and bladder. Raw vegetables appear to be the most protective against cancer, followed by allium vegetables, carrots, green vegetables, cruciferous vegetables, and tomatoes (32). A review of medical literature from 1994 to 2003 found that consumption of both raw and cooked vegetables are inversely related to epithelial cancers, particularly those of the upper gastrointestinal tract, and possibly to breast cancer (33). More of

the studies in this review, however, showed a statistically significant inverse relationship between raw vegetables and cancer compared with cooked or total vegetables. There are many reasons why raw and cooked foods may affect the body differently. Cooking foods can destroy nutrients and enzymes, alter the structure and digestibility, and can create by-products that may be harmful. On the other hand, cooking can also improve bioavailability of certain nutrients, improve digestibility, and kill potentially harmful organisms (33). Low fruit and vegetable intake maybe one of the leading risk factors for death from cancer worldwide (34). Despite these findings, data from cohort studies have not consistently shown a protective effect of fruits and vegetables on cancer (30, 35). This may be partly explained by the protective effects of specific fruits, vegetables or nutrients on specific types of cancer. For example, several studies suggest that diets high in tomatoes and tomato products are associated with decreased risk of prostate cancer. A case control study within the Health Professionals Follow-up Study, found an inverse association between higher lycopene levels and risk of prostate cancer in participants over 65 years of age who did not have a family history of prostate cancer (36). A meta-analysis of case-control and cohort studies found a significant reduction in the risks of cancers of the esophagus, lung, stomach, and colorectum associated with fruit and vegetable intake in case-control studies (37). Breast cancer was associated with vegetables, but not with fruit, and bladder cancer was associated with fruit but not with vegetables. In the cohort studies, the protective effect was observed for cancers of the lung and bladder only, and only with fruit intake, but not with vegetable intake. Another explanation for variation in results may be due to genetic polymorphisms that effect the way individuals respond to nutrients. An excellent example is polymorphisms of one-carbon metabolizing genes [methylenetetrahydrofolate reductase (MTHFR) 677C>T and 1298A>C] on breast cancer risk. A recent study found that individuals

with the MTHFR 677T variant allele had an increased risk of breast cancer (P, trend = 0.03) compared to those with the 1298C variant allele (P, trend = 0.03) (38). Furthermore, compared with 677CC individuals with high folate intake, an elevated risk of breast cancer was seen in 677TT individuals with low dietary folate intakes (OR, 1.83; 95% CI, 1.13-2.96) or total folate intake (OR, 1.71; 95% CI, 1.08-2.71).

Studies show that fruit and vegetable consumption plays a protective role in type 2 diabetes. An examination of NHANES I participants who were followed for about 20 years found that women who consumed five or more serving of fruits and vegetables per day had a significantly lower risk (relative risk 0.61, 95 CI 0.42-0.88) of developing diabetes compared with those who consumed none ((39). These associations did not, however, remain significant for men in the study. In contrast, a 30-year follow-up of 338 men in the Dutch and Finnish cohorts of the Seven Countries Study (40) found that increased consumption of vegetables, legumes and potatoes was inversely associated with 2-hour glucose levels ($P < 0.05$). A recent case-control study of participants in the European Prospective Investigation into Cancer and Nutrition (EPIC) found that a high intake of fresh fruit was associated with high plasma concentrations of HDL cholesterol and adiponectin, low plasma concentrations of HbA_1c and C-reactive protein, and a reduced incidence of type 2 diabetes (41).

Diets high in fruits and vegetables may aid in weight management by promoting satiety and decreasing caloric intake due to high water and fiber content and low energy density. Short-term clinical studies have shown that substituting fruits and vegetables for foods with higher energy densities can be an effective weight-management strategy resulting in increased satiety, reduced hunger, and lower energy intake (42). One study of 248 subjects with a follow-up of about 6 years showed that increased consumption of whole fruit was associated with better body

weight control over time (43). During a 12-year follow-up of 74,063 women aged 38-63 in the Nurses' Health Study, participants tended to gain weight with age, but increases in fruit and vegetable intake were associated with a 24% lower risk of becoming obese and a 28% lower risk of gaining at least 25 kg (44). In a prospective study of over 79,000 healthy adults (with a BMI of at least 18 but less than 32), those in the top quintile of vegetable intake had significant decreases in BMI over a 10 year period (45). The object of this study was to identify behaviors associated with change in BMI. Subjects were initially recruited and interviewed in 1982 for the Cancer Prevention Study II. In 1992, subjects in 21 states and who were between the ages of 50 and 74 were then followed-up, and after meeting inclusion criteria, were included in the current study. Other behaviors that were significantly and inversely associated with BMI included vitamin E supplementation, continued smoking and some vigorous activities.

Fruits and vegetables may also help prevent two common age-related eye diseases; cataract and age-related macular degeneration (AMD). A prospective study of over 36,000 men age 45-75 found that men in the highest quintile of lutein and zeaxanthin intake, antioxidants most commonly found in green, leafy vegetables had a 19% lower risk of cataract compared with men in the lowest quintile (46). Broccoli and spinach were most consistently associated with lower risk. A follow-up study of the Nurses' Health Study and the Health Professionals Follow-up Study found that high fruit intake was related to a reduced risk of AMD (47). Participants who consumed three or more servings of fruit per day had a pooled multivariate relative risk of 0.64 (95 CI 0.44-0.93; $P = 0.004$) compared with those who consumed less than 1.5 servings per day. Although these studies appear promising, other studies have shown no beneficial result. For example, neither the Beaver Dam Study nor the Blue Mountains Eye Study found significant associations between intakes of lutein and zeaxanthin (assessed by food-frequency

questionnaires) and 5-year incidence of early AMD (48, 49). The Carotenoids in Age-Related Eye Disease Study (CAREDS) observed 1787 women aged 50-79 with high (above the 78th percentile) and low (below the 28th percentile) intakes of lutein and zeaxanthin and who were part of the Women's Health Initiative Observational Study (WHI-OS) (50). After an average follow up of seven years, the prevalence of intermediate AMD was not found to be statistically different between the high and low lutein plus zeaxanthin intake groups (OR, 0.96; 95% CI, 0.75-1.23). However, when the analyses were limited to women younger than 75 years with stable intake of lutein plus zeaxanthin and without a history of CVD, diabetes, hypertension, or previously diagnosed AMD, high lutein plus zeaxanthin intake was associated with a lower risk of intermediate AMD (OR, 0.57; 95% CI, 0.34-0.95). The Food and Drug Administration (FDA) recently reviewed intervention and observational studies which evaluated the role of lutein and zeaxanthin in reducing the risk of AMD and cataract and determined that no scientific conclusion could be made about the relationship between intake of lutein and zeaxanthin and risk of AMD or cataracts (51). It is important to note, however, that foods which contain lutein and zeaxanthin also contain other compounds that may be associated with the pathogenesis of cataracts or AMD.

Aging is associated with reduced energy intake and loss of appetite (52), which indicates nutritional challenges for older adults. Increased consumption of nutrient-dense fruits and vegetables could improve diet quality; increasing fiber and micronutrient intakes are associated with reductions in risk for age-related disease (53). In a cross-sectional analysis comparing the diets of adults over age 50 to the dietary reference intakes (DRIs) and USDA recommendations, less than half of the subjects met the daily vegetable recommendation of three to five servings at the time, just slightly more met the fruit recommendation of two to four servings at the time, and

more than 60% reported low intakes of vitamin D, vitamin E, folate and calcium (53). In a study of older men living alone (54), those who consumed at least four servings of fruits and vegetables daily had significantly higher intakes of vitamin C, a greater percentage of energy as protein, and more adequate diets in general.

Predictors of Fruit and Vegetable Intakes in Older Adults

Despite national campaigns to increase consumption of fruits and vegetables, such as the Five a Day for Better Health Program (55)and Healthy People 2010 (8), older adults are not meeting the recommendation. Although studies in the US have shown that older adults consume more fruits and vegetables than younger adults, results from BRFSS 2005 prevalence data indicate that 71% of older Georgians and 69% of older Americans consume less than five servings of fruits and vegetables per day (4). In Georgia, suboptimal intakes were observed in a study of OAANP participants who took part in a nutrition and physical activity intervention. Sixty-three percent of those surveyed consumed less than five servings of fruits and vegetables daily (56).

Numerous studies have examined predictors of fruit and vegetable intake in adults aged 18 and older (57-60), but few have focused specifically on adults aged 60 and older who may face different barriers to fruit and vegetable intake than younger adults. Factors that may affect fruit and vegetable intake in the elderly include those related to retirement, increased prevalence of chronic health conditions, and physiological changes. Aging is associated with losses of taste and smell which may be a result of normal aging, certain disease states, medications or environmental exposures (61). Decreased or altered smell and taste perception results in appetite suppression, increasing the risk for weight loss, malnutrition, impaired immunity, and deterioration of medical conditions in older adults (62). Older adults may complain of taste

distortions such as bitter or metallic tastes (63), and this may contribute to decreased intake of fruits and vegetables.

In a report of factors affecting nutrient intakes of the elderly, diets of people with low income and low education, blacks, and women were more deficient in essential vitamins and minerals than others (64). Also, elderly Southerners and those residing in urban areas tended to consume less of selected nutrients. Analysis of data for 4,622 participants of NHANES III, aged 60 years and over, found that social isolation, dental problems, poor self-reported health, and obesity were among the biggest predictors of low fruit and vegetable intake (65). In addition, older adults who were non-Hispanic blacks, of lower economic status, of lower educational attainment, and reporting not having enough food, were more likely to report eating fewer fruits and vegetables per day than older adults who were Non-Hispanic Whites and Mexican-Americans, of higher economic status, higher education attainment, and food-secure. Lifestyle factors including smoking, physical activity less than five times per week, and not using vitamin/mineral supplements were also significantly associated with lower consumption of fruits and vegetables (65). The baseline survey of the Five a Day Program (57) found similar results; intake of fruits and vegetables increased with higher education, higher income and non-smoking status. Women had higher intakes than men at all ages, and the differences in intake increased with increasing age. However, these differences increased in age only for Caucasians and Hispanics, but not for African Americans. A fruit and vegetable intervention in home-bound elders found that age and female gender were positively correlated with intake (66). A cross-sectional analysis of data from the BRFSS, 1990-1996, found that among Black and White Americans, the highest proportions of men and women who consumed fruits and vegetables at least five times per day were Whites, college graduates, those actively engaged in leisure-time

physical activity, and non-smokers (58). Serdula et al. examined trends in fruit and vegetable intake on 434,121 adults aged 18 and older from 1994 through 2000 in 49 states and the District of Columbia using data from the BRFSS 6-item food frequency questionnaire (59). The geometric mean frequency of fruit and vegetable intake declined slightly from 3.44 times per day in 1994 to 3.37 times per day in 2000. Overall, the prevalence of consuming at least five fruits and vegetables per day was higher among women, individuals aged 55 or older, and non-smokers than men, individuals younger than 55 years, and current smokers, respectively.

Location may affect fruit and vegetable consumption in the elderly due to a number of factors, which include the capability to grow produce, proximity and variety of food stores and services, financial prospects, cultural viewpoints, and exposure to media (64). Rural older adults are at risk for poor quality diets due to environmental barriers such as distance to food stores and transportation issues (67). Older adults who live in rural areas also tend to have lower incomes and lower educational attainment than their urban counterparts (68); both of which have been shown to be negatively associated with fruit and vegetable intake (65). Supermarkets generally offer a larger selection of healthy foods at a lower cost than other types of food retailers such as small, locally owned grocers (69), and a lack of access to supermarkets has been reported in rural areas (70).

Accessibility to fruits and vegetables is a predictor of intake, regardless of whether residence is rural or urban. A study of 10,623 Black and White Americans, with a mean age of 59.0 ± 5.7 and 60.4 ± 5.7, respectively, found that Black Americans reported increased intake of fruits and vegetables when there was at least one supermarket in their census tract (RR = 1.30; 95% CI = 0.93, 1.81) (69). There was a 32% increase in fruit and vegetable intake for each additional supermarket in the census tract (RR = 1.32; 95% CI = 1.08, 1.60), and this association

remained significant after controlling for education and income. White Americans reported an 11% increase in fruit and vegetable consumption with the presence of at least one supermarket, although the association was not significant (RR = 1.11; 95% CI = 0.93, 1.32). Furthermore, a secondary analysis of data from the National Food Stamp Program Survey found that easy access to a supermarket was positively associated, and distance from home to a food store, was negatively associated with higher fruit consumption among low-income households (71). These patterns were similar for vegetable intake, although not significant. Billson et al. found that having home-grown produce was significantly associated with fruit and vegetable consumption in British adults. Over 40% of subjects in the highest quartile of fruit and vegetable intake consumed home grown produce (72). This is logical since home-grown produce would reduce the burdens of expense and accessibility.

Data regarding mean intakes of fruits and vegetables among African Americans and Caucasians have shown mixed results. Sahyoun and colleagues reported that a larger percentage of older, non-Hispanic Black participants in NHANES III consumed fruits and vegetables in the lowest quartile of intake compared with non-Hispanic whites and Mexican Americans (65). On the other hand, food frequency questionnaires (FFQ) of 10,623 participants of the Atherosclerosis Risk in Communities (ARIC) study (with a mean age of about 60 years) found that fruit and vegetable intake was higher among African Americans than Caucasians, and more African Americans reported consuming at least five fruits and vegetables daily (69). According to prevalence data from the 2005 BRFSS, 23.5% of Black Americans and 23.0% of White Americans consume five or more servings of fruits and vegetables per day (4). These discrepancies may be partly explained by inconsistencies in the measures used to assess fruit and vegetable intake. The FFQ used by Sahyoun and colleagues included six questions that

addressed fruit intake and twelve that targeted vegetable intake, including intake of white potatoes. Serving sizes were not defined and responses signified the number of times the food was eaten. The FFQs used in the ARIC study and BRFSS survey included 26 and 6 questions that addressed frequency of fruit and vegetable intake, respectively, but they did not include consumption of potatoes in their analyses. Another explanation for the discrepancy in fruit and vegetable intake among African Americans and Caucasians may be due to limited access to produce in predominantly African-American, low-socioeconomic status communities (73).

In an evaluation of the Five a Day Program, researchers found that the strongest predictors of increases in fruit and vegetable intake were knowledge of the recommendation to eat five or more servings per day, taste preferences, and self-efficacy (specifically, having the confidence in the ability to eat fruit and vegetables in a variety of circumstances) (55). A review of 22 fruit and vegetable behavioral intervention studies (74) reported that interventions were shown to be more effective at changing dietary behavior among populations at risk for or diagnosed with disease compared with healthy populations. Seventeen of the 22 studies reported significant increases in fruit and vegetable intake, with a mean increase of 0.6 servings per day. The most successful components of interventions for changing behavior were found to be goal setting and interventions conducted in small groups.

Fruit and Vegetable Intervention Studies in Older Americans

The Seniors Farmers' Market Nutrition Program (SFMNP) provides low-income seniors with coupons that can be exchanged for foods at farmers' markets, roadside stands, and community supported agriculture programs (75). An evaluation was conducted on data from the first SFMNP in South Carolina (76). Five vouchers worth $10 each, as well as brochures with nutrition information, were given to 15,000 eligible seniors in South Carolina. A random sample

of 1,500 participants was mailed a survey, and 658 (44%) of participants responded. Sixty-four percent of respondents reported that having the coupons changed the way they ate, 89% reported they would eat more fresh fruits and vegetables year round because of the program, 62% reported that they canned or froze the produce for longer storage, and 92% reported that the nutrition information given with the coupons was helpful. Overall this program was beneficial to both the farmers and the low-income seniors.

As part of the SFMNP, the Seattle Senior Farmers' Market Nutrition Pilot Program delivered fresh produce to 480 low-income seniors (66). Baskets of produce were delivery bi-weekly over a five-month period and averaged 1.6 servings of vegetables and 0.67 servings of fruits per day. Baskets included a newsletter that promoted fruit and vegetable consumption and provided information on the produce as well as recipes. Eighty-seven basket recipients and 44 control subjects (who lived outside the project service area) completed baseline and six-month follow-up surveys assessing fruit and vegetable intake. Mean daily servings of fruits and vegetables increased from 3.51 ± 1.67 to 4.55 ± 1.98 in the intervention group, and the control group showed a decline in intake from 4.02 ± 2.07 to 3.75 ± 1.55 servings per day. The proportion of older adults who consumed at least five servings of fruits and vegetables increased from 22% to 39% in the intervention group, while control subjects decreased from 30% at baseline to 23%.

Body and Soul was a six-month dietary intervention conducted in African-American churches (77). It was carried out by partnerships among the University of North Carolina, Emory University, the American Cancer Society (ACS) and the National Cancer Institute (NCI). The cohort consisted of 854 participants who were predominantly female (74%), with a mean age of 51 (range 17-89), and belonged to one of 15 churches in California, the Southeast (GA,

NC, SC), and the Northeast (DE, VA). Churches were randomized to either an intervention group (8 churches) or a control group (7 churches). Two measures of fruit and vegetable intake were obtained from self-reported food frequency questionnaires at baseline and at the six-month follow-up. One instrument was a 19-item measure developed by NCI, which included portion-size estimates. However, the two-part question addressing French fry consumption and portion size was excluded, leaving a 17-item measure. The second instrument included two questions to assess usual intake of fruits and vegetables. Separate questions assessed total fruits and total vegetables consumed each day. Church-wide activities were incorporated into the intervention. Participants received a cookbook, ACS educational pamphlets, a video developed for the study that targeted fruit and vegetable intake, and motivational interviews delivered by trained church members. Participants in the intervention group had significantly higher intake of fruits and vegetables compared with the control group. The adjusted post-test difference between groups was 0.7 servings per day based on the 2-item instrument, and 1.4 servings for the 17-item instrument. Daily fruit intake increased by 0.4 and 0.9 servings based on the 2-item and 17-item measures, respectively, and vegetable intake increased by 0.2 and 0.5 servings. In addition, secondary outcomes of the intervention group showed significant results for the following: lower percentages of calories from fat, more intrinsic and extrinsic motivation to eat fruits and vegetables, greater self-efficacy to eat fruits and vegetables, and better social support to eat more fruits and vegetables.

A six-month, home-based nutrition intervention designed to increase fruit, vegetable, and calcium-rich food consumption in community-dwelling, functionally impaired older adults was conducted in the greater Boston area (78). Subjects were 70 men and women aged 70 and older who were randomized to the intervention group or a control group that received an exercise

intervention. Eight lessons were delivered at the participants' home and focused on increasing fruit and vegetable intake to at least five servings per day. Subjects were given an educational book, and behavior modification techniques included goal setting, food log recording, and games. After the intervention, self-reported fruit consumption increased by 1.1 ± 0.2 ($P = 0.01$) servings per day and vegetable intake increased by 1.1 ± 0.2 ($P = 0.001$) servings per day as well. Increases in blood concentrations of α-carotene and β-carotene correlated with increased dietary intake of α-carotene and β-carotene.

Fruit and Vegetable Studies in Georgia's OAANP

A statewide educational intervention study titled "Take Charge of Your Health for Older Adults" was conducted through the University of Georgia and community partnerships to improve the nutritional status, functional capacity, and physical activity of older adults (56). Participants were 501 older adults in Georgia's congregate meals programs, and were given a pre-test, a series of 12 nutrition education and physical activity lessons over an approximate six-month period, and a post-test. Three key areas covered in the lessons were increasing fruit and vegetable intake, decreasing fat intake, and increasing physical activity. The participants' knowledge of health-promoting behaviors improved significantly in each of these areas. For example, 64% of participants knew that five daily servings of fruits and vegetables were recommended at post-test as compared with only 34% at pre-test ($P = 0.0001$). Vegetable consumption (excluding carrots, potatoes, and salad) increased from 1.6 to 1.8 average daily servings ($P = 0.02$).

A fruit and vegetable education intervention also conducted through the University of Georgia improved consumption of selected fruits and vegetables, and behaviors, attitudes, and knowledge related to intake in OAANP participants in northeast Georgia (79). This study

included a pre-test, a series of nutrition education lessons, and a post-test. The intervention consisted of 10 fruit and vegetable educational modules delivered over a seven month period. Fruits and vegetables in each module were grouped by similar nutrient content and characteristics. Participants received three to four handouts and recipes at each session. The handouts contained information on health benefits, ways to increase intakes, preparation methods and storage tips for fruits and vegetables. Each 30 minute session ended with a taste-testing of a recipe included in the corresponding lesson. Mean intakes of fruits and vegetables increased significantly from 22.8 to 25.2 servings per week ($P = 0.04$).

An expansion of this intervention was conducted in northeast and south Georgia in 73 OAANP participants (80). As a result of this study, knowledge of the recommendation increased from 21% at baseline to 36% at post-test ($P = 0.04$). Mean intakes of fruits and vegetables also increased from 21.8 to 24.2 servings per week, although not significantly ($P = 0.12$).

Health Belief Model

Dietary interventions should be based on a theoretical model to achieve change in nutrition behavior. Theoretical models of behavior change are based on understanding what motivates people and on principles of communication. The Health Belief Model is a widely recognized conceptual framework of behavior change (81) and is the theoretical basis for this intervention. This model was developed during the 1950s and was based on an assumption that people fear disease and this fear will motivate them to make a behavior change as long as the benefits outweigh the risks (81). This model is based on six concepts that are theorized to influence people's decisions to make a behavior change: perceived susceptibility and severity, perceived benefits and barriers, cues to action, and self-efficacy. According to this model, people are ready to make a behavior change if they: 1) believe they are susceptible to a condition

(*perceived susceptibility*), 2) believe the condition has serious consequences (*perceived severity*), 3) believe changing behavior would reduce their susceptibility to the condition or its severity (*perceived benefits*), 4) believe the benefits of changing behavior outweigh the costs (*perceived barriers*), 5) are exposed to factors that prompt behavior change (*cue to action*), and 6) are confident in their ability to successfully perform an action (*self-efficacy*) (82). The Health Belief Model can play an important role in interventions conducted in populations with nutrition-related risk factors such as high blood cholesterol or diabetes (83), therefore it is applicable to OAANP participants because of the heightened possibility of ill health in this population (16).

Rationale, Specific Aims, Hypotheses

Increased intakes of fruits and vegetables are linked with a reduced risk of a range of health conditions and related factors (19-25). Older Americans are not meeting the recommended intakes of fruits and vegetables. Therefore, effective nutrition education interventions are needed in this older population to aid in the prevention of disease and to improve health and the quality of life. Knowledge of the recommendations and nutritional benefits are associated with increased intake, and evidence of low-intake has been shown in previous studies in Georgia's OAANP participants (56, 84).

OAANP participants are an excellent population for intervention because they typically face increased barriers to fruit and vegetable intake (16). Furthermore, nutrition and health education interventions have the potential to be funded by federal, state, and local sources at their senior centers. There are few interventions in the literature that aim to increase fruit and vegetable consumption in low-education, low-income elderly, however, the interventions implemented in Georgia's OAANP participants have been successful in changing behavior and increasing knowledge (56, 79, 80).

This study differs from previous interventions conducted by the University of Georgia in that it has a larger sample size. Second, the curriculum has been updated to meet the new 2005 Dietary Guidelines for Americans recommendations of seven to ten servings of fruits and vegetable per day based on the calorie range recommended for most older adults. The new recommendations were updated to reflect the latest nutrition science and to meet the new nutrient standards published by the National Academy of Sciences Institutes of Medicine. Thirdly, this intervention focused on total fruit and vegetable intake with emphasis on easy ways to consume fruits and vegetables at meals and snack, rather than a focus on specific types of fruits and vegetables.

The specific aims of this study were:

1. Do fruit and vegetable education interventions increase fruit and vegetable consumption in older adults?
2. Do fruit and vegetable education interventions increase and knowledge of recommendations in older adults?
3. Is knowledge of the 2005 Dietary Guidelines for Americans recommendations positively associated with changes in fruit and vegetable intake?
4. What are the determinants of changes in fruit and vegetable intake among Georgia's OAANP participants?

The hypotheses of this study were:

1. Older adults who participate in a fruit and vegetable education intervention will increase intakes of fruits and vegetables.

2. Older adults who participate in a fruit and vegetable education intervention will improve their knowledge of the 2005 Dietary Guidelines for Americans recommendations for intake.
3. The changes in intakes of fruits and vegetables will be positively associated with knowledge of the 2005 Dietary Guidelines for Americans recommendation.

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CHAPTER 3

EVALUATION OF A FRUIT AND VEGETABLE EDUCATION INTERVENTION FOR GEORGIA'S OLDER AMERICANS ACT NUTRITION PROGRAM PARTICIPANTS

ABSTRACT

The rapid growth of Americans aged 65 and over is associated with an increase in the prevalence of chronic disease and health care costs. Diet is a major modifiable lifestyle factor in preventing disease and improving health and quality of life among older adults. Increased intakes of fruits and vegetables are associated with a reduced risk of many chronic diseases. A convenience sample of older adults in senior centers across Georgia (N = 558, mean age = 75, 83% female, 53% African American) completed a pre-test, intervention, and post-test. Eight lessons given over about 16 weeks included information on current guidelines for fruit and vegetable intake, and ways to increase fruit and vegetable intake at meals and snacks. Pre- and post-tests examined self-reported intake of fruits and vegetables at breakfast, lunch, the evening meal and snacks, knowledge of recommended intakes, and barriers to intake. The following showed significant improvement after the intervention ($P < 0.0001$): the number of participants reporting they eat 7 or more fruits and vegetables daily increased by 21-percentage points, and knowledge that 7 to 10 servings of fruits and vegetables are recommended daily (for 1,600 to 2,200 calories) increased from 7% to 57%. Significant decreases in three reported perceived barriers to consumption were found as a result of the intervention ($P < 0.05$). Ninety-eight percent of participants reported that their satisfaction with the program was good, very good or excellent. In conclusion, this intervention improved knowledge and behaviors related to nutrition in older adults.

INTRODUCTION

The United States is witnessing an unprecedented growth in the number and percentage of older adults. Longer life spans and aging baby boomers will combine to nearly double the population of Americans aged 65 and older during the next 25 years. Currently older adults

comprise about 12% of the total US population. By 2030, older adults will account for about 20% of the US population (1). Georgia is expected to see a similar increase, from just over 9.5% of the population in 2004, to nearly 16% in 2030 (1). In addition, America's older adult population is becoming more racially and ethnically diverse. Older Americans utilize health care more than any other age group (2), and the cost of providing health care to older adults is three to five times higher than for those under age 65 (3). Because of these demographic changes, by 2030 the nation's health care spending is projected to increase by 25%. As the composition of the US population continues to change, an enhanced focus on promoting and preserving the health of older adults will be crucial to managing the health and economic challenges that lie ahead (3).

With advancing age, chronic diseases such as diabetes and high blood pressure are more prevalent, particularly in minority status seniors. Disease negatively impacts quality of life and the ability to live independently. However, disease is not inevitable; diet is a major modifiable lifestyle factor in preventing or delaying disease, and improving health and quality of life (4). Evidence for the importance of fruit and vegetable intake to health and the quality of life has been widely recognized (5). High intakes of fruits and vegetables are associated with reduced risk of stroke, cardiovascular disease, certain cancers, type 2 diabetes, overweight and obesity (5-12). With mounting evidence of the health benefits of fruit and vegetable intake, the recently updated Dietary Guidelines for Americans has increased recommendations for fruit and vegetable intake. The current recommendation is 5 to 13 servings (2.5 to 6.5 cups) of fruits and vegetables daily, depending on calorie needs (13). Most older adults need 7 to 10 servings (3.5 to 5 cups) of fruits and vegetables daily, based on typical energy recommendations of 1,600 to 2,200 calories.

Despite national campaigns to increase consumption of fruits and vegetables, such as the Five a Day for Better Health Program (14) and Healthy People 2010 (4), older adults are not meeting the current recommendations. Although studies in the United States have shown that older adults consume more fruits and vegetables than younger adults, results from the Behavioral Risk Factor Surveillance System (BRFSS) 2005 prevalence data indicate that 71% of older Georgians and 69% of older Americans consume less than five servings of fruits and vegetables per day (15). In Georgia, suboptimal intakes were observed in a study of adults in senior centers who took part in a nutrition and physical activity intervention in 2001. Sixty-three percent of those surveyed consumed less than five servings of fruits and vegetables daily (16).

Recognizing the importance of adequate nutrition in the elderly, the Older Americans Act Nutrition Program (OAANP) was established in 1972 to improve dietary intakes and provide opportunities for greater social interaction of individuals age 60 and over, with priority given to those with the greatest economic and social need, in particular low-income and minority older persons (17). It is an effective program that provides congregate and home-delivered meals, as well as other nutrition services to older adults throughout the country. The OAANP reaches over three million elderly adults annually, and these participants receive from 40 to 50% of most required nutrients from provided meals (17). In 2005, home delivered meals were served to 15,624 older Georgians, and 13,762 older Georgians received meals in senior centers (18). A national evaluation of this program showed that OAANP participants are at high nutritional risk and thus an appropriate population for nutrition intervention (19). Participants have on average, two to three chronic health problems, and approximately two-thirds are either overweight or underweight (20). Many of these health conditions, such as diabetes, obesity, cardiovascular

disease, and hypertension are related to poor nutrition, therefore, participants may benefit from nutrition education interventions.

Research shows that simple behavioral changes can improve the health condition of older adults (21). Community interventions conducted in Georgia's OAANP participants have been shown to improve behaviors and knowledge related to nutrition (16, 22, 23). Interventions conducted in older adults across the nation have been successful at improving nutrition-related knowledge and behaviors. Body and Soul was a six-month dietary intervention conducted in African American churches (24). The cohort consisted of 854 participants who were predominantly female (74%), with a mean age of 51 (range 17-89), and belonged to one of 15 churches in California, the Southeast (GA, NC, SC), and the Northeast (DE, VA). Church-wide activities were incorporated into the intervention. Participants received a cookbook, ACS educational pamphlets, a video developed for the study that targeted fruit and vegetable intake, and motivational interviews delivered by trained church members. Daily fruit intake increased by 0.9 servings and vegetable intake increased by 0.5 servings after the intervention. In addition, secondary outcomes of the intervention showed significant results for the following: lower percentages of calories from fat, more intrinsic and extrinsic motivation to eat fruits and vegetables, greater self-efficacy to eat fruits and vegetables, and better social support to eat more fruits and vegetables. A six-month, home-based nutrition intervention designed to increase fruit, vegetable, and calcium-rich food consumption in community-dwelling, functionally impaired older adults was conducted in the greater Boston area (25). Subjects were 70 men and women aged 70 and older who were randomized to the intervention group or a control group that received an exercise intervention. Eight lessons were delivered at the participants' home and focused on increasing fruit and vegetable intake to at least five servings per day. After the

intervention, mean self-reported fruit consumption increased by 1.1 ± 0.2 (P = 0.01) servings per day and vegetable intake increased by 1.1 ± 0.2 (P = 0.001) servings per day. The goal of the current study was to evaluate the impact of a fruit and vegetable education intervention designed to improve knowledge and behaviors related to nutrition, and to identify determinants of behavior change among OAANP participants in Georgia.

METHODS

The methods described below are from internal documentation by Speer et al. (26) as pursuant to authorization from the faculty members supervising the work as allowed by The University of Georgia.

Study Population

A convenience sample of older adults enrolled in the OAANP was recruited from 39 senior centers in rural and urban areas of the 12 Area Agencies on Aging (AAA) in Georgia. One of the AAAs also included participants from a housing and urban development, and an adult day care adjacent to the senior center. Recruitment of participants was accomplished by Wellness Coordinators, senior center directors, and their staff. Most participants were recipients of congregate meals, and homebound elders were excluded. Older adults with cognitive impairment were excluded as determined by interviewer assessment. Eight hundred and fifteen participants were recruited (about 70 participants per AAA). These individuals represent a subset of approximately 3,000 individuals who participated in the state-wide intervention. The average age of the population was 74 years, and participants were 55% African American, 44% white, 1% Hispanic, Asian or other, and 84% female. Written informed consent was obtained from all participants, and all procedures were approved by the Institutional Review Boards of The University of Georgia and the Georgia Department of Human Resources.

Of the 815 participants who completed pre-test assessments, 210 participants did not complete post-tests due to the following: deceased, hospitalized/sick, no longer attended the senior center, refused, cognitive impairment, or no reason was given. This resulted in a completion rate of 74%. Chi square analyses using the Kruskal-Wallis statistic showed that participants who did not complete the study were not statistically different from those who completed the study with respect to gender, race, health conditions, education or food security. However, non-completers were more likely to be younger ($P = 0.03$), live in urban areas ($P = 0.0003$), and have higher body mass indexes ($P = 0.02$) compared with completers. Participants excluded from statistical analyses were those who were < 60 years (n = 28), not of white or African American race (n = 13), or had self-completed questionnaires rather than interviewer administered (n = 35). Forty-seven participants met one or more of the exclusion criteria. People less than 60 years and not of white or African American race were excluded to accurately evaluate the effect of the intervention specifically in white and African American older adults. Participants were excluded when the questionnaires were completed by participants, rather than trained interviewers as required by the study protocol. Thus, the final sample size included for statistical analyses was 558.

Pre-tests

Experts in nutrition, physical activity, and diabetes (three faculty members and three registered dietitians in the Department of Foods and Nutrition, The University of Georgia, and the Georgia Division of Aging Services) reviewed and edited the pre- and post-test questionnaires to ensure content validity and cultural appropriateness based on their collective experience working with the target population. Input from other Division of Aging Services staff and the Wellness Coordinators also was solicited and incorporated into the questionnaires.

Pre-tests were administered in November and December 2006. About one hour was required to explain the study, obtain informed consent, and complete the pre-tests for each participant. In each AAA, participants from one to four senior centers were recruited and interviewed by Wellness Coordinators who read the questions to participants and recorded their responses. Assessments included demographic information, general health including current illnesses (self-reported diabetes, high blood pressure, heart disease, and arthritis), and anthropometrics (self-reported or measured height and weight, and measured waist circumference). Food insecurity was assessed by asking, "Do you always have enough money to buy the food you need?" The questionnaires focused on consumption of fruits and vegetables at breakfast, lunch, the evening meal and snacks (eight questions), as well as knowledge about recommended intakes. A sample question is, "How many servings of vegetables do you usually have as snacks each day?" Frequency categories were servings per meal or snack (0, 1, 2, 3, 4, or 5). It was felt that the frequency of intake was more important than the serving size to gauge exposure of this population to the target foods (27). However, the interviewers read examples of typical serving sizes for fruits and vegetables prior to asking about intake. Barriers to consuming fruits and vegetables, such as dental problems, cooking issues, cost, taste, transportation, too much trouble, and others were also assessed (yes/no format, 16 questions).

Intervention

After participants completed pre-test questionnaires, the educational intervention was initiated at the senior centers. The intervention consisted of eight fruit and vegetable lessons given over 16 weeks (January – April 2006). Each lesson was given one time and lasted 30 to 60 minutes and incorporated physical activity. Nutrition, physical activity, and diabetes experts from The University of Georgia (four faculty, including two registered dietitians) and the

Georgia Department of Aging Services (one registered dietitian), who have experience with the target population, assisted in developing the materials and reviewing the curriculum for the intervention. These experts reviewed the curriculum for accuracy, cultural appropriateness and participant safety. The curriculum was developed based on the previously successful educational interventions developed by The University of Georgia for older adults to increase fruit and vegetable intake (28, 29). The updated curriculum incorporated recent changes in fruit and vegetables recommendations (USDA/USDHHS, 2005).

The conceptual framework for this intervention was based on the Health Belief Model (30). The key concepts of this framework that were incorporated were perceived susceptibility and severity (e.g., emphasizing the health conditions that occur frequently in older adults), perceived benefits (e.g., defining how to take action by increasing fruit and vegetable intake and subsequently improving health and decreasing risk for disease), perceived barriers (e.g., providing information and correcting misinformation about fruits and vegetables), cues to action (e.g., provide "how-to" information on including fruits and vegetables at all meals and snacks), and self-efficacy (e.g., by demonstrating and reinforcing various ways to include fruits and vegetables).

The first lesson, "Serving Up Fruits, Vegetables, and Physical Activity Everyday," focused on the health benefits, recommended daily servings and serving sizes of fruits and vegetables, and set goals for eating more fruits and vegetables. The second lesson, "Staying Healthy with Fruits, Vegetables, and Physical Activity," discussed shopping ideas for buying fruits and vegetables. The third lesson, "Easy Colorful Snacks," discussed ways to eat more colorful fruits and vegetables as snacks. The fourth lesson, "Canned and Frozen Fruits and Vegetables," focused on ways to stock the pantry and freezer with nutritious and convenient

canned and frozen fruits and vegetables. The fifth lesson, "Serve Up Healthy Fruits and Vegetables with Breakfast," discussed ways to eat more fruits and vegetables at breakfast. The sixth lesson, "Loading Up Lunch with Healthy Fruits and Vegetables," discussed ways to eat more fruits and vegetables at lunch. The seventh lesson, "Serving Up Healthy Fruits and Vegetables for the Evening Meal," identified ways to eat more fruits and vegetables at the evening meal. The eighth lesson, "Eating Healthy Fruits and Vegetables Away from Home," focused on ways to eat more fruits and vegetables when eating away from home. Each lesson had a lesson plan and handouts including recipes, menus and tips on how to include more fruits and vegetables as part of an overall healthy diet.

In addition to the lessons on fruits and vegetables, many participants (n = 216) also attended up to eight lessons on diabetes self-management. Lessons on fruits and vegetables and diabetes self-management were given on alternating weeks. The diabetes self-management lessons presented general information on diabetes and included daily suggestions for diabetes self-management such as taking medications, testing blood sugar, eating healthy, being physically active, and checking feet. The physical activity portion of the lessons was incorporated into both the fruit and vegetable and the diabetes self-management lessons, and lasted up to 30 minutes. Exercises were demonstrated by the educator, and the older adults participated. The primary exercises included were strength, balance, flexibility, endurance adapted from the National Institute on Aging Exercise Guide (31), and walking was encouraged. The methods and results of the physical activity and diabetes self-management interventions are discussed elsewhere (32, 33). A series of 16 chair exercises were presented throughout the lessons and are available online at

http://noahnet.myweb.uga.edu/niaexercises/exercise_booklet.pdf. Pedometers were given as incentive and the older adults were instructed on how to use them to record their daily steps.

Post-tests

The post-test questionnaire was administered within one to two months following the last lesson of the intervention (May and June 2006) to allow participants time to make behavior changes. The post-test questions were very similar to the pre-test, except that additional questions were added to allow participants to further describe changes in their behaviors related to fruit and vegetable intake as well as their satisfaction with the lessons and overall program. Questionnaires and study materials are available online at www.livewellagewell.info/study/materials.htm.

Community Partners

The success of this intervention has been dependent upon the cooperation of many community partners. Therefore, the initiative was presented to and discussed with the Georgia Division of Aging Services and Georgia Division of Public Health, Wellness Coordinators, Area Agency on Aging Directors, and the Diabetes Association of Atlanta, during state-wide trainings covering the development, implementation, and evaluation of the intervention. The University of Georgia staff provided on-site assistance in each AAA for up to five days to assist with: 1) collection of pre-test data, 2) the intervention, and 3) collection of post-test data. Additional assistance was available by telephone and email on a regular basis.

Statistical Analyses

Pre- and post-test questionnaires were sent to The University of Georgia for analysis. Data were analyzed using the Statistical Analysis System (SAS, Version 8, SAS Institute, Cary, NC). Descriptive statistics, including frequencies, means, standard deviations, and Spearman

correlation coefficients were calculated. The Shapiro-Wilk test was used to evaluate normality of data. All data were non-normally distributed. Analysis of variance and chi square analyses were used to determine the effect of age, gender and race on pre-test characteristics. Due to the presence of some extreme values of reported fruit and vegetable intake, the highest category of intake was capped at 13 and above, which is the high end of the 2005 Dietary Guidelines for Americans recommendation for fruit and vegetable intake (13). The senior centers were coded into four areas based on U.S. Census Bureau metropolitan and non-metropolitan characteristics, and the population growth that occurred on a county-level basis in Georgia between 1980 and 1990 (34). Mean changes in fruit and vegetable intake from the pre-test to the post-test were evaluated with the Signed Rank Test for non-normally distributed data. Categorical data from the pre-test to post-test were compared using chi-square analyses. Spearman correlations were used to identify factors associated with changes in fruit and vegetable intake, which were further assessed using linear regression analyses. Linear regression analyses were used to determine predictors of changes in fruit and vegetable intake and to identify factors associated with making changes in intake of fruits and vegetables. The criterion for statistical significance was $P < 0.05$.

RESULTS

Demographics and health characteristics for participants are shown in **Table 3.1**. The mean age of the 558 participants was 75 years. Participants were predominately women (83%) and African American (53%). Many were considered overweight (33%) or obese (41%); and a large percentage (62%) rated their health as good, very good or excellent.

Sample at Pre-test

Characteristics of the sample at pre-test by gender, race, age (< 80 vs. ≥ 80), and degree of ruralness are shown in the Appendix (Tables D.1 – D.3). The majority of women were

African American (55%) and the majority of men were white (57%). There were no significant differences in fruit and vegetable intake or knowledge of the recommendations concerning fruit and vegetable intake for men and women, except that women were more likely to consume at least one serving of fruit with breakfast ($P = 0.03$). Women, compared to men, had a higher mean BMI; the mean ± standard deviation (SD) was 29.6 ± 6.6 for women versus 28.1 ± 5.6 for men ($P = 0.02$). Women were more likely to have hypertension ($P = 0.006$).

There were many differences between whites and African Americans. For example, African Americans had less formal education; the mean ± SD was 10.3 ± 3.4 years for African Americans and 10.9 ± 2.9 years for whites ($P = 0.02$). African Americans also reported food insecurity more frequently than whites ($P < 0.0001$). African Americans had a higher mean BMI than whites; the mean ± SD was 30.2 ± 6.6 for African Americans and 28.5 ± 6.2 for whites ($P = 0.0007$). African Americans were more likely to report having diabetes ($P = 0.04$) and hypertension ($P = 0.0001$), but whites were more likely to report the presence of heart disease ($P = 0.0004$). Although there were no significant differences in knowledge of the recommendations for fruit and vegetable intakes by race, African Americans reported higher intakes of fruits and vegetables than whites ($P = 0.002$). African Americans had higher mean intakes of fruit with lunch ($P = 0.0006$) and the evening meal ($P = 0.009$), and of vegetables with breakfast ($P = 0.002$) and as snacks ($P = 0.0003$). More African Americans reported cost ($P = 0.004$) and their grocery store not carrying what they like ($P = 0.03$) as barriers to fruit and vegetable intake, while whites reported more difficulties with digestion ($P = 0.03$) and being told more often by their doctor not to eat certain fruits and vegetables ($P = 0.02$) as barriers.

Participants who were 80 years and older had a significantly lower mean BMI than those under 80 years (27.4 ± 5.3 vs. 30.1 ± 6.7, $P < 0.0001$). Older participants were less likely to

report presence of diabetes (30% vs. 45%, $P = 0.002$) and hypertension (65% vs. 76%, $P = 0.01$), but were more likely to report heart disease (36% vs. 27%, $P = 0.04$) compared with younger participants. Older participants had higher mean intakes of fruit (3.8 ± 1.8 servings/d vs. 3.5 ± 1.9, $P = 0.03$) than younger participants, although total fruit and vegetable intake was similar.

Degree of ruralness was associated with differences in race. African Americans comprised 72%, 41%, 43%, and 57% of participants at senior centers in urban, suburban, growing rural and declining rural locations, respectively. Participants in urban and suburban areas had more years of formal education than those in growing and declining rural areas ($P = 0.002$). Fruit and vegetable intake and knowledge of intake recommendations were not different by degree of ruralness. Barriers to fruit and vegetable intake did not differ by ruralness either, although there was a trend for more dental problems in declining rural areas ($P = 0.07$) and transportation issues in suburban areas ($P = 0.05$). Participants attending senior centers located in declining rural areas had a significantly higher mean BMI than urban, suburban and growing rural areas ($P = 0.0004$).

Intervention Results

Table 3.2 shows daily fruit and vegetable intake at pre- and post-test. Intake was self-reported as the number of servings of fruits and vegetables the participant usually consumed at each meal or snack. The mean ± SD for total fruit and vegetable intake was 7.2 ± 2.5 servings per day, and significant mean increases in fruits and vegetables were reported at all eating periods except for vegetables at breakfast. There was a 21-percentage point increase in the number of participants meeting the 2005 Dietary Guidelines for Americans recommendation of at least seven servings (3.5 cups) of fruits and vegetables daily (recommended for sedentary older women).

Table 3.3 compares knowledge of the recommendations for fruits and vegetables, and barriers to fruit and vegetable intake from pre- to post-test. Knowledge that older people should eat seven to ten servings of fruits and vegetables daily (based on energy requirements of most older adults) was low at pre-test (7%), but increased by 50-percentage points after the intervention. At pre- and post-test, participants were asked what keeps them from eating more fruits and vegetables. After the intervention, significantly fewer participants reported that "digestion problems", "too many recommended servings of fruits and vegetables", and "fruits and vegetables are too much trouble" were barriers to intake. Furthermore, the number of days that participants reported following a healthful diet increased from 4.5 ± 2.4 days per week at pre-test to 5.7 ± 1.8 days per week at post-test. Additionally, participant's self-rated health increased from 1.7 ± 0.8 to 1.8 ± 0.9 on a scale of zero to four with higher numbers representing better health.

Spearman correlations were used to determine potential predictors of changes in fruit and vegetable intake including pre-test characteristics and post-test knowledge of the recommendation **(Tables 3.4 – 3.6)**. After controlling for fruit and vegetable intake at pre-test, changes in total fruit and vegetable intake were found to be negatively correlated with presence at senior centers located in rural areas, and positively correlated with BMI and post-test knowledge of the recommendations. These correlations remained significant when examining fruit intake and vegetable intake separately, except that years of education were positively correlated with changes in fruit intake and vegetable intake, and degree of ruralness was not significantly correlated with changes in vegetable intake.

Table 3.5 shows spearman correlations among changes in fruit intake at specific eating periods with pre-test characteristics and post-test knowledge. There were several characteristics

correlated with changes in fruit intake at breakfast. Knowledge, years of education, and self-rated health were positively correlated, while tobacco use and degree of ruralness were negatively correlated with changes in fruit intake at breakfast. The only items significantly correlated with changes in fruit intake at lunch were degree of ruralness and knowledge of the recommendation. These correlations remained significant for changes in fruit intake at the evening meal, but race became significantly correlated, with African Americans having larger increases in intake. Change in fruit intake as a snack was significantly correlated with knowledge, but not with degree of ruralness. However, hypertension and BMI were positively correlated with changes in intake of fruit as a snack.

Spearman correlations for changes in vegetable intake at specific eating periods were also examined and results are shown in **Table 3.6**. Knowledge of fruit and vegetable intake recommendations was not correlated with changes in vegetable intake at breakfast. However, degree of ruralness was negatively correlated with changes in intake, as was heart disease. Race and self-rated health were positively correlated, with African Americans and those with better self-rated health having larger increases in vegetables with breakfast. The only significant correlation with changes in vegetable intake at lunch was age, which showed that intake increased with age. Changes in vegetable intake at the evening meal were positively correlated with years of education, number of days with 30 minutes of physical activity, hypertension, and knowledge of the recommendation. Negative correlations with changes in vegetable intake at the evening meal were found for degree of ruralness and heart disease. Change in intake of vegetables as snacks was negatively correlated with degree of ruralness and positively correlated with having diabetes.

Linear regression models **(Table 3.7)** show that changes in total fruit and vegetable intakes were positively associated with knowledge of intake recommendations at post-test and negatively associated with degree of ruralness. When changes in fruit intake were examined, degree of ruralness and knowledge of the intake recommendations remained significantly associated with changes in fruit intake, however. When examining changes in vegetable intake alone, knowledge of the recommendations and years of education were positively associated, and degree of ruralness and participants reporting a history of heart disease were negatively associated with changes in intake.

Linear regression models examining predictors of changes in fruit intake at meal and snack times are shown in **Table 3.8**. Years of education, post-test knowledge of the intake recommendations, and reporting that fruits and vegetables were not in season as a barrier to intake were positively associated, while degree of ruralness, and high blood pressure were negatively associated with changes in fruit intake at breakfast. Knowledge of intake recommendations was positively associated with changes in fruit intake at lunch and evening meal, and degree of ruralness was negatively associated with changes in fruit intake at lunch and evening meal. Increased intake of fruit as snacks was positively associated with age, degree of ruralness, BMI, physical activity, and participants reporting transportation issues.

Table 3.9 shows linear regression models of characteristics associated with changes in vegetable intake at meals and snacks. Heart disease and location in rural areas were negatively associated with changes in vegetable intake at breakfast. Participants who were older had larger changes in vegetable intake at lunch. Degree of ruralness and heart disease were inversely related to changes in vegetable intake at the evening meal. Changes in intakes of vegetables as

snacks was found to be positively associated with report of cost as a problem and negatively associated with ruralness.

Table 3.10 shows the mean changes in fruit and vegetable intake by degree of ruralness. Participants who attended senior centers in urban locations had mean changes of 2.1 ± 4.3 servings per day, while those at senior centers in declining rural areas had mean increases of only 1.2 ± 2.6 servings per day.

Additional questions were added to post-test questionnaires to assess participant's perception of the intervention. Results are shown in **Table 3.11**. For each eating period, at least 50% of participants reported increasing intakes of fruits and vegetables as a result of the intervention. Ninety-eight percent of participants reported good, very good or excellent satisfaction with the education program. Eighty-eight percent of participants attended at least half of the eight lessons.

DISCUSSION

This study was designed to evaluate the impact of a fruit and vegetable intervention in Georgia's OAANP participants, a population that typically faces many barriers to fruit and vegetable intake (20). Additional goals were to identify factors associated with changes in fruit and vegetable intake. Most participants receive a congregate meal at the senior center during lunchtime; according to our state regulations the meal is required to have one serving of fruit and two servings of vegetables. We were, therefore, particularly interested in identifying predictors of changes at breakfast, evening meal and snacks.

The major findings of this study were a mean increase of 1.7 servings of fruits and vegetables per day ($P < 0.0001$), with significant mean increases ($P < 0.01$) reported at all meals and snacks except for vegetables at breakfast. Significant decreases in the number of

participants reporting three of the barriers to fruit and vegetable intake were reported after the intervention. These barriers were: too many fruits and vegetables are recommended, fruits and vegetables are too much trouble, and difficulties with digestion. Positive predictors of changes in fruit and vegetable intake were found to be age, attending senior centers in urban areas compared with rural areas, and knowledge of the 2005 Dietary Guidelines recommendations for fruit and vegetable intake. This study shows that a community-based nutrition intervention can successfully increase knowledge of dietary recommendations and reported fruit and vegetable intake in a diverse group of OAANP participants attending senior centers.

The increases reported in the current study are greater than those described in other interventions conducted in Georgia's OAANP participants in which total fruit and vegetable intake increased by 0.56 (28) and 0.35 (22) servings per day. These studies, however, assessed intake of specific fruit and vegetable groupings, and may have missed increases in certain fruits and vegetables that were not included in the questionnaires. A home-based intervention designed to increase fruit, vegetable and dairy consumption in older adults by conducting a nutrition education intervention and using a pre- and post-test design, found results that were similar to the current study. This study assessed fruit and vegetable intake with a FFQ comprised of 32 food groups based on nutritional similarity, which had been validated in older adults. Mean intakes of fruits, vegetables and dairy products all increased by more than one serving per day (25).

Overall, the largest increases were found to be in fruit intake; reported fruit consumption increased by more than one serving per day and vegetable consumption increased by more than one-half serving per day. In line with our results, Campbell et al. (35) reported a larger increase in daily fruit intake compared with vegetable intake following a multi-component intervention

designed to increase fruit and vegetable consumption by African American church members in North Carolina. A possible explanation for this result may be the ready-to-eat and easy-to-take convenience of fruits over vegetables. Another possible explanation may be related to seasonality of fresh fruits and vegetables. Pre-test assessments were conducted in the fall and winter, the intervention was delivered during late winter and spring, and post-tests were conducted in the late spring and summer. At pre-test, 18% of participants reported that "fruits and vegetables not in season" kept them from eating more fruits and vegetables, and this percentage decreased to 13% ($P = 0.05$) at post-test. Although the current study did not assess intakes of specific fruits and vegetables, which would allow increases in seasonal produce to be determined, a previous nutrition intervention in this population conducted post-test assessments in the late summer and early fall and found that melon consumption significantly increased after the intervention, and there was a trend toward increased consumption of peaches, nectarines, or apricots (22). However, Spearman correlations were used to examine the relationship between changes in fruit and vegetable intake and "fruits and vegetables not in season" reported as a barrier to intake, and found no correlation.

The mean increases of more than one serving of fruits and vegetable per day after this intervention have implications for improved health of the participants. In a recent study (36) of 501 initially healthy men in the Baltimore Longitudinal Study of Aging (BLSA), with a mean 18 year follow-up, investigators found that each serving of fruits and vegetables was associated with a 6% lower risk for total mortality ($P < 0.05$), and a 21% risk reduction in coronary heart disease (CHD) mortality ($P < 0.01$). Fruit intake examined separately was inversely associated with total mortality ($P < 0.05$), with a 9% lower risk per serving ($P < 0.05$), and vegetable intake was inversely associated with CHD mortality ($P < 0.01$), with a 40% lower risk per servings ($P <$

0.001). These findings were attenuated when the models were adjusted for saturated fat intake. However, intake of total fruits and vegetables, and vegetables, remained significantly protective against CHD mortality.

This intervention increased reported mean intakes of fruits and vegetables to 8.8 ± 2.6 servings per day. The Dietary Approaches to Stop Hypertension (DASH) randomized controlled trial (6) found that a dietary pattern high in fruits and vegetables (8.5 servings per day) significantly lowered blood pressure of subjects with and without hypertension. The high fruit and vegetable diet reduced systolic blood pressure by 2.8 mmHg more ($P < 0.001$) and diastolic blood pressure by 1.1 mmHg more ($P < 0.07$) than the control diet, which was low in fruits, vegetables, and dairy, and provided about 36% calories from fat. A combination diet providing 9.6 servings of fruits and vegetables, plus 2.7 servings of dairy products per day further reduced systolic and diastolic blood pressure by 5.5 and 3.0 mm Hg more, respectively, than the control diet ($P < 0.001$ for each). Furthermore, reductions in blood pressure were seen within two weeks of adopting the intervention diet.

The use of simple messages repeated at each lesson was important to the success of this intervention. Three simple messages were reinforced at each lesson. One example is, "Seven to ten a day the color way." Our intervention was novel in that the lessons included the new, increased fruit and vegetable recommendations from the 2005 Dietary Guidelines for Americans, which are seven to ten servings (3½ to 5 cups) per day based on energy requirements for most older adults. As a result of this intervention, the number of participants that correctly stated the intake recommendation increased by 50 percentage points. A recent evaluation of nutrition education interventions for older adults also reported that positive outcomes were evident when educational nutrition messages were limited to one or two and were simple, practical,

personalized, and reinforced (37). The present study also concurs with an evaluation of the Five a Day Program in which researchers found that one of the strongest predictors of increases in fruit and vegetable intake was knowledge of the recommendation to eat five or more servings per day (14). Regression analyses in this study showed that knowledge of the recommendation was the strongest predictor of changes in intakes of fruits and vegetables.

Components of successful interventions include goal setting, hands-on activities, participant-educator interaction, distinct topics, and the use of a theoretical model. Goal setting has previously been identified as a successful feature of interventions for changing dietary behaviors (38). One reason for the success of the current intervention may have been the emphasis placed on goal setting. At each lesson, participants were given a handout on which to record their goals to eat more fruits and vegetables, and to list ideas on how to include more fruits and vegetables. Sahyoun and colleagues (37) found that a successful feature of nutrition interventions in older adults was hands-on activities. This may also have been an important component of our intervention. Each of our lessons provided a choice of activities for the educator to perform with the participants. Fruit and vegetable bingo was a particular highlight of the lessons. Games are a creative, fun, and interactive way to assist in the emphasis, review, and reinforcement of nutrition information, and should be encouraged to make the learning environment more pleasing. Participant interaction with educators is also a central element of our intervention and has been shown to be an important predictor of behavior change compared with studies that have no or little contact with participants, such as when educational materials are received by mail (37).

Participants had the opportunity to taste-test fruits and vegetables, which was shown in a recent review to be an effective element of nutrition interventions in older adults (39). An

additional aspect that likely contributed to the success of the present intervention was the focus on only fruits and vegetables rather than multiple nutrition topics. As reported by Higgins and Barkley (39), conducting a series of lessons on a single topic allows participants the opportunity to repeat new food behaviors and talk about ways to overcome any barriers encountered during the course of the intervention. Indeed, significant reductions in modifiable barriers were reported as a result of this intervention.

Incorporating principles from the Health Belief Model proved to be effective with this population. This model was developed based on an assumption that people fear disease and this fear will motivate them to make a behavior change as long as the benefits outweigh the risks (30). According to this model, people are ready to make behavior changes if they 1) believe they are susceptible to a condition (*perceived susceptibility*), 2) believe the condition has serious consequences (*perceived severity*), 3) believe taking action would reduce their susceptibility to the condition or its severity (*perceived benefits*), 4) believe benefits of taking action outweigh the costs (*perceived barriers*), 5) are exposed to factors that prompt action (*cues to action*), and 6) are confident in their ability to successfully perform an action (*self-efficacy*) (40). At pre-test, 17% of participants reported that they felt that the recommendation for fruits and vegetables was too high (low self-efficacy), and 14% reported that consuming fruits and vegetables was too much trouble (barrier). An evaluation of the Five a Day Program found that self-efficacy, specifically, having confidence in the ability to eat fruits and vegetables in a variety of circumstances, was an important predictor of increases in fruit and vegetable intake (14). Each of our lessons addressed perceived barriers by providing information and correcting misinformation about barriers to fruit and vegetable intake. The lessons provided cues to action, such as handouts on how to include more fruits and vegetables at all meals and snacks. Self-

efficacy was addressed by demonstrating and reinforcing way to include fruits and vegetables, for example, taste-testing demonstrations and goal setting were included in each lesson. After the intervention, the percent of participants reporting these perceived barriers was significantly lower.

The Health Belief Model suggests that a person's perceived susceptibility and severity of disease are motivating factors for making behavior changes (30). A review of 22 fruit and vegetable behavioral intervention studies published in 2002 (38) reported that interventions were shown to be more effective at changing dietary behavior among populations at risk for or diagnosed with disease compared with healthy populations. Over two-thirds of participants in the current study were either overweight or obese, or had hypertension or arthritis. Additionally, nearly one-third of participants had heart disease and over 40% had diabetes. Due to the high prevalence of chronic conditions among our participants, incorporating information about disease and benefits of fruit and vegetable intake into the lessons likely added to the success of this intervention. For example, the lessons emphasized the health conditions that occur frequently in older adults and their consequences, as well as the benefits that increased fruit and vegetable intake have on improving health and decreasing the risk for disease. There were no significant positive associations between changes in total fruit and vegetable intake and the presence of these diseases in the present study. Surprisingly though, participants with heart disease were less likely to increase their intake of vegetables, particularly at evening meal. These results are contradictory to the literature that suggests subjects with high risk for heart disease or other diseases may have increased motivation to improve dietary intake. The recent review by Pomerleau and colleagues (41) found that individuals in India with cardiovascular risk factors had the highest increases in fruit and vegetable intake compared to other groups in the

general population, healthcare settings, churches and low-income populations. An explanation for the findings in the current study is that older adults with heart disease may feel overwhelmed by the management of this disease, such as taking medications and avoiding high-fat and high-sodium foods; therefore they may give the importance of consuming more fruits and vegetables a lower priority.

Analysis of data from 4,622 participants of NHANES III (42), aged 60 years found that older adults who were non-Hispanic blacks, of lower economic status, of lower educational attainment, and reporting not having enough food, were more likely to report eating fewer fruits and vegetables per day than older adults who were Non-Hispanic whites and Mexican-Americans, of higher economic status, higher educational attainment, and food-secure. In contrast, African Americans in the present study reported higher intakes of fruits and vegetables than whites at pre-test. Similar to our results, the Atherosclerosis Risk in Communities (ARIC) study (43) found that fruit and vegetable intake was higher among African Americans than whites. Subjects were 10,623 adults with a mean age of about 60 years living in Maryland, North Carolina, Mississippi, and Minnesota. Also, a previous intervention conducted in this population of older Georgians found that African Americans had higher intakes of orange juice, sweet potatoes and yams, and leafy green vegetables such as turnip, collard, and mustard greens compared to whites (28).

The cost of fruits and vegetables and food insecurity are factors that are commonly related to consumption. In a recent review of environmental determinants of fruit and vegetable intake of adults, Kamphuis and colleagues (44) concluded that people with lower household income consistently had lower intakes of fruits and vegetables. Although a large percentage of participants were food insecure in the present study, this did not appear to be a barrier to

consuming more fruits and vegetables. Furthermore, participants who reported the cost of fruits and vegetables as a barrier actually had greater increases in intakes of vegetables as snacks. A possible explanation for this result may be that as participants spend more money on fruits and vegetables, they see cost as more of an issue than those who don't purchase as many fruits and vegetables. Even though participants attending senior centers in urban areas had the most food insecurity compared to other locations, urbanization was positively associated with increases in fruit and vegetable intake.

Georgia's counties have been classified into four areas (urban, suburban, growing rural, and declining rural) based on US Census Bureau metropolitan and non-metropolitan characteristics, and the population growth that has occurred on a county-level basis from 1980 to 1990 (34). Urban counties have populations of 100,000 or more, and they have very diverse demographics. A large percentage of its population has high income and education levels while a similar percentage are poorly educated with income near or below the poverty level. Suburban counties are predominantly white and affluent, with relatively higher education and income than other areas. Growing rural counties are often located near a military base or other attraction that is capable of sustaining economic growth. Declining rural counties have faced long-term population loss, lack of employment opportunities, and often low levels of educational attainment. They tend to have a less healthy population compared with other areas due to a lack of access to healthcare facilities. Changes in fruit and vegetable intake were negatively associated with the senior center's degree of ruralness. This relationship was expected since rural older adults are at risk for poor quality diets due to environmental barriers such as distance to food stores and transportation issues (45). Rural residents are likely to have less access to

supermarkets (46), which generally offer a larger selection of healthy foods at a lower cost than other types of food retailers such as small, locally owned grocers (43).

Fruit and vegetable intake at pre-test was high in the present study. A recent intervention conducted in OAANP participants throughout Georgia found that mean daily intakes were only 3.4 servings, and only 12% of participants reported eating five or more servings of fruits and vegetables daily (22). The dietary instrument used in this previous study was based on the Block Food Frequency Questionnaire and it contained 25 questions that assessed the frequency of intake for selected fruits and vegetables; occasions when fruits and vegetables were consumed (such as snack or dessert); frequency of canned, fresh, and frozen fruit and vegetable consumption; and how often fruits and vegetables were consumed at home. Data from the 2005 BRFSS (15) indicate that 29% of older Georgians and 31% of older Americans consume five or more servings of fruits and vegetables per day. The discrepancy in reported fruit and vegetable intake between studies may be explained by differences in the collection of data. The study by Garcia (22) assessed frequency of intake by fruit and vegetable groupings and did not include serving sizes. The BRFSS survey assesses intake using a six-item food frequency questionnaire (FFQ) which includes two questions assessing fruit intake and four questions assessing vegetable intake, excluding French fries, fried potatoes, and potato chips, and does not gauge serving sizes. A validity study reported that the BRFSS instrument underestimates fruit and vegetable intake (47). The current study assessed frequency of intake of fruits and vegetables at each meal and as snacks using an eight-item FFQ, and did not exclude any foods (i.e. potatoes). In addition, interviewers read examples of typical serving sizes for fruits and vegetables prior to asking about intake. This questionnaire was not validated against another method, however, and asking about intake at each meal and snack may have caused participants to inflate their actual intake, because

the number of fruit and vegetable questions on a FFQ have been found to influence the number of fruits and vegetables that are estimated to be consumed (48). A study evaluating the ability of two short assessment instruments, including a By-Meal screener similar to the instrument used in the current study, concluded that this type of instrument may be useful in estimating median intakes of fruit and vegetable servings (49). Thompson et al. designed this study to evaluate the By-Meal screener which asked participants to report fruit and vegetable intake by three time periods, 1) morning, 2) lunchtime and afternoon, 3) and suppertime and evening. In addition, this instrument assessed usual portion size for each food item. The results using this instrument were compared with actual intakes which were evaluated with four nonconsecutive 24-hour dietary recalls. The By-Meal screener was highly correlated with actual intakes; correlation coefficients were 0.67 for men, and 0.53 for women. FFQs are useful in ranking individuals according to their usual consumption of foods, but a major limitation is that quantification of intake is not as accurate as with recalls or records (27).

There were several limitations associated with this study. Dietary intake was self-reported, which may have been imprecise due to age-related changes in hearing as well as cognitive function, although this limitation was minimized by the revision and editing of questionnaires by experts in nutrition who have previous experience with the target population. Also, the questionnaires were administered by trained interviewers. Attendance at the lessons was voluntary, and participants who did not attend all of the lessons would have missed the benefits of some hands-on activities and interaction with the educators. However, attendance was good, with 88% of participants attending at least half of the lessons, and handouts were available for those who missed a lesson. Although a fairly large number of participants (12%) attended less than half of the lessons, they were included in the data analyses because the goal of

this study was to evaluate the intervention in OAANP participants who attend senior centers. These participants are likely to gain exposure to nutrition education outside of the lessons (i.e. discussion among participants or other community programs). Data analyses showed that there were no correlations or associations among changes in fruit and vegetable intake and the number of lessons attended. Lastly, delivery of the intervention and data collection may have been affected by the varied experience levels of the educators involved in the statewide intervention. However, this limitation was minimized by a statewide training, visits by University of Georgia staff to senior centers in each AAA, to assist with distribution of education materials to all educators, and technical assistance provided on site or by phone.

In summary, the goals of this intervention were to increase fruit and vegetable consumption and knowledge of the recommendations, and to identify determinants of changes in intake. This proved to be a successful intervention. Significant increases in fruit and vegetable intake and knowledge of the recommendation, and significant decreases in perceived barriers to intake resulted after the intervention. Additionally participant's self-rated health improved significantly. Participants were very satisfied with the fruit and vegetable intervention. The positive outcomes of this intervention provide encouragement to continue nutrition and health education among OAANP participants.

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Table 3.1 Demographics and health characteristics of participants at pre-test, and attendance (N = 558).

Characteristic	n[a]	Mean ± SD or %[b]
Age (y, range 60-96)	558	75 ± 8
< 80	399	72
≥ 80	159	28
Gender		
Men	94	17
Women	464	83
Race		
White	261	47
African American	297	53
Area		
Urban	169	30
Suburban	140	25
Growing rural	181	33
Declining rural	68	12
BMI[c]	529	29.4 ± 6.5
< 25 (normal)	137	26
25 to 30 (overweight)	177	33
≥ 30 (obese)	215	41
Self-rated health		
Excellent	12	2
Very good	67	12
Good	268	48
Fair	184	33
Poor	24	5
Health conditions (self-report)		
Diabetes	227	41
High blood pressure	401	73
Heart disease	162	29
Arthritis	394	71
Formal education (y)	555	10.6 ± 3.2
< 12	309	56
≥ 12	246	44
Do you always have enough money to buy the food you need? (% no)	128	23
Participant attendance at 8 fruit and vegetable lessons	514	6 ± 2
< 4 lessons	63	12
≥ 4 lessons	451	88

[a] Unweighted sample size. The number within groups may not sum to the total sample of 558 because missing values and unknown responses were excluded from the analyses.
[b] Weighted percent and means.
[c] BMI = body mass index; calculated as kg/m².

Table 3.2 Comparison of daily fruit and vegetable intake in participants at pre- and post-test.

Intake (servings/d)	n	Pre-test	Post-test	Change	*P* value[a]
Fruits and vegetables					
Mean ± SD	490	7.2 ± 2.5	8.8 ± 2.6	1.7 ± 3.6	< 0.0001
≥ 7 servings daily (%)		58	79		< 0.0001
≥ 5 servings daily (%)		89	95		0.0002
Fruit					
Mean ± SD	526	3.6 ± 1.9	4.7 ± 2.2	1.2 ± 2.3	< 0.0001
Vegetables					
Mean ± SD	510	3.8 ± 1.7	4.4 ± 1.8	0.6 ± 2.0	< 0.0001
Fruit with breakfast					
Mean ± SD	556	0.8 ± 0.8	1.2 ± 0.9	0.3 ± 1.0	< 0.0001
≥ 1 serving (%)		65	81		< 0.0001
Vegetables with breakfast					
Mean ± SD	549	0.1 ± 0.5	0.2 ± 0.5	0.0 ± 0.6	0.60
≥ 1 serving (%)		10	12		0.29
Fruit with lunch					
Mean ± SD	555	1.1 ± 0.6	1.4 ± 0.8	0.3 ± 0.9	< 0.0001
≥ 1 serving (%)		89	94		0.001
Vegetables with lunch					
Mean ± SD	551	1.8 ± 0.6	2.0 ± 0.6	0.2 ± 0.7	< 0.0001
≥ 1 serving (%)		97	98		0.14
Fruit with evening meal					
Mean ± SD	540	0.7 ± 0.7	0.9 ± 0.8	0.2 ± 1.0	< 0.0001
≥ 1 serving (%)		58	69		<0.0001
Vegetables with evening meal					
Mean ± SD	546	1.5 ± 0.8	1.8 ± 0.9	0.3 ± 1.0	< 0.0001
≥ 1 serving (%)		87	91		0.04
Fruit as snack					
Mean ± SD	548	0.9 ± 0.8	1.2 ± 0.9	0.2 ± 1.1	< 0.0001
≥ 1 serving (%)		69	78		0.0003
Vegetables as snack					
Mean ± SD	536	0.4 ± 0.7	0.5 ± 0.8	0.1 ± 1.0	0.001
≥ 1 serving (%)		27	35		0.006

[a] Wilcoxon signed rank test used to evaluate mean changes from pre-test to post-test. Chi square analyses were used to compare percents. *P* values < 0.05 considered statistically significant. *P* values 0.05 – 0.15 considered trends.

Table 3.3 Comparison of knowledge of the recommendation, perceived barriers to fruit and vegetable intake, self-rated health, and following a healthful diet in participants at pre- and post-test.

Measure	n	Pre-test	Post-test	*P* value[a]
		%		
Knowledge				
How many fruits and vegetables should older people eat each day?	547			< 0.0001
Correct answer (7, 8, 9, 10, or 7 to 10 daily)		7	57	
Incorrect answer or "don't know"		93	43	
Barriers				
What keeps you from eating more fruits and vegetables? (% yes)				
Chewing or dental problems	549	19	16	0.18
Cooking problems	544	11	8	0.07
Cost	546	24	21	0.24
Difficulties with digestion	545	20	15	0.03
Don't like the taste	547	14	14	0.73
Grocery store does not have what I like	540	10	10	0.61
Lack of storage space	539	7	7	0.81
Not in season	542	18	13	0.05
Spouse doesn't like them	492	4	2	0.13
Takes too much time	542	10	7	0.09
Too heavy to carry home from the store	539	7	5	0.13
Too many are recommended	542	17	12	0.04
Too much trouble	541	14	9	0.008
Transportation problems	542	10	12	0.38
Doctor told me not to eat some fruits and vegetables	537	14	13	0.79
		Mean ± SD		
Self-rated health[b]				
How would you rate your overall health?	555	1.7 ± 0.8	1.8 ± 0.9	0.02
Healthful diet				
How many of the last 7 days have you followed a healthful eating plan?	551	4.5 ± 2.4	5.7 ± 1.8	< 0.0001

[a] Chi square analyses used to compare percents. Wilcoxon signed rank test used to evaluate mean changes from pre-test to post-test. *P* values < 0.05 considered statistically significant. *P* values 0.05 – 0.15 considered trends.
[b] Higher number indicates better health status on a scale of 0 to 4.

Table 3.4 Spearman correlations among changes in fruit and vegetable intake with pre-test characteristics and post-test knowledge of the recommendation.[a]

Independent variables	Change in total fruit and vegetable intake (n = 439)		Change in total fruit intake (n = 471)		Change in total vegetable intake (n = 455)	
	rho	*P* value	rho	*P* value	rho	*P* value
Age (y)	-0.02	0.62	-0.03	0.55	-0.02	0.60
Gender (male = 0, female = 1)	0.05	0.27	0.08	0.07	0.04	0.46
Race (white = 1, African American = 2)	0.04	0.37	0.09	0.05	0.01	0.86
Education (y)	0.09	0.08	0.11	0.02	0.12	0.02
Food security (no = 0, yes = 1)	0.02	0.74	0.00	0.98	0.02	0.63
Degree of ruralness[b]	-0.14	0.003	-0.15	0.0008	-0.09	0.05
Days with 30 minutes of moderate physical activity	0.05	0.25	0.04	0.43	0.05	0.24
Tobacco use (no = 0, yes = 1)	-0.03	0.48	0.00	0.92	-0.05	0.30
Self-rated health (poor = 0, excellent = 4)	0.05	0.30	0.02	0.62	0.07	0.14
Diabetes (no = 0, yes = 1)	0.03	0.48	0.01	0.90	0.05	0.29
High blood pressure (no = 0, yes = 1)	0.06	0.18	0.06	0.21	0.07	0.12
Heart disease (no = 0, yes = 1)	-0.08	0.11	-0.05	0.27	-0.08	0.08
Arthritis (no = 0, yes = 1)	0.07	0.14	0.03	0.53	0.07	0.13
BMI[c]	0.13	0.009	0.10	0.04	0.10	0.03
How many fruits and vegetables should older people eat each day?[d]	0.25	< 0.0001	0.25	< 0.0001	0.15	0.002
Is cost of fruits and vegetables a problem? (no = 0, yes = 1)	0.09	0.06	0.04	0.42	0.08	0.10
Do not like the taste of fruits and vegetables (no = 0, yes = 1)	0.02	0.68	0.02	0.73	0.01	0.87
Too many are recommended (no = 0, yes = 1)	-0.00	0.98	0.02	0.62	-0.03	0.58
Transportation problems (no = 0, yes = 1)	-0.03	0.48	-0.01	0.90	-0.05	0.29

[a] Controlled for fruit and vegetable intake at pre-test. *P* values < 0.05 considered significant. *P* values 0.05 – 0.15 considered trends.
[b] Urban = 1; suburban = 2; growing rural = 3; declining rural = 4.
[c] Body mass index (kg/m²).
[d] Knowledge at post-test. Correct answer (7, 8, 9, 10, or 7 to 10 daily) = 1; incorrect answer or "don't know" = 0.

Table 3.5 Spearman correlations among changes in fruit intake with pre-test characteristics and post-test knowledge of the recommendation.[a]

Independent variables	Change in fruit intake at breakfast (n = 495)		Change in fruit intake at lunch (n = 494)		Change in fruit intake at evening meal (n = 479)		Change in fruit intake as snacks (n = 490)	
	rho	***P* value**	**rho**	***P* value**	**rho**	***P* value**	**rho**	***P* value**
Age (y)	0.02	0.72	-0.02	0.62	-0.04	0.39	0.02	0.64
Gender (male = 0, female = 1)	0.03	0.54	0.06	0.15	0.05	0.30	0.04	0.43
Race (white = 1, African American = 2)	0.02	0.69	0.07	0.11	0.10	0.03	0.04	0.40
Education (y)	0.12	0.008	-0.00	0.93	0.08	0.08	0.06	0.22
Food security (no = 0, yes = 1)	-0.02	0.68	-0.01	0.77	-0.02	0.68	0.05	0.28
Degree of ruralness[b]	-0.15	0.0007	-0.12	0.02	-0.17	0.0002	-0.01	0.83
Days with 30 minutes of moderate physical activity	0.05	0.23	0.05	0.27	0.00	0.94	0.06	0.16
Tobacco use (no = 0, yes = 1)	-0.13	0.003	-0.02	0.60	0.02	0.73	0.03	0.53
Self-rated health (poor = 0, excellent = 4)	0.09	0.04	-0.04	0.44	0.04	0.37	0.01	0.85
Diabetes (no = 0, yes = 1)	0.00	0.99	-0.04	0.39	0.06	0.18	0.00	0.94
High blood pressure (no = 0, yes = 1)	-0.06	0.18	0.05	0.24	0.02	0.71	0.09	0.04
Heart disease (no = 0, yes = 1)	-0.05	0.24	-0.02	0.64	-0.02	0.59	-0.03	0.55
Arthritis (no = 0, yes = 1)	-0.06	0.19	0.07	0.14	0.03	0.45	0.03	0.46
BMI[c]	-0.06	0.20	0.07	0.11	0.05	0.27	0.10	0.03
How many fruits and vegetables should older people eat each day?[d]	0.11	0.01	0.20	< 0.0001	0.13	0.004	0.14	0.002
Is cost of fruits and vegetables a problem? (no = 0, yes = 1)	0.03	0.49	0.01	0.82	0.00	0.96	-0.00	0.97
Do not like the taste of fruits and vegetables (no = 0, yes = 1)	-0.02	0.70	0.00	0.99	0.04	0.34	0.02	0.59
Too many are recommended (no = 0, yes = 1)	0.00	0.99	-0.02	0.69	-0.03	0.55	0.00	0.98
Transportation problems (no = 0, yes = 1)	-0.07	0.12	-0.01	0.85	-0.05	0.23	0.06	0.18

[a] Controlled for fruit intake at pre-test. *P* values < 0.05 considered significant. *P* values 0.05 – 0.15 considered trends.
[b] Urban = 1; suburban = 2; growing rural = 3; declining rural = 4.
[c] Body mass index (kg/m²).
[d] Correct answer (7, 8, 9, 10, or 7 to 10 daily) = 1; incorrect answer or "don't know" = 0.

Table 3.6 Spearman correlations among changes in vegetable intake with pre-test characteristics and post-test knowledge of the recommendation.[a]

Independent variables	Change in vegetable intake at breakfast (n = 490)		Change in vegetable intake at lunch (n = 491)		Change in vegetable intake at evening meal (n = 484)		Change in vegetable intake as snacks (n = 478)	
	rho	*P* value	rho	*P* value	rho	*P* value	rho	*P* value
Age (y)	-0.03	0.57	0.10	0.03	-0.07	0.11	-0.04	0.35
Gender (male = 0, female = 1)	0.00	0.92	-0.04	0.39	0.04	0.42	-0.00	0.99
Race (white = 1, African American = 2)	0.10	0.02	-0.03	0.44	-0.02	0.70	0.07	0.06
Education (y)	0.03	0.45	0.03	0.54	0.11	0.01	0.07	0.10
Food security (no = 0, yes = 1)	-0.04	0.39	0.08	0.08	-0.01	0.85	0.01	0.87
Degree of ruralness[b]	-0.10	0.02	0.02	0.67	-0.10	0.02	-0.10	0.03
Days with 30 minutes of moderate physical activity	-0.04	0.35	-0.03	0.50	0.09	0.04	0.04	0.35
Tobacco use (no = 0, yes = 1)	0.02	0.64	-0.01	0.85	-0.07	0.10	-0.02	0.59
Self-rated health (poor = 0, excellent = 4)	0.12	0.009	0.03	0.49	0.06	0.19	-0.01	0.78
Diabetes (no = 0, yes = 1)	0.04	0.41	-0.07	0.11	0.04	0.41	0.11	0.02
High blood pressure (no = 0, yes = 1)	-0.07	0.11	-0.01	0.76	0.10	0.04	0.06	0.18
Heart disease (no = 0, yes = 1)	-0.10	0.02	0.01	0.90	-0.10	0.02	-0.05	0.26
Arthritis (no = 0, yes = 1)	-0.03	0.57	0.08	0.08	0.05	0.30	0.04	0.34
BMI[c]	0.06	0.16	0.04	0.39	0.09	0.06	0.04	0.34
How many fruits and vegetables should older people eat each day?[d]	0.06	0.21	0.04	0.38	0.13	0.003	0.09	0.05
Is cost of fruits and vegetables a problem? (no = 0, yes = 1)	0.04	0.32	-0.01	0.80	0.08	0.07	0.07	0.15
Do not like the taste of fruits and vegetables (no = 0, yes = 1)	0.01	0.88	-0.04	0.37	0.05	0.30	0.02	0.72
Too many are recommended (no = 0, yes = 1)	-0.03	0.44	-0.04	0.44	0.03	0.50	-0.03	0.55
Transportation problems (no = 0, yes = 1)	-0.03	0.44	0.01	0.76	-0.02	0.59	-0.02	0.59

[a] Controlled for vegetable intake at pre-test. *P* values < 0.05 considered significant. *P* values 0.05 – 0.15 considered trends.
[b] Urban = 1; suburban = 2; growing rural = 3; declining rural = 4.
[c] Body mass index (kg/m²).
[d] Correct answer (7, 8, 9, 10, or 7 to 10 daily) = 1; incorrect answer or "don't know" = 0.

Table 3.7 Linear regression models of characteristics associated with changes in fruit and vegetable intake.[a]

Independent variables	Change in total fruit and vegetable intake		Change in total fruit intake		Change in total vegetable intake	
	n = 434 R-square = 0.23		n = 466 R-square = 0.27		n = 450 R-square = 0.29	
	Parameter estimate ± SE	***P* value**	**Parameter estimate ± SE**	***P* value**	**Parameter estimate ± SE**	***P* value**
Intercept	-1.06 ± 2.36	0.65	-0.24 ± 1.43	0.87	-0.22 ± 1.25	0.86
Age (y)	0.05 ± 0.02	0.05	0.02 ± 0.01	0.15	0.02 ± 0.01	0.13
Formal education (y)	0.08 ± 0.05	0.12	0.05 ± 0.03	0.12	0.05 ± 0.03	0.04
Degree of ruralness[b]	-0.41 ± 0.16	0.008	-0.30 ± 0.09	0.002	-0.18 ± 0.08	0.03
Knowledge at post-test[c]	1.47 ± 0.33	< 0.0001	0.90 ± 0.20	< 0.0001	0.46 ± 0.17	0.006
Heart disease (no = 0, yes = 1)	-0.51 ± 0.35	0.15	-0.17 ± 0.21	0.44	-0.38 ± 0.18	0.04

[a] Characteristics at pre-test unless otherwise noted. Other variables included in the model, but were not statistically significant in any model included fruit and vegetable intake at pre-test, race, gender, food security, body mass index, diabetes, high blood pressure, arthritis, physical activity, tobacco use, barriers (cost, season, taste preference, too many are recommended, and transportation problems), and changes in barriers from pre-test to post-test (cost and season). *P* values < 0.05 considered significant. *P* values 0.05 – 0.15 considered trends.

[b] Urban = 1; suburban = 2; growing rural = 3; declining rural = 4.

[c] How many fruits and vegetables should older people eat each day? Correct answer (7, 8, 9, 10, or 7 to 10 daily) = 1; incorrect answer or "don't know" = 0.

Table 3.8 Linear regression models of characteristics associated with changes in fruit intake at meals and snacks.[a]

Independent variables	Change in fruit intake at breakfast		Change in fruit intake at lunch		Change in fruit intake at evening meal		Change in fruit intake at snack	
	n = 489 R-square = 0.36		n = 488 R-square = 0.32		n = 4 R-square = 0.35		n = 4 R-square = 0.36	
	Parameter estimate ± SE	***P* value**	**Parameter estimate ± SE**	***P* value**	**Parameter estimate ± SE**	***P* value**	**Parameter estimate ± SE**	***P* value**
Intercept	0.18 ± 0.56	0.75	0.53 ± 0.53	0.32	0.46 ± 0.57	0.42	-1.23 ± 0.62	0.05
Age (y)	0.01 ± 0.01	0.13	na		na		0.01 ± 0.01	0.03
Formal education (y)	0.03 ± 0.01	0.03	na		na		na	
Degree of ruralness[b]	-0.10 ± 0.04	0.01	-0.07 ± 0.04	0.04	-0.11 ± 0.04	0.004	na	
Knowledge at post-test[c]	0.20 ± 0.08	0.01	0.28 ± 0.07	0.0001	0.20 ± 0.08	0.01	0.22 ± 0.08	0.01
BMI[d]	na[e]		na		na		0.02 ± 0.01	0.01
High blood pressure (no = 0, yes = 1)	-0.17 ± 0.09	0.04	na		na		na	
Physical activity[f]	na		na		na		0.0. ± 0.02	0.04
Not in season[g]	0.32 ± 0.14	0.02	na		na		na	
Transportation problems[h]	-0.19 ± 0.13	0.14	na		na		0.32 ± 0.15	0.03
Change in "season" as a barrier[i]	0.37 ± 0.11	0.001	na		na		na	
Change in "cost" as a barrier[j]	-0.24 ± 0.10	0.02	0.03 ± 0.09	0.10	na		-0.18 ± 0.12	0.14

[a] Characteristics at pre-test unless otherwise noted. Other variables included in the model, but were not statistically significant in any model included fruit intake at pre-test, race, gender, food security, diabetes, heart disease, arthritis, tobacco use, and barriers (cost, taste preference, and too many are recommended). *P* values < 0.05 considered significant. *P* values 0.05 – 0.15 considered trends.

[b] Urban = 1, suburban = 2, growing rural = 3, declining rural = 4.

[c] How many fruits and vegetables should older people eat each day? Correct answer (7, 8, 9, 10, or 7 to 10 daily) = 1; incorrect answer or "don't know" = 0.

[d] BMI = body mass index; calculated as kg/m^2.

[e] na indicates not associated (P > 0.15).

[f] Number of days per week with at least 30 minutes of moderate physical activity.

[g] Does the reason "not in season" keep you from eating more fruits and vegetables? No = 0, yes = 1.

[h] Do transportation problems keep you from eating more fruits and vegetables? No = 0, yes =1.

[i] Change in participant's response to "fruits and vegetables not in season keeps me from eating more" calculated by subtracting pre-test values from post-test values. No = 0, yes = 1.

[j] Change in participant's response to "cost of fruits of vegetables keeps me from eating more" calculated by subtracting pre-test values from post-test values. No = 0, yes = 1.

Table 3.9 Linear regression models of characteristics associated with changes in vegetable intake at meals and snacks.[a]

Independent variables	Change in vegetable intake at breakfast		Change in vegetable intake at lunch		Change in vegetable intake at evening meal		Change in vegetable intake at snack	
	n = 484 R-square = 0.42		n = 485 R-square = 0.35		n = 478 R-square = 0.33		n = 473 R-square = 0.36	
	Parameter estimate ± SE	***P* value**	**Parameter estimate ± SE**	***P* value**	**Parameter estimate ± SE**	***P* value**	**Parameter estimate ± SE**	***P* value**
Intercept	-0.06 ± 0.32	0.85	0.42 ± 0.45	0.35	0.54 ± 0.61	0.38	-0.26 ± 0.55	0.63
Age (y)	na[b]		0.01 ± 0.00	0.04	na		na	
Formal education (y)	na		na		na		0.02 ± 0.01	0.11
Degree of ruralness[c]	-0.05 ± 0.02	0.02	na		-0.06 ± 0.04	0.02	-0.10 ± 0.04	0.007
Knowledge at post-test[d]	0.08 ± 0.05	0.06	na		0.16 ± 0.08	0.05	na	
Heart disease (no = 0, yes = 1)	-0.10 ± 0.05	0.03	na		-0.20 ± 0.09	0.03	-0.12 ± 0.08	0.15
Cost[d]	na		na		na		0.31 ± 0.13	0.02

[a] Characteristics at pre-test unless otherwise noted. Other variables included in the model, but were not statistically significant in any model included vegetable intake at pre-test, race, gender, food security, body mass index, diabetes, high blood pressure, arthritis, physical activity, tobacco use, barriers (season, taste preference, too many are recommended, and transportation problems), and changes in barriers from pre-test to post-test (cost and season). *P* values < 0.05 considered significant. *P* values 0.05 – 0.15 considered trends.

[b] na indicates not associated (P > 0.15).

[c] Urban = 1, Suburban = 2, Growing rural = 3, Declining rural = 4.

[d] How many fruits and vegetables should older people eat each day? Correct answer (7, 8, 9, 10, or 7 to 10 daily) = 1; incorrect answer (includes people who responded "Don't Know") = 0.

[e] Does the cost of fruits and vegetables keep you from eating more? No = 0, yes = 1.

Table 3.10 Mean changes in fruit and vegetable intake by degree of ruralness.									
	Total fruit and vegetable intake			**Fruit intake**			**Vegetable intake**		
	n	**Mean ± SD**	**P value[a]**	**n**	**Mean ± SD**	**P value**	**n**	**Mean ± SD**	**P value**
Degree of ruralness									
Urban	135	2.1 ± 4.3	< 0.0001	154	1.4 ± 2.6	< 0.0001	143	0.7 ± 2.3	0.0007
Suburban	123	1.9 ± 3.7	< 0.0001	133	1.2 ± 2.3	< 0.0001	128	0.7 ± 2.2	< 0.0001
Growing rural	167	1.5 ± 3.1	< 0.0001	173	1.0 ± 2.1	< 0.0001	173	0.5 ± 1.6	< 0.0001
Declining rural	65	1.2 ± 2.6	0.0003	66	0.7 ± 2.0	0.004	66	0.5 ± 1.5	0.002
[a] Wilcoxon signed rank test was used to evaluate mean changes from pre-test to post-test. P values < 0.05 considered significant.									

Table 3.11 Changes in behaviors and satisfaction with intervention.	
Variable	**Post-test (%)**
After attending the fruit and vegetable program, have you done any of the following?	
Tried to follow a healthier diet?	87
Increased your intake of fruit?	78
Increased your intake of vegetables?	75
Ate more fruits and vegetables for snacks?	66
Ate more fruits and vegetables with breakfast?	52
Ate more fruits and vegetables with lunch?	72
Ate more fruits and vegetables with your evening meal?	66
Made a recipe from one of the lessons?	30
What was your overall level of satisfaction with this fruit and vegetable nutrition education program?	
Poor	0
Fair	2
Good	33
Very good	38
Excellent	27

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CHAPTER 4

CONCLUSIONS

The main goals of this study were to: 1) evaluate the effectiveness of a fruit and vegetable education intervention for Georgia's Older Americans Act Nutrition Program participants by assessing changes in intakes and knowledge of fruits and vegetables, and barriers to intake, 2) determine whether knowledge of the 2005 Dietary Guidelines for Americans recommendation is associated with changes in fruit and vegetable intake, and 3) identify determinants of changes in fruit and vegetable intake among these participants.

Major Findings

This fruit and vegetable education intervention resulted in several positive outcomes. Significant mean increases in fruits and vegetables were reported at all meals and snacks, except for vegetables at breakfast. Overall, participants reported a mean increase of 1.7 ± 3.6 servings of fruits and vegetables per day ($P < 0.0001$). Larger increases in fruit intake than vegetable intake were observed, although vegetable intake increased significantly. Knowledge of the 2005 Dietary Guidelines for Americans increased significantly as well. At pre-test, only 7% of participants knew that seven to ten servings of fruits and vegetables are recommended daily (based on energy needs of most older adults). After the intervention, 57% of participants knew the recommendation for fruit and vegetable intakes. Another important outcome was the significant decreases the number of participants reporting three of the barriers to fruit and vegetable intake.

These barriers were: too many fruits and vegetables are recommended, fruits and vegetables are too much trouble, and difficulties with digestion.

Regression analyses found that factors associated with changes in total fruit and vegetable intakes were knowledge of the intake recommendations, age, and senior center location. Knowledge of the recommendation was the strongest determinant of increases in intakes of fruits and vegetables. Participants who attend senior centers in rural areas had smaller increases in fruit and vegetable intake compared with those attending senior centers in urban locations. Increasing age was also a positive predictor of changes in intake.

Additional questions were added to the post-tests to allow participants to further describe changes in their behaviors related to fruit and vegetable intake as well as their satisfaction with the lessons and the overall program. Eighty-seven percent of participants reported that they tried to follow a healthier diet after attending the intervention. Ninety-eight percent of participants reported their overall satisfaction with the fruit and vegetable intervention to be good, very good or excellent. Attendance at the lessons was fair, with 88% of participants attending at least half of the lessons, and 28% attending all eight.

Implications

The results of this study show that OAANP participants in Georgia are a receptive population for nutrition education interventions. This group of older adults successfully applied knowledge gained from the intervention to make positive changes in behavior related to fruit and vegetable intake. Since OAANP participants have a high prevalence of chronic disease (1), providing nutrition and health information is particularly important

in this population. Although many significant improvements resulted from this intervention, continued interventions to target behavior changes related to nutrition are recommended because dietary changes are difficult to maintain over time, and few studies have evaluated long-term efficacy of nutrition programs for older adults.

There were many successful components to this intervention that should be included in future studies. The use of simple and practical messages that were reinforced at each lesson proved to be an important element to increasing knowledge in this intervention as well as in others (2). Providing cues to action, such as ways to increase fruit and vegetable intake at specific meals and snacks was helpful in increasing self-efficacy and should be implemented in future interventions. In addition, goal setting, games, sample menus, recipes and taste-testing were also important components.

Cost was the most commonly reported perceived barrier to fruit and vegetable intake, and inadequate income has often been associated with low intakes (3, 4). Considerations for future studies may be to collaborate with local a Seniors Farmers' Market Nutrition Program (SFMNP) which provides low-income older adults with coupons that can be exchanged for foods at farmers' markets, roadside stands, and community supported agriculture programs (5). An evaluation of the first SFMNP in South Carolina showed positive results (6). Five vouchers worth $10 each, as well as brochures with nutrition information, were given to 15,000 eligible seniors. Sixty-four percent of evaluation respondents reported that having the coupons changed the way they ate and 89% reported they would eat more fresh fruits and vegetables year round because of the program. Overall this program was beneficial to both the farmers and the low-income older adults.

Since smaller increases in vegetable intake than fruit intake were observed, future studies should consider targeting vegetable intake separately among this population. A cross-sectional survey of adults in Washington State assessed factors associated with fruit and vegetable intake (7). Health status, health-related behavior, and psychosocial factors were found to be more strongly associated with fruit intake than vegetable intake. The authors of this study suggested that interventions should provide information on vegetables during meal planning, shopping, and preparation.

Future interventions should target rural older adults and their communities. Participants who attended senior centers in rural areas had smaller increases (although significant) in fruit and vegetable intake than those in urban locations. Other recent studies have reported low fruit and vegetable intake (8) and increased nutritional risk among rural older adults (9). These older adults may be vulnerable to nutritional inadequacies due to potential social and geographic isolation, limited access to transportation, and limited availability of nutrition services (10). Blanchard and Lyson (11) reported that rural counties in the South have limited access to supermarkets, supercenters and wholesale clubs, which generally have a larger selection of higher quality fruits and vegetables than smaller grocers, convenience stores, and gas stations commonly located in rural areas. Thus, participants living in areas with low access to large food retailers are likely to pay higher prices for lower quality foods.

Declines in memory and cognitive abilities are a normal consequence of aging, and participants with low cognitive functioning may report unreliable intakes of fruits and vegetables. Therefore, cognitive ability should be assessed with Folstein's Mini-Mental State Examination or another similar instrument before inclusion into the study.

Other suggestions for future studies include the use of a control group to determine the affect of seasonal variation on changes in intakes. An evaluation of long-term fruit and vegetable intake would assess maintenance of behavior change.

The questionnaires in the current intervention did not assess social isolation or marital status, both of which have been associated with fruit and vegetable intake. Although the congregate meal recipients in this study are likely to receive more social interaction than homebound elders, older adults in general experience more social isolation than younger adults. Lower frequencies of social contact among older adults have been associated with lower intakes of fruits and vegetables (3). In a recent review of observational studies examining environmental determinants of fruit and vegetable intake, married individuals were found to have higher intakes of fruits and vegetables than those who were single (12). Future research should take social isolation and marital status into account.

Future programs may benefit from more incentives. In a recent evaluation of nutrition education interventions for older adults, Sahyoun and colleagues found that incentives were a useful feature for positive behavior change (2). A successful nutrition intervention designed for older adults with diabetes provided participants with a small honorarium upon completion of the intervention (13). However, there are issues concerning incentives. It is not sustainable to offer incentives when the program operates on a limited budget and the program is provided to the participants free of charge. Furthermore, the issue of internal versus external rewards is evident when incentives are given. Nutrition education through senior centers benefits the participants and is available to them free of charge. The education itself is the value.

Suggestions for questions to use in future interventions include some open-ended, qualitative questions. For example, 1) Do you have any early experiences or memories that relate to the fruits and vegetables that you eat or don't eat? If yes please explain. 2) Of all the fruits or fruit juices that you eat or drink, which do you eat or drink most often and how is it prepared? 3) Of all the vegetables or vegetable juices that you eat or drink, which do you eat or drink most often and how is it prepared? 4) What is your marital status? Married, single, widowed or divorced? 5) How often to you eat breakfast with at least one other person? Less than 1 time per month, 1 time per month, 2 times per month, 3 times per month, 1 time per week, 2 times per week, 3 times per week, 4 times per week, 5 times per week, 6 times per week, 7 times per week? 6) How often to you eat your evening meal with at least one other person? Less than 1 time per month, 1 time per month, 2 times per month, 3 times per month, 1 time per week, 2 times per week, 3 times per week, 4 times per week, 5 times per week, 6 times per week, 7 times per week? Future interventions should consider changing questions assessing barriers to fruit and vegetable intake to address fruits and vegetables separately. For example, "What keeps you from eating more fruits?" Circle all that apply: 1) Difficulties with digestion; 2) Don't like taste; and 3) Not in season; and "What keeps you from eating more vegetables?" Circle all that apply: 1) Difficulties with digestion; 2) Don't like taste; and 3) Not in season.

In conclusion, this population of predominantly minority status older adults has a high prevalence of chronic disease and faces many barriers to fruit and vegetable intake. Interventions that promote increased intakes of fruits and vegetables among these older adults are critical in helping them to maintain quality of life and lessen the burden of

disease with aging. Integrating these ideas into future intervention programs may promote further improvements in fruit and vegetable intake and knowledge of the recommendations, and reduce perceived and actual barriers to consumption.

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APPENDICES

APPENDIX A

Consent Form

LIVE HEALTHY GEORGIA – SENIORS TAKING CHARGE!
CONSENT FORM (NO DIABETES)

I, _____, agree to participate in the research study titled "Live Healthy Georgia – Seniors Taking Charge" conducted by Dr. Mary Ann Johnson in the Department of Foods and Nutrition at the University of Georgia and at my local Senior Center. I understand that participation is voluntary and I do not have to take part if I do not want to. I can stop taking part anytime 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.

By participating in this study, I may improve my nutrition and physical activity habits. This study will also help the investigators learn more about good ways to help older adults improve their nutrition and physical activity habits. 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, nutrition and physical activity.
2) Obtain physician approval to participate in a physical activity program.
3) Attend two sessions for collecting information about my health, fitness, food, and nutrition habits. The first session will last about 60 minutes and the second session will last about 30 minutes.
4) Attend up to 8 nutrition and physical activity programs that will last about 30 to 60 minutes each over a four month period. I will learn how to use a step counter and record my number of daily steps.
5) Take part in a physical activity program of chair exercises and walking to improve my strength, balance, endurance, and flexibility.
6) Someone from the study may contact me to clarify my information throughout the study.

The instructor may 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.

There is minimal risk to participation in this study. I may experience some discomfort or stress when the researchers ask me questions about my nutrition, health, and physical activity habits. There is a possibility that I could temporarily injure a muscle or be sore from physical exertion. This risk is minimized by ability to rest at any time. If additional care is needed, then my insurance company or myself will be responsible for any expense that may be incurred. The Senior Center where the programs are conducted and the University of Georgia and their employees shall not incur any liability for incidents that may occur during or as a result of my participation in this study.

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. My identity will not be revealed in any reports or published materials that might result from this study. 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 study I can call Ms. Tiffany Sellers (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 study. 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

Email: mjohnson@fcs.uga.edu

_____	_____	_____
Signature of Staff who Reads	**Printed Name of Staff**	**Date**

Consent Form to Participant

For questions or problems about your rights as a research participant please call or write: The Chairperson, Institutional Review Board, University of Georgia, 612 Boyd Graduate Studies Research Center, Athens, Georgia 30602-7411; Telephone (706) 542-3199; E-Mail Address IRB@uga.edu.

UGA project number: 2006-10022-0 DHR project number: 050801 Date: October 10, 2005 maj

UGA IRB APPROVAL
OCT 26 '05 OCT 25 '06

DHR INSTITUTIONAL REVIEW BOARD
Project # 050801
Consent Form Approval Period
From: 10-26-05 To: 10-7-06
Authorization: M.P

APPENDIX B

Pre-test Questionnaire

LIVE HEALTHY GEORGIA – SENIORS TAKING CHARGE!

		Line 1
ID of Participant:		1-4
Phone number to use to clarify information and get step counts:		
1. County:		10-12
2. Date (M/D/Y): ___/___/___		13-18
3. Age of Participant: ___ ___ ___		19-21
4. Gender: Male (0) Female (1)		22
5. Ethnicity: White (1) Black (2) Hispanic/Latino (3) Asian (4) Other (5)		23
6. How many years did you complete in school: ____ years		24-25
7. How would you rate your overall health? Circle one: Poor (0) Fair (1) Good (2) Very good (3) Excellent (4)		26
8. Do you use any tobacco products such as cigarettes, cigars, pipe, or chewing tobacco?	No (0) Yes (1)	27
9. Do you have diabetes?	No (0) Yes (1)	28
10. Do you have high blood pressure?	No (0) Yes (1)	29
11. Do you have heart disease such as angina, congestive heart failure, heart attack or other heart problems?	No (0) Yes (1)	30
12. Do you have arthritis?	No (0) Yes (1)	31
13. During the past 30 days, have you had symptoms of pain, aching, or stiffness in or around a joint?	No (0) Yes (1)	32
14. Do you always have enough money to buy the food you need?	No (0) Yes (1)	33
15. How many over the counter medications do you take?		34-35
16. How many prescription medications, including insulin, do you take?		36-37
Think about the fruits and vegetables you usually eat each day, such as 100% juices; fresh, frozen or canned fruits; fruits for dessert, as well as potatoes, salads, slaws, and other fresh, frozen or canned vegetables. A serving is a piece of fruit or about ½ cup of most fruits and vegetables; ¼ cup of dried fruits (such as raisins); or 1 cup of raw leafy greens used in salads. The next questions are about your usual intake of fruits and vegetables at each meal and for snacks <u>each day.</u>		
17. How many servings of fruit do you usually have with breakfast?	0 1 2 3 4 5	38
18. How many servings of vegetables do you usually have with breakfast?	0 1 2 3 4 5	39
19. How many servings of fruit do you usually have with lunch?	0 1 2 3 4 5	40
20. How many servings of vegetables do you usually have with lunch?	0 1 2 3 4 5	41
21. How many servings of fruit do you usually have with your evening meal?	0 1 2 3 4 5	42
22. How many servings of vegetables do you usually have with your evening meal?	0 1 2 3 4 5	43
23. How many servings of fruit do you usually have as snacks each day?	0 1 2 3 4 5	44
24. How many servings of vegetables do you usually have as snacks each day?	0 1 2 3 4 5	45
25. How many fruits and vegetables should older people eat each day? (Circle the participant's response) 0 1 2 3 4 5 6 7 8 9 10 "5 a day" "5 or more a day" "7 to 10 a day" DK Missing		46-47
26. On how many of the last SEVEN DAYS did you eat five or more servings of fruits and vegetables?	0 1 2 3 4 5 6 7	48

What keeps you from eating more fruits and vegetables? *Circle all that apply.*		
27. Chewing or dental problems	No (0) Yes (1)	49
28. Cooking problems	No (0) Yes (1)	50
29. Cost	No (0) Yes (1)	51
30. Difficulties with digestion	No (0) Yes (1)	52
31. Don't like taste	No (0) Yes (1)	53
32. Grocery store does not have what I like	No (0) Yes (1)	54
33. Lack of storage space	No (0) Yes (1)	55
34. Not in season	No (0) Yes (1)	56
35. Spouse doesn't like them	No (0) Yes (1)	57
36. Takes too much time	No (0) Yes (1)	58
37. Too heavy to carry home from the store	No (0) Yes (1)	59
38. Too many are recommended	No (0) Yes (1)	60
39. Too much trouble	No (0) Yes (1)	61
40. Transportation problems	No (0) Yes (1)	62
41. Doctor told me not to eat some fruits and vegetables. If yes, please list:	No (0) Yes (1)	63
42. Other reasons that keep you from eating more fruits and vegetables. If yes, please list:	No (0) Yes (1)	64
43. How many of the last SEVEN DAYS have you followed a healthful eating plan?	0 1 2 3 4 5 6 7	65
44. On average, over the past month, how many DAYS PER WEEK have you followed an eating plan prescribed by your health care provider?	0 1 2 3 4 5 6 7	66
45. On how many of the last SEVEN DAYS did you eat high fat foods such as high fat red meats or full-fat dairy foods?	0 1 2 3 4 5 6 7	67
46. On how many of the last SEVEN DAYS did you participate in at least 30 minutes of **moderate** physical activity? Examples of **moderate** activities are regular walking, housework, yard work, lawn mowing, painting, repairing, light carpentry, ballroom dancing, light sports, golf, or bicycling on level.	0 1 2 3 4 5 6 7	68
47. On how many of the last SEVEN DAYS did you participate in a specific exercise session other than what you do around the house or as a part of your daily activities?	0 1 2 3 4 5 6 7	69
48. On how many of the last SEVEN DAYS, did you participate in specific exercises for your arthritis?	0 1 2 3 4 5 6 7	70
49. How many days of the week do you participate in physical activity?	0 1 2 3 4 5 6 7	71
50. About how many minutes of physical activity do you do on the days you are physically active?	____ minutes	72 - 74
What keeps you from being physically active for at least 30 minutes on all or most days of the week? *Circle all that apply.*		
51. I already am this physically active on all or most days of the week	No (0) Yes (1)	75
52. I have a health condition that keeps me from being active	No (0) Yes (1)	76
53. It costs too much	No (0) Yes (1)	77
54. I don't have time	No (0) Yes (1)	78
55. I don't like to	No (0) Yes (1)	79
56. It's not safe	No (0) Yes (1)	80
57. It's too late to improve my health	No (0) Yes (1)	81
58. 30 minutes daily is too much for me	No (0) Yes (1)	82

List of FV barriers selected from John and Ziebland, 2004 (http://her.oxfordjournals.org/cgi/reprint/19/2/165).

Diabetes Risk - Could You Have Diabetes and Not Know It?

	Circle the answers		Line 2
1. Are you 65 years old or older?	Yes (9)	No (0)	10
2. Are you between 45 and 64 years of age?	Yes (5)	No (0)	11
3. Are you under 65 years of age AND get little or no exercise?	Yes (5)	No (0)	12
4. Do you have a sister or brother with diabetes?	Yes (1)	No (0)	13
5. Do you have a parent with diabetes?	Yes (1)	No (0)	14
6. Are you a woman who had a baby weighing more than nine pounds at birth?	Yes (1)	No (0)	15
7. What is your current height without shoes? _____ feet and ____ inches			inches 16-18
8. What is your current weight without clothes? _____ pounds			19-21
9. Is weight equal to or above that listed in the chart?	Yes (5)	No (0)	22

Height in feet and inches without shoes	Weight in pounds without clothing
4 feet, 10 inches	129
4 feet, 11 inches	133
5 feet	138
5 feet, 1 inches	143
5 feet, 2 inches	147
5 feet, 3 inches	152
5 feet, 4 inches	157
5 feet, 5 inches	162
5 feet, 6 inches	167
5 feet, 7 inches	172
5 feet, 8 inches	177
5 feet, 9 inches	182
5 feet, 10 inches	188
5 feet, 11 inches	193
6 feet	199
6 feet, 1 inches	204
6 feet, 2 inches	210
6 feet, 3 inches	216
6 feet, 4 inches	221

10. TOTAL Score: 23-24

If 10 points are more, then you are at high risk for having diabetes. Only your health care provider can check to see if you have diabetes. Take this sheet to your health care provider to find out for sure.

If 3 to 9 points, then you are probably at low risk for having diabetes now. But don't just forget about it. Keep your risk low by losing weight if you are overweight, being active most days, and eating low fat meals that are high in fruits, vegetables, and whole grain foods.

Diabetes Facts You Should Know

Diabetes is a serious disease that can lead to blindness, heart disease, strokes, kidney failure, and loss of limbs.

You are at great risk for diabetes if:

You are 45 and older * You are overweight * You have high blood pressure * You have a family history of diabetes *

For more information, call 1-800-Diabetes(342-2883) or visit www.diabetes.org

WAIST CIRCUMFERENCE:
Instructions for Measuring Waist Circumference

<u>The measurement should be made under the clothes</u>.

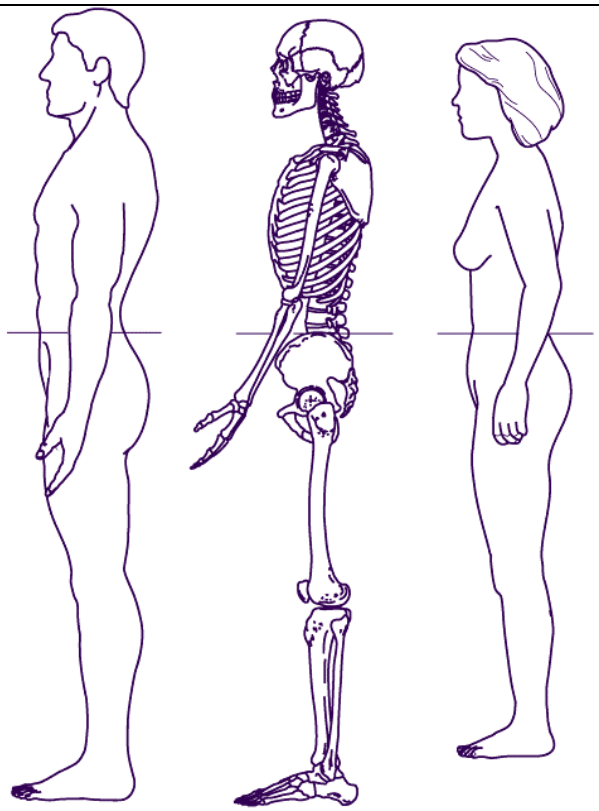
To measure waist circumference, locate the upper hipbone and the top of the right iliac crest. Place a measuring tape in a horizontal plane around the abdomen at the level of the iliac crest. Before reading the tape measure, ensure that the tape is
snug, but does not compress the skin, and is parallel to the floor. The measurement is made at the end of a normal expiration.

A high waist circumference is associated with an increased risk for type 2 diabetes, dyslipidemia, hypertension, and CVD in patients with a BMI between 25 and 34.9 kg/m2.

High-Risk Waist Circumference

Men: > 40 in (> 102 cm)
Women: > 35 in (> 88 cm)

http://www.nhlbi.nih.gov/guidelines/obesity/prctgd_c.pdf



59. Waist Circumference = _____ INCHES		Line 3 10-13
60. How was measurement made? (1) Under clothes OR (2) Over clothes	1 2	14
61. Chair Sit-and-Reach: sit in stable chair, knees straight, bend over, reach with arms straight to toes, then measure with a ruler: Number of inches person is short of reaching the toes: ___ ___ . ___ (-) or Number of inches person reaches beyond toes: ___ ___ . ___ (+) *Measure to the nearest ½ inch*		15-18 19-22
62. What is your current height without shoes? _____ feet and ____ inches		23-25
63. What is your current weight without clothes? _____ pounds		26-28
64. How was weight measurement made? PREFERRED: With a scale and without shoes (1) With a scale and with shoes (2) Self-report (3)		29

ID: _____DATE (M/D/Year):_____STAFF NAME:_____PHYSICAL PERFORMANCE

Physical Performance Test-Task Descriptions Equipment: Stopwatch, 8-Ft Tape Measure, Ruler, Folding Chair		RECORD TIME IN SECONDS	LINE 4 UGA Staff can score with open coding
ASB	STANDING BALANCE: Time each item until >10.0 sec. OR until participant moves feet or reaches for support. 1a) SEMI-TANDEM (heel of one foot placed at mid-position of the other) *If can hold for 10 seconds, move to 1b) *If can NOT hold for 10 seconds, move to 1c) 1b) TANDEM (heel to toe, one foot directly in front of the other) 1c) SIDE-BY-SIDE (toes lined up evenly and feet touching)	Time to the nearest 10th second: a) ___ ___ . ___ > 10.0 sec. Go to b) < 10.0 sec. Go to c) **b)** ___ ___ . ___ c) ___ ___ . ___	10-13 14-17 18-21
ASB D	DOMAIN SCORE: If A= <10 & C= 0-9, score= 0 A= <10 & C= 10, score= 1 A= ≥10 & B= 0-2, score= 2 A= ≥10 & B= 3-9, score= 3 A= ≥10 & B= ≥10, score= 4	SCORE: _____	22
AFW	8 FOOT WALK: Participant begins at standing position and will walk a straight distance of 8-feet, measured with tape on the floor. Instruct the participant to walk at normal gait using any assistive devices. If possible, have them begin walking a few feet before starting mark, and continue walking a few feet past the 8-foot mark. Tester will start and stop watch at the distance marks. Complete the walk twice.	Time to the nearest 10th second: 1) ___ ___ . ___ 2) ___ ___ . ___ Use best (lowest) time Assistive device used? NO (0) YES (1) Describe _____	23-26 27
AFW D	DOMAIN SCORE: 1= ≥5.7 2= 4.1-5.6 3= 3.2-4.0 4= ≤3.1	SCORE: _____	28
ACS	CHAIR STANDS: Participant is asked to stand one time from a seated position in an armless, straight-backed chair (such as a folding metal chair) with their arms folded across their chest. If able, participant is asked to stand-up and sit-down 5 times as quickly as possible while being timed. If not able to perform, then the test is complete.	Time to the nearest 10th second: 1) ___ ___ . ___	29-32
ACSD	DOMAIN SCORE: 1= ≥16.7 2= 13.7-16.6 3= 11.2-13.6 4= ≤11.1	SCORE: _____	33
TDS	TOTAL SCORE: Add all 3 domain scores (1-12)	TOTAL SCORE:__ __	34-35
Coding: 8 = physically unable, 9=refused, 7=not applicable. Good function (score of 10 to 12); moderate function (score of 6 to 9); poor function (score of 0 to 5).			

THE END

APPENDIX C

Post-test Questionnaire

LIVE HEALTHY GEORGIA – SENIORS TAKING CHARGE!

		Line 1
ID of Participant:		1-4
Phone number to use to clarify information and get step counts:		
59. County:		10-12
60. Date (M/D/Y): ___/___/___		13-18
61. Age of Participant: ___ ___ ___		19-21
62. Gender: Male (0) Female (1)		22
63. Ethnicity: White (1) Black (2) Hispanic/Latino (3) Asian (4) Other (5)		23
64. How many years did you complete in school: ____ years		24-25
65. How would you rate your overall health? Circle one: Poor (0) Fair (1) Good (2) Very good (3) Excellent (4)		26
66. Do you use any tobacco products such as cigarettes, cigars, pipe, or chewing tobacco?	No (0) Yes (1)	27
67. Do you have diabetes?	No (0) Yes (1)	28
68. Do you have high blood pressure?	No (0) Yes (1)	29
69. Do you have heart disease such as angina, congestive heart failure, heart attack or other heart problems?	No (0) Yes (1)	30
70. Do you have arthritis?	No (0) Yes (1)	31
71. During the past 30 days, have you had symptoms of pain, aching, or stiffness in or around a joint?	No (0) Yes (1)	32
72. Do you always have enough money to buy the food you need?	No (0) Yes (1)	33
73. How many over the counter medications do you take?		34-35
74. How many prescription medications, including insulin, do you take?		36-37
Think about the fruits and vegetables you usually eat each day, such as 100% juices; fresh, frozen or canned fruits; fruits for dessert, as well as potatoes, salads, slaws, and other fresh, frozen or canned vegetables. A serving is a piece of fruit or about ½ cup of most fruits and vegetables; ¼ cup of dried fruits (such as raisins); or 1 cup of raw leafy greens used in salads. The next questions are about your usual intake of fruits and vegetables at each meal and for snacks <u>each day.</u>		
75. How many servings of fruit do you usually have with breakfast?	0 1 2 3 4 5	38
76. How many servings of vegetables do you usually have with breakfast?	0 1 2 3 4 5	39
77. How many servings of fruit do you usually have with lunch?	0 1 2 3 4 5	40
78. How many servings of vegetables do you usually have with lunch?	0 1 2 3 4 5	41
79. How many servings of fruit do you usually have with your evening meal?	0 1 2 3 4 5	42
80. How many servings of vegetables do you usually have with your evening meal?	0 1 2 3 4 5	43
81. How many servings of fruit do you usually have as snacks each day?	0 1 2 3 4 5	44
82. How many servings of vegetables do you usually have as snacks each day?	0 1 2 3 4 5	45
83. How many fruits and vegetables should older people eat each day? (Circle the participant's response) 0 1 2 3 4 5 6 7 8 9 10 "5 a day" "5 or more a day" "7 to 10 a day" DK Missing		46-47
84. On how many of the last SEVEN DAYS did you eat five or more servings of fruits and vegetables?	0 1 2 3 4 5 6 7	48

What keeps you from eating more fruits and vegetables? *Circle all that apply.*		
85. Chewing or dental problems	No (0) Yes (1)	49
86. Cooking problems	No (0) Yes (1)	50
87. Cost	No (0) Yes (1)	51
88. Difficulties with digestion	No (0) Yes (1)	52
89. Don't like taste	No (0) Yes (1)	53
90. Grocery store does not have what I like	No (0) Yes (1)	54
91. Lack of storage space	No (0) Yes (1)	55
92. Not in season	No (0) Yes (1)	56
93. Spouse doesn't like them	No (0) Yes (1)	57
94. Takes too much time	No (0) Yes (1)	58
95. Too heavy to carry home from the store	No (0) Yes (1)	59
96. Too many are recommended	No (0) Yes (1)	60
97. Too much trouble	No (0) Yes (1)	61
98. Transportation problems	No (0) Yes (1)	62
99. Doctor told me not to eat some fruits and vegetables. <u>If yes, list.</u>	No (0) Yes (1)	63
100. Other reasons that keep you from eating more fruits and vegetables. <u>If yes, please list</u>:	No (0) Yes (1)	64
101. How many of the last SEVEN DAYS have you followed a healthful eating plan?	0 1 2 3 4 5 6 7	65
102. On average, over the past month, how many DAYS PER WEEK have you followed an eating plan prescribed by your health care provider?	0 1 2 3 4 5 6 7	66
103. On how many of the last SEVEN DAYS did you eat high fat foods such as high fat red meats or full-fat dairy foods?	0 1 2 3 4 5 6 7	67
104. On how many of the last SEVEN DAYS did you participate in at least 30 minutes of **<u>moderate</u>** physical activity? Examples of **<u>moderate</u>** activities are regular walking, housework, yard work, lawn mowing, painting, repairing, light carpentry, ballroom dancing, light sports, golf, or bicycling on level.	0 1 2 3 4 5 6 7	68
105. On how many of the last SEVEN DAYS did you participate in a specific exercise session other than what you do around the house or as a part of your daily activities?	0 1 2 3 4 5 6 7	69
106. On how many of the last SEVEN DAYS, did you participate in specific exercises for your arthritis?	0 1 2 3 4 5 6 7	70
107. How many days of the week do you participate in physical activity?	0 1 2 3 4 5 6 7	71
108. About how many minutes of physical activity do you do on the days you are physically active?	____ minutes	72 - 74
What keeps you from being physically active for at least 30 minutes on all or most days of the week? *Circle all that apply.*		
109. I already am this physically active on all or most days of the week	No (0) Yes (1)	75
110. I have a health condition that keeps me from being active	No (0) Yes (1)	76
111. It costs too much	No (0) Yes (1)	77
112. I don't have time	No (0) Yes (1)	78
113. I don't like to	No (0) Yes (1)	79
114. It's not safe	No (0) Yes (1)	80
115. It's too late to improve my health	No (0) Yes (1)	81
116. 30 minutes daily is too much for me	No (0) Yes (1)	82

List of FV barriers selected from John and Ziebland, 2004 (http://her.oxfordjournals.org/cgi/reprint/19/2/165).

After attending the fruit, vegetable, and physical activity programs, have you done any of the following? (*Circle all the apply.)*		Line 2
1. Increased your physical activity?	No (0) Yes (1)	10
2. Tried to follow a healthier diet?	No (0) Yes (1)	11
3. Increased your intake of fruit?	No (0) Yes (1)	12
4. Increased your intake of vegetables?	No (0) Yes (1)	13
5. Ate more fruits and vegetables for snacks?	No (0) Yes (1)	14
6. Ate more fruits and vegetables with breakfast?	No (0) Yes (1)	15
7. Ate more fruits and vegetables with lunch?	No (0) Yes (1)	16
8. Ate more fruits and vegetables with your evening meal?	No (0) Yes (1)	17
9. Made a recipe from one of the lessons?	No (0) Yes (1)	18
10. What was your overall level of satisfaction with this fruit and vegetable nutrition education program? Circle one: Poor (0) Fair (1) Good (2) Very good (3) Excellent (4)	0 1 2 3 4 5	19
11. What was your overall level of satisfaction with this physical activity program? Circle one: Poor (0) Fair (1) Good (2) Very good (3) Excellent (4)	0 1 2 3 4 5	20
12. How many sessions of the fruit and vegetable nutrition education program did the participant attend? *Staff should document with attendance records.*		21

WAIST CIRCUMFERENCE:
Instructions for Measuring Waist Circumference

<u>The measurement should be made under the clothes</u>.

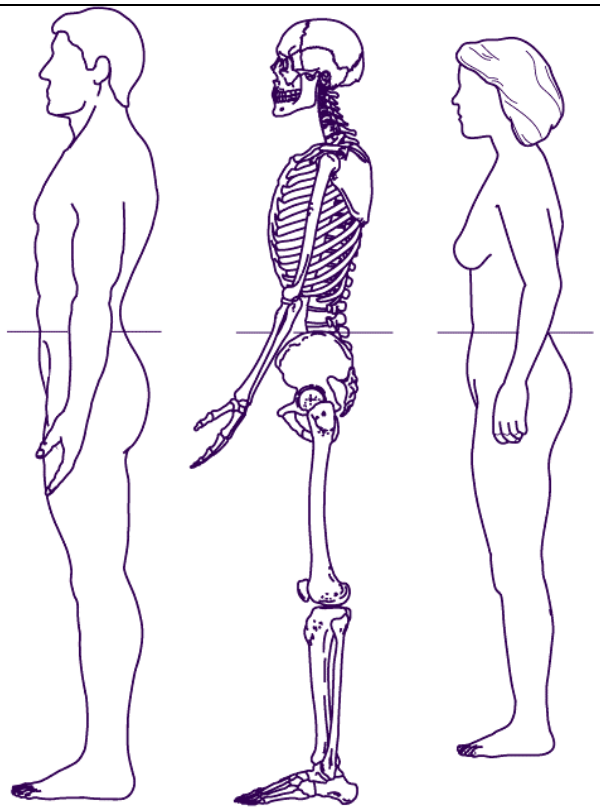
To measure waist circumference, locate the upper hipbone and the top of the right iliac crest. Place a measuring tape in a horizontal plane around the abdomen at the level of the iliac crest. Before reading the tape measure, ensure that the tape is
snug, but does not compress the skin, and is parallel to the floor. The measurement is made at the end of a normal expiration.

A high waist circumference is associated with an increased risk for type 2 diabetes, dyslipidemia, hypertension, and CVD in patients with a BMI between 25 and 34.9 kg/m2.

High-Risk Waist Circumference

Men: > 40 in (> 102 cm)
Women: > 35 in (> 88 cm)

http://www.nhlbi.nih.gov/guidelines/obesity/prctgd_c.pdf



59. Waist Circumference = _____ INCHES		Line 3 10-13
60. How was measurement made? (1) Under clothes OR (2) Over clothes	1 2	14
61. Chair Sit-and-Reach: sit in stable chair, knees straight, bend over, reach with arms straight to toes, then measure with a ruler: Number of inches person is short of reaching the toes: ___ ___ . ___ (-) *or* Number of inches person reaches beyond toes: ___ ___ . ___ (+) *Measure to the nearest ½ inch*		15-18 19-22
62. What is your current height without shoes? _____ feet and ____ inches		23-25
63. What is your current weight without clothes? _____ pounds		26-28
64. How was weight measurement made? PREFERRED: With a scale and without shoes (1) With a scale and with shoes (2) Self-report (3)		29

ID: _____ DATE (M/D/Year): _____ STAFF NAME: _____ PHYSICAL PERFORMANCE

	Physical Performance Test-Task Descriptions Equipment: Stopwatch, 8-Ft Tape Measure, Ruler, Folding Chair	RECORD TIME IN SECONDS	LINE 4 UGA Staff can score with open coding
ASB	STANDING BALANCE: Time each item until >10.0 sec. OR until participant moves feet or reaches for support. 1a) SEMI-TANDEM (heel of one foot placed at mid-position of the other) *If can hold for 10 seconds, move to 1b) *If can NOT hold for 10 seconds, move to 1c) 1b) TANDEM (heel to toe, one foot directly in front of the other) 1c) SIDE-BY-SIDE (toes lined up evenly and feet touching)	Time to the nearest 10th second: a) ___ ___ . ___ > 10.0 sec. Go to b) < 10.0 sec. Go to c) b)___ ___ . ___ c) ___ ___ . ___	10-13 14-17 18-21
ASB D	DOMAIN SCORE: If A= <10 & C= 0-9, score= 0 A= <10 & C= 10, score= 1 A= ≥10 & B= 0-2, score= 2 A= ≥10 & B= 3-9, score= 3 A= ≥10 & B= ≥10, score= 4	SCORE: _____	22
AFW	8 FOOT WALK: Participant begins at standing position and will walk a straight distance of 8-feet, measured with tape on the floor. Instruct the participant to walk at normal gait using any assistive devices. If possible, have them begin walking a few feet before starting mark, and continue walking a few feet past the 8-foot mark. Tester will start and stop watch at the distance marks. Complete the walk twice.	Time to the nearest 10th second: 1) ___ ___ . ___ 2) ___ ___ . ___ Use best (lowest) time Assistive device used? NO (0) YES (1) Describe _____	23-26 27
AFW D	DOMAIN SCORE: 1= ≥5.7 2= 4.1-5.6 3= 3.2-4.0 4= ≤3.1	SCORE: _____	28
ACS	CHAIR STANDS: Participant is asked to stand one time from a seated position in an armless, straight-backed chair (such as a folding metal chair) with their arms folded across their chest. If able, participant is asked to stand-up and sit-down 5 times as quickly as possible while being timed. If not able to perform, then the test is complete.	Time to the nearest 10th second: 1) ___ ___ . ___	29-32
ACSD	DOMAIN SCORE: 1= ≥16.7 2= 13.7-16.6 3= 11.2-13.6 4= ≤11.1	SCORE: _____	33
TDS	TOTAL SCORE: Add all 3 domain scores (1-12)	TOTAL SCORE:__ __	34-35
Coding: 8 = physically unable, 9=refused, 7=not applicable. Good function (score of 10 to 12); moderate function (score of 6 to 9); poor function (score of 0 to 5).			

THE END

APPENDIX D

Tables

Table D.1 Participant responses on pre-test questionnaire by total sample, gender, and ethnicity.

	n	Total Mean ± SD or %	Men n = 94 Mean ± SD or %	Women n = 464 Mean ± SD or %	*P* value[a]	White n = 261 Mean ± SD or %	African American n = 297 Mean ± SD or %	*P* value[a]
Characteristics								
Age (y)	558	75 ± 8	76 ± 8	75 ± 8	0.2530	76 ± 8	75 ± 7	0.2927
Body mass index; calculated as kg/m²	528	29.4 ± 6.5	28.1 ± 5.6	29.6 ± 6.6	0.0221	28.5 ± 6.2	30.2 ± 6.6	0.0007
Ethnicity	558							
White	261	47	57	45	0.0230	100	0	-
African American	297	53	43	55		0	100	
Gender	558							
Men	94	17	100	0	-	21	13	0.0230
Women	464	83	0	100		79	87	
How many years did you complete in school?	555	10.6 ± 3.2	10.4 ± 4.0	10.6 ± 3.0	0.5861	10.9 ± 2.9	10.3 ± 3.4	0.0207
How would you rate your overall health?	555	1.7 ± 0.8	1.7 ± 0.8	1.8 ± 0.8	0.3568	1.8 ± 0.8	1.7 ± 0.8	0.2257
Poor = 0	24	4	8	4		5	4	
Fair = 1	184	33	34	33		30	36	
Good = 2	268	48	43	49	0.1595	48	48	0.4684
Very good = 3	67	12	15	11		14	11	
Excellent = 4	12	2	0	3		3	2	
Do use any tobacco products such as cigarettes, cigars, pipe, or chewing tobacco?	544							
(%) Yes	52	10	17	8	0.0059	7	12	0.0625
Do you have diabetes?	557							
(%) Yes	227	41	46	40	0.2801	36	45	0.0387
Do you have high blood pressure?	551							
(%) Yes	401	73	61	75	0.0063	65	80	0.0001
Do you have heart disease such as angina, congestive heart failure, heart attack or other heart problems?	552							
(%) Yes	162	29	34	28	0.2725	37	23	0.0004

	n	Total Mean ± SD or %	Men n = 94 Mean ± SD or %	Women n = 464 Mean ± SD or %	*P* value[a]	White n = 261 Mean ± SD or %	African American n = 297 Mean ± SD or %	*P* value[a]
Do you have arthritis?	553							
(%) Yes	394	71	67	72	0.2845	70	72	0.6336
Do you always have enough money to buy the food you need?	547							
(%) No	128	23	28	23	0.2838	13	33	<0.0001
How many over the counter medications do you take?	528	1.5 ± 1.5	1.2 ± 1.3	1.6 ± 1.5	0.0197	1.9 ± 1.6	1.2 ± 1.2	< 0.0001
How many prescription medications, including insulin, do you take?	534	4.5 ± 3.0	4.9 ± 3.1	4.4 ± 2.9	0.1067	4.8 ± 3.3	4.2 ± 2.7	0.0346
Fruit and vegetable intake								
Total fruits and vegetables (servings/d)	490	7.2 ± 2.5	7.3 ± 2.8	7.2 ± 2.4	0.9680	6.9 ± 2.4	7.6 ± 2.5	0.0016
≥ 7 servings	284	58	52	59	0.2671	53	63	0.0178
≥ 5 servings	436	89	90	89	0.6887	87	91	0.1684
Fruit (serving/d)	526	3.6 ± 1.9	3.6 ± 2.1	3.6 ± 1.8	0.5672	3.3 ± 1.6	3.9 ± 2.0	0.0002
Vegetables (serving/d)	510	3.8 ± 1.7	3.9 ± 1.6	3.8 ± 1.7	0.6401	3.7 ± 1.7	3.9 ± 1.7	0.1106
On how many of the last 7 days did you eat ≥ 5 servings of fruits and vegetables?	547	4.2± 2.5	4.1 ± 2.5	4.2 ± 2.5	0.6886	4.3 ± 2.6	4.0 ± 2.5	0.0986
How many servings of fruit do you usually have with breakfast?	556	0.8 ± 0.8	0.8 ± 0.9	0.8 ± 0.8	0.4148	0.8 ± 0.8	0.9 ± 0.8	0.1574
≥ 1 serving	360	65	55	67	0.0284	62	68	0.1376
How many servings of vegetables do you usually have with breakfast?	549	0.1 ± 0.5	0.2 ± 0.5	0.1 ± 0.5	0.1775	0.1 ± 0.4	0.2 ± 0.6	0.0023
≥ 1 serving	54	10	14	9	0.1532	6	14	0.0022
How many servings of fruit do you usually have with lunch?	555	1.1 ± 0.6	1.1 ± 0.6	1.1 ± 0.6	0.9334	1.0 ± 0.5	1.2 ± 0.6	0.0006
≥ 1 serving	494	89	90	89	0.6850	86	92	0.0435
How many servings of vegetables do you usually have with lunch?	551	1.8 ± 0.6	1.9 ± 0.6	1.8 ± 0.6	0.5289	1.9 ± 0.7	1.8 ± 0.6	0.1770
≥ 1 serving	527	98	97	98	0.5439	98	98	0.9701

	n	Total Mean ± SD or %	Men n = 94 Mean ± SD or %	Women n = 464 Mean ± SD or %	*P* value[a]	White n = 261 Mean ± SD or %	African American n = 297 Mean ± SD or %	*P* value[a]
How many servings of fruit do you usually have with your evening meal?	540	0.7 ± 0.7	0.8 ± 0.8	0.7 ± 0.7	0.7095	0.6 ± 0.6	0.8 ± 0.8	0.0091
≥ 1 serving	311	58	58	58	0.9401	54	61	0.1053
How many servings of vegetables do you usually have with your evening meal?	546	1.5 ± 0.8	1.5 ± 0.8	1.5 ± 0.8	0.2816	1.5 ± 0.9	1.4 ± 0.8	0.2771
≥ 1 serving	479	87	89	86	0.3912	84	89	0.1124
How many servings of fruit do you usually have as snacks each day?	548	0.9 ± 0.8	0.9 ± 0.9	1.0 ± 0.8	0.3954	0.9 ± 0.8	1.0 ± 0.9	0.1448
≥ 1 serving	380	69	63	70	0.2382	68	70	0.6176
How many servings of vegetables do you usually have as snacks each day?	536	0.4 ± 0.7	0.3 ± 0.7	0.4 ± 0.7	0.0647	0.3 ± 0.7	0.5 ± 0.8	0.0003
≥ 1 serving	145	27	19	29	0.0661	20	34	0.0002
Knowledge								
How many fruits and vegetables should older people eat each day?	547							
Correct (7, 8, 9, 10, or 7 to 10 daily)	39	7	7	7	0.8276	9	6	0.1253
Incorrect or "don't know")	508	93	93	93		91	94	
Barriers								
What keeps you from eating more fruits and vegetables? (% responding yes)								
Chewing or dental problems	106	19	17	20	0.5373	19	20	0.7629
Cooking problems	62	11	11	11	0.8932	12	11	0.6890
Cost	129	24	22	24	0.6403	18	29	0.0042
Difficulties with digestion	111	20	18	21	0.4699	24	17	0.0260
Don't like the taste	78	14	12	15	0.5164	14	14	0.9868
Grocery store does not have what I like	56	10	10	10	0.9304	7	13	0.0264
Lack of storage space	38	7	8	7	0.7551	8	7	0.7300
Not in season	97	18	13	19	0.2162	13	19	0.2348
Spouse doesn't like them	18	4	2	4	0.4686	2	4	0.4809
Takes too much time	56	10	7	11	0.1990	7	11	0.2109
Too heavy to carry home from the store	40	7	4	8	0.2490	4	8	0.2490

	n	Total Mean ± SD or %	Men n = 94 Mean ± SD or %	Women n = 464 Mean ± SD or %	*P* value[a]	White n = 261 Mean ± SD or %	African American n = 297 Mean ± SD or %	*P* value[a]
Too many are recommended	90	17	17	17	0.9863	17	17	0.9863
Too much trouble	76	14	20	13	0.0845	20	13	0.0751
Transportation problems	54	10	9	10	0.7095	9	10	0.7095
Doctor told me not to eat some fruits and vegetables	73	14	21	12	0.0226	21	12	0.0226
Other reasons that keep you from eating more fruits and vegetables	53	11	4	13	0.0201	4	13	0.0201
Diet								
How many of the last 7 days have you followed a healthful eating plan?	551	4.5 ± 2.4	4.2 ± 2.6	4.6 ± 2.4	0.3036	4.6 ± 2.5	4.4 ± 2.3	0.2392
On average, over the past month, how many days per week have you followed an eating plan prescribed by your health care provider?	474	2.8 ± 2.9	3.0 ± 2.9	2.7 ± 2.9	0.4479	2.3 ± 2.9	3.1 ± 2.9	0.0032
On how many of the last 7 days did you eat high fat foods such as high fat red meats or full fat dairy foods?	545	2.0 ± 2.0	2.6 ± 2.3	1.9 ± 1.9	0.0027	2.2 ± 2.1	1.8 ± 1.8	0.0341

[a] ANOVA was used to evaluate differences in means. Chi square analyses used to compare percents. *P* values < 0.05 considered statistically significant. *P* values = 0.05 – 0.15 considered trends.

Table D.2 Participant responses on pre-test questionnaire by total sample and age.

	Total Sample		< 80 y n = 399	≥ 80 y n = 159	*P* value[a]
	n	Mean ± SD or %	Mean ± SD or %	Mean ± SD or %	
Characteristics					
Body mass index; calculated as kg/m²	529	29.4 ± 6.5	30.1 ± 6.7	27.4 ± 5.3	< 0.0001
Ethnicity	558				
White	261	47	46	49	0.4952
African American	297	53	54	51	
Gender	558				
Men	94	17	17	18	0.7608
Women	464	83	83	82	
How many years did you complete in school?	555	10.6 ± 3.2	10.8 ± 3.1	10.1 ± 3.4	0.0075
How would you rate your overall health?	555	1.7 ± 0.8	1.7 ± 0.8	1.8 ± 0.9	0.3355
Poor = 0	24	4	4	6	
Fair = 1	184	33	34	30	
Good = 2	268	48	49	46	0.2250
Very good = 3	67	12	10	17	
Excellent = 4	12	2	2	2	
Do use any tobacco products such as cigarettes, cigars, pipe, or chewing tobacco?	544				
(%) Yes	52	10	11	6	0.0641
Do you have diabetes?	557				
(%) Yes	227	41	45	31	0.0026
Do you have high blood pressure?	551				
(%) Yes	401	73	76	65	0.0112
Do you have heart disease such as angina, congestive heart failure, heart attack or other heart problems?	552				
(%) Yes	162	29	27	35	0.0464
Do you have arthritis?	553				
(%) Yes	394	71	72	71	0.8580
Do you always have enough money to buy the food you need?	547				
(%) No	128	23	24	21	0.4039
How many over the counter medications do you take?	528	1.5 ± 1.5	1.5 ± 1.5	1.5 ± 1.3	0.7683
How many prescription medications, including insulin, do you take?	534	4.5 ± 3.0	4.5 ± 3.0	4.3 ± 2.9	0.2835

	Total Sample		< 80 y n = 399	≥ 80 y n = 159	*P* value[a]
	n	Mean ± SD or %	Mean ± SD or %	Mean ± SD or %	
Fruit and vegetable intake					
Total fruits and vegetables (servings/d)	490	7.2 ± 2.5	7.1 ± 2.4	7.5 ± 2.6	0.1895
≥ 7 servings	284	58	56	62	0.2354
≥ 5 servings	436	89	88	91	0.2736
Fruit (servings/d)	526	3.6 ± 1.9	3.5 ± 1.9	3.8 ± 1.8	0.0272
Vegetables (servings/d)	510	3.8 ± 1.7	3.9 ± 1.8	3.7 ± 1.4	0.5253
On how many of the last 7 days did you eat ≥ 5 servings of fruits and vegetables?	547	4.2± 2.5	4.2 ± 2.6	4.3 ± 2.5	0.7220
How many servings of fruit do you usually have with breakfast?	556	0.8 ± 0.8	0.8 ± 0.8	1.0 ± 0.8	0.0026
≥ 1 serving	360	65	62	71	0.0563
How many servings of vegetables do you usually have with breakfast?	549	0.1 ± 0.5	0.2 ± 0.6	0.1 ± 0.4	0.9158
≥ 1 serving	54	10	10	10	0.8349
How many servings of fruit do you usually have with lunch?	555	1.1 ± 0.6	1.1 ± 0.6	1.2 ± 0.6	0.0381
≥ 1 serving	494	89	88	92	0.1066
How many servings of vegetables do you usually have with lunch?	551	1.8 ± 0.6	1.8 ± 0.7	1.8 ± 0.6	0.6644
≥ 1 serving	527	98	97	98	0.6703
How many servings of fruit do you usually have with your evening meal?	540	0.7 ± 0.7	0.7 ± 0.7	0.8 ± 0.7	0.0750
≥ 1 serving	311	58	55	64	0.0468
How many servings of vegetables do you usually have with your evening meal?	546	1.5 ± 0.8	1.5± 0.8	1.4 ± 0.8	0.5627
≥ 1 serving	479	87	87	85	0.4523
How many servings of fruit do you usually have as snacks each day?	548	0.9 ± 0.8	0.9 ± 0.8	0.9 ± 0.8	0.7720
≥ 1 serving	380	69	69	68	0.7332
How many servings of vegetables do you usually have as snacks each day?	536	0.4 ± 0.7	0.4 ± 0.7	0.3 ± 0.6	0.0315
≥ 1 serving	145	27	30	20	0.0253
Knowledge					
How many fruits and vegetables should older people eat each day?	547				0.0594
Correct (7, 8, 9, 10, or 7 to 10 daily)	39	7	8	4	
Incorrect "or "don't know"	508	93	92	96	

	Total Sample		< 80 y n = 399 Mean ± SD or %	≥ 80 y n = 159 Mean ± SD or %	*P* value[a]
	n	Mean ± SD or %			
Barriers					
What keeps you from eating more fruits and vegetables? (% responding yes)					
Chewing or dental problems	106	19	17	21	0.5203
Cooking problems	62	11	10	15	0.0879
Cost	129	24	26	18	0.0676
Difficulties with digestion	111	20	21	18	0.4001
Don't like the taste	78	14	14	14	0.9471
Grocery store does not have what I like	56	10	11	10	0.7860
Lack of storage space	38	7	7	8	0.6150
Not in season	97	18	20	13	0.0407
Spouse doesn't like them	18	4	4	2	0.2734
Takes too much time	56	10	11	10	0.8248
Too heavy to carry home from the store	40	7	7	8	0.7926
Too many are recommended	90	17	17	16	0.7822
Too much trouble	76	14	13	17	0.2157
Transportation problems	54	10	11	7	0.1764
Doctor told me not to eat some fruits and vegetables	73	14	14	12	0.3935
Other reasons that keep you from eating more fruits and vegetables	53	11	13	8	0.1237
Diet					
How many of the last 7 days have you followed a healthful eating plan?	551	4.5 ± 2.4	4.5 ± 2.4	4.4 ± 2.5	0.8949
On average, over the past month, how many days per week have you followed an eating plan prescribed by your health care provider?	474	2.8 ± 2.9	2.9 ± 2.9	2.5 ± 2.9	0.2275
On how many of the last 7 days did you eat high fat foods such as high fat red meats or full fat dairy foods?	545	2.0 ± 2.0	1.9 ± 1.9	2.1 ± 2.1	0.4437

[a] ANOVA was used to evaluate differences in means. Chi square analyses used to compare percents. *P* values < 0.05 considered statistically significant. *P* values = 0.05 – 0.15 considered trends.

Table D.3 Participant responses on pre-test questionnaire by total sample and degree of ruralness.

	Total Sample		Urban = 1 n = 169	Suburban = 2 n = 140	Growing rural = 3 n = 181	Declining rural = 4 n = 68	*P* value†
	n	Mean ± SD or %	Mean ± SD or %	Mean ± SD or %	Mean ± SD or %	Mean ± SD or %	
Characteristics							
Age (y)	558	75 ± 8	75 ± 7	75 ± 7	76 ± 8	77 ± 7	0.2477
Body mass index (kg/m²)	529	29.4 ± 6.5	29.4 ± 6.9[a]	28.9 ± 5.7[a]	28.5 ± 6.3[a]	32.3 ± 6.5[b]	0.0004
Ethnicity	558						< 0.0001
White	261	47	28	59	57	43	
African American	297	53	72	41	43	57	
Gender	558						0.7575
Men	94	17	17	14	19	18	
Women	464	83	83	86	81	82	
How many years did you complete in school?‡	555	10.6 ± 3.2	11.0 ± 3.2[b]	11.1 ± 3.0[b]	10.0 ± 3.1[a]	10.1 ± 3.3[a]	0.0016
How would you rate your overall health?‡*	555	1.7 ± 0.8	1.9 ± 0.7[c]	1.7 ± 0.7[ab]	1.7 ± 0.9[bc]	1.5 ± 0.8[a]	0.0023
Do use any tobacco products such as cigarettes, cigars, pipe, or chewing tobacco?	544						
(%) Yes	52	10	8	9	10	15	0.4303
Do you have diabetes?	557						
(%) Yes	227	41	42	40	40	40	0.9826
Do you have high blood pressure?	551						
(%) Yes	401	73	77	66	71	82	0.0431
Do you have heart disease such as angina, congestive heart failure, heart attack or other heart problems?	552						
(%) Yes	162	29	27	26	32	35	0.3846
Do you have arthritis?	553						
(%) Yes	394	71	68	67	72	84	0.0688
Do you always have enough money to buy the food you need?	547						
(%) No	128	23	27	22	23	18	0.4391

	Total Sample		Urban = 1 n = 169	Suburban = 2 n = 140	Growing rural = 3 n = 181	Declining rural = 4 n = 68	*P* value†
	n	Mean ± SD or %	Mean ± SD or %	Mean ± SD or %	Mean ± SD or %	Mean ± SD or %	
How many over the counter medications do you take?‡	528	1.5 ± 1.5	1.4 ± 1.4[ab]	1.6 ± 1.4[bc]	1.7 ± 1.6[c]	1.1 ± 1.3[a]	0.0098
How many prescription medications, including insulin, do you take?	534	4.5 ± 3.0	4.3 ± 2.8	4.4 ± 3.0	4.5 ± 3.1	5.1 ± 3.0	0.2717
Fruit and vegetable intake							
Total fruits and vegetables (servings/d)	490	7.2 ± 2.5	7.5 ± 2.6	7.2 ± 2.3	7.1 ± 2.3	7.2 ± 2.3	0.5714
≥ 7 servings	284	58	59	57	59	55	0.9465
≥ 5 servings	436	89	91	57	88	91	0.6848
Fruit (servings/d)	526	3.6 ± 1.9	3.9 ± 2.2	3.5 ± 1.8	3.4 ± 1.5	3.6 ± 1.8	0.1036
Vegetables (servings/d)	510	3.8 ± 1.7	4.0 ± 1.8	3.8 ± 2.1	3.7 ± 1.3	3.5 ± 1.3	0.1451
On how many of the last 7 days did you eat ≥ 5 servings of fruits and vegetables?	547	4.2± 2.5	4.3± 2.3	4.1± 2.5	4.1± 2.7	4.2± 2.5	0.9148
How many servings of fruit do you usually have with breakfast?	556	0.8 ± 0.8	0.9 ± 0.8	0.9 ± 0.7	0.8 ± 0.8	0.8 ± 0.9	0.4921
≥ 1 serving	360	65	67	69	62	59	0.3437
How many servings of vegetables do you usually have with breakfast?‡	549	0.1 ± 0.5	0.2 ± 0.7[c]	0.2 ± 0.6[ac]	0.1 ± 0.3[ab]	0.0 ± 0.1[ab]	0.0194
≥ 1 serving	54	10	14	9	10	1	0.0302
How many servings of fruit do you usually have with lunch?‡	555	1.1 ± 0.6	1.2 ± 0.7[b]	1.0 ± 0.5[a]	1.0 ± 0.5[a]	1.2 ± 0.7[ab]	0.0265
≥ 1 serving	494	89	90	87	88	94	0.4396
How many servings of vegetables do you usually have with lunch?	551	1.8 ± 0.6	1.8 ± 0.7	1.8 ± 0.7	1.9 ± 0.6	1.9 ± 0.5	0.1740
≥ 1 serving	527	98	97	96	99	100	0.1514
How many servings of fruit do you usually have with your evening meal?	540	0.7 ± 0.7	0.8 ± 0.8	0.7 ± 0.7	0.6 ± 0.7	0.6 ± 0.7	0.0705
≥ 1 serving	311	58	62	61	53	54	0.2935
How many servings of vegetables do you usually have with your evening meal?	546	1.5 ± 0.8	1.5 ± 0.8	1.5 ± 0.9	1.5 ± 0.8	1.4 ± 0.8	0.6500
≥ 1 serving	479	87	88	84	89	82	0.3869

	Total Sample		Urban = 1 n = 169	Suburban = 2 n = 140	Growing rural = 3 n = 181	Declining rural = 4 n = 68	*P* value†
	n	Mean ± SD or %	Mean ± SD or %	Mean ± SD or %	Mean ± SD or %	Mean ± SD or %	
How many servings of fruit do you usually have as snacks each day?	548	0.9 ± 0.8	1.0 ± 0.9	0.8 ± 0.8	0.9 ± 0.8	1.0 ± 0.8	0.1663
≥ 1 serving	380	69	71	63	72	67	0.3739
How many servings of vegetables do you usually have as snacks each day?‡	536	0.4 ± 0.7	0.5 ± 0.8[b]	0.5 ± 0.9[b]	0.2 ± 0.5[a]	0.3 ± 0.7[ab]	0.0103
≥ 1 serving	145	27	34	31	21	19	0.0169
Knowledge							
How many fruits and vegetables should older people eat each day?	547						0.7566
Correct (7, 8, 9, 10, or 7 to 10 daily)	39	7	7	7	7	10	
Incorrect or "don't know"	508	93	93	93	93	90	
Barriers							
What keeps you from eating more fruits and vegetables? (% responding yes)							
Chewing or dental problems	106	19	14	19	21	28	0.0746
Cooking problems	62	11	14	7	11	13	0.2733
Cost	129	24	22	28	24	18	0.4504
Difficulties with digestion	111	20	15	23	23	21	0.2052
Don't like the taste	78	14	14	19	11	13	0.2750
Grocery store does not have what I like	56	10	12	9	10	12	0.7930
Lack of storage space	38	7	5	7	9	5	0.4930
Not in season	97	18	20	17	18	14	0.6769
Spouse doesn't like them	18	4	5	3	2	7	0.3271
Takes too much time	56	10	11	8	12	11	0.7307
Too heavy to carry home from the store	40	7	6	7	10	6	0.5055
Too many are recommended	90	17	20	14	16	14	0.4543
Too much trouble	76	14	16	13	14	12	0.7980
Transportation problems	54	10	7	15	11	5	0.0525

	Total Sample		Urban = 1 n = 169	Suburban = 2 n = 140	Growing rural = 3 n = 181	Declining rural = 4 n = 68	*P* value†
	n	**Mean ± SD or %**	**Mean ± SD or %**	**Mean ± SD or %**	**Mean ± SD or %**	**Mean ± SD or %**	
Doctor told me not to eat some fruits and vegetables	73	14	11	13	16	15	0.5907
Other reasons that keep you from eating more fruits and vegetables	53	11	11	11	12	9	0.9767
Diet							
How many of the last 7 days have you followed a healthful eating plan?	551	4.5 ± 2.4	4.6 ± 2.3	4.4 ± 2.4	4.6 ± 2.6	4.1 ± 2.4	0.3784
On average, over the past month, how many days per week have you followed an eating plan prescribed by your health care provider?	474	2.8 ± 2.9	3.3 ± 2.9[b]	2.8 ± 2.9[ab]	2.2 ± 3.0[a]	2.7 ± 2.8[ab]	0.0261
On how many of the last 7 days did you eat high fat foods such as high fat red meats or full fat dairy foods?‡	545	2.0 ± 2.0	1.9 ± 1.9	2.0 ± 1.9	2.0 ± 2.1	2.0 ± 2.0	0.9259

† General linear models procedure was used for continuous variables and Chi square procedure was used for dichotomous variables. (*P* values < 0.05 considered significant. *P* values = 0.05 – 0.15 considered trends).

‡ Superscript letters indicate significant differences ($P < 0.05$) using least significant difference procedure.

* Higher number indicates better health status on a scale of 0 to 4.