ERICA ANN ASPINWALL
Serum Carotenoid Concentrations and Fruit and Vegetable Intakes Among Participants in Northeast Georgia's Elderly Nutrition Program
(Under the Direction of MARY ANN JOHNSON)

The objective of this research was to determine serum carotenoid concentrations and fruit, vegetable, and carotenoid intake among participants in the Northeast Georgia Elderly Nutrition Program (ENP). Intake was estimated by the Behavioral Risk Factor Surveillance System Questionnaire (BRFSS) and the Block Food Frequency Questionnaire (FFQ). Participants were a convenience sample who attended senior centers where lunch was provided (n = 71; mean age = 76; 85.5% female; 65% white; 35% black). When compared to non-participants, participants were similar in age, gender and race. 25-33% of the participants ate 5 or more servings of fruit and vegetables daily. Only 24% of the participants knew that people should eat 5 or more fruit and vegetables daily. Serum carotenoids were more highly correlated with the Block FFQ than the BFRSS Questionnaire measure of fruit and vegetable intake, thus the Block FFQ may be better for this population.

INDEX WORDS: Carotenoids, Elderly, Fruits and vegetables, Humans, Serum, Dietary questionnaire

SERUM CAROTENOID CONCENTRATIONS AND FRUIT, VEGETABLE AND CAROTENOID INTAKE AMONG PARTICIPANTS IN NORTHEAST GEORGIA'S ELDERLY NUTRITION PROGRAM

by

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CHAPTER 1

INTRODUCTION

The U.S. Bureau of Census (2000) found that the elderly population is rapidly increasing in number with the fastest growing age population being the 85+ group. In fact, by the year 2030, one in five people will be over the age of 65. Approximately 80% of the elderly have at least one of the following chronic health conditions: cardiovascular disease, cancer, diabetes, auditory problems, visual problems, or dementia (Guralnik et al., 1989; US Dept. of Health and Human Services, 1994). Cardiovascular disease and cancer are the leading causes of death in the United States (Centers for Disease Control and Prevention, 2001). Diets rich in fruits and vegetables have been associated with decreased risk of cardiovascular disease, cancer, hypertension, age-related macular degeneration, and stroke (Johnson et al., 1998).

Under Title III (State and Community Programs), the Administration on Aging provides services and opportunities for older adults. Among those services are the congregate meal sites set up within communities. The Older Americans Act of 1965 funds the congregate meal program established in 1972. It provides 3 million meals daily for participants in the ENP. This program served nearly 45,000 elderly in Georgia in 1999 (Sudha Reddy, Georgia Division of Aging Services, personal communication). The Northeast Georgia ENP has approximately 1,400 registered and active clients. A previous study in this population has shown several nutritional deficiencies (Brackett, 1999). Among those deficiencies were vitamin B12, vitamin D, and protein. This thesis examines the fruit, vegetable and carotenoid intakes and serum carotenoid

concentrations of participants in the Northeast Georgia ENP. The purpose of this study was to determine fruit and vegetable intake, knowledge of fruit and vegetable recommendations, the relationship between intake and knowledge of fruits and vegetables, and the correlation of fruit, vegetable and carotenoid intake with serum carotenoid concentrations in Northeast Georgia's ENP participants.

CHAPTER 2

LITERATURE REVIEW

The literature on carotenoids and their potential impact on human health is vast. Thus this literature review relies primarily on the Institute of Medicine's (2000) report for background information on carotenoids and health. Leading experts in the field of nutrition, health and disease prepared this review. Primary literature on the relationship between dietary carotenoid intake and serum carotenoids will be examined in detail.

DIETARY AND SERUM CAROTENOIDS

Carotenoids are found in all fruits and vegetables, excluding some root vegetables (Scott et al., 1996). Over 500 different kinds of carotenoids exist, but the predominate ones studied are beta-carotene, alpha-carotene, lutein/zeaxanthin, lycopene, and beta-cryptoxanthin (Institute of Medicine, 2000). Lutein, lycopene, and beta-carotene are the predominant carotenoids found in serum (Scott et al., 1996). Lutein, the carotenoid seen in the greatest concentration in the U.S., is found in fruits, vegetables, and egg yolks (Zeigler, 1991). Each carotenoid has different hypothetical health effects; therefore, it is imperative to assess each one individually (Tucker et al., 1999).

Unlike many nutrients measured in the blood, no normative values exist for serum carotenoid levels. However, serum carotenoids are a good indicator of recent fruit and vegetable intake (Ascherio et al., 1992). Studies in which supplements were given show that carotenoid concentrations in the blood do reflect dietary intake (Willett, 1983). Relating servings of fruits and vegetables contained in the Food Guide Pyramid to serum carotenoid concentrations would be a useful tool in assessing intake of carotenoids in the population (Polsinelli et al., 1998). A study conducted by Polsinelli

and others compared fruit and vegetable intake and serum carotenoid concentrations using a sample of 20 women. Their results showed significant correlations between servings of fruits and vegetables and serum alpha-carotene ($r = 0.70$), beta-carotene ($r = 0.48$), lutein ($r = 0.60$), and total serum carotenoid concentration ($r = 0.48$). These significant correlations in such a small sample size make this type of measure conducive to field-based research.

Research from the National Health and Nutrition Examination Survey III data provides mean serum concentrations and selected percentiles of beta-carotene, alpha-carotene, beta-cryptoxanthin, lutein/zeaxanthin, and lycopene. These values were determined using high performance liquid chromatography (HPLC) at the Centers for Disease Control and Prevention in Atlanta, Georgia. The results were published by the Institute of Medicine according to gender and age. See appendix for serum carotenoid concentrations for men and women ages 51 and older.

Due to the nature of serum carotenoids, seasonal variations are seen, specifically with lutein, lycopene, and beta-carotene (Scott et al., 1996). The highest concentrations of these were seen in the summer and fall, most likely attributed to increased availability of fruits and vegetables during these seasons.

Although some nutrients in fruits and vegetables are not very heat stable, carotenoids appear to have increased bioavailability when heated (van het Hofetal, 2000). The breakdown of the food matrix with heating releases the carotenoids, making them more bioavailable (van het Hofetal, 2000). However, prolonged boiling or exposure to high heat reduced bioavailability due to increased production of isomers or oxidation products (Institute of Medicine, 2000). Adequate fat consumption (3-5g) along with carotenoids also improves absorption significantly (van het Hofetal, 2000). One factor thought to impede absorption is the fiber found in fruits and vegetables (van het Hofetal, 2000). Fiber may interfere with micelle formation, which reduces carotenoid absorption. The degree to which fiber inhibits absorption is undetermined

(McEligot et al., 1999). Studies in this area remain contradictory (Castenmiller, 1999; Rock, 1992; Erdman, 1986).

Carotenoids can compete with each other for intestinal absorption. Most research in this area involves beta-carotene and lutein. A study by Micozzi et al. (1992) found that subjects taking 12 mg or 30 mg capsules of beta-carotene had significantly lower serum lutein concentrations. Plasma lutein concentrations of those supplemented with 30 mg of beta-carotene were decreased by 152 ± 48 nmol/L and were significantly different from the average maximum change in lutein plasma concentrations of the placebo group, 233 ± 199 nmol/L ($P < 0.05$). Kostic et al. (1995) supplemented subjects with both crystalline beta-carotene and lutein and found the area under the curve (AUC) value, a measure of total absorption, was significantly lower for lutein, 54% of its AUC value when given alone ($P = 0.1$). The same study showed that its AUC value was higher for beta-carotene when lutein and beta-carotene were given simultaneously. This suggests that both beta-carotene and lutein affect the absorption of one another.

CAROTENOIDS AND LIFESTYLE FACTORS

Tobacco Use

A study conducted by Stryker et al. (1988) showed than men and women who smoke had a lower association between dietary carotene and plasma beta-carotene ($r = 0.02$ vs. 0.44 among men, $r = 0.19$ vs. 0.45 among women). The same study showed that men and women who smoke had much lower serum carotenoid concentrations than nonsmokers (metric mean 8.5 vs. 15.3 μg/dl for men and 17.3 vs. 26.3 μg/dl for women). Another study showed that all serum carotenoids excluding lycopene were lower by 16-40% in smokers versus non-smokers. The same study showed no significant difference between past smokers versus non-smokers. It also showed that dietary lycopene, but not serum lycopene was significantly lower among smokers (Brady et al., 1996). In the Finnish study where smokers were given beta-carotene supplements, the incidence of lung cancer did increase but only significantly in those

who also consumed alcohol, showing there may be some relationship between alcohol and carotenoids (Birt et al., 1999). In the Carotene and Retinol Efficacy Trial, supplements of beta-carotene were given to smokers and the study was terminated because the incidence of lung cancer rose 28% (Birt et al., 1999). So, it appears that beta-carotene supplements may be detrimental to smokers when looking at the occurrence of lung cancer. However, it may be other components in fruit and vegetables along with beta-carotene that have a preventive effect since these subjects were just supplemented with beta-carotene.

Medications

One type of medication observed to lower serum carotenoid concentrations is cardiac glycosides. However, this lowering effect has only been seen in women (Vogel, 1997). A study by Elinder et al. looked at the effects of two lipid lowering drugs, cholestyramine and probucol, on serum carotenoid concentrations (1995). In the intestine cholestyramine binds with bile acids to form an insoluble substance, which is excreted in the feces. This causes an increase in hepatic synthesis of cholesterol which becomes bile acids and is subsequently excreted. This results in lower plasma cholesterol (Physicians' Desk Reference, 1999). Elinder et al. found that subjects treated with cholestyramine for 2 months had decreased serum concentrations of beta-carotene and lycopene, 40% and 30%, respectively. Adding probucol, an antioxidant drug, to the therapy further reduced serum beta-carotene and lycopene levels, 39% and 30%, respectively. These effects were independent of the treatment's effects on serum lipid levels. The mechanism for these effects is unknown (Elinder et al., 1995). Olestra, a fat replacer used in snack foods, can reduce the absorption of carotenoids when simultaneous consumption occurs (Rock, et al., 1999). Even though products containing olestra have been enriched or fortified with fat-soluble vitamins, fortification with carotenoids has not been implemented.

Body Mass Index (BMI) and Body Composition

A study conducted by Scott et al. (1996) showed an inverse correlation between serum beta-carotene and BMI. Another study by Ascherio et al. (1992) also showed an inverse correlation between serum beta-carotene and BMI in men but not women. This suggests gender may play a role in beta-carotene distribution and metabolism. No correlation was seen between serum lutein or lycopene and BMI or the intake of lutein, lycopene, or beta-carotene and BMI (Scott et al., 1996). Brady at al. found that "BMI was inversely related to serum concentrations of alpha- and beta-carotene" (1996). With adjustments for other factors, BMI was inversely related to all serum carotenoids except lycopene. Due to the fact that carotenoids are stored in adipose tissue, the inverse correlations of BMI with serum levels may be due to great storage of carotenoids in adipose tissue than in serum in persons with more body fat (Brady et al., 1996).

Serum Cholesterol

Carroll and colleagues found that in a healthy elderly population (ages 65 years and older) the plasma concentrations of beta-carotene and lutein/zeaxanthin were positively associated with plasma cholesterol levels (2000). No relationship was found between plasma cholesterol concentrations and the plasma concentrations of lycopene, alpha-carotene, and beta-cryptoxanthin. Low-density lipoproteins are responsible for carrying the hydrocarbon carotenoids alpha-carotene, beta-carotene, and lycopene while high-density lipoproteins are responsible for carrying the more polar xanophylls, lutein and zeaxanthin (Institute of Medicine, 2000). However, the study by Carroll et al. reported that the high-density lipoproteins in the participants did not contain carotenoids (2000).

Age

Advancing age has been associated with a decrease in overall energy intake. Decreased appetite with aging, limited incomes in the elderly, cooking less food, lowered energy needs, including other factors should be considered when looking at this association. In a study of elderly men and women by Donkin et al. (1998), the age group over 75 showed a significant drop in vegetable consumption. However, a cross-sectional study by Winklhofer-Roob et al. (1997) found a linear increase with age for beta-carotene and lycopene but not for alpha-carotene. Beta-carotene and lycopene increased by 1.3% and 1.6% per year, respectively. Since this study did not use elderly people, the results may not reflect an overall trend in serum carotenoid concentrations in relation to advanced age. No decrease in serum carotenoid concentrations is evidenced with healthy aging, suggesting no absorption obstacles and accurate determination of intake after correcting for other lifestyle factors.

Gender

Many studies have shown fruit and vegetable intake and serum carotenoids are higher in women than in men (Jacques et al., 1993; Roidt et al., 1988). A study of 302 subject ages 48-68 showed mean concentrations of serum beta-carotene in men to be 213 ng/ml versus 227 ng/ml for women. The same study found mean serum alpha-carotene to be 38.8 ng/ml for men and 46.5 ng/ml for women (Roidt et al., 1988). Serum concentration of triglycerides appears to have an affect on the serum concentration of beta-carotene in women but not in men (Ascherio et al., 1992). Tucker et al. found significantly higher plasma concentrations of alpha-carotene and beta-cryptoxanthin in women than in men (1999). In this same study, women also reported higher intake of carotenoids, fruits, and vegetables.

Race

A study conducted among rural elderly in Maryland showed that white participants had higher intakes of most nutrients and mean energy than black participants (Cid-Ruzafa et al., 1999; n = 2,886, aged 65 to 84). Black participants

reported higher intakes of cholesterol, vitamin A, and carotenoids than white participants. Nebeling and colleagues (1997) found, as part of the 1987 National Health Interview Survey, that blacks consumed more beta-carotene, beta-cryptoxanthin, lutein, and total carotenoids than whites. These blacks tended to eat more dark leafy greens and sweet potatoes than whites, which could lead to the higher carotenoid intake.

Fitness Level

No research has been found linking an individual's fitness level with serum carotenoid concentration. There is some evidence that physically active people report a higher intake of beta-carotene when compared to their sedentary counterparts (Eaton et al., 1995). However, this study looked at younger adults (mean age = 37.4 ± 13.1), not elderly. Another study examined patients waiting for a scheduled appointment at the General Medical Clinic at the State University of New York Health Science Center aged 20-91, and found that people who reported little or no regular physical activity were less likely to eat fruits and vegetables (Rogers et al., 1995).

FOOD RECALL METHODS FOR ASSESSING FRUIT, VEGETABLE, AND/OR CAROTENOID INTAKE

Presently, no method for determining true dietary intake in the elderly population has been developed. The Beaver Dam Eye Study compared the Block-NCI Health Habits and History Questionnaire (HHHQ) with the USDA-NCI carotenoid food consumption database. This study showed that even though there were differences in intake estimates, the two databases similarly ranked people according to carotenoid intake (Vandenlangenberg et al., 1996). Another study by Forman et al. (1993) compared the HHHQ with 7-day food diaries. Estimates for the HHHQ for individual and total mean intake were consistently higher than the mean intake from the 7-day food diaries.

A study assessing HHHQ and serum carotenoid concentration in men ($n = 65$, mean age $= 28 \pm 5$) found significant correlations: alpha-carotene ($r = 0.29$, $P \leq 0.05$),

beta-carotene ($r = 0.36$, $P \leq 0.01$), beta-cryptoxanthin ($r = 0.46$, $P \leq 0.01$), and total carotenoids ($r = 0.41$, $P \leq 0.01$; Forman et al., 1993). The study by Jacques et al. (1993) showed a similar correlation for total serum carotenoids ($r = 0.37$; $n = 139$, mean age = 61).

Tucker and colleagues compared plasma carotenoid concentrations with dietary carotenoid intakes measured by the Willett FFQ and found significant correlations between all carotenoids in women and all except lutein/zeaxanthin in men when adjusted for age, BMI, plasma cholesterol concentration and smoking (1999). Tucker et al. also examined the relationship between plasma carotenoid concentrations and fruit and vegetables intake measured by the Willett FFQ. They found significant correlations similar to the other correlations (1999). Thus, assessment of both blood carotenoid concentrations and dietary patterns will be useful in assessing baseline measures of fruit and vegetable intake.

Previous research by Serdula et al. (1995) using the BRFSS Questions found that the median intake of fruits and vegetables for men and women over the age of 65 were 4.0 and 4.2 servings per day, respectively. In this study, 24% of older men and 28.9% of older women reported eating 5 or more servings per day.

SPECIFIC AIMS

Previous research has shown that older adults in the ENP are at risk for many nutritional problems (Brackett, 1999; Accettura, 2000). The overall aim of the present study was to examine fruit, vegetable, and carotenoid status and to assess the need for nutrition intervention to improve intakes of fruits and vegetables.

The specific aims of this study were to study older adults in the ENP to:

1. Estimate fruit and vegetable intakes by 2 methods: the Behavioral Risk Factor Surveillance System Questionnaire and the Block FFQ.
2. Determine the knowledge of recommendations for intakes of fruits and vegetables.

3. Examine the relationship of fruit and vegetable intake to fruit and vegetable knowledge.
4. Determine the relationship of serum carotenoids with fruit and vegetable intake and dietary intake of carotenoids.

RATIONALE

Previous research shows that older adults in the Northeast Georgia ENP have poor vitamin D and vitamin B12 status (Brackett, 1999; Accettura, 2000). However, this is the first study to investigate in detail serum carotenoid status and fruit and vegetable intake in ENPs in Georgia.

High fruit and vegetable consumption has been associated with a decreased risk of cardiovascular disease, certain cancers, hypertension, and stroke. Studies have shown other elderly populations are not consuming the recommended amounts of fruits and vegetables (Johnson et al., 1998; Donkin et al., 1998). Increasing the proportion of persons over 2 years of age who consume at least 2 servings of fruits and 3 servings of vegetables a day to 75% and 50%, respectively, are two objectives of Healthy People 2010 (2000). One of the first steps in improving fruit and vegetable consumption is to determine baseline intakes of fruits and vegetables. The validity of self-reported fruit and vegetable intake can be determined, in part, by assessing the relationship of fruit and vegetable intake with serum carotenoids. Knowledge of baseline fruit and vegetable intake including serum carotenoids will lay the foundation for developing appropriate nutrition interventions. These interventions are expected to improve the intake of these foods, thus lowering the risk of several chronic diseases.

HYPOTHESES

It was hypothesized that among older adult participants in the ENP:

1. Fruit and vegetable consumption would be less than 5 servings daily.
2. Knowledge and intake of fruits and vegetables would be positively correlated.

3. At least 50% of participants would know that 5 fruits and vegetables are recommended daily.
4. Fruit and vegetable consumption and dietary intake of carotenoids would be positively correlated with serum carotenoids when controlled for other factors influencing serum carotenoids including age, BMI, percent body fat, smoking, and serum cholesterol.

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CHAPTER 3

SERUM CAROTENOID CONCENTRATIONS AND FRUIT, VEGETABLE AND CAROTENOID INTAKE AMONG PARTICIPANTS IN NORTHEAST GEORGIA'S ELDERLY NUTRITION PROGRAM[1]

[1]Aspinwall, E. A., Johnson, M. A., Fischer, J. G., Gunter, E. W. To be submitted to The American Journal of Clinical Nutrition

Abstract

The objective of this research was to determine serum carotenoid concentrations and fruit, vegetable, and carotenoid intake among participants in the Northeast Georgia Elderly Nutrition Program (ENP). Fruit and vegetable intake was estimated by 2 methods: the Behavioral Risk Factor Surveillance System Questionnaire (BRFSS) and the Block Food Frequency Questionnaire (FFQ). Results were similar for both methods. Participants were a convenience sample who attended senior centers where lunch was provided (n = 70; mean age = 76; 85.5% female; 65% white; 35% black). When compared to non-participants, participants were similar in age, gender and race. Among the participants, 25-33% ate 5 or more servings of fruit and vegetables daily. Only 24% of the participants knew that people should eat 5 or more fruit and vegetables daily. 18-22% of those who knew people should eat 5 servings daily actually ate 5 or more servings daily. Knowledge and intake of fruits and vegetables were not correlated for the BRFSS questions ($r = .22$, $P = .07$) or the Block FFQ ($r = 0.12$, $P = .36$). Serum carotenoids were more highly correlated with the Block FFQ than the BFRSS Questionnaire measure of fruit and vegetable intake. In summary, fruit and vegetable intake was below recommendations among these elders, and the Block FFQ appeared to be a better indicator of fruit and vegetable intake than the BRFSS Questionnaire in this population.

Introduction

The purpose of this study was to estimate fruit and vegetable intake and carotenoid status in older adults participating in Elderly Nutrition Programs. The U.S. Bureau of Census (2000) reported the elderly population showing a large increase in number with the fastest growing age population being the 85+ group. In fact, by the year 2030, one in five people will be over the age of 65.

To help improve the nutritional status of older adults, Title III of the Older Americans Act (State and Community Programs), administered by the Administration on Aging, provides services and opportunities for older adults. Among those services are the congregate meal sites in community settings. The congregate meal program was established in 1972. Funded by the Older Americans Act of 1965, it provides 3 million meals daily for participants in the ENP. This program served nearly 45,000 people in Georgia in 1999 (Sudha Reddy, Georgia Office of Aging, personal communication). The Northeast Georgia ENP has approximately 1,400 registered and active clients. Despite provision of meals, older adults in the ENP are particularly vulnerable to nutritional problems (Brackett, 1999; Accettura, 2000). We have previously found that older adults in the ENP have a high prevalence of poor vitamin D and vitamin B12 status. Thus, the purpose of this study was to examine the prevalence of other nutrition related problems such as low fruit and vegetable intake and poor carotenoid status.

Approximately 80% of the elderly have at least one of the following chronic health conditions: cardiovascular disease, cancer, diabetes, auditory problems, visual problems, or dementia (Guralnik et al., 1989; US Dept. of Health and Human Services, 1994). Cardiovascular disease and cancer are the leading causes of death in the United States (Centers for Disease Control and Prevention, 2001). High fruit and vegetable consumption has been associated with a decreased risk of cardiovascular disease, certain cancers, hypertension, and stroke. Studies have shown other elderly populations are not consuming the recommended amounts of fruits and vegetables (Johnson et al., 1998; Donkin et al., 1998). Increasing the proportion of persons over 2 years of age who consume at least 2 servings of fruits and 3 servings of vegetables a day to 75% and 50%, respectively, are two objectives of Healthy People 2010 (2000). One of the first steps in improving fruit and vegetable consumption is to determine baseline intakes of fruits and vegetables. The validity of self-reported fruit and vegetable intake can be determined, in part, by assessing the relationship of fruit, vegetable, and carotenoid

intake with serum carotenoids. Information concerning fruit and vegetable intake including serum carotenoids will lay the foundation for developing appropriate nutrition interventions. These interventions are expected to improve the intake of these foods, thus lowering the risk of several chronic diseases.

One of the problems in estimating fruit, vegetable, and carotenoid status is identifying reliable measures of these indices particularly related to dietary intake. Several investigators have estimated the validity of fruit and vegetable intake by comparing intakes of serum or plasma carotenoids (Brady et al., 1996, Coates et al., 1991; Forman et al., 1993; Jacques et al., 1993; Roidt et al., 1988; Stryker et al., 1988; Tucker et al., 1999; Willett et al., 1983). Most investigators find considerable variability in the relationship of fruit and vegetable intake with blood carotenoids. Reasons for the variability include: problems in reliably estimating food intake, differences in carotenoid absorption related to cooking methods and fat intake, sample size, seasonal variations, regional food differences, and health status of participants.

The specific aims of this study were to: 1) estimate fruit and vegetable intake, 2) determine the knowledge of recommendations for intakes of fruits and vegetables, 3) examine the relationship of fruit and vegetable intake to fruit and vegetable knowledge, and 4) determine the relationship of serum carotenoids with the intakes of fruits, vegetables and carotenoids. It was hypothesized that older adults in ENPs would have low intake and low knowledge concerning fruits and vegetables, that knowledge would be related to intake, and the intake of fruits, vegetables, and carotenoids would be significantly and positively correlated with serum carotenoids.

Methods and Procedures

The University of Georgia and the Georgia Department of Human Resources Institutional Review Boards on Human Subjects approved all procedures. All questionnaires are in the Appendix.

Research Participants

A total of 11 men and 60 women, aged 62-93 were recruited. For the non-participant group there were 11 men and 41 women ages 60 to 95. The Senior Center Directors assisted in recruiting participants and displaying advertisements for this study. They were involved in setting the dates for the interviews and reminding participants of the days they were to participate. Dr. Mary Ann Johnson and/or Erica Aspinwall answered any questions they had about the study or the procedures.

The inclusion criteria were age 60 or older and a congregate meal participant in the Northeast Georgia ENP. The participants had to be community dwelling and physically and cognitively able to comply with testing procedures. Everyone attending the senior center was invited to participate in the study. The following counties participated in the study: Oconee, Jackson, Greene, and Morgan.

Information regarding demographics and general health from fifty-three non-participants was also collected. Potential participants were given a complete description of the study, informed of the requirements, and instructed that they may refuse at any time to be a part of the study. The participants were made aware of the benefits of the study, both to themselves, humankind, and science. After giving informed consent, participants gave samples of blood and answered questions administered by trained staff of the Department of Foods and Nutrition at the University of Georgia. The questions pertained to their diet, health, and lifestyle. As an incentive for participation, participants were given ten-dollar gift certificates to a local grocery store and the results from their blood analysis.

Blood Collection and Analysis

A licensed Medical Technologist collected blood one time from each consenting participant. It was not necessary that participants fast, but they were encouraged to do so if there was no medical reason for not fasting, such as diabetes. Four 7-10-mL tubes of blood were collected for tests including CBC and hematology (lavender whole blood tube); cholesterol, triglycerides, glucose and albumin other clinical indices (red top SST serum tube); and vitamins and carotenoids (2 red top serum tubes). Blood was transported in a container approved by Dr. Daryl Rowe, Bio-Safety Officer, to the laboratory of Dr. Mary Ann Johnson in room 379 Dawson Hall where the blood was processed (centrifuged and separated) and delivered by Jean Edmonds to the University Health Services Laboratory according to guidelines in our Standards Of Procedure. Laboratory Corporation of America (Birmingham, AL) was responsible for picking up the samples for analysis. The serum used for vitamin analysis was stored in 0.5 to 1.0 ml aliquots in Nalge 1.3 ml tubes (Nalge Nunc International, Rochester, NY). Blood used to analyze carotenoid levels was transported in aluminum bags to protect it from light. Ms. Elaine W. Gunter, a scientist with the Centers for Disease Control and Prevention in Atlanta, assessed in serum the major carotenoids (alpha-carotene, beta-carotene, beta-cryptoxanthin lycopene, and lutein/zeaxanthin), retinol and retinyl esters, and alpha-tocopherol (vitamin E) according to the procedures established by the CDC (1.0 ml serum; Gunter et al., 1985, 1996; Sowell et al., 1994; Miller & Yang, 1985). Reverse phase HPLC with multiple wavelength detection was used. We did not measure other nutritional antioxidants, such as vitamin C, which is unstable under our field conditions.

Health Assessment

Assessment was made of current use (years and amounts) of any medications or supplements and current and past health conditions as described previously (Brackett, 1999; Accettura, 2000). Participants were asked to bring in their medicine and supplement bottles for verification of drug names and dosages. Total numbers of

prescription, nonprescription, vitamin and mineral supplements were calculated along with total number of illnesses. Amounts of vitamins and minerals taken per day were also calculated.

Cognitive Screen

Cognitive status was evaluated using the short six-item Orientation-Memory-Concentration Test (Katzman et al., 1983). It has been validated against other mental status tests. The test assess knowledge of the current month, year, and time of day, and the ability to repeat phrases, and counting numbers and months backwards. Errors made by the subject are given a point. A score ≤ 8 indicates normal or minimal impairment, 9 to 19 indicates moderate impairment, and ≥ 20 indicates severe impairment.

Nutritional Assessment

The Nutrition Screening Initiative (NSI) Level I Screen was used to determine nutritional risk (NSI Manual for Professionals, 1991). This questionnaire has proven useful in determining increased risk for malnutrition in this target population. It includes ten questions regarding nutritional habits, weight changes, socioeconomic changes, and functional status. Weighted points are assigned for each question answered “yes”. A score of 3-5 indicates moderate nutritional risk while a score of 6 or higher indicates high nutritional risk. The maximum score for this test is 21.

Anthropometric measures were also used to assess nutritional status. Included in these measures are the following: mid-arm circumference (MAC), triceps skin fold (TSF), weight (using a digital scale with clothes and shoes on), height (in centimeters with client standing on a flat surface), knee height and calf circumference.

Food and Nutrient Intakes

The participants past month's intake of fruits, vegetables, and carotenoids was assessed using 38 questions from the Block FFQ (Block et al., 1998) and 6 questions

taken from the Behavioral Risk Factor Surveillance System (www.cdc.gov/nccdphp/brfss/brfsques-questionnaires.htm).

Bioelectrical Impedance

Percent body fat was collected from each participant using bioelectrical impedance. The instrument used to measure this was the Omron Body Logic Pro Model HBF-300 (Omron Health, INC., Vernon Hills, IL). Age, weight, and height were entered into the instrument and the participants were asked to hold the instrument in their hands with their arms stretched out in front of their body. The analyzer measures the resistance the body gives off as this current flows through it. Since fat tissues have little to no electrical conductivity, it can detect the ratio of fat tissues to other tissues. The Body Logic Pro was unable to read the percent body fat in some participants but a trend was not seen in its exclusion when looking at body weight and BMI.

Statistical Analysis

The data were analyzed using the Statistical Analysis System (version 6.10; SAS Institute, Cary, NC). All data was entered twice and the results compared to insure accuracy. Results from participants and non-participants were compared by univariate analyses. The analytical strategy for analysis of fruit, vegetable and carotenoid intake and serum carotenoid concentrations was similar to that described by Tucker et al. (1999) as part of the Framingham Study. Where indicated, serum carotenoid concentrations were square-root transformed to achieve normality. For specific aim 1, fruit and vegetable intake was examined by summing all categories within each questionnaire and calculating median, mean, and standard deviation.

For specific aim 2, participant's knowledge of fruit and vegetable recommendations was determined using frequency analysis. For specific aim 3, the relationship of fruit and vegetable intake to fruit and vegetable knowledge was determined by correlation analyses.

For specific aim 4, the relationship of serum carotenoids with fruit, vegetable, and carotenoid intake was examined with univariate (correlation) analyses. The dependant variables were the serum carotenoids (beta-carotene, alpha-carotene, lutein/zeaxanthin, lycopene, and cryptoxanthin), and the primary independent variables were the summary scores from the Behavioral Risk Factor Surveillance System or Block FFQ and each dietary carotenoid. T-test and ANOVA analyses were used to identify factors associated with serum carotenoids. There were no associations of total fruit and vegetable intake (measured by the Block FFQ and the BRFSS) or serum carotenoids with gender, race, education, cognition, knowledge of fruit and vegetable intake, self-reported health, health troubles, hypertension, diabetes, laxative use, lutein or vitamin A supplement use, percent body fat, BMI, or being at nutrition risk. However, there were associations of age, serum cholesterol, and/or smoking with some of the serum carotenoids. Therefore, in tables 7 through 9, the correlations were adjusted for these factors as needed.

Results

Table 1 shows the characteristics of the study population. The mean ages of the men and women were similar and the mean age was 76. There was equal representation of whites and blacks among the men (64 and 36%, respectively) and women (65 and 35%, respectively). Approximately 25% reported they were in poor or fair health, 19% reported that health troubles got in the way of them doing the things they wanted to do "a great deal," 42% could only walk 1 block or less without stopping, and 13% had severe cognitive impairment. Two participants (1 man, 1 woman) were current smokers while 7 participants (1 man, 7 women) currently used some other type of tobacco. When cognition status was measured using the Orientation-Memory-Concentration Test (Katzman et al., 1983) 66.2% of participants showed normal cognitive status, 21.1% showed moderate cognitive impairment and 12.7% showed severe cognitive impairment.

Table 2 presents the characteristics of non-participants surveyed. There were no statistically significant differences between the participants and non-participants for age, gender, race, or in the number of blocks they could walk without stopping. However, participants and non-participants were significantly different in self-reported health (P = 0.03) and the limitations their health troubles put on their activities and interests (P = 0.01) **(Table 3 and Table 4**). When comparing participant to non-participant self-reported health, the most obvious difference was that non-participants were more likely to be in excellent, fair or poor health and less likely to be in very good or good health. Thus, no clear trend emerged. Similarly, the most obvious difference in the limitations placed on activities and interests due to health troubles was that compared to participants, non-participants were more likely to report "not at all" or a great deal," but less likely to report "a little." Thus, no clear trend emerged.

Means, medians, and ranges for intake and serum concentrations for each of the 5 carotenoids are presented in **Table 5**. Some serum carotenoids were coded as missing for id 707 (lutein/zeaxanthin, missing from CDC analyses) and id 728 (alpha-carotene, beta-cryptoxanthin, and lycopene because they were "0" in analyses from CDC; this individual was in "fair" health, had NSI score of 13 indicating high nutritional risk, and was unable to do the fitness tests). The results are reported as μmol/L and μg/dL for comparison with previously reported data. Also presented, is the number of servings of fruits and vegetables eaten per day as reported for each of the two dietary intake methods. From the Block FFQ, the mean intake was 4.4 servings/d, the median was 4.4 servings/d, and 32.8% of the participants reported eating 5 or more servings a day. Fruit and vegetable intake was somewhat lower with the BRFSS Questionnaire with a mean intake of 4.2 servings/d, the median was 3.8 servings/d, and 25.4% reported

eating 5 or more servings/d. When asked how many servings of fruits and vegetables should people eat each day, only 24% reported 5 or more. Knowledge and intake of fruits and vegetables showed no correlation when estimated by the BRFSS questions (r = .22, P = .07) or the Block FFQ (r = 0.12, P = .36).

The distribution of serum carotenoids in these ENP participants (**Table 6**) was compared to NHANES III data reported by the Institute of Medicine (2000; See Appendix). Generally, at the 50^{th} percentile ENP participants had higher beta-carotene and higher alpha-carotene but lower beta-cryptoxanthin, lycopene, and lutein/zeaxanthin compared to NHANES participants of similar age.

Table 7 presents the Spearman and Pearson correlation coefficients between serum carotenoid concentrations and dietary carotenoid intake. In most instances, beta-cryptoxanthin, lycopene, total lutein, and dietary lutein/zeaxanthin, but not alpha-carotene, total beta-carotene, and dietary beta-carotene were significantly and positively correlated ($P \leq 0.05$). Adjustment for age, serum cholesterol, or smoking had little impact on these correlation coefficients except that significance was lost for lycopene. In univariate correlations, serum beta-cryptoxanthin was significantly correlated with dietary beta-cryptoxanthin (Spearman: r = 0.56, P < 0.001; Pearson: r = 0.40, P = 0.002), and was associated with serum cholesterol (Pearson: r = 0.38, P = 0.001). Serum lutein was significantly correlated with total lutein (Spearman: r = 0.35, P = 0.01; Pearson: r = 0.41, P = 0.003) and dietary lutein/zeaxanthin (Spearman: r = 0.35, P = 0.006; Pearson: r = 0.41, P = 0.001). Serum lutein was associated with serum cholesterol (Spearman: r = 0.36, P = 0.003) and smoking (Spearman: r = 0.24, P = 0.05). The sample size is lower in the dietary beta-carotene analyses due to the exclusion of participants taking supplements of vitamin A. The sample size is lower in

the dietary lutein/zeaxanthin analyses due to the exclusion of participants taking supplements of lutein.

There were no statistically significant correlations between serum carotenoid concentrations and fruit and vegetable intake measured by the Block FFQ even when adjusted for factors found to affect particular carotenoids (**Table 8**). However, when lycopene was adjusted for age, serum cholesterol, and smoking, and lutein/zeaxanthin was adjusted for serum cholesterol and smoking, the correlations tended to increase (Pearson: lycopene r = 0.02 to 0.11 and lutein/zeaxanthin r = 0.03 to 0.12). Although not statistically significant, all correlations were in the expected direction (positive). The sample size was lower in the dietary beta-carotene analyses due to the exclusion of participants taking supplements of vitamin A. The sample size was lower in the dietary lutein/zeaxanthin analyses due to the exclusion of participants taking supplements of lutein.

There were no significant positive correlations between serum carotenoid concentrations and fruit and vegetable intake as measured by the BRFSS Questionnaire (**Table 9**). The best positive correlations were seen for beta-cryptoxanthin when adjusted for serum cholesterol. The sample size was lower in the dietary beta-carotene analyses due to the exclusion of participants taking supplements of vitamin A. The sample size was lower in the dietary lutein/zeaxanthin analyses due to the exclusion of participants taking supplements of lutein.

Discussion

The main findings of this study were as follows; fruit and vegetable intake was below recommendations, knowledge and intake of fruit and vegetables were not significantly related, the intake of several dietary carotenoids was significantly and

positively correlated with serum carotenoids, and the serum concentrations of beta-cryptoxanthin, lutein/zeaxanthin, and lycopene tended to be lower than representative samples of older adults from NHANES III (Institute of Medicine, 2000). Also, based on correlational analyses of fruit and vegetable intake with serum carotenoids, the Block FFQ appears to be a more valid measure of fruit and vegetable intake than the BRFSS Questionnaire in this population. Although this was a convenience sample in 4 counties in Northeast Georgia, the demographic characteristics of participants and non-participants were very similar. Differences in self-reported health and health-related problems interfering with daily activities did not suggest that one group was in better physical or functional health than the other group. Thus, the participants included in this report reflect a representative sample of older adults receiving congregate meals in Elderly Nutrition Programs from these 4 counties.

Compared with previous research in this population, cognition was worse in these participants. Accettura (2000) reported that 71%, 24%, and 5% of participants had normal, moderate impairment, or severe impairment, respectively. Brackett (1999) reported similar findings. So while these participants had about 21% with moderate cognitive impairment much like the other 2 studies, this study had a greater percentage (13% vs. 5%) with severe cognitive impairment. Cognitive impairment was not associated with total fruit and vegetable intake or serum carotenoids (T-tests, ANOVA analyses). However, it is still possible that the poor cognition of this sample contributed to the low correlations of serum carotenoids with fruit, vegetable, and carotenoid intake.

Both dietary measures showed that fruit and vegetable intake averaged less than 5 daily. Similar findings have been reported in other samples (Tucker et al., 1999, Serdula et al., 1995). Knowledge and intake of fruits and vegetables were not strongly

correlated (r = 0.12 to 0.22), and only 24 % knew that the recommendation for fruits and vegetables is 5 or more servings daily. Thus, as emphasized by others (Owen, Splett, & Owen, 1999) it may be more important to increase skills in obtaining and preparing fruits and vegetables rather than just increasing knowledge alone. There are many reasons why fruit and vegetable intake may be less than recommended. Advancing age has been associated with a decrease in overall energy intake. Decreased appetite with aging, limited incomes in the elderly, cooking less food, lowered energy needs, including other factors may affect fruit and vegetable intake (Donkin et al., 1998). Thus, interventions designed to improve fruit and vegetable intake in older adults should take all of these factors into consideration.

The serum carotenoid concentrations of these elders were compared to older adults in NHANES III (Institute of Medicine, 2000). When comparing the 50th percentiles, the strongest trends were that older adults in ENP had lower serum lutein/zeaxanthin (men = 17.90 µg/dL, women = 19.60 µg/dL) than older adults in NHANES III (range for men, women ages 51 to 71 and 71+ was 21.2-23.4 µg/dL) and lower serum lycopene (men = 11.10 µg/dL, women = 15.40 µg/dL; NHANES III: 14.1-20.7 µg/dL) and beta-cryptoxanthin (men = 5.60 µg/dL, women = 8.50 µg/dL; NHANES III: 15.3-24.25 µg/dL). Green vegetables such as spinach and collard greens have the highest concentrations of lutein/zeaxanthin (Institute of Medicine, 2000) and Tucker reported that spinach, iceberg and romaine lettuce, and broccoli were the greatest contributor to lutein/zeaxanthin in older adults in Boston (Tucker et al., 1999). Tomatoes and tomato-based products are the richest sources of lycopene (Institute of Medicine, 2000). Beta-cryptoxanthin is found mainly in orange juice and other orange juice blends (Institute of Medicine, 2000). Thus, these data suggest that compared to a

nationally representative sample of older adults, elderly participating in ENPs in Georgia may have lower intakes of green vegetables, tomato products, and citrus fruits such as oranges. The findings related to lutein/zeaxanthin were surprising in light of the stereotypical assumption that people in the south consume large amounts of leafy greens (Houston et al., 1994). It is also possible that the somewhat poor health and high intakes of medication in these older adults in ENPs may have decreased the absorption of carotenoids when compared to representative samples of older adults. These findings suggest that interventions designed to increase fruit and vegetable intake in these elders should target green vegetables, tomato products, and citrus fruits.

In general, the Block FFQ was a better predictor of serum carotenoid concentrations than the BRFSS Questionnaire. We were unable to find any previous studies that compared these two diet assessment measures. Furthermore, the BRFSS Questionnaire has not been previously correlated with serum carotenoid concentrations. While the format and the brevity of these questions make them ideal for use in this population, the only significant correlations we found were negative. Some interviewers and participants reported that these BRFSS questions were confusing. We will test the reliability of both the FFQ and the BRFSS Questionnaire in this population in the future by administering each questionnaire twice. Previous researchers have reported positive associations using both the Willett and Block FFQ when correlated with serum or plasma carotenoid concentrations (Forman et al., 1993; Jacques et al., 1993; Tucker et al., 1999). Forman et al. found significant correlations for alpha-carotene, beta-carotene, beta-cryptoxanthin, and total carotenoids (1993). Jacques et al. found significant correlations for total serum carotenoids with dietary carotenoid intakes (1993). Similarly in the present study we found significant correlations between serum

and dietary beta-cryptoxanthin, lycopene, total lutein, and dietary lutein/zeaxanthin. Tucker et al. found significant correlations for all carotenoids in women and all except lutein/zeaxanthin in men (1999). The fact that Tucker's study had more significant associations may be due to the large sample size (n = 547) (1999).

Correlations between individual carotenoid intakes and serum carotenoids were much higher than the correlations between fruit and vegetable intakes and serum carotenoids. Tucker et al. found similar outcomes with their study (1999). Beta-carotene, and beta-cryptoxanthin, and lutein/zeaxanthin were better predictors of fruit and vegetable intake with correlations ranging from 0.16-0.18, than were alpha-carotene and lycopene. One reason for the lack of significant correlations between fruit and vegetable intake and serum carotenoid concentrations may be due to the inclusion of fruits and vegetables with low carotenoid concentrations when calculating intake using FFQs. Also, we did not assess the intake of other sources of carotenoids such as from meat, fish, poultry, and dairy products (Institute of Medicine, 2000).

Most studies comparing fruit and vegetable intake with serum carotenoid concentrations using FFQs actually use the entire set of questions. Due to the short attention span of our participants and the length of the other questionnaires used in this study we decided to use only 38 questions from the Block FFQ. As a result we were unable to correct for total energy intake as other researchers have done (Tucker et al., 1999; Forman et al., 1993). However, our correlations for carotenoid intakes with serum carotenoids (range 0.13–0.54) were not so different from Tucker's (range 0.14–0.36) when adjusted for the same variables except total energy intake. For correlations between fruit and vegetable intake and serum carotenoids ours were much lower, ranging from 0.01–0.18, than Tucker's ranging from 0.14–0.34 (1999). This may be

due to a combination of confounding factors including, but not limited to seasonal variation, health status of participants, regional food differences, and/or sample size.

In conclusion, fruit and vegetable intakes did not meet national recommendations and averaged only about 4 servings daily. The serum carotenoid analyses suggested that serum beta-cryptoxanthin, lutein/zeaxanthin, and lycopene were lower than nationally representative samples of older adults. Thus targets for future interventions should include foods rich in lutein/zeaxanthin (green vegetables), lycopene (tomato products), and beta-cryptoxanthin (citrus fruits such as oranges). The Block FFQ was more strongly positively correlated with serum carotenoids than was the BRFSS, thus the Block FFQ appears to be a more valid measure of fruit and vegetable intake.

Studies are ongoing to assess the reliability of these measures of fruit and vegetable intake (by administering each questionnaire twice to participants) and the frequency intake of every category of fruits and vegetables from the Block FFQ. Findings from these ongoing studies will also help identify foods that should be promoted in these elders and the best methods to measure changes in fruit and vegetable intake.

Table 1
Characteristics of the study population

	All Participants			Men			Women		
	n	Mean	SD	n	Mean	SD	n	Mean	SD
Age, y	71	76.1	7.9	11	75.1	8.7	60	76.8	7.8
White	46	64.8		7	63.6		39	65.0	
Black	25	35.2		4	36.4		21	35.0	
Would you say that in general your health is?, %									
Excellent	2	2.9		0	0.0		2	3.3	
Very Good	18	25.7		1	10.0		17	28.3	
Good	31	44.3		7	70.0		24	40.0	
Fair	13	18.6		1	10.0		12	20.0	
Poor	6	8.6		1	10.0		5	8.3	
How much do your health troubles stand in the way of you doing things?, %									
Not at all	21	30.0		4	40.0		17	28.3	
A little	36	51.4		5	50.0		31	51.7	
A great deal	13	18.6		1	10.0		12	20.0	

	All Participants			Men			Women		
	n	Mean	SD	n	Mean	SD	n	Mean	SD
How many blocks can you walk without stopping?, %									
0	15	21.7		2	20.0		13	22.0	
1	14	20.3		2	20.0		12	20.3	
2	11	15.9		1	10.0		10	16.9	
3	5	7.2		1	10.0		4	6.8	
4 or more	24	34.8		4	40.0		20	33.9	
BMI, kg/m^2	68	28.3	6.5	9	29.2	2.8	59	28.2	6.8
Body fat, %	60	39.0	6.7	9	29.6	4.2	51	40.7	5.6
Total serum cholesterol, mg/dL (μmol/L)[1]	69	213.3 (5.5)	43.5 (1.1)	11	207.6 (5.4)	52.8 (1.4)	58	214.5 (5.6)	41.9 (1.1)
Serum LDL cholesterol, mg/dL (μmol/L)[1]	68	126.2 (3.3)	39.3 (1.0)	11	134.6 (3.4)	43.3 (1.1)	57	125.3 (3.3)	38.8 (1.0)
Serum HDL cholesterol, mg/dL (μmol/L)[1]	69	53.3 (1.4)	14.1 (0.4)	11	38.6 (1.0)	9.0 (0.2)	58	56.1 (1.4)	13.2 (0.3)
Serum triglycerides, mg/dL (μmol/L)[1]	69	169.9 (4.4)	91.8 (2.4)	11	190.0 (4.5)	86.3 (2.2)	58	166.1 (4.3)	93.1 (2.4)

	All Participants			Men			Women		
	n	Mean	SD	n	Mean	SD	n	Mean	SD
Current smoker, %	2	2.8		1	9.1		1	1.7	
Current use of other tobacco, %	7	9.9		1	9.1		6	10	
Orientation-Memory-Concentration Test Scores, %									
Normal	47	66.2		7	63.6		40	66.7	
Moderate impairment	15	21.1		2	18.2		13	21.7	
Severe impairment	9	12.7		2	18.2		7	11.7	

[1] Non-fasted samples were collected.

Table 2
Characteristics of non-participants[1]

	All non-participants			Men			Women		
	n	Mean	SD	n	Mean	SD	n	Mean	SD
Age, y	41	77.2	10.4	6	76.7	10.4	35	77.3	10.5
White, %	31	59.6		6	60.0		25	59.5	
Black, %	21	40.4		4	40.0		17	40.5	
Would you say that in general your health is:, %									
Excellent	6	13.3		0	0.0		6	16.2	
Very good	8	17.8		2	25.0		6	16.2	
Good	12	26.7		3	37.5		9	24.3	
Fair	13	28.9		3	37.5		10	27.0	
Poor	6	13.3		0	0.0		6	16.2	
How much do your health troubles stand in the way of you doing things?, %									
Not at all	18	40.9		3	42.9		15	40.5	
A little	11	25.0		2	28.6		9	24.3	
A great deal	15	34.1		2	28.6		13	35.1	
How many blocks can you walk without stopping?, %									
0	16	38.1		3	37.5		13	38.2	
1	7	16.7		2	25.0		5	14.7	
2	7	16.7		2	25.0		5	14.7	
3	6	14.3		0	0.0		6	17.7	
4 or more	6	14.3		1	12.5		5	14.7	

[1] N varies for each variable because non-participants did not answer every question.

Table 3
Self-reported health responses
of participants versus non-participants[1]

	Participant*	Non-participant+
	%	%
Excellent	2.9	13.3
Very Good	25.7	17.8
Good	44.3	26.7
Fair	18.6	28.9
Poor	8.6	13.3

*n = 70
+n = 46
[1] P = 0.01

Table 4
Health trouble hindrances of
participants versus non-participants[1]

	Participants*	Non-participants+
	%	%
Not at all	30.0	40.9
A little	51.4	25.0
A great deal	18.6	34.1

*n = 70
+n = 45
[1] P = 0.055

Table 5
Serum carotenoid concentrations and dietary carotenoid intake in participants in the ENP

	n	Median	Mean (range)	SD	Median	Mean (range)	SD
Plasma carotenoid concentration			μmol/L			μg/dL	
Total carotenoids	43	1.38	1.610 (0.06-3.9)	0.82	75.20	87.82 (3.4-212.6)	44.73
Alpha-carotene	68	0.08	0.107 (0.03-0.6)	0.10	4.25	5.762 (1.6-32.1)	5.39
Beta-carotene[1]	69	0.45	0.593 (0.03-2.8)	0.45	24.2	31.833(1.4-154.3)	24.4
Beta-carotene[2]	43	0.42	0.525 (0.2-1.6)	0.35	22.7	28.181 (9.8-85.8)	18.57
Beta-cryptoxanthin	68	0.15	0.210 (0.05-1.2)	0.20	8.25	11.587 (2.6-65.2)	11.08
Lycopene	68	0.29	0.332 (0.07-1.2)	0.22	15.35	17.851 (3.8-62)	12.06
Lutein/zeaxanthin[3]	68	0.34	0.380 (0.04-1.0)	0.19	19.15	21.613 (2.0-57.5)	10.66
Lutein/zeaxanthin[4]	57	0.38	0.387 (0.1-1.01)	0.18	19.2	22.004 (7.1-57.5)	10.45
Dietary carotenoid intake, μg/d							
Alpha-carotene	66	821	1240 (62-7284)	1320			
Total beta-carotene (dietary & supplements)	66	6632	7471 (435-28,894)	5651			
Dietary beta-carotene	66	3547	5260 (435-19,591)	4304			
Beta-cryptoxanthin	66	172	199 (6-774)	158			
Lycopene	66	2212	3854 (78-30648)	5069			
Total lutein (dietary & supplements)	63	2006	3054 (329-12,790)	2648			
Dietary lutein/zeaxanthin	66	1893	3004 (329-12,790)	2621			

	n	Median	Mean (range)	SD	Median	Mean (range)	SD
Fruit and Vegetable Intake							
Block, servings/d	66	4.4	4.4 (9.9-1.1)	1.5			
Block, ≥ 5 servings/d, %	22	32.8					
BRFSS, servings/d	69	3.8	4.2 (1.4-11.1)	1.72			
BRFSS, ≥ 5 servings/d, %	18	25.4					
Knew to eat 5 or more servings per day, %	17	24.0					

[1] Includes both dietary and supplement intake of beta-carotene.
[2] Participants taking vitamin A supplements were excluded.
[3] Includes both dietary and supplement intake of lutein.
[4] Participants taking lutein supplements were excluded.
Molecular weights of carotenoids: alpha-carotene = 537; beta-carotene = 537; beta-cryptoxanthin = 553; lutein/zeaxanthin = 569; lycopene = 537. Source: Weast, R. C. Ed. (1975). Handbook of Chemistry and Physics, 56th ed. Cleveland; CRC Press, Inc.

Table 6
Serum carotenoid concentrations of participants

Sex	n	Mean	5th percentile	10th percentile	25th percentile	50th percentile	75th percentile
Beta-carotene (μg/dL)							
Men	11	27.71	11.00	11.40	19.10	24.20[1]	38.60
Women	58	32.62	9.90	12.10	15.20	24.00[2]	43.00
Alpha-carotene (μg/dL)							
Men	11	5.41	1.90	2.20	2.20	5.10[1]	5.60
Women	57	5.83	1.70	1.90	2,50	4.00[3]	6.30
Beta-cryptoxanthin (μg/dL)							
Men	11	10.55	3.40	3.80	4.90	5.60[3]	16.00
Women	57	11.79	3.30	3.80	4.90	8.50[3]	13.00
Lutein/zeaxanthin (μg/dL)							
Men	11	19.72	8.00	9.40	12.40	17.90[3]	22.80
Women	57	22.00	8.50	10.90	14.60	19.60[3]	28.10
Lycopene (μg/dL)							
Men	11	16.21	4.10	5.60	5.70	11.10[3]	26.30
Women	57	18.17	4.90	5.80	9.20	15.40[2]	25.40

1 Value higher than NHANES III data for people 71+.
2 Value similar to NHANES III data for people 71+.
3 Value lower than NHANES III data for people 71+.

Table 7
Correlations between serum carotenoid concentrations and dietary intake of carotenoids estimated by Block FFQ in participants of the ENP

	Spearman		Pearson	
	Crude	Adjusted	Crude	Adjusted
Alpha-carotene	0.18 (63)	0.18 (63)[5,6]	0.15 (63)	0.16 (63)[5,6]
Total beta-carotene[1]	0.13 (64)	0.12 (64)[6]	0.15 (64)	0.13 (64)[6]
Dietary beta-carotene[2]	0.10 (39)	0.10 (39)[6]	0.10 (39)	0.10 (39)[6]
Beta-cryptoxanthin	0.53* 63)	0.56 * (63)[6]	0.39* (63)	0.40* (63)[6]
Lycopene	0.26* (63)	0.17 (63)[6]	0.27* (63)	0.21 (63)[6]
Total lutein[3]	0.37* (62)	0.35* (62)[6,7]	0.36* (62)	0.41* (62)[6,7]
Dietary lutein/zeaxanthin[4]	0.38+(52)	0.35* (52)[6,7]	0.39*(55)	0.41* (52)[6,7]

Correlation Coefficient (n); Pearson correlations used square root transformations of the data.
* $P \leq 0.05$
+ $P = 0.05$ to 0.10
[1] Includes both dietary and supplement intake of beta-carotene.
[2] Participants taking vitamin A supplements were excluded.
[3] Includes both dietary and supplement intake of lutein.
[4] Participants taking lutein supplements were excluded.
[5] Adjusted for age.
[6] Adjusted for serum cholesterol.
[7] Adjusted for smoking.

Table 8
Correlations between serum carotenoid concentrations and fruit and vegetable intake measured by the Block FFQ in participants in the ENP

	Spearman		Pearson	
	Crude	Adjusted	Crude	Adjusted
Alpha-carotene	0.13 (63)	0.07 (63)[3,4]	0.03 (63)	0.02 (63)[3,4]
Beta-carotene[1]	0.18 (39)	0.18 (39)[4]	0.11 (39)	0.11 (39)[4]
Beta-cryptoxanthin	0.17 (63)	0.16 (63)[4]	0.16 (63)	0.21 (63)[4]
Lycopene	0.04 (63)	0.08 (63)[3,4,5]	0.02 (63)	0.11 (63)[3,4,5]
Lutein/zeaxanthin[2]	0.11 (52)	0.16 (52)[4,5]	0.03 (52)	0.12 (52)[4,5]

Correlation Coefficient (n); Pearson correlations used square root transformations of the data.
[1] Participants taking vitamin A supplements were excluded.
[2] Participants taking lutein supplements were excluded.
[3] Adjusted for age.
[4] Adjusted for serum cholesterol.
[5] Adjusted for smoking.

Table 9
Correlations between serum carotenoid concentrations and fruit and vegetable intake measured by the BRFSS in participants in the ENP

	Spearman		Pearson	
	Crude	Adjusted	Crude	Adjusted
Alpha-carotene	0.14 (66)	0.10 (63)[3,4]	0.09 (66)	0.11 (63)[3,4]
Beta-carotene[1]	-0.30[+] (41)	-0.35[*] (39)[4]	-0.32[*] (41)	-0.35[*] (39)[4]
Beta-cryptoxanthin	0.10 (66)	0.11 (63)[4]	0.05 (66)	0.12 (63)[4]
Lycopene	-0.18 (66)	-0.19 (63)[3,4,5]	-0.27[*] (66)	-0.26 (63)[3,4,5]
Lutein/zeaxanthin[2]	-0.30[*] (55)	-0.31[*] (52)[4,5]	-0.23[+] (55)	-0.20 (52)[4,5]

Correlation Coefficient (n); Pearson correlations used square root transformations of the data.
* $P \leq 0.05$
+ P = 0.05 to 0.10
[1] Participants taking vitamin A supplements were excluded.
[2] Participants taking lutein supplements were excluded.
[3] Adjusted for age.
[4] Adjusted for serum cholesterol.
[5] Adjusted for smoking.

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CHAPTER 4

OVERALL PURPOSE

The purpose of this study was 4-fold; 1) to estimate fruit and vegetable intake, 2) to determine knowledge of fruit and vegetable recommendations, 3) to determine the relationship between intake and knowledge of fruits and vegetables, and 4) to determine the correlation of fruit, vegetable and carotenoid intake with serum carotenoid concentrations in Northeast Georgia's ENP participants.

MAJOR FINDINGS

Based on nutritional assessments conducted in 71 older adults who were participants in the Northeast Georgia ENP and who were age 60 or older, fruit and vegetable intake was below 5 servings daily based on the Block FFQ and the Behavioral Risk Factor Surveillance System Questionnaire. Only 25-33% of participants reported eating 5 or more servings per day. Knowledge of fruit and vegetable recommendations was not associated with fruit and vegetable intake (Block $r = 0.12$, $P = 0.36$; BRFSS $r = 0.22$, $P = 0.07$). When fruit, vegetable and carotenoid intakes were correlated with serum carotenoid concentrations, the Block FFQ was a more reliable estimate of fruit and vegetable intake than the BRFSS Questionnaire.

A total of 53 non-participants were asked general health questions. When compared to participants, there were no differences in age, gender, race, or the number of blocks they reported they could walk without stopping. Non-participants were more likely ($P = 0.01$) to report their health troubles affected their activities "a great deal" or "not at all," while participants were more likely to report "a little." There was also a

significant difference ($p = 0.03$) in self-reported health, but no trends were seen. It could not be concluded that there were major differences in general health between participants and non-participants.

IMPLICATIONS

Knowing the importance of fruits and vegetables as part of a healthy diet in the prevention of several chronic diseases and that fruit and vegetable intake is low in this population of older adults who are at a greater risk of chronic disease, more research in this area should be done to determine a means to improve fruit and vegetable intake in this population. Gathering baseline data on fruit and vegetable intake was one of the first steps in improving the nutritional status and health of these individuals. Further research need to be done to develop a reliable means of assessing fruit and vegetable intake in the elderly population. This research reemphasizes the need to understand why varying correlations between carotenoid intake and serum carotenoid concentrations exist in the literature. Also, based on the comparison with national data, there is a need to promote the consumption of more green vegetables, tomato products, and citrus fruits in this population.

APPENDIX

Questionnaires

Nutrition and Physical Activity: Elderly Nutrition Programs

Questionnaire	Completed Yes/No	Reason NOT completed	Initials	Date (M/D/Y)
Consent Form				
Pre-Test Questionnaire				
Pre-Test Fitness Tests				
General Information				
Cognitive Screen				
Nutritional Screening Initiative				
Mini-Nutritional Assessment				
Medications				
Illnesses				
Food Frequency Instrument				
Nutritional Supplements				
Blood Collected				
Nutritional Status Report Sent to Individual				
Post-Test Questionnaires				
Post-Test Fitness Tests				

CONTACT INFORMATION FOR PARTICIPANT

*** Health Care Provider _____**

Address_____

_____

Phone_____

*** Care giver/ Next of Kin**

(1) _____ Phone_____

Address_____

_____

(2) _____ Phone_____

Address_____

_____

GENERAL INFORMATION ID: _____

_ _ _ _ _ _ **1. Today's date: ___ / ____ / ____** ***Month/Day/Year***

_ **2. This information was obtained from:**

0 _____ Client
1 _____ Senior center staff person
2 _____ Family member of client
3 _____ Caregiver for client
4 _____ Other: _____

_ _ . _ **3. How long has the client been using the services of the senior center?**

___ ___.___ years *Code as years (xx.x years)*

_ _ _ _ _ _ _ _ **4. Date of birth: ___ / ____ / ____** ***Month/Day/Year***

_ _ _ **5. Current age: _____** years *Example: age 75 is 075*

_ **6. Gender:** _____ Male (0) _____ Female (1)

_ **7. Ethnicity:** _____ Caucasian (0) _____ Black (1)
_____ Hispanic (2) _____ Asian (3) _____ Other (4)

_ _ **8. Years completed in school?** _____ Years

_ **9. Do you take a multiple-vitamin/mineral supplement?**
_____ No (0) ____ Yes (1)

_ **10. Do you take any other nutritional supplements that contain vitamins or minerals?**

_____ No (0) _____ Yes (1)

**** Fill out pages 11 and 12 with complete supplement information ****

For Nutritional Status Assessment only

__ __ 11. How many hours ago did you last eat? _____
(code number of hours ago).

__ 12. If you would like to, we can take a sample of your blood today. You don't have to give blood if you don't want to. If you choose not to give blood, you can still participate in the study. (0=no blood, 1=gave blood sample).

___ 13. Interviewed at home or senior center?
0= Home
1= Senior Center

__ __ 14. County of residence 00-10
00= Madison 03= Jackson 06= Greene 09= Elbert
01= Morgan 04= Newton 07= Clarke 10= Oconee
02= Walton 05= Barrow 08= Oglethorpe

___ 15. How was participant enrolled?
0= Recruited by flyer distributed by research staff
1= Referred by Senior Center Director

__ 16. Do you receive any supplemental food assistance such as having meals at the senior center, food stamps or other assistance?
0 = Yes
1 = No

__ 17. What kind of breakfast cereal do you eat most often?
0 = Grits
1= Oatmeal
3= Cold Cereal (Name)_____

__ 18. Do you smoke of use any other type of tobacco?
0= No
2= Smoke
3= Other type of tobacco

SUN EXPOSURE

___ 19. How many minutes of sun exposure do you get each week?

__ (0) < 9 minutes/week
__ (1) 10-30 minutes/week
__ (2) 30-59 minutes/week
__ (3) 60-89 minutes/week
__ (4) 90-119 minutes/week
__ (5) 120 (2 hours) or more minutes/week

__ (8) Do not know
__ (9) Missing

__ 20. How often do you use sunscreen when you go outside?

__ (0) Rarely/Never
__ (1) Sometimes
__ (2) Always
__ (8) Not applicable; does not go outside
__ (9) Missing

__ 21. If you use sunscreen, what level do you use?

__ (0) Don't know
__ (1) SPF 4 or less
__ (2) SPF 6 or 8
__ (3) SPF 10
__ (4) SPF 15
__ (5) SPF 30 and up
__ (8) Doesn't use
__ (9) Missing

ORIENTATION-MEMORY-CONCENTRATION TEST

Read all questions to the participant. Tell them that some of the questions may be easy and some may be hard -- just do the best you can.

	Response	# of Errors	Max. Errors	Weight Factor	Total
1) What is the year now?			**1**	**4**	
2) What month is it now?			**1**	**3**	
Please repeat this phrase after me: **JOHN BROWN, 42 MARKET STREET, CHICAGO** *No score for this -- it is a memory phrase for Item # 6. Allow the person up to three trials for learning (repeating) the phrase. If the subject has not learned the phrase after three trials, record the value of "0" as the total score for Item #6, and proceed to Item #3.*					
3) Without looking at your watch or a clock, tell me about what time is it? *Note: score is correct if within one hour of actual time.*			**1**	**3**	
4) Count backwards from 20 to 1. *20, 19, 18, 17, 16, 15, 14, 13, 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1*			**2**	**2**	
5) Say the months of the year in reverse order. *DEC, NOV, OCT, SEPT, AUG, JULY, JUNE, MAY, APR, MAR, FEB, JAN*			**2**	**2**	
6) Please repeat the name and address I asked you to remember. *Count the number of items (5) in memory phrase recalled incorrectly. An answer of either Market or Market Street is acceptable.* John / Brown / 42 / Market Street / Chicago			**5**	**2**	
TOTAL SCORE					

Interpretation of corrected scores:

≤ 8	Normal or minimal impairment
9-19	Moderate impairment
≥ 20	Severe impairment

Source: Katzman, R., Brown, T., Fuld, P., Peck, A., Schechter, R., Schimmel, H. Validation of a short orientation-memory-concentration test of cognitive impairment. *American Journal of Psychiatry* 140: 734-739, 1983.

NUTRITIONAL HEALTH: Nutritional Screening Initiative Questionnaire
ID: _____

No=0

Yes=

____ NH1. I have an illness or condition that made me change the kind and/or amount of food I eat.....Yes / No (2) (10)

____ NH2. I eat fewer than 2 meals per day.....Yes / No (3) (11)

____ NH3. I eat few fruits or vegetables, or milk products.....Yes / No (2) (12)

____ NH4. I have 3 or more drinks of beer, liquor or wine almost every day.....Yes / No (2) (13)

____ NH5. I have tooth or mouth problems that make it hard for me to eat .....Yes / No (2) (14)

____ NH6. I don't' always have enough money to buy the food I need.....Yes / No (4) (15)

____ NH7. I eat alone most of the time.....Yes / No (1) (16)

____ NH8. I take 3 or more different prescribed or over-the-counter drugs a day....Yes / No (1) (17)

____ NH9. Without wanting to, I have lost or gained 10 pounds in the last 6 months.....Yes / No (2) (18)

____ NH10. I am not always physically able to shop, cook, and/or feed myself.....Yes/No (2) (19)

Your Nutritional Score is: _____. If it's:

0-2 **Good.** Recheck your nutritional score in 6 months.

3-5 **You are at moderate nutritional risk.** See what can be done to improve your eating habits and lifestyle. Your office on aging, senior nutrition program, senior citizens center or health department can help. Recheck your nutritional score in 3 months.

6 or more. **You are at high nutritional risk.** Bring this checklist the next time you see your doctor, dietitian or other qualified health or social service professional. Talk with them about any problems you may have. Ask for help to improve your nutritional health.

MINI-NUTRITIONAL ASSESSMENT

ID# _____

Name: First name: Sex: Date:

Age:

TSF. Triceps skin fold (mm): __ __.__

Kneeht. Knee Height (cm): __ __.__

I. ANTHROPOMETRIC ASSESSMENT

____ MNA1. BMI (weight/(height)^2 in kg/m^2); weight = _____ lbs. / 2.205 = __ __ __ . __kg
0 = BMI < 19 height = _____ in. * .0254 = __ __ __ . __ meters
1 = 19 ≤ BMI < 21 BMI = __ __ . __
2 = 21 ≤ BMI < 23
3 = BMI ≥ 23

_____ MNA2. Mid arm circumference (MAC in cm.): __ __ . __ cm.
0.0 = MAC < 21
0.5 = 21 ≤ MAC ≤ 22
1.0 = MAC > 22

_____ MNA3. Calf circumference (CC in cm.): __ __ . __cm.
0 = CC < 31
1 = CC ≥ 31

_____ MNA4. Weight loss during last 3 months: _____ lbs. / 2.205 = __ __ __ . __ kg (40-44)kg
0 = weight loss > 3 kg
1 = does not know
2 = weight loss between 1 and 3 kg
3 = no weight loss

_____ MNA12A. How many servings of milk, yogurt, or cheese does the individual consume?

0 ____ Less than one per week	*3 ____ 3 per week*	*6 ____ 6 per week*
1 ____ 1 per week	*4 ____ 4 per week*	*7 ____ At least one per day*
2 ____ 2 per wee k	*5 ____ 5 per week*	*8 ____ 2 or more per day*
		9 ____ Missing/don't know

_____ MNA12D. How many servings of meat, fish, or poultry does the individual consume?

0 ____ Less than one per week	*3 ____ 3 per week*	*6 ____ 6 per week*
1 ____ 1 per week	*4 ____ 4 per week*	*7 ____ At least one per day*
2 ____ 2 per wee k	*5 ____ 5 per week*	*8 ____ 2 or more per day*
		9 ____ Missing/don't know

MEDICATIONS AND ILLNESSES - IN THE PAST YEAR NAME/ID: _____

Obtain information from reliable source. This information was provided by: client, caretaker, other _____?

IN THE PAST YEAR	YES (1)	NO (0)	DON'T KNOW	Space
Total number of PRESCRIPTION medications				10-11
Total number of NON -PRESCRIPTION medications, not counting vitamins and minerals				12-13
Multiple vitamin mineral supplement? 0 = no, 1 = yes				14
Number of other nutritional supplements?				15
Total number of illnesses - fill in when finished below.				16-17
1) Anemia				18
2) Alzheimer's				19
3) Other dementia's				20
4) Cancer				21
5) Circulatory problems				22
6) Congestive heart failure				23
7) Constipation				24
8) Diabetes				25
9) Diarrhea				26
10) Glaucoma				27
11) Hearing problems				28
12) Heart disease				29
13) Hypertension				30
14) Legally blind				31
15) Liver disease				32
16) Mental illness				33
17) Osteoporosis				34
18) Hip fracture				35
19) Pace maker				36
20) Parkinson's disease				37
21) Renal disease				38
22) Respiratory disease				39
23) Seizures				40
24) Skin rashes, bed sores				41
25) Stroke				42
26) Thyroid problems				43
27) Visual disturbances				44
28) Cataracts				45
29) Smoking: cigarettes, pipes, cigars, OR chewing tobacco				46
30) Surgery				47
31) Emergency room visit in the past year?				48
32) Other?				49
33)				50
34)				51
35)				52
36)				53
37)				54

RESIDENT MEDICATION RECORDS:
Include prescription, non-prescription, diet medications, and vitamins/minerals
ID _____

Medication	Dosage	Schedule	Route of Administration	*How Long have you been taking medication	DOCUMENTATION (Check all that apply)		
					Bottle only	Cardex Record	Signature Administration Record

MEDICATIONS			Space:
1)	Are you currently taking aspirin?	1 = Yes 0 = No	10
2)	Are you currently taking ibuprofen such as Advil, Motrin, Nuprin?	1 = Yes 0 = No	11
3)	Are you currently taking Aleve?	1 = Yes 0 = No	12
4)	Are you currently taking Acetaminophen such as Tylenol or similar medication?	1 = Yes 0 = No	13
5)	Are you currently taking antacids or medications for heartburn or indigestion such as maalox, mylanta, alka aid (alka-seltzer) gaviscon, propulsid, zantac, pepcid, axid, cyotec, tums or other medication?	1 = Yes 0 = No	14
6)	Are you currently taking laxatives such as milk of magnesia, fiber tablets, metamucil or other laxative medication?	1 = Yes 0 = No	15
7)	Are you currently taking a cough suppressant such as humibid, robitussin, entrex or other medication?	1 = Yes 0 = No	16
8)	Are you currently taking allergy, sinus, or cold medication such as chlorpheniramine, relief, allerfed, seldane, sudafed, sine aid, Tylenol allergy sinus, contac, tylenol cold formulas, methypred dose, claritin, phenylprop, guaif, bromfed, tavist-d, actifed, benadryl, equate allergy sinus or other medication?	1 = Yes 0 = No	17
9)	Are you currently using nasal spray for allergy or sinus, such as aerobid, flonase, beconase, Nasalcrom or other medication?	1 = Yes 0 = No	18
10)	Are you currently taking a non-steroidal anti-inflammatory drug (NSAID) such as voltaren, diclofenac, naprosyn, naproxyn, sulindac, lodine, relafen, daypro, oruvail or similar medication?	1 = Yes 0 = No	19
11)	Are you currently taking a pain medication such as ultram, darvocet-N-100, fiorinal or similar medication?	1 = Yes 0 = No	20
12)	Are you currently taking an arthritis medication such as prednisone, rheumatrex methotrexate, orasone, deltasone or other medication?	1 = Yes 0 = No	21
13)	Are you currently taking antibiotics such as zithromax, amoxicillin or other antibiotic medication?	1 = Yes 0 = No	22
14)	Are you currently taking a sleeping aid such as Tylenol PM or other medication?	1 = Yes 0 = No	23

MEDICATIONS			Space:
15)	Are you currently taking migraine medication such as mepergan fortis, imitrex, ercaf, Forbal-S or other migraine medication?	1 = Yes 0 = No	24
16)	Are you currently taking anti-anxiety medication such as xanax, tranxene, bellergal or other anti-anxiety medication?	1 = Yes 0 = No	25
17)	Are you currently taking anti-depressant medication such as prozac, klonopin, zoloft, diazepam (valium), amitriptyline (elavil), paxil, effexor, doxepin, hydroxyzine, trazodone (desyrel) or other anti-depressant medication?	1 = Yes 0 = No	26
18)	Are you currently taking diverticulitis medication such as levsin or other medication?	1 = Yes 0 = No	27
19)	Are you currently taking colitis medication such as dicyclomine or other medication?	1 = Yes 0 = No	28
20)	Are you currently taking any medications for gout (such as allopurinol), an ulcer (such as prilosec or prevacid), or any other GI medications?	1 = Yes 0 = No	29
21)	Are you currently taking high cholesterol medication such as questran, lopid, mevacor, niacin or other medication?	1 = Yes 0 = No	30
22)	Are you currently taking a diuretic such as hydrochloro-thiazide, lasix, furosemide, triamterene/HCTZ, aldactone or other medication?	1 = Yes 0 = No	31
23)	Are you currently taking hypokalemia medication such as potassium chloride or potassium gluconate or other medication?	1 = Yes 0 = No	32
24)	Are you currently taking high blood pressure medication such as hydrochlorothiazide, regroton, triamterene, maxzide, zestril, norvasc, verapamil, vasotec, prinivil, zestoretic, aldactone (aldosterone), lopressor, capoten, captopril, minipril or other medication?	1 = Yes 0 = No	33
25)	Are you currently taking heart or cardiac medication such as lanoxin or other medication?	1 = Yes 0 = No	34
26)	Are you currently taking an anticoagulant such as coumadin, dipyridamole or other medication?	1 = Yes 0 = No	35
27)	Are you currently taking urinary tract medication such as nitrofurantoin, macrobid, macrodantin or other medication?	1 = Yes 0 = No	36
28)	Are you currently taking incontinence medication such as oxybutynin, ditropan, detrol or other medication?	1 = Yes 0 = No	37
29)	Are you currently taking asthma medication such as theophylline, singulair or other medication?	1 = Yes 0 = No	38

MEDICATIONS			Space:
30)	Are you currently using a topical medication such as aclovate, cleocin-t, metrogel, elocon lotion or other topical medication?	1 = Yes 0 = No	39
31)	Are you currently using eye medication such as timoptic, Beta-optic or other medication?	1 = Yes 0 = No	40
32)	Are you currently taking weight loss medication such as profast hs, phentermine, meridia or other medication?	1 = Yes 0 = No	41
33)	Are you currently taking any medications for Parkinson's disease such as seligiline, carbidopa or other medicaiton?	1 = Yes 0 = No	42
34)	Are you currently taking any medication for dizziness or vertigo such as meclizine, antivert or other medication?	1 = Yes 0 = No	43
35)	Are you currently taking any anticonvulsant medication such as clonidine or other medication?	1 = Yes 0 = No	44
36)	Are you currently taking any estrogen/hormone therapy such as premarin, prempro or other medication?	1 = Yes 0 = No	45
37)	Are you currently taking any thyroid hormones such as synthroid or other medication?	1 = Yes 0 = No	46
38)	Are you currently taking chemotherapy or tamoxifen?	1 = Yes 0 = No	47
39)	Are you currently taking any bone-altering drugs such as bisphosphonates (Fosomax) or calcitonin?	1 = Yes 0 = No	48
40)	List any other medications currently taken:		
			49
			50
			51
			52
			53
			54
			55
	Total number of prescription medications		56-57
	Total number of non-prescription medications		58-59

	SUPP # __	***SUPP # __***	***SUPP # __***	***SUPP # __***	***SUPP # __***	***TOTAL***
	__ # pills per D, W, M **WRITE IN AMOUNT /PILL & CIRCLE UNIT**	**__ # pills per D, W, M** **WRITE IN AMOUNT /PILL & CIRCLE UNIT**	**__ # pills per D, W, M** **WRITE IN AMOUNT /PILL & CIRCLE UNIT**	**__ # pills per D, W, M** **WRITE IN AMOUNT /PILL & CIRCLE UNIT**	**__ # pills per D, W, M** **WRITE IN AMOUNT /PILL & CIRCLE UNIT**	
Vitamin A	IU RE	IU RE	IU RE	IU RE	IU RE	
Vitamin C	mg	mg	mg	mg	mg	
Vitamin D	IU mg	IU mg	IU mg	IU mg	IU mg	
Vitamin E	IU mg	IU mg	IU mg	IU mg	IU mg	
Thiamin (B1)	mg	mg	mg	mg	mg	
Riboflavin (B2)	mg	mg	mg	mg	mg	
Niacin or Niacinamide or Vit. B3	mg	mg	mg	mg	mg	
Pyridoxine or Vitamin B6	mg	mg	mg	mg	mg	
Folic acid or Folate	mcg mg	mcg mg	mcg mg	mcg mg	mcg mg	
Vitamin B-12	mg mcg	mg mcg	mg mcg	mg mcg	mg mcg	
Biotin	mg mcg	mg mcg	mg mcg	mg mcg	mg mcg	
Pantothenic Acid	mg	mg	mg	mg	mg	
Vitamin K	mcg	mcg	mcg	mcg	mcg	
Calcium	mg	mg	mg	mg	mg	
Iron	mg	mg	mg	mg	mg	
Phosphorus	mg	mg	mg	mg	mg	
Iodine	mcg	mcg	mcg	mcg	mcg	
Magnesium	mg	mg	mg	mg	mg	
Zinc	mg	mg	mg	mg	mg	
Copper	mg	mg	mg	mg	mg	
Potassium	mg	mg	mg	mg	mg	
Manganese	mg	mg	mg	mg	mg	
Chromium	mcg	mcg	mcg	mcg	mcg	
Molybdenum	mcg	mcg	mcg	mcg	mcg	
Chloride	mg	mg	mg	mg	mg	
Nickel	mcg	mcg	mcg	mcg	mcg	
Silicon	mg mcg	mg mcg	mg mcg	mg mcg	mg mcg	
Vanadium	mcg	mcg	mcg	mcg	mcg	
Boron	mg mcg	mg mcg	mg mcg	mg mcg	mg mcg	
Fluoride	mg	mg	mg	mg	mg	
Selenium	mcg	mcg	mcg	mcg	mcg	
Other						

NUTRITIONAL STATUS REPORT

NAME: _____

NUTRITION SCREENING INITIATIVE - 10 ITEM QUESTIONAIRE: _____

This questionnaire screens for nutritional problems.

_____	0-2	Good
_____	3-5	Moderate nutritional risk
_____	6 or more.	High nutritional risk; recommend nutrition consult

BODY MASS INDEX (KG/M2) - INDEX OF WEIGHT FOR HEIGHT: _____

This is an index of underweight, normal weight, and obesity.

_____ Greater than 27	Overweight; recommend nutrition consult
_____ 23-27	Good
_____ Less than 23	At risk for nutrition problems; recommend nutrition consult

WEIGHT LOSS (> 3 KG or 7 POUNDS IN PREVIOUS 3 MONTHS): _____

Unintentional weight loss is an indicator of low food intake or illness. However, some people need to lose weight if they are overweight and their weight is contributing to health problems.

_____ No weight loss	Good
_____ Weight loss > 7 lbs.	At risk for nutrition problems; recommend nutrition consult

PLEASE FEEL FREE TO CONTACT DR. JOAN FISCHER, REGISTERED AND LICENSED DIETITIAN, TO MAKE AN APPOINTMENT FOR A NUTRITION CONSULT: 706-542-7983.

PRE-TEST
PARTICIPANT EVALUATION
STATE - WIDE INSTRUMENT
Take Charge of Your Health – The Active Older Adult Speaker's Kit & Leg Exercises for Strength and Balance

	Read each question to the participant and record their answer. Encourage the participant to answer all questions and to give the best answer they can.		*Please do not write in this column.*
A1	**Participant ID:**	___	(1-3)
A2	**County**		(4-5)
A3	**Age**	___	(6-8)
		Circle One	
A4	**Gender**	Male (0) Female (1)	(9)
A5	**Ethnicity**	White (0) Black (1) Hispanic (2) Asian (3) Other (4)	
A6	**Would you say that in general your health is:**	Excellent (1) Very Good (2) Good (3) Fair (4) Poor (5)	
A7	**How much do your health troubles stand in the way of you doing things?**	Not at all (0) A little (1) A great deal (2)	

		Circle One	
A8	**How important is it to your health to be active on all or most days of the week?**	Not at all (0) Somewhat (1) Very (2) Extremely (3)	
	For Questions A9-A14: Do not read responses. Probe with categories as needed. Write response in the blanks. ***Think about your diet during the past month ...***	***Write servings in blanks.***	
A9	**How often did you drink fruit juices such as orange, grapefruit, or tomato?**	Day 1 __ __ Week 2 __ __ Month 3 __ __ Year 4 __ __ Never 555	
A10	**Not counting juice, how often did you eat fruit?**	Day 1 __ __ Week 2 __ __ Month 3 __ __ Year 4 __ __ Never 555	
A11	**How often did you eat green salad?**	Day 1 __ __ Week 2 __ __ Month 3 __ __ Year 4 __ __ Never 555	
A12	**How often did you eat potatoes not including french fries, fried potatoes, or potato chips?**	Day 1 __ __ Week 2 __ __ Month 3 __ __ Year 4 __ __ Never 555	
A13	**How often did you eat carrots?**	Day 1 __ __ Week 2 __ __ Month 3 __ __ Year 4 __ __ Never 555	
A14	**Not counting carrots, potatoes, or salad, how many servings of vegetables did you usually eat?**	Day 1 __ __ Week 2 __ __ Month 3 __ __ Year 4 __ __ Never 555	

		Circle one	
A15	**How are your vegetables usually prepared?**	Fried (0) Steamed or boiled (1) Uncooked or raw (2)	
A16	**How many servings of fruits and vegetables <u>should</u> people eat each day?**	0 1 2 3 4 5 or more	
A17	**On average, how much milk do you usually drink or eat on cereal each day?**	Cups: 0 1 2 3 or more	
A18	**What type of milk do you usually drink?**	(0) Don't drink milk (1) Whole (2) 2% (3) 0.5-1% (4) Skim	
A19	**To lower your risk of developing heart disease or stroke, are you?** **a. Eating fewer high fat or high cholesterol foods?**	Yes (1) No (2) Don't know/No response (3)	
A20	**b. Exercising more?**	Yes (1) No (2) Don't know/No response (3)	
A21	**How is your meat, chicken, or fish usually prepared?**	Fried (0) Broiled or grilled (1) Baked (2)	
A22	**I read the nutrition labels on food packages before I buy.**	No (0) Yes (1)	
A23	**What kind of fat increases the risk of heart disease?**	Saturated fat (0) Unsaturated fat (1) *Don't know (2)*	

		Circle One	
A24	**How many blocks can you walk without stopping?**	0 1 2 3 4 or more blocks	
A25	**During the past <u>month</u>, did you participate in any physical activities or exercises such as running, calisthenics, golf, gardening, or walking for exercise?**	No (0) Yes (1)	
A26	**During the past <u>week</u>, did you do leg exercises (as shown in this picture)?**	No (0) Yes (1)	
A27	**During the past <u>month</u>, did you do leg exercises (as shown in this picture)?**	No (0) Yes (1)	
A28	**How much physical activity should people do most days of the week?**	(0) 0 minutes (1) 1-5 minutes (2) 6-10 minutes (3) 11-15 minutes (4) 16-20 minutes (5) 21-25 minutes (6) 26-29 minutes (7) 30 or more	
	Do any of the following keep you from being active on all or most days of the week?		
A29	**I have a health condition that keeps me from being active.**	No (0) Yes (1)	
A30	**I already am active on all or most days of the week.**	No (0) Yes (1)	
A31	**It costs too much.**	No (0) Yes (1)	
A32	**I don't have time.**	No (0) Yes (1)	
A33	**I don't like to.**	No (0) Yes (1)	
A34	**It's too late to improve my health.**	No (0) Yes (1)	
A35	**It's not safe.**	No (0) Yes (1)	

	EPESE SHORT BATTERY **Physical Performance Test - Task Descriptions** ***Equipment:*** ***Stop watch, 8 foot tape measure, chair with no arms***	**RECORD TIME IN SECONDS**	
ASB	**STANDING BALANCE:** Includes (a) semi-tandem (heel of one foot placed at mid-position of the other) followed by either: (b) tandem (one foot directly in front of the other, heel to toe) if semi-tandem is held for 10 seconds **OR** (c) side-by-side if semi-tandem is not held for 10 seconds. Each is timed until 10 seconds, participant moves feet, or grasps support, whichever first occurs.	Time in seconds to the nearest 10th second: (a) _____ (b) _____ (c) _____	
AFW	**8 FOOT WALK:** Participant is timed to walk an 8-foot straight walking course at their normal gait, using any assistive devices they normally use while walking (such as canes or walkers). Participant completes walk 2 times.	Time in seconds to the nearest 10th second (do twice): (a) _____ (b) _____ (c) Was assistive devise used? (0) No (1) Yes	
ACS	**CHAIR STANDS:** Participant is asked to stand one-time from a seated position on a straight-backed chair with their arms folded across their chest. If successful, participant is asked to stand up and sit down 5 more times as quickly as possible. If not initially successful, then it is not performed beyond initial request.	Time in seconds to the nearest 10th second for 5 times quickly: (a) _____	
	Notes on scoring (seconds): **Standing balance:** 1= <1.0; 2= ≥1.0 and ≤2; 3= 3-9; 4= 10+ **Walk 8 feet:** 1= ≥5.7; 2= 4.1-5.6; 3= 3.2-4.0; 4= ≤3.1 **Chair stand 5 times:** 1= ≥16.7; 2= 13.7-16.6; 3= 11.2-13.6; 4= ≤11.1		

	Functional Fitness Test for Older Adults		
AFF1	30-Second Chair Stand	# Stands in 30 Sec.: _____	(10-11)
AFF2	Arm Curl	# Curls in 30 Sec.: _____	(12-13)
AFF3	Chair Sit-and-Reach *(two times)*	**Time 1** # Inches person is short of reaching the toe: _____ (-) ***or*** # Inches person reaches beyond toe _____ (+) *Measure to the nearest 1/2 inch* **Time 2** # Inches person is short of reaching the toe _____ (-) ***or*** # Inches person reaches beyond toe _____ (+) *Measure to the nearest 1/2 inch*	(14-16)
AFF4	8-Foot Up-and-Go *(two times)*	**Time 1:** Time in Sec.: _____ **Time 2:** Time in Sec.: _____	(17-19)
AFF5	Back Scratch *(two times*)	**Time 1** Distance of overlap to the nearest 1/2 inch _____ (+) ***or*** Distance between the finger tips to the nearest 1/2 inch: _____ (-) **Time 2** Distance of overlap to the nearest 1/2 inch _____ (+) ***or*** Distance between the finger tips to the nearest 1/2 inch: _____ (-)	(20-22)

Nutrition and Physical Activity: Elderly Nutrition Programs
NON-PARTICIPANT INTERVIEW FORM

The following information is to be provided for all individuals declining participation in the study.

	Read each question to the participant and record their answer. Encourage the participant to answer all questions and to give the best answer they can.		***Please do not write in this column.***
A1	**Participant ID:**	— — —	(10-13)
A2	**County**		(14-15)
A3	**Age**	— — —	(16-18)
		Circle One	
A4	**Gender**	Male (0) Female (1)	(19)
A5	**Ethnicity**	White (0) Black (1) Hispanic (2) Asian (3) Other (4)	(20)
A6	**Would you say that in general your health is:**	Excellent (1) Very Good (2) Good (3) Fair (4) Poor (5)	(21)
A7	**How much do your health troubles stand in the way of you doing things?**	Not at all (0) A little (1) A great deal (2)	(22)
A24	**How many blocks can you walk without stopping?**	0 1 2 3 4 or more blocks	(23)
NP1	**What are the reasons you do not wish to participate in the study which consists of answering questions, having a fitness test, having blood drawn, and attending nutrition education and physical activity lessons? (List all that apply).**		
NP2	**Who was this information obtained from?** (1) Client (2) Senior Center Director (3) Other (please indicate):		(24)

NUTRITION AND PHYSICAL ACTIVITY CONSENT FORM

I, _____ agree to part in the research titled "NUTRITION AND PHYSICAL FITNESS" conducted by Dr. Mary Ann Johnson Investigator from the Department of Foods and Nutrition at the University of Georgia. I understand that I do not have to take part if I do not want to. I can stop taking part without giving any reason, and without penalty. I can ask to have all of the information about me returned to me, removed from the research records, or destroyed.

The reason for this study is to test nutrition education and physical activity programs to find out if senior citizens enjoy them and benefit from them.

If I volunteer to take part in this study, I will be asked to do the following things:

1) **Answer questions about my health, food, nutrition, and physical activity,**
2) **Have my fitness level tested by doing everyday activities such as getting out of a chair and walking a short distance,**
3) **Listen to nutrition education programs,**
4) **Take part in a physical activity program to improve my strength and balance,**
5) **If I am willing, a medical technologist will take samples of my blood one time at the beginning of the study to measure my blood sugar, cholesterol, vitamins and minerals,**
6) **Someone from the study may call me to clarify my information,**
7) **My information will be kept and I will be contacted in 5 years for a follow-up.**

I will receive a $10 gift certificate for answering questions, having my fitness tested, and/or giving a blood sample at the beginning of this study. I will also receive another $10 gift certificate for answering questions and/or having my fitness tested at the end of the study. Even if I do not give a blood sample, I will still receive the gift certificates.

My blood will not be tested for HIV-AIDS. I understand that these questions and blood tests are not for diagnostic purposes. If I have questions about my test results I should see a physician. I understand that I do not have to give a blood sample and I can still be in this study even if I choose not to give blood. The benefits for me are that the nutrition and physical activity programs may help me understand and improve my health.

No risk is expected but I may experience some discomfort or stress when my fitness is tested, my blood is drawn or when the researchers ask me questions about health, nutrition and physical activity. The risks of drawing blood from my arm include the unlikely possibilities of a small bruise or localized infection, bleeding, and fainting. These risks will be reduced in the following ways: my blood will be drawn only by a qualified and experienced person who will follow standard sterile techniques, who will observe me after the needle is withdrawn, and who will apply pressure to the blood draw-site. In the event that I have any health problems associated with the blood draws, my insurance or me will be responsible for any related medical expenses.

No information about me, or provided by me during the research, will be shared with others without my written permission, except if it is necessary to protect my welfare (for example, if I were injured and need physician care) or if required by law. I will be assigned an identifying number and this number will be used on all of the questionnaires I fill out.

The investigator will answer any further questions about the research, now or during the course of the project (706-542-4838).

I give my permission for the researchers to release my blood analysis information to my health care provider.
Circle one: YES / NO. Initial _____.

I will allow the staff to take my picture, videotape or record me while participating in the study. I can verbally refuse at anytime and my wishes will be upheld. My pictures will only be used to promote this nutrition and physical activity program.
Circle one: YES / NO. Initial _____.

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

_____ _____

Signature of Investigator **Date**

Signature of Participant **Date**

_____ _____

Phone Number **Address**

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

Department of Foods and Nutrition
University of Georgia
390 Dawson Hall
Athens, GA 30602

June 12, 2000

Dear _____,

Thank you for participating in the research study titled "Nutrition and Physical Activity" conducted by Dr. Mary Ann Johnson in the Department of Foods and Nutrition at the University of Georgia. As a service to participants in the study, we are sending you your blood work and nutritional status report. These tests are not for diagnostic purposes. If you have any questions about your results, you should consult your physician. Your physician will also receive a copy of your blood results and nutritional status report if you requested us to do so on your consent form.

We appreciate you donating your time to help with this study. If you have any questions please feel free to contact us at 706-542-4838.

Sincerely,

Mary Ann Johnson, Ph.D.
Professor of Foods and Nutrition
& Faculty of Gerontology

Enc.

Department of Foods and Nutrition
University of Georgia
390 Dawson Hall
Athens, GA 30602

June 12, 2000

Dear Physician:

Your patient, _____, recently participated in the research study titled "Nutrition and Physical Activity" conducted by Dr. Mary Ann Johnson in the Department of Foods and Nutrition at the University of Georgia. As a service to our participants, we are providing their physicians a copy of their blood work and a nutritional status report. Any critical values have been previously reported to your office. We do not provide a diagnosis based on the results of their blood work.

The "Nutritional and Physical Activity" study is a 12 week intervention involving weekly nutrition education and chair exercises among participants in the Northeast Georgia senior centers. We hope you will encourage your patient to participate in this program.

If you have any questions, please feel free to contact me at 706-548-2292.

Sincerely,

Mary Ann Johnson, Ph.D.
Professor of Foods and Nutrition
& Faculty of Gerontology

Enc.

Serum Carotenoid Concentrations of Persons Ages 51 Years and Older: Mean and Select Percentiles, United States, NHANES III, 1988-1994

Sex and Age, y	Number of Persons Examined	Mean	5th percentile	10th percentile	25th percentile	50th percentile	75th percentile
Beta-carotene (μg/dL)							
M, 51-70	1,892	19.5	4.7	6.3	9.6	15.3	24.1
SE		0.6	0.4	0.3	0.4	0.4	0.8
M, 71+	1,193	23.4	5.7	7.6	11.6	18.0	28.1
SE		0.9	0.2	0.3	0.6	0.6	1.8
F, 51-70	1,955	26.4	6.4	8.5	13.1	20.6	32.3
SE		0.8	0.3	0.4	0.6	0.6	1.7
F, 71+	1,289	31.1	8.4	10.6	15.7	24.5	38.7
SE		1.0	0.4	0.4	0.5	0.7	1.2

Sex and Age, y	Number of Persons Examined	Mean	5th percentile	10th percentile	25th percentile	50th percentile	75th percentile
Alpha-carotene (μg/dL)							
M, 51-70	1,856	4.75	1.05	1.25	2.28	3.89	5.98
SE		0.14	0.04	0.04	0.13	0.12	0.19
M, 71+	1,175	4.79	1.12	1.25	2.71	4.07	5.93
SE		0.15	0.02	0.08	0.12	0.12	0.19
F, 51-70	1,938	6.01	1.20	1.60	3.30	4.90	7.50
SE		0.22	0.03	0.19	0.12	0.18	0.31
F, 71+	1,279	6.38	1.50	2.20	3.50	5.20	7.70
SE		0.20	0.08	0.12	0.11	0.13	0.24
Beta-cryptoxanthin (μg/dL)							
M, 51-70	1,893	8.83	2.90	3.70	5.00	7.30	10.90
SE		0.21	0.14	0.15	0.14	0.22	0.31
M, 71+	1,193	8.58	2.60	3.40	4.80	7.10	10.70

Sex and Age, y	Number of Persons Examined	Mean	5th percentile	10th percentile	25th percentile	50th percentile	75th percentile
SE		0.2	0.15	0.16	0.16	0.23	0.37
F, 51-70	1,954	10.25	3.30	4.00	5.70	8.50	12.80
SE		0.27	0.13	0.16	0.17	0.24	0.37
F, 71+	1,287	11.38	3.40	4.30	6.30	9.60	14.40
SE		0.45	0.19	0.19	0.22	0.38	0.71
Lutein/zeaxanthin (μg/dL)							
M, 51-70	1,894	24.0	10.2	12.4	16.4	21.7	28.7
SE		0.5	0.3	0.3	0.3	0.4	0.6
M, 71+	1,193	23.5	10.1	11.9	15.6	21.2	28.8
SE		0.6	0.3	0.3	0.3	0.5	0.7
F, 51-70	1,956	24.4	10.2	12.2	16.2	21.7	29.4
SE		0.5	0.2	0.5	0.7	0.4	1.4
F, 71+	1,289	25.7	10.8	12.9	17.2	23.4	31.6

Sex and Age, y	Number of Persons Examined	Mean	5th percentile	10th percentile	25th percentile	50th percentile	75th percentile
SE		0.7	0.4	0.4	0.5	0.7	0.9
Lycopene (μg/dL)							
M, 51-70	1,893	22.0	7.7	10.0	14.5	20.7	28.0
SE		0.4	0.3	0.3	0.4	0.4	0.5
M, 71+	1,188	15.5	4.7	6.1	9.3	14.1	20.3
SE		0.4	0.2	0.3	0.4	0.4	0.6
F, 51-70	1,955	20.9	7.4	9.5	13.7	19.5	26.6
SE		0.4	0.3	0.3	0.3	0.4	0.6
F, 71+	1,282	17.0	5.2	6.8	10.3	15.4	22.0
SE		0.4	0.3	0.3	0.3	0.4	0.6

Institute of Medicine Food and Nutrition Board. (2000). Dietary reference intakes: vitamin C, vitamin E, selenium, carotenoids. Washington, D.C.: National Academy Press.

Biochemical indices of older adults in ENPs

Variables	Description	Normal Range	Mean ± SD n=69
GLU	Glucose	65-109 mg/dL	140.0±70.9
URIC	Uric acid	1.5-6.7 mg/dL	5.4±0.7
BUN	Urea Nitrogen	5-26 mg/dL	19.8±8.4
CREAT	Creatinine	0.5-1.5 mg/dL	1.2±0.5
BUNCREAT	BUN/Creatinine ratio	6-25	17.0±5.1
NABLOOD	Sodium	135-148 meq/L	140.4±2.8
KBLOOD	Potassium	3.5-5.5 meq/L	4.7±0.5
CLBLOOD	Chloride	96-109 meq/L	103.0±3.1
CABLOOD	Calcium	8.5-10.6 mg/dL	9.4±0.5
PHBLOOD	Phosphorus	2.5-4.5 mg/dL	3.5±0.5
PROBLOOD	Protein, total	6.0-8.5 g/dL	7.1±0.5
ALB	Albumin	3.6-4.8 g/dL	4.1±0.3
GLOB	Globulin	1.5-4.5 g/dL	3.0±0.5
ALBGLOB	Albumin/Globulin ratio	1.1-2.5	1.4±0.3
BILI	Bilirubin	0.1-1.2 mg/dL	0.5±0.3
ALKPHOS	Alkaline Phosphatase	25-165 IU/L	84.2±32.0
LDH	LDH	100-250 IU/L	162.1±32.7
AST	AST (SGOT)	0-45 IU/L	18.9±5.1
ALT	ALT (AGPT)	0-50 IU/L	14.8±6.1
GGT	GGT	0-70 IU/L	29.5±17.2
CHOLBLD	Cholesterol, total	<200 mg/dL	213.3±43.5
TRIGLY	Triglycerides	<200 mg/dL	169.9±91.8
HDL	HDL Cholesterol	≥35 mg/dL	53.3±14.1
VLDL	VLDL Cholesterol	5-40 mg/dL	32.5±16.1
LDL	LDL Cholesterol	<130 mg/dL	126.2±39.3
CHOLHDLC	T. Chol/HDL Ratio	<4.45	4.2±1.5
CHDRISK	Estimated CHD Risk	0.0-1.0	0.9±0.5
TSH	TSH	0.35-5.5 mcIU/mL	2.7±1.9
T4	T-4 (thyroxine)	4.5-12 mcg/dL	8.4±1.5
T3	T-3 uptake	24-39 %	30.1±3.1
FREET4	Free T4 index	1.2-4.9	2.5±0.5
WBC	WBC count	4.0-10.5 thous/μL	6.2±1.7

Variables	Description	Normal Range	Mean ± SD n=69
RBC	RBC count	3.8-5.1 mill/µL	4.3±0.5
HB	Hemoglobin	11.5-15.0 g/dL	13.1±1.5
HMT	Hematocrit	34.0-44.0 %	39.4±4.2
MCV	MCV	80-98 fL	92.0±5.6
MCH	MCH	27.0-34.0pg	30.6±2.0
MCHC	MCHC	32.0-36.0 g/dL	33.2±0.8
RDW	Red Cell Width	11.7-15.0 %	13.9±1.24
PLATELET	Platelets	140-415 x 10-3/µL	227.5±66.0
POLYS	Polycytes	40-74 %	58.6±9.9
LYMPCYTE	Lymphocytes	14-46 %	30.3±9.0
MONCYTE	Monocytes	4-13 %	7.6±3.3
EOSIN	Esinophils	0-7 %	2.8±1.6
BASOPHIL	Basophils	0-3 %	0.7±0.8
ABSPOLYS	Absolute Polycytes	1.8-7.8 x 10-3/µL	3.7±1.4
ABSLYMP	Absolute Lymphocytes	0.7-4.5 x 10-3/µL	1.9±0.7
ABSMONO	Absolute Monocytes	0.1-1.0 x 10-3/µL	0.5±0.2
ABSEOSIN	Absolute Esinophils	0.0-0.4 x 10-3/µL	0.2±0.1
BSBASO	Absolute Basophils	0.0-0.2 x 10-3/µL	0.0±0.1

Illnesses of older adults in ENP

Illnesses	Percent of Total Sample n=69
Anemia	14.5
Alzheimer's Disease	1.4
Other Dementia	1.4
Cancer	11.6
Circulatory Problems	15.9
Congestive Heart Failure	5.9
Constipation	29.0
Diabetes	34.8
Diarrhea	8.7
Hearing Problems	4.3
Glaucoma	29.0
Heart Disease	21.7
Hypertension	58.0
Legally Blind	8.7
Liver Disease	0.0
Mental Illness	0.0
Osteoporosis	20.6
Hip Fracture	7.2
Pace Maker	2.9
Parkinson's Disease	5.8
Renal Disease	4.3
Respiratory Disease	14.7
Seizures	2.9
Skin rashes, bed sores	2.9
Stroke	15.9
Thyroid Problems	20.3
Visual Disturbances	20.3
Cataracts	61.8
Smoking/chewing tobacco	14.5
Surgery in the past year	58.0
ER visit in last year	33.3
Arthritis	8.7
Hiatal Hernia	1.4
Allergies	1.4
Ulcerated Stomach	1.4

Percentage of ENP participants taking certain medications more than 3 times a week

Medication Category	Percent of Total Sample N = 71
Aspirin	44.9
Ibuprofen	11.6
Aleve	2.9
Acetaminophen	42.0
Antacids	31.9
Laxative	26.1
Cough suppressant	5.8
Allergy	10.1
Nasal spray	4.3
NSAID	2.9
Pain medication	10.0
Arthritis	21.4
Antibiotic	1.4
Sleep aid	5.7
Migraine	0.0
Antianxiety	4.3
Antidepressant	10.0
Diverticulitis	0.0
Colitis	0.0
GI medication	11.4
Cholesterol	14.3
Diuretic	30.0
Hypokalemia	4.3
High blood pressure	61.4
Cardiac	21.4
Anticoagulant	5.7
Urinary tract	0.0
Incontinence	0.0
Asthma medication	11.4
Topical medications	0.0
Eye medication	2.9
Parkinson’s	5.7
Dizziness	4.3
Anticonvulsant	4.3
Estrogen	5.7
Thyroid	15.7
Chemotherapy	0.0
Bone medication	7.1
Diabetes medication	30.0
Prostate	1.4
B12 shot	0.0

Block Food Frequency Questionnaire Items

The following foods were assessed for the frequency that the food was eaten and the serving size typically eaten each time.

Frequency responses included:

- Never
- A few times per year
- Once per month
- 2-3 times per month
- Once per week
- 2 times per week
- 3-4 times per week
- 5-6 times per week
- Every day

Serving responses included (depending on food type):

- 1 glass
- 2 glasses
- 3 glasses
- 4 glasses
- 1 cup
- 2 cups
- 3-4 cups
- 5+ cups
- Various portions of whole fruit (1/8, ¼, ½, 1, 2, 3)

Food items assessed:

- Tomato juice or v-8 juice
- Real 100% orange juice or grapefruit juice, including fresh, frozen or bottled
- Other real fruit juices like apple juice, prune juice, lemonade
- Raw peaches, apricots, nectarines, while they are in season
- Cantaloupe, in season
- Strawberries, in season
- Watermelon, in season
- Any other fruit in season, like grapes, honeydew, pineapple, kiwi
- Bananas
- Apples or pears
- Oranges or tangerines
- Grapefruit
- Canned fruit like applesauce, fruit cocktail, or dried fruit like raisins
- Eggs, including egg biscuits or Egg McMuffins (Not egg substitutes)
- Broccoli

- Carrots, or mixed vegetables or stews containing carrots
- Corn
- Green beans or green peas
- Spinach
- Mustard greens, turnip greens, collards
- French fries, fired potatoes, or hash browns
- White potatoes not fried, including boiled, baked, mashed, and potato salad
- Sweet potatoes, yams (Not in pie)
- Cole slaw, cabbage
- Green salad
- Raw tomatoes, including in salad
- Any other vegetable, like okra, squash, cooked green peppers
- Refried beans or bean burritos
- Chili with beans (with or without meat)
- Baked beans, black-eyed peas, pintos, any other dried beans
- Vegetable stew
- Vegetable soup, vegetable beef, chicken vegetable, or tomato soup
- Spaghetti, lasagna, or other pasta with tomato sauce
- Pizza, including carry-out
- Pumpkin pie, sweet potato pie
- Any other pie or cobbler
- Catsup, salsa, or chile peppers

Percent consumption frequency of food items measured by the Block Food Frequency Questionnaire

Food Item	Never	A few times per year	once per month	2-3 times per month	once per week	2 times per week	3-4 times per week	5-6 times per week	Every day
Tomato juice or v-8 juice	69.7	6.1	3.0	12.1	1.5	4.5	1.5	0	1.5
Real 100% orange juice or grapefruit juice, including fresh, frozen or bottled	16.7	3.0	6.1	15	4.5	9.1	16.7	0	42.4
Other real fruit juices like apple juice, prune juice, lemonade	28.8	0	6.1	7.6	15.2	13.6	9.1	1.5	18.2
Raw peaches, apricots, nectarines, while they are in season	33.3	1.5	7.6	9.1	7.6	10.6	10.6	3.0	16.7
Cantaloupe, in season	16.7	3.0	13.6	9.1	7.6	13.6	15.2	1.5	19.7
Strawberries, in season	33.3	3.0	18.2	18.2	9.1	3.0	7.6	1.5	6.1
Watermelon, in season	48.5	6.1	13.5	15.2	4.5	4.5	4.5	0	3.0
Any other fruit in season, like grapes, honeydew, pineapple, kiwi	25.8	1.5	16.7	16.7	7.6	16.7	4.5	0	10.6
Bananas	3.0	1.5	4.5	12.1	9.1	12.1	22.7	3.0	31.8
Apples or pears	21.2	4.5	6.1	10.6	18.2	18.2	7.6	0	13.6
Oranges or tangerines	25.8	1.5	13.6	18.2	19.7	13.6	6.1	0	1.5

Grapefruit	59.1	6.1	16.7	7.6	4.5	1.5	1.5	0	0
Canned fruit like applesauce, fruit cocktail, or dried fruit like raisins	10.6	1.5	12.1	9.1	7.6	30.3	13.6	3.0	12.1
Eggs, including egg biscuits or Egg McMuffins (Not egg substitutes)	12.1	6.1	7.6	7.6	16.7	16.7	24.2	1.5	7.6
Broccoli	16.7	4.5	13.6	16.7	22.7	15.2	7.6	3.0	0
Carrots, or mixed vegetables or stews containing carrots	12.1	0	9.1	10.6	16.7	19.7	19.7	3.0	9.1
Corn	16.7	3.0	3.0	15.8	21.2	19.7	9.1	0	1.5
Green beans or green peas	0	0	1.5	15.2	33.3	31.8	16.7	0	1.5
Spinach	42.4	3.0	16.7	12.1	16.7	6.1	1.5	0	1.5
Mustard greens, turnip greens, collards	16.7	3.0	6.1	18.2	27.3	13.6	13.6	0	1.5
French fries, fired potatoes, or hash browns	47.0	3.0	7.6	7.6	19.7	10.6	3.0	0	1.5
White potatoes not fried, including boiled, baked, mashed, and potato salad	9.1	1.5	7.6	16.7	12.1	30.3	15.2	3.0	4.5
Sweet potatoes, yams (Not in pie)	21.2	10.6	27.3	16.7	4.5	15.2	4.5	0	0
Cole slaw, cabbage	3.0	4.5	6.1	22.7	33.3	22.7	4.5	0	3.0

Green salad	15.2	1.5	6.1	21.2	16.7	15.2	16.7	1.5	6.1
Raw tomatoes, including in salad	16.7	0	1.5	15.2	16.7	21.2	19.7	3.0	6.1
Any other vegetable, like okra, squash, cooked green peppers	18.2	1.5	16.7	18.2	15.2	13.6	13.6	1.5	1.5
Refried beans or bean burritos	92.4	0	4.5	0	1.5	1.5	0	0	0
Chili with beans (with or without meat)	65.2	3.0	16.7	9.1	4.5	1.5	0	0	0
Baked beans, black-eyed peas, pintos, any other dried beans	9.1	1.5	13.6	22.7	30.3	13.6	6.1	0	3.0
Vegetable stew	42.4	1.5	25.8	12.1	15.2	0	1.5	0	1.5
Vegetable soup, vegetable beef, chicken vegetable, or tomato soup	24.2	0	27.3	21.2	15.2	4.5	6.1	0	1.5
lasagna, or other pasta with tomato sauce	89.4	0	6.1	3.0	1.5	0	0	0	0
Spaghetti,	34.8	3.0	21.2	15.2	19.7	4.5	1.5	0	0
Pizza, including carry-out	53.0	3.1	16.7	9.1	13.6	15.	0	0	0
Pumpkin, sweet potato pie	53.0	18.2	13.6	7.6	4.5	3.0	0	0	0