Special Issue
Elderly Nutrition

Research Articles

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**Center for Nutrition Policy and Promotion
Mission Statement**

*To improve the health of Americans by developing and promoting dietary
guidance that links scientific research to the nutrition needs of consumers.*

Family Economics and Nutrition Review

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Regular Items

Foreword

With this issue, we here at the Center for Nutrition Policy and Promotion celebrate the 60th anniversary of *Family Economics and Nutrition Review*. From its beginning as a monthly newsletter, to its transformation as a research journal, *Family Economics and Nutrition Review* has provided valuable information to the American public. Whether named *Wartime Family Living* (1943), *Rural Family Living* (1945), *Family Economics Review* (1957), or *Family Economics and Nutrition Review* (1995), this USDA publication has always provided information—based on current scientific knowledge—for Americans to make decisions about food, clothing, and shelter, as well as provided information about other aspects of daily living (e.g., energy prices, welfare reform, and population trends for quality of life).

Started during World War II, *Wartime Family Living*, a newsletter, kept Americans abreast of war-related food concerns: distribution, production and manufacturing quotas, and rationing. USDA Cooperative Extension agents, the audience that translated the information in *Wartime Family Living* into forms useful to the American public, found this helpful advice in the December 27, 1943, issue: "Wartime diets for good nutrition, presented in April's *Wartime Family Living*, has now been printed and is called Family food plans for good nutrition. These plans, a low-cost and a moderate-cost one, have been revised slightly since their earlier release. Both will be helpful in planning diets that will measure up to the yardstick of good nutrition."

We have produced several special issues: the Special Economic Problems of Low-Income Families (1965), the Economic Role of Women in Family Life (1973), Promoting Family Economic and Nutrition Security (1998), and the Food Guide Pyramid for Young Children (1999). The USDA's 60th anniversary edition of *Family Economics and Nutrition Review,* a special issue, focuses on our elderly population: By focusing on this growing population, we are not only addressing some important implications of aging in relation to nutrition and well-being, we are also continuing our tradition of linking "scientific research to the nutrition needs of consumers" and thus improving the well-being of American families and consumers.

On the 25th anniversary, *Family Economics Review* was recognized as having helped the USDA reach its goal of providing Americans with a flow of information on problems affecting their welfare: "Today, *Family Economics Review* brings together and interprets economic data affecting consumers from USDA and many Government sources, for use by [Cooperative] Extension workers, college and high school teachers, social welfare workers, and other leaders working with farm and city people."

On this 60th anniversary, *Family Economics and Nutrition Review* reflects the USDA's goal to improve the Nation's nutrition and health through nutrition education and promotion. It is our wish here at the Center for Nutrition Policy and Promotion that *Family Economics and Nutrition Review* will continue to serve the needs of the American public.

Julia M. Dinkins
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Improving Calcium Intake Among Elderly African Americans: Barriers and Effective Strategies

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The objectives of this pilot study were to identify barriers to and informed strategies for improving calcium intake among elderly African Americans. To accomplish these objectives, researchers recruited 56 seniors (age 60 or older) from a congregate meal site in a large urban senior center in the mid-South region of the United States. In focus group discussions, participants answered questions related to food preferences, calcium intake, motivations, and barriers to calcium intake, as well as recommended educational strategies. Researchers used both quantitative and qualitative methods to evaluate the data. The study revealed eight barriers to dietary calcium intake: concern for health and disease states, lack of nutrition knowledge, behaviors related to dairy products, limited food preferences, financial concerns, lack of food variety, food sanitation concerns, and limited food availability. Participants suggested several educational strategies, including group discussions, taste-testing sessions, and peer education at various locations. Other suggestions were direct mail, television, and newspapers with large print text and colorful depictions of diet-appropriate ethnic foods. Focus group interactions are excellent means of eliciting nutrition-related opinions from African-American elders.

The results of the Third National Health and Nutrition Examination Survey (NHANES III) (Alaimo et al., 1994) agree with the conclusions of other studies that the calcium intake of many African Americans is below recommended levels (National Research Council, 1989) and especially below the new calcium goals (Dietary Reference Intakes) for the American population (National Academy Press, 1997; Yates, Schliker, & Suitor, 1998). The limited intake of calcium by African Americans places this subgroup of the American population at risk for chronic diseases that may be alleviated by achieving adequate calcium. Although many African Americans consume milk, the consumption of dairy products—a major source of calcium in the United States—by African-American men and women is significantly lower than that of White men and women (Shimakawa et al., 1994; Koh & Chi, 1981). Osteoporosis associated with calcium-intake deficiencies and possibly hypertension contributes to the high cost of medical care in the United States (Riggs, Peck, & Bell, 1991; Joint National Committee, 1993).

Prevalence of deficiencies in lactase, an enzyme required to metabolize the primary milk sugar lactose, is blamed for the low intake of dairy products among African Americans (Pollitzer & Anderson, 1989). Although the consumption of milk and dairy products is inadequate in terms of calcium intake, nutrient supplementation is not a solution for many African Americans. Results from the 1992 National Health Interview Survey Epidemiology

Supplement (Slesinski, Subar, & Kahle, 1996) indicate that of the 1,353 Blacks surveyed, three-fourths (77.2 percent) seldom or never used any vitamin and mineral supplement, less than 5 percent (4.4 percent) used supplements occasionally, and 18.4 percent used them daily.

Commonly called the "silent disease" because pain or symptoms are not experienced until a fracture occurs, osteoporosis is a metabolic bone disease characterized by low bone mass, which makes bones fragile and susceptible to fracture. While African-American women tend to have higher bone mineral density than White women have, they are still at significant risk of developing osteoporosis. Furthermore, as African-American women age, their risk of developing osteoporosis more closely resembles the risk among White women. So, as the number of older women in the United States increases, an increasing number of African-American women with osteoporosis can be expected (National Institutes of Health, 1998).

Background

The literature is replete with studies indicating that calcium intakes of African Americans are below the recommended dietary guidelines (e.g., Alaimo et al., 1994), as well as the new calcium intake standards set by the Institute of Medicine (National Academy Press, 1997). In addition to verifying the poor status of calcium intake among African-American adults, much of the literature focuses on the dichotomy of lactose intolerance and bone densities of African Americans. Lactose intolerance is thought to be the primary barrier to consumption of milk and dairy products among African Americans (Buchowski, Semenya, & Johnson, 2002). The empirical work on lactose intolerance among African

Americans, however, does not establish that African Americans choose not to consume milk because of gastrointestinal distress. Researchers have found that lactose intolerance among some African Americans may be overestimated because of lactose digesters' belief that consumption of milk leads to this distress (Johnson, Semenya, Buchowski, Enwonwu, & Scrimshaw, 1993). Even with lactose intolerance, small quantities of milk can be consumed with little or no discomfort, and specialty milk products and lactase tablets are available to ameliorate the symptoms related to lactose consumption. In addition, promising dietary management strategies are available, such as consuming lactose-containing dairy foods more frequently and in smaller amounts as well as with meals, eating live culture yogurt, using lactose-digestive aids, and the consumption of calcium-fortified foods (Jackson & Savaiano, 2001).

The other side of the dichotomy is bone mineral density and osteoporosis. A major reason for the sense of security regarding calcium-intake research may be the higher bone mineral density of African-American women (e.g., Luckey et al., 1989) coupled with their lower rates of osteoporosis. The implications are that high bone mineral density will protect African Americans from osteoporosis and symptoms of calcium deficiency. Silverman and Madison (1988) found that the incidence of age-adjusted fracture rates for non-Hispanic White women is greater than twice the rate for African Americans. But low risk does not translate into no risk. A fact sheet from the National Institutes of Health (1998) states that

> [A]pproximately 300,000
> African-American women
> currently have osteoporosis;
> between 80 and 95 percent of

fractures in African-American women over 64 are due to osteoporosis; African-American women are more likely than White women to die following a hip fracture; as African-American women age, their risk of hip fractures doubles approximately every 7 years; [and] diseases more prevalent in the African-American population, such as sickle-cell anemia and systemic lupus erythematosus, are linked to osteoporosis.

Some researchers have developed a prudent approach to this dichotomy. One group concluded that the "higher values of bone densities in African-American women, compared with White women are caused by a higher peak bone mass, as a slower rate of loss from skeletal sites comprised predominantly of trabecular bone. Low-risk strategies to enhance peak bone mass and to lower bone loss, such as calcium and vitamin D augmentation of the diet, should be examined for African-American women" (Aloia, Vaswani, Yeh, & Flaster, 1996). To promote higher intakes of calcium more effectively, researchers and nutrition educators need to know more about food practices in relationship to dietary calcium. However, little information is available on the effect that food practices of older African Americans may have on nutrient intake, particularly calcium (Cohen, Ralston, Laus, Bermudez, & Olson, 1998).

The Council on Aging's congregate meal feeding program is an excellent means of studying the problem of dietary calcium barriers among African-American elders. Even though the Council's meals provide one-third of the RDA for all nutrients, African-American participants consumed less calcium, thiamin, iron, fat, carbohydrate,

fiber, niacin, and vitamin C than did White participants (Holahan & Kunkel, 1986).

The purpose of the current pilot study was to examine the barriers to adequate calcium intake, through focus group discussions, among the African-American elderly population that participates in the congregate meal program. The information from this study is needed to prepare effective, relevant, and appropriate nutritional education presentations and materials.

Methods

Participant Recruitment

In the mid-South region of the United States, researchers recruited partici-pants from a congregate meal site in a large urban senior center. Researchers held a recruitment session during which they explained the project's focus, time commitment, and purpose to potential participants; scheduled participants for the focus group sessions; and distrib-uted appointment cards. Upon complet-ing all focus group sessions, partici-pants received a $15 gift certificate to a local grocery store. The researchers completed the official recruitment process in 1 day; however, the partici-pants, without prompting, recruited others. Only African-American elders 60 years and older participated in this study.

Assessment Instruments

The assessment instruments consisted of the Demographic and Calcium Intake Questionnaire (DCIQ) (Fleming & Heimbach, 1994) and the focus group questions (box 1). In addition to collecting demographic data, researchers used the DCIQ to assess participants' food preferences in relationship to dairy and calcium-containing foods. To make the focus group procedures and questions more reliable and while taking into account

the age and cultural differences of elderly African Americans, the researchers used a dietary calcium intake questionnaire developed for low-income Vietnamese mothers (Reed, Meeks, Nguyen, Cross, & Garrison, 1998). For example, where Reed and colleagues emphasized Asian cultural references, the researchers substituted African-American cultural references and maintained the theoreti-cal framework of the original template, which was based on the PRECEDE-PROCEED model (Green & Kreuter, 1991). This model has three central components related directly to the types of questions raised during a focus group discussion that seeks to understand how to address, in a better fashion, dairy calcium needs through nutrition education: (1) predisposing (knowledge, attitudes, and motiva-tions), (2) enabling (resources and skills), and (3) reinforcing (praise and perceived benefits). Based on the recommendations of Krueger (1998), the researchers interspersed these questions within the procedural framework described in box 1.

Procedures for Data Collection and Data Analysis

Each of the six focus groups was limited to no more than 12 participants, and each session lasted no longer than 1½ hours. A total of 56 African Americans participated. At the beginning of each focus group session, the researchers obtained a written consent from each participant. Before group discussions began, the researchers administered the DCIQ to participants and offered assistance if needed. To help partici-pants become comfortable, the re-searchers asked each to "tell us your name, and tell us what your favorite food is." To transition to the discus-sion, the researchers asked participants to talk about some of the good points about their diet and how they would improve their diet.

Participants considered milk good for bones and teeth and were concerned about bone health and disease prevention in spite of being unable to describe calcium-related deficiency diseases.

Box 1. Focus group transition statements and questions[1]	
Transition	*The USDA Food Guide Pyramid recommends that adults consume milk and dairy products every day.*
Key Questions #1	What dairy products do you commonly consume? How often do you have foods in this group? Which of the dairy foods do you select when you eat away from home? What things hinder you from eating these foods more often? What keeps you from ordering milk and dairy products when you eat away from home? As you see it, what is the relationship of milk and health? What people or materials helped you develop your viewpoint?
Key Questions #2	Foods in the milk and dairy group are high in calcium. Calcium helps prevent several diseases: thinning of the bones or osteoporosis; high blood pressure or hypertension; and weak bones or rickets. What have you heard about these diseases? What would you like to know about these diseases? How does knowing about diseases related to poor calcium intake impact your diet choices? What would motivate you to eat more of the foods in the dairy group?
Transition	*So, you are saying that milk is important because of the nutrients it provides such as calcium.*
Key Questions #3	Here is a list of foods with their calcium content. What are your impressions of this list? So you eat several of these foods, what keeps you from purchasing/eating other foods on the list? What would motivate you to eat other foods that contain calcium? Think about the last time you tried something you never tried before. How did you go from never eating it to having tried it? How do your friends and family influence the foods you buy or prepare?
Transition	*So, what I am hearing is that your friends and family impact your food choices.* *When you think back on it, how much does your family influence the foods you buy or prepare?*
Key Questions #4	What are your thoughts about what your grandchildren need in terms of milk and dairy foods? Where do you like to get nutrition information? What is your impression about food labels? Are there places or people who don't provide nutrition information that you would like to hear from? What nutrition information do you get from the following materials or places: brochures, reading materials, recipes high in calcium, grocery store lists, foods to select in a restaurant, signs, community classes—in the library, community center, and/or church? What are appealing and convenient ways for us to provide you with information about foods and nutrition? What is your impression of the "Got Milk" signs? What is your family and grandchildren's impressions of the posters? What would you like to know about calcium, milk, and dairy foods? How much time would you like to spend learning about calcium?
[1]Krueger, 1998; Reed et al., 1998.	

Researchers used the focus group discussion questions to identify the barriers to calcium intake. This discussion was followed by a transition to the key questions. The first and second sets of key questions focused on current dietary behavior and predisposing factors, respectively; the third set focused on reinforcing factors. Finally, the fourth set of key questions focused on enabling factors. Researchers combined the last two sets of questions to determine educational strategies. One additional question in this combined set focused on participants' opinion about their grandchildren's need for milk and dairy products. To close the discussion, researchers asked the participants to give any advice that would help African Americans increase the calcium content of their diets.

Both quantitative and qualitative procedures were used to analyze the data. The Statistical Package for the Social Sciences (SPSS, 1999) was used to analyze the descriptive data; frequencies were determined for food preferences and the demographic variables. The models were used to analyze the qualitative data: (1) the inductive data analysis model identified topics, categories, themes, and concepts as a means of bringing forth knowledge (McMillan & Schumacher, 1997) and (2) the PRECEDE-PROCEED model was used to subdivide the knowledge gained into categories (Green & Kreuter, 1991).

Researchers completed and compiled the qualitative data in the form of tape recordings and handwritten notes. During analysis, the researchers reviewed both the notes and the tapes from each focus group session and then used the tape recordings to complete the notes. Next, researchers identified barriers, placed the individual barriers into categories, and organized the categories into patterns or themes and concepts (e.g., related to a predisposing or an enabling factor).

Results and Discussion

The focus group attendance was excellent, with only six no-shows. Six other participants attended a focus group session other than the one they had originally planned to attend. By casual observation, we noted that all but two of the participants appeared to be able-bodied: one revealed a hearing loss and one used a walker. Even though over half (n=28) of the African-American seniors in this study reported income below the poverty index (Annual Update of the HHS Poverty Guidelines, 1999), finances were rarely mentioned as a barrier to adequate calcium intake in the focus groups. These seniors seemed adept at managing their finances, and 40 percent used resources other than congregate meals, frequently citing commodity foods as supplements to their food budgets.

Most African-American participants (84 percent) agreed to provide demographic information (table 1). Six of ten participants had less than a high school education, about 6 of 10 had a monthly income of less than $700, and about 6 of 10 were not receiving food assistance. Almost three-quarters of the participants were single, separated, divorced, or widowed; over half (57 percent) lived alone. Most of the 56 participants (n=47) completed the food preference survey, which indicated that greater

than 90 percent of the respondents liked and ate milk and dairy products as well as some other foods with moderate or high amounts of calcium (e.g., salmon with bones). However, some participants, while reviewing a list of calcium-containing foods, noted unfamiliarity with relatively new products such as tofu. In terms of general categories of calcium-containing supplements (calcium, antacids, or vitamins and minerals), 83 percent of the participants reported using supplements of various types daily, weekly, or seldom. Fifty-five percent reported taking at least one of the calcium-containing supplements daily, 13 percent reported using calcium supplements or other antacids (e.g., Tums), and 49 percent reported using vitamin-mineral supplements (data not shown).

Focus group discussions revealed a list of barriers to calcium intake among African-American seniors:

- concern for health and disease states
- lack of nutrition knowledge
- behaviors related to dairy products
- limited food preferences
- concerns about finances
- lack of food variety
- concerns about food sanitation
- limited food availability

Two subcategories represented the barriers: predisposing factors and enabling factors. Researchers identified four types of barriers related to predisposing factors: customs and beliefs, food handling/sanitation, nutrition knowledge, and health reasons/disease state/food intolerance. Researchers also identified four types of barriers related to enabling factors: food preferences, financial issues, food variety and availability, and behaviors. In terms of food preferences, the participants discussed the need to learn to eat and learn to like new foods to increase calcium intake. Participants identified

Table 1. Demographic characteristics of African-American seniors

Variables	Percent
Educational level[1]	
<8th grade	40.4
9th-11th grade	19.1
12th grade	31.9
Technical school	12.7
Some college	4.3
College degree	4.3
Monthly income	
$687 or less	55.3
$688-$922	23.4
$923 or more	21.3
Food assistance[2]	
Yes	40.4
No	59.6
Marital status	
Single, separated, divorced, widowed	72.3
Married	27.7
Gender	
Male	13.0
Female	87.0
Living situation	
Lives alone	57.4
Lives with spouse	27.7
Lives with other	14.9

[1]Participants selected all that applied. For example, a participant that completed 12th grade and technical school may have selected both categories.
[2]Participants' most frequently reported food assistance was commodity foods.
n = 47.

several marketing and educational strategies to improve the calcium nutrition knowledge of the African-American population. Although most participants had less than a high school education, they were articulate and participated actively in the focus group discussions. The only physical barrier mentioned in the focus groups was digestive problems, which is different from the findings of others (Fischer & Johnson, 1990; Skaien, 1982). These researchers had shown physical barriers to be a substantial cause of nutritional deficiencies.

Demographic Data and Food Preference

For these participants, fruits, vegetables, grains, and desserts were the favorite foods. The frequency data derived from the demographic survey supported these statements and revealed that almost 90 percent of these participants liked and ate food from all food groups. Several of the participants stated that collard or mustard greens were a favorite food. Of those that mentioned greens as a favorite food, several said they not only ate greens for dinner but sometimes for breakfast or lunch as well.

Because salmon was the only meat mentioned in the frequency data, meat preferences were not determined. On the frequency checklist, the participants indicated whether they liked or ate dairy products, but these items were not mentioned as favorite foods in the focus group discussions. When the moderators probed about dairy foods, many participants indicated they did not like the taste of the foods or they had been instructed to eliminate them from their diet for health/disease reasons. These participants did not mention total avoidance of calcium-rich foods.

Barriers to Calcium Intake

One of the challenges for understanding and discussing the barriers to calcium intake among the urban African-American elders is the interaction among factors. For example, lack of nutritional knowledge may interact with health status and disease state. Alternatively, concern for food handling and sanitation can interact with food preferences and selections. Overall, barriers discovered during this investigation are similar to the barriers identified by Zablah, Reed, Hegsted, and Keenan (1999) when they interviewed 90 African-American women who were either pregnant or had children 5 years old or younger. Zablah and colleagues found that participants perceived they consumed enough calcium, disliked the taste of some calcium-rich foods, experienced digestion problems, had a perceived lack of knowledge of products containing calcium, and were concerned about cholesterol and the high-calorie content of these foods. Thus, both the mothers of young children and elderly African Americans have concerns related to dietary calcium intake and food sources of calcium.

Barriers Related to Predisposing Factors

Customs and beliefs. In general, participants considered milk a healthful food, connected with cows and wonderful family memories. For example, one participant stated, ". . . [B]eing raised on the farm, we had to milk the cows. So we knew that was good. We always knew. My daddy insisted that we drink milk." A participant even considered milk a healing food, having recommended milk as a food to a convalescing friend. This friend, a member of the same focus group as the participant, testified that she now drinks milk daily. However, participants discussed the image of milk as a child's food as well, associating the "Got Milk" campaign with children. Calcium

requirements were not mentioned in the context of a chronic disease state or as a religious dietary restriction. (In a similar focus group held with Women, Infants, and Children Program participants, one mother mentioned her plans to eliminate milk from the diet of an elementary school-age child because of her religious beliefs [unpublished data].) Participants suggested milk as an aid for acute problems, such as ankle problems and "popping bones," described as "bones that don't act right."

Food and nutrition knowledge. Participants in the focus group discussions wanted information about nutrition and calcium. Participants considered milk good for bones and teeth and were concerned about bone health and disease prevention in spite of being unable to describe calcium-related deficiency diseases. However, one participant discussed her bout with osteoporosis, and the pain and discomfort involved with this debilitating disease. Additional examples of basic lack of knowledge included calcium content of foods and complications related to poor calcium intake. Participants also confused eggs with dairy products. In addition, although participants correctly identified milk and cheese products as containing cholesterol, they failed to identify lowfat milk and cheese products as appropriate dietary modification for those concerned with dietary cholesterol. For example, one participant stated, "Well, I like cheese, but you know they say cheese is so bad for you now for cholesterol. So I don't eat too much cheese."

The discussions revealed that participants were surprised that greens were a source of calcium. When moderators provided the participants with a list of calcium-rich foods that included greens (100 mg calcium per ½ cup serving), many said they were unaware that

greens were a good source of dietary calcium. One participant commented, "I didn't know [turnip greens] had calcium. I know I love them." In addition to greens, participants seemed surprised to learn about the high calcium content of many foods, such as sardines with bones, prunes, broccoli, spinach, and tofu. Although the basis of such confusion may be lack of nutrition knowledge, the confusion may also relate to how health care professionals organize nutrition knowledge. It is possible that the issue of food categories in terms of nutrients may represent a difference in the organizational schema of nutritional sciences based on nutrients, while that of the participants' knowledge may be based on other factors. Krall, Dwyer, and Coleman (1988) said it this way:

> [A] person's memory is likely to follow personal schemes such as food combinations, time, location, etc. The categorization scheme, such as nutrient-related groups, is not well understood by most lay persons, [and is] therefore, alien to the manner in which [their] information was stored, [and] imposes an arbitrary structure which potentially leads to inefficient recall.

In addition, concerns about food handling and sanitation practices of food service establishments served as a deterrent to ordering milk as a beverage when eating out.

> "Now, I wouldn't order milk out—because I use to work at a restaurant . . . . If they bring [milk] to me in a glass, I wouldn't drink it. [Researcher: How come?]. . . Well, we had a keg. And, everyone would dip their hand down in that keg, and they'd want the

employees to drink that milk, . . . Well, we *could* get milk [from] the dining room, but the other help had to get milk from . . . that keg, and I didn't think that was right."

Health reasons, disease state, and food intolerance. Many of the participants were concerned about health and disease-related issues. They were especially concerned with heart disease, high blood pressure, high cholesterol, and arthritis. Previous research also found similar health concerns in rural African-American elderly (Lee, Templeton, Marlette, Walker, & Fahm, 1998; Wallace, Fox, & Napier, 1996). As one participant in the 1996 study commented: "I drink a little milk, . . . I can't handle milk too good unless I'm at home." Thus, participants in the 1996 study sometimes tied these concerns to food restrictions, especially when their physician instructed them to eliminate certain foods from their diets. The participants reported being educated by their physician or nurse (none mentioned a dietitian) about which foods to avoid. Participants often followed medical recommendations to avoid or restrict a food group that was a calcium source without any instruction on how to replace the calcium in their diet.

In terms of lactose intolerance, symptoms mentioned included flatulence, and stomach problems. Participants also mentioned that dairy products, such as milkshakes, were "too rich for the system," although this could be related to the fat or sugar content. Generally, participants did not specifically mention dietary strategies for managing lactose intolerance, such as consuming yogurt or acidophilus milk or using lactase tablets. However, one participant mentioned the lack of lactose-free products as a barrier to purchasing dairy products in food service establishments.

The focus group participants expressed an interest in all types of educational media including direct mail, television, radio, newspapers, and magazines.

Among the elderly, the perception of milk intolerance appears to vary with ethnicity and gender. Elbon, Johnson, Fisher, and Searcy (1999), in a national telephone survey of 475 older American participants, including 27 African Americans, found that 35 percent of the African-American respondents considered themselves milk intolerant, whereas only 17 percent of the Whites did so. Twice as many women (21 percent) considered themselves milk intolerant than did the men (10 percent). Others found similar avoidance based on perception (Buchowski, Semenya, & Johnson, 2002).

Barriers Related to Enabling Factors

The barriers related to enabling factors were food preferences, financial issues, food variety and availability, and behaviors related to calcium-containing foods. In terms of food preferences, to help improve calcium intake, the participants discussed the need to learn to eat and enjoy new foods and learn how relatives, friends, and interactions at social gatherings (e.g., at church) influenced their food choices by introducing new foods. (Participants demonstrated a willingness to try the calcium-fortified juice provided as a snack during all focus group discussions.)

Subjects participated in the tradition of extended family members influencing food choices by encouraging their grandchildren to drink milk. One subject told the story of how she learned to eat broccoli:

> "This broccoli, I never was too fond of it, but my son-in-law, when they were living here in town, use to cook dinner on Sundays and invite me over. And he would fix the broccoli. I didn't want to hurt his feelings. So I started eating broccoli, and

Table 2. Marketing and educational strategies for promoting calcium intake suggested by African-American seniors

Strategies	Recommendations
Direct mail	
Media	Brochures
	Newsletters
	Magazines
	Television
	Radio
	Newspapers
Informal educational sessions	Tasting parties
	Focus group discussions
	Peer education
Location	Senior citizens' center schools
	Library
	Grocery store
	School or family reunions
Desired tactics	Large print text
	Colorful with pictures
	Diet-appropriate ethnic foods

n = 56.

sometimes I get it . . . when I go out, 'cause I don't do too much cooking at home. But, I'll eat the broccoli especially, you know, with some cheese on it."

In addition, the participants seemed to categorize foods into good and bad foods as well as in terms of a disease-based model, that is, to eliminate foods due to a disease.

Some participants mentioned financial concerns as a barrier to intake of milk products. Financial issues related to the cost of food are not only a concern among the urban southern elderly African Americans, but also among the rural southern African Americans. Lee and colleagues (1998) found that more than 70 percent of rural African-American elders considered food (and medical) costs to be a serious issue.

For example, focus group participants mentioned cost issues as reasons for not ordering milk at a food service establishment.

Participants indicated that availability of some calcium-containing foods might influence consumption (e.g., calcium-containing juice). In terms of behaviors, participants mentioned postponing drinking milk to avoid flatulence during social engagements. This behavior appears to indicate that participants were struggling with how to maintain consumption of dairy products in spite of symptoms of lactose intolerance. In such cases, nutrition education could help the elderly develop more effective strategies for managing lactose intolerance.

Marketing and education strategies

The focus group participants expressed an interest in all types of educational media including direct mail, television, radio, newspapers, and magazines (table 2). They found it enjoyable to learn in social settings, such as community center classes, church meetings, family and class reunions, and the senior citizens' center. Taste-testing sessions in any setting were particularly appealing to the group. Other routes of nutrition education delivery included sessions at the library, food bank, and the commodity food distribution centers. The input from the participants involved in the present study clearly shows that a number of strategies might be successful in increasing African-American seniors' knowledge about adequate calcium intake.

One strategy that has benefitted elders is church-based health promotion. Ransdell (1995) discussed why such promotional strategies have been successful and are appropriate for many elderly. In addition, the comments of African-American caregivers that spiritual activities promote health, as reported in a recent study (McDonald, Fink, & Wykle, 1999), probably reflect the sentiment of many others in the community. While working with urban-dwelling minority elders, Wieck (2000) found that health promotion activities work best when the focus is on small, achievable goals in the context of short-focused educational sessions.

Hurdle (2001) discussed the importance of social support as a component of health promotion activities. Hurdle's report helps, in part, to explain the positive response of the elders to the focus group approach used by this study. The focus group may have helped support "connectedness" (Belenky, Clinchy, Goldberger, & Tarule, 1986), and may help with the

sense of community fostered by the center at which the focus groups were conducted. Furthermore, others found that women were more likely than men to participate in health-promoting activities and relaxation, while men were more likely than women to participate in exercise (Felton, Parsons, & Bartoces, 1997). Therefore, gender patterns of response to health promotion should be considered when planning health-promoting activities.

Summary and Recommendations

In this pilot study, focus group interactions were excellent means to elicit African-American elders' opinions about barriers and educational strategies related to calcium intake. The results may not be generally applicable, because they pinpoint the existence of barriers to adequate calcium intake among one group of African-American seniors. Within this group, health/disease states and lack of knowledge appeared to be the primary and secondary barriers reported, respectively. Although similar studies quantify calcium intake in this population, they provide only limited insight of the barriers. Therefore, further studies are necessary to validate the current findings. A future research plan could include correlating calcium intake data with results from focus group discussions.

The participants in the present study provided suggestions that are beneficial for educators who develop materials and methods for nutrition instruction. Specifically, the elderly participants requested disease-specific calcium education directed to their level of learning and that would be provided in a community-based and socially centered environment. The seniors in this study wanted the following

information: linkage between calcium sources and specific disease states, calcium content of foods, high-calcium recipes provided in grocery stores at the point of purchase, cooking demonstrations or taste-testing parties featuring calcium-rich foods, and strategies for managing dairy-related food intolerance.

Health care providers, social workers, food assistance program managers, volunteers who work with the elderly, and family members must also be educated on adequate calcium intake for these seniors. Educational programs should concentrate on introducing new foodstuffs into seniors' diets and teaching them to substitute item that have been omitted from their diets for medical reasons with alternative calcium-containing foods. Identification and recognition of calcium barriers should be determined across cultures and age groups, if educators hope to promote adequate calcium intakes.

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The Influence of the Healthy Eating for Life Program on Eating Behaviors of Nonmetropolitan Congregate Meal Participants

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Current research indicates that when older adults increase their consumption of fruits and vegetables, they maintain or improve their health. Thus, their quality of life can be improved and health care costs lowered. A purposive sample of older adults (treatment group, n=50; control group, n=51) attending congregate meals participated in this study, with the treatment group receiving four lessons on fruits and vegetables over 4 weeks. The Stages of Change construct of the Transtheoretical Model was used to identify separate stages of change related to fruit- and vegetable-eating behaviors. Pre- versus post-test results showed that the treatment group's consumption of vegetables changed significantly, a positive movement from a lower stage of change (e.g., from Precontemplation, which was 30 percent at pre-test and 12 percent at post-test) to a higher category at post-test (e.g., taking action to change, or maintaining, their fruit- and vegetable-eating behaviors). Based on findings of this study, lessons on fruits and vegetables that include the Healthy Eating for Life Program (HELP) may promote positive changes in eating behaviors of nonmetropolitan participants of congregate meals and should be considered for study with similar older adult populations.

The older adult population in the United States is growing quickly (Price, 2001). The older adult population is projected to increase throughout the next several decades. In 2000, for example, 35.0 million Americans (12.4 percent) were 65 years old and older (Hetzel & Smith, 2001). By 2010, 39.7 million Americans (13.2 percent) will be 65 years old and over, and by 2030, up to 20 percent of the U.S. population will be over age 65 (U.S. Census Bureau, 2000a; U.S. Census Bureau, 2000b). Along with this redistribution of the U.S. population, concerns related to aging may increase, including those related to the health and well-being of the older generation (Rogers, 1999).

For example, the U.S. Department of Agriculture reported that Americans' diets need to improve, including those of the elderly (Basiotis, Carlson, Gerrior, Juan, & Lino, 2002). Although aging is not itself a cause of malnutrition, related risk factors can affect older adults' nutritional intake, contribute to malnutrition (Wellman, Weddle, Kranz, & Brain, 1997), and be "multiple and synergistic" (American Dietetic Association [ADA], 2000). Other factors that may contribute to the dietary status of the members of this growing older population are the types of nutrition messages they receive and their readiness to change diet-related behaviors.

Background

A 1996 report by the American Dietetic Association discussed the increased challenges of competing with conflicting nutrition messages that consumers receive from a variety of sources. The public needs science-based information that not only educates, but also encourages the adoption of more healthful nutrition-related behaviors. An update of this Association's report notes that research is needed to develop and test cost-effective methods for evaluating the efficacy of nutrition education programs. For effective behavior change, nutrition education programs must be based on the target audience's needs, behaviors, motivations, and desires. And the gap between knowledge of nutrition and actual healthful eating practices must be narrowed by providing nutrition information in a usable form to consumers (ADA, 1996).

In the 1970s, Prochaska and colleagues began studying how people make changes. Their efforts led to the development of the Transtheoretical Model, of which the Stages of Change is a construct (Prochaska, Norcross, & DiClemente, 1994). Prochaska, attempting to bring together the components of the major psycho-therapy theories regarding how people acquire successful behavior change, found that the many theories could be summarized by principles called the "processes of change." He was especially interested in how "self-changers" progress along a continuum of change—from Precontemplation to Contemplation, Preparation, Action, Maintenance, and Termination—without therapy or a professional program (box 1).

According to this construct, successful change requires that self-changers

know the stage in which they are located and subsequently use appropriately timed strategies. Initial thoughts were that self-changers moved linearly from one stage to the next. In reality, successful self-changers may recycle through the Stages of Change several times before successfully reaching the Maintenance or Termination stage (Prochaska, Norcross, & DiClemente, 1994).

In studies of health behaviors, older adults have been found to fall pri-marily into the Precontemplation or Maintenance stage, therefore, calling for nutrition education efforts to be targeted at the Precontemplation stage (Nigg et al., 1999), where people do not perceive there is a need to change. The assumption is that people at the Precontemplation stage for adoption of a healthful diet need information that assists them in becoming aware of the personal benefits of healthful eating behaviors (Laforge, Greene, & Prochaska, 1994). Persons in the Maintenance stage—where behavior changes have occurred for more than 6 months—may experience some relapse (Kristal, Glanz, Curry, & Patterson, 1999), may need infor-mation about local resources, and may need strategies to help them deal with barriers to maintaining their dietary changes.

Implications for nutrition education programs for older adults include understanding and applying successful program elements, providing a clear plan for education and having that education based on segmented needs of the older population, adapting locally, and using existing services to provide education. These implications point to the need for research of behavior-based nutrition education for older adults (Contento et al., 1995). Thus, this study examines the in-fluence of a nutrition education intervention—the Healthy Eating

for Life Program (HELP)—on the eating behaviors of a select group of older adults that participated in congregate meal programs. Because the scientific evidence supporting the healthful benefits of fruit and vegetable consumption is significant (U.S. Department of Health and Human Services [DHHS], 2000; Tate & Patrick, 2000; Gerrior, 1999), we focus on behavior changes related to the consumption of these food items.

According to current research, older adults may maintain or improve their health by increasing their intake of fruits and vegetables, thus possibly lowering health care costs and increasing their quality of life (ADA, 2000; Gerrior, 1999). Nutrition education curricula for older adults are available for use, but the ability of these curricula to increase the servings of fruits and vegetables consumed by older adults is uncertain (Clarke & Mahoney, 1996; Contento et al, 1995). Hence, more evaluation studies are needed of the influence of nutrition education programs that are designed for older adults at congregate meal sites.

Methods

Subjects
The target population for this study consisted of community-dwelling, nonmetropolitan older adults who attended congregate meal sites. The participants were at least 60 years old (as required for attendance at the congregate meals), with the exception of spouses under 60 years old who could attend meals when accompany-ing their older spouse.

The treatment group was chosen from three Ohio counties; the control group,

Box 1 – Basic definitions of the Stages of Change Construct of the Transtheoretical Model and operational definitions used in this study	
Basic definition	Operational definition
Precontemplation No intention of changing behavior and does not see a need to change.	*Participant consumed fewer than 3 to 4 servings of fruits (vegetables) each day and did not say he or she was seriously thinking about eating more servings of fruits (vegetables) during the next 6 months.*
Contemplation Acknowledges need to change behavior and begins to think seriously about doing so during the next 6 months or so.	*Participant consumed fewer than 3 to 4 servings of fruits (vegetables) each day and said he or she was seriously thinking about eating more servings of fruits (vegetables) during the next 6 months.*
Preparation Plans to take action during the next month to change a behavior.	*Participant consumed fewer than 3 to 4 servings of fruits (vegetables) each day and was planning to eat more servings of fruits (vegetables) during the next 30 days.*
Action Takes action to change behavior but action has lasted for 6 months or less.	*Participant consumed 3 to 4 or more servings of fruits (vegetables) each day and has been consuming this amount of fruits (vegetables) for 6 months or less.*
Maintenance Has been practicing a changed behavior for more than 6 months.	*Participant consumed 3 to 4 or more servings of fruits (vegetables) each day and has been consuming this amount of fruits (vegetables) for more than 6 months.*
Termination Has reached ultimate goal of behavior change, with no concern for relapse.	
Note: Stages of change definitions are by Prochaska, Norcross, and DiClemente (1994).	

from another Ohio county.[1] The Area Agency on Aging, county offices of Ohio State University Extension, and coordinators of the congregate meal sites assisted with site selection, which needed to be more rural than urban or nonmetropolitan.[2] Fifty treatment and 51 control participants were selected.[3]

[1]The data for this study were collected as part of the multi-State effort to test the lesson plans of the HELP.

[2]Ohio was selected to provide data from a nonurban population, as part of a coordinated effort to compare data among States.

Survey Instruments

Three instruments were used in this study: a demographics instrument, a questionnaire entitled Checkup on Your Good Eating Practices, and a Stages of Change instrument that consisted of

[3]The size of the sample was based on guidance from the HELP Elderly Nutrition Education Coordinating Group: Mary P. Clarke, PhD, RD, Kansas State University; Sherrie M. Mahoney, MS, Kansas Extension Service; Jacquelyn McClelland, PhD, RD, North Carolina State University; William D. Hart, PhD, RD, St. Louis University; Denise Brochetti, PhD, Virginia Polytechnic Institute and State University; Alma Montano Saddam, PhD, RD, The Ohio State University.

two subscales—one for fruits and another for vegetables. These instruments were developed by Extension nutrition professionals of the HELP Elderly Nutrition Education Coordinating Group that developed the HELP instructor's manual.

The demographics instrument collected information on gender, age, race, number in household, educational level, income, how often meals were eaten with someone else, and how often meals and snacks were eaten. Checkup on Your Good Eating Practices consisted of seven questions related to eating fruits and vegetables,

and the Stages of Change instrument consisted of eight separate questions, four each for fruits and for vegetables (box 2). Questions on the Stages of Change instrument asked older adults the number of servings of fruits and vegetables they were eating, how long they had been eating that number of servings, and whether they were seriously thinking of increasing this number either in the next 30 days or in the next 6 months. These questions were based on the criteria of the Transtheoretical Model Stages of Change construct (W.D. Hart, personal communication, October 19, 2001). Thus, the questions were based on a standardized length of time individuals had been working on, or intended to implement, a behavior change.

The Extension nutrition specialists, dietetic nutrition professionals, and county Extension agents (who also field tested the teaching materials) tested the instruments for content and face validity. The instruments were reviewed for content accuracy and suitability for the older adult target audience, after which appropriate adjustments were made.

Extensive field testing addressed any issues related to reliability. Cronbach's Alpha was used to test internal consistency of the instruments. The instrument Checkup on Your Good Eating Practices tested at an alpha of .77. The subscale for Stages of Change for fruit-related behaviors tested at an alpha of .53, and the subscale for Stages of Change for vegetable-related behaviors tested at an alpha of .63. Research in applying the Stages of Change construct to measurement of behavior change of nutritional behaviors is relatively new. Therefore, the alpha levels were considered acceptable (Nunnally, 1967).

Box 2 – Major Survey Instruments[1]

Checkup on Your Good Eating Practices: Example questions

(Answer choices: Almost never, Seldom, Often, Almost always, and Doesn't apply.)

What do you do?

Include at least three food groups in my breakfast
(e.g., milk, fruit, and grains such as bread and cereal)?

Eat 3 or more servings of different vegetables daily?

Eat at least 1 serving of vitamin A-rich foods daily
(e.g., dark green, leafy [spinach, kale, broccoli] and deep yellow
[sweet potatoes, cantaloupe, apricots])?

Choose potatoes prepared in lower fat ways (not fried)?

Eat 2 or more servings of different fruits daily?

Choose at least 1 serving of vitamin C-rich foods daily
(e.g., orange juice, grapefruit, broccoli, cabbage, tomatoes)?

Include at least 1 serving from each of the five food groups
(i.e., grains, fruits, vegetables, meat group, and milk products)?

Stages of Change: Questions

Separate questions were asked for fruit- and vegetable-eating behaviors.

How many servings of fruits (vegetables) do you eat each day?
0
1 or 2
3 or 4
5 or more
Don't know

About how long have you been eating this amount of fruits (vegetables)?
Less than 1 month
1 to 3 months
4 to 6 months
Longer than 6 months
Don't know

Are you **seriously thinking** about eating more servings of fruits (vegetables) starting sometime in the next 6 months?
Yes
No
I already eat enough
Undecided

Are you **planning** to eat more servings of fruits (vegetables) during the next 30 days?
Yes
No
I already eat enough
Undecided

[1]HELP evaluation instruments developed by Mary P. Clarke, PhD, RD; Jacquelyn McClelland, PhD, RD; William D. Hart, PhD, RD; and Alma Montano Saddam, PhD, RD of the Elderly Nutrition Education Coordinating Group.

Treatment and Analysis

The HELP was developed as a joint project of the Cooperative Extension Services at Kansas State University, The Ohio State University, North Carolina State University, and St. Louis University. The program's theme focused on having participants depend primarily on food for good nutritional health and encouraging them to eat a variety of nutritious foods even though the adults' calorie needs may have declined. HELP lessons were designed to facilitate movement of nutrition behaviors along a continuum—from being unaware of eating habits and health connections to applying skills to maintain healthful eating behaviors (Clarke & Mahoney, 1996).

The HELP lessons specifically addressed nutritional needs of older adults. The connection between good health and healthful eating habits was emphasized. The fruit and vegetable lessons also presented practical ways for small households to purchase and store fruits and vegetables. Suggestions were shared for preparing fruits and vegetables that are easier to chew; lower in salt, sugar, and fat; and preserve other nutrients. The recipes, varying in texture, flavor, and temperature, were chosen because of their ability to appeal to the changing taste buds of many older adults.

The treatment group was taught a series of four HELP nutrition lessons. The lessons for the first 2 weeks focused on vegetables, with a lesson on potatoes included, while the second 2 weeks focused on fruits. The objectives of the lessons related to the following: suggested number and sizes of servings; vegetables and fruits as sources of various nutrients and few calories; links between eating vegetables and fruits and decreased risk for some diseases; cost-effective purchasing, storage, and preparation of vegetables and fruits; and vegetables and fruits with less fat, salt, and sugar.

A dish featuring vegetables or fruits was brought to each class for participants to taste. Also, at each of the four sessions, the participants were given handouts of the lessons, "challenges" for planning behavior changes, copies of recipes (including those tasted in class) in the HELP, and educational aids (e.g., refrigerator magnets of vegetables and fruits). For each group (one each from three counties), all lessons were taught in the same order by the researcher who used the same visuals, dishes to taste, and style of presentation. The control group did not receive the weekly lessons. However, after completing the post-test, they were offered a set of handouts and the HELP recipes. Pre- and post-tests, respectively, were administered to the control group from September through December 1998, with these results being used to test and retest the study instruments. The instruments tested reliably below .05, with the exception of the question that dealt with how long the reported number of vegetables had been eaten. This question, however, was accepted as reliable because of the slightly lower number of participants answering the question.

To consider this study quasi-experimental and a nonequivalent control-group design, we made efforts to select similar treatment and control groups. Analysis of the demographics conducted on treatment and control groups was only significantly different on one variable: how often they ate meals with someone else.

For the questionnaire Checkup on Your Good Eating Practices, we summed a score for each treatment and control group participant by using answers from seven questions related to fruit and vegetable behavior (total possible

> For vegetable-eating behaviors, the treatment groups' pre-test responses were mostly indicative of Precontemplation, followed closely by Maintenance, and then Preparation . . . .

score of 28, after eliminating "doesn't apply"). A paired-sample *t*-test was used to compare the means of the pre- and post-test scores for each group.

Post- and pre-test matched summed scores were also measured with a sign test. This test determined whether significant differences exist between positive and negative changes from the pre-test to the post-test. These changes, derived by subtracting pre-test from post-test results, were placed into three categories: negative differences, positive differences, or ties (i.e., no change).

For the Stages of Change instrument, we used sign tests to measure differences of matched cases from pre-test to post-test administration, excluding "don't know" for the number of servings, how long this amount of fruits and vegetables had been eaten, and for computed stages of change for fruit- and vegetable-eating behaviors for participants in both groups. An algorithm was used to calculate a separate stage of change for eating fruits and vegetables (box 1). Pre- and post-test fruit and vegetable stages were calculated for the treatment and control participants, except for those without sufficient data to categorize.

Results

Sample Characteristics
Overall, the older adults in the treatment and control groups were similar. Seventy-six percent of the 50 participants in the treatment group were women, and 92 percent were White. Sixty-seven percent of the 51 participants in the control group were women, and 94 percent were White (data not shown).

Table 1. Post-test/pre-test sign test for Checkup on Your Good Eating Practices regarding fruit- and vegetable-eating behaviors of elderly participants

	Treatment group[1]	Control group[2]
	Percent	
Negative differences	32	31
Positive differences	59	43
Ties	9	26

[1]n = 44.
[2]n = 49.

Eating Practices
Results from the questionnaire entitled Checkup on Your Good Eating Practices showed that, compared with the control group, a significant difference existed between the means for the treatment group from the pre-test to the post-test. From the pre- to the post-test, mean scores by the treatment group increased from 20.86 to 22.73 (p≤.05). For the control group, the means were 19.46 at the pre-test and 20.67 at the post-test (data not shown).

For the sign test, although two-tailed significance levels did not show a significant difference in either group's summed scores, the percentages of negative and positive differences and the ties for the treatment group were noteworthy (table 1). From the pre-test to the post-test, for example, 59 percent of changes by the treatment group were positive, compared with 43 percent of the changes by the control group that were positive. The percentage of ties (no change) was low for the groups (9 vs. 26 percent). These results imply that some type of change took place from pre-test to post-test administration, particularly in how members of the treatment group viewed their eating behaviors.

Stages of Change
Members of the treatment group categorized their fruit-eating behavior most often as Maintenance at the

pre-test and post-test (32 percent each), followed by Pre-contemplation at pre-test and post-test (24 and 28 percent, respectively) and Preparation (20 percent each at pre-test and post-test) (table 2). Changes that could not be categorized dropped from 20 percent at pre-test to 4 percent at post-test. Responses reflective of behaviors in the Action category increased from 0 at pre-test to 8 percent at post-test; that is, at post-test, members of the treatment group consumed 3 to 4 or more servings of fruits each day and had been consuming this amount for no more than 6 months.

Among the control group members, pre-test responses regarding their fruit-eating behaviors fell most frequently into Precontemplation, followed by Preparation and Maintenance (43, 25, and 20 percent, respectively). For this group, pre-test and post-test differences were minor among all categories.

For vegetable-eating behaviors, the treatment groups' pre-test responses were mostly indicative of Precontemplation, followed closely by Maintenance, and then Preparation (30, 28, and 24 percent, respectively). That is, some members of the treatment group had not considered changing their vegetable-eating behavior, some had practiced changing their behavior, and

Table 2. Pre-test and post-test computed Stages of Change for fruit- and vegetable-eating behaviors of elderly participants

Treatment group[1]	Fruits		Vegetables	
Stage of change	Pre-test	Post-test	Pre-test	Post-test
	Percent			
Maintenance	32	32	28	46
Action	0	8	4	10
Preparation	20	20	24	26
Contemplation	4	8	0	0
Precontemplation	24	28	30	12
Cannot categorize	20	4	14	6

Control group[2]	Fruits		Vegetables	
Stage of change	Pre-test	Post-test	Pre-test	Post-test
	Percent			
Maintenance	20	18	47	33
Action	2	6	0	4
Preparation	25	19	8	18
Contemplation	2	4	2	2
Precontemplation	43	49	33	33
Cannot categorize	8	4	10	10

[1]n = 50.
[2]n = 51.

> Our findings indicate that the HELP nutrition lessons made a difference . . . in how some older adults in the treatment group thought about changes, planned for changes, or made changes in their fruit- and vegetable-eating behaviors.

others planned to take action during the next month to change their vegetable-eating behavior. At the post-test, members of the treatment group most frequently characterized their vegetable-eating behavior as being related to Maintenance, followed by Preparation, and Precontemplation (46, 26, and 12 percent, respectively), a different pattern than was the case at the pre-test phase. The control group's responses at pre-test were mostly in two categories: Maintenance (47 percent) and Precontemplation (33 percent). The post-test category for Precontemplation remained at 33 percent, but the Preparation category was 18 percent, a change from the pre-test (8 percent). Also, control group participants categorizing their behavior as Maintenance dropped to 33 percent at the post-test phase.

Results from the sign tests revealed no significant difference between pre-test and post-test results for neither the treatment group nor the control group for stage of change related to fruit-eating behaviors nor for the control group for stage of change related to vegetable-eating behaviors (table 3). However, a significant positive change for stage of change for the treatment group's vegetable-eating behaviors existed. This positive change shows movement from a lower stage of change category to a higher category from the pre-test to the post-test.

Limitations of the Study

Findings were limited to the older adults in this study. Participants were not randomly selected because they were attendees of pre-arranged class sites, and some self-selection occurred.

Measurable behavior change may have been limited because of the short span of weeks in which treatment took place. Other considerations were (1) the environments of the congregate meal sites that varied in lighting, seating arrangements, distractions, and participant attentiveness and (2) the nutrition education on fruits and vegetables that the control group may have received from other sources prior to this study.

Conclusions

This study specifically examined the influence of nutrition education on the eating behaviors of older adults who resided in nonmetropolitan or semi-rural geographic areas and who were also participants of congregate meal programs. Based on recent trends, the nonmetropolitan or semi-rural older adult population is an important group to focus on because of factors such as the out-migration of younger persons in these areas and the sometimes-segmented nutrition and health care services (ADA, 2000; Rogers, 1999). Further study is recommended of not only this geographic audience but also of a comparison of this audience with *urban* older adults who participate in congregate meal programs.

Our findings indicate that the HELP nutrition lessons made a difference, measured by real and statistical significance, in how some older adults in the treatment group thought about changes, planned for changes, or made changes in their fruit- and vegetable-eating behaviors. Additionally, there is merit to the use and further study of the questions on the Stages of Change instrument for fruit- and vegetable-eating behaviors; that is, for the categorization of older adults' behaviors into the Precontemplation, Contemplation, Preparation, Action, or Maintenance stages.

Realistically, diets vary over time because of a number of factors—one being changes in foods that are available. Therefore, a more relevant application of the Stages of Change construct, compared with simply measuring eating behavior, may be to measure cognitive and behavioral engagement. This approach allows researchers to focus more on what people are thinking about eating during the process of changing their diet, compared with measuring specific foods and nutrients consumed (Kristal, Glanz, Curry, & Patterson, 1999). This approach also may be more empowering to individuals who are working toward more healthful eating behaviors.

Table 3. Post-test/pre-test sign test for Stages of Change computed for fruit- and vegetable-eating behaviors of elderly participants

	Treatment[1]	Control[2]
	Fruits	
	Percent	
Negative differences	24	16
Positive differences	22	20
Ties	54	64

	Treatment[1]	Control[2]
	Vegetables	
	Percent	
Negative differences	8	17
Positive differences	41*	5
Ties	51	78

[1]n = 37 for fruit-eating behaviors, and n = 37 for vegetable-eating behaviors.
[2]n = 45 for fruit-eating behaviors, and n = 41 for vegetable-eating behaviors.
*Differences in behavior changes from the pre-test to the post-test are significant, at $p \leq .05$.

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Using a Concurrent Events Approach to Understand Social Support and Food Insecurity Among Elders

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This study tested a concurrent events approach to understand better the relationships between social support and food insecurity of a sample (n=9) of low-income elders that had participated in an earlier study (n=53) in Upstate New York. This approach involved the use of time-intensive telephone interviews over a span of 4 months. Results indicated that the concurrent events approach provided a fuller understanding of food insecurity, social support, other events, and experiences among these elderly participants. The researchers found that the telephone interviews helped with obtaining a better understanding of the elders' "monthly cycle" of food insecurity and the importance of food exchange as a source of social and food support among elders, a finding that had not been captured in the two in-depth retrospective interviews of the earlier study.

M any elders experience hunger and food insecurity because of low incomes, limited mobility, or poor health (Cook & Brown, 1992; Cohen, Burt, & Schulte, 1993; Lee & Frongillo, 2001a; Nord et al., 2002). Food insecurity among elders contributes to poor diet and malnutrition, which exacerbates disease, increases disability, decreases resistance to infection, and extends hospital stays (Administration on Aging, 1994; Torres-Gil, 1996; Lee & Frongillo, 2001b). Food insecurity is defined as "the inability to acquire or consume an adequate quality or sufficient quantity of food in socially acceptable ways, or the uncertainty that one will be able to do so" (Radimer, Olson, Greene, Campbell, & Habicht, 1992).

Food insecurity among the elderly also includes the inability to obtain and use food in the household (e.g., to gain access to, prepare, and eat available food) because of functional impair-ments, health problems, or lack of social support (Lee & Frongillo, 2001a). Social support affects whether an elderly person with financial or physical limitations or both experiences food insecurity. This support can result from informal social networks, such as family and friends, or more formal programs, such as food programs (Wolfe, Olson, Kendall, & Frongillo, 1996). Functional impairments, health problems, and lack of social support have significant relations with food insecurity (Burt, 1993; Frongillo, Rauschenbach, Roe, & Williamson, 1992; New York State Department of Health and Office for the Aging, 1996; Quandt & Rao, 1999; Roe, 1990; Wolfe et al., 1996). Social support and food insecurity interact in complex ways. At least partly due to method-ological limitations, these interactions are neither well understood nor easy to study (Lee & Frongillo, 2001c). For example, equivocal evidence has revealed the buffering effect of social

support among elders (Newsom & Schulz, 1996; Lee & Frongillo, 2001a).

For some elders, family or friends—even if needed routinely—cannot always help as planned, resulting sometimes in hunger or food insecurity. Although it is important to understand these types of situations, it is difficult to obtain adequate details about these experiences from one or even two in-depth interviews (Wolfe et al., 1996). When experiences such as these occur, participants tend to talk in general terms about what they did and suggest that they are okay. However, they often do not mention exactly what they consumed or mention the anxiety they experienced. In addition, they tend to talk more about one or two problematic times that resulted in greater anxiety or more severe food insecurity rather than including other less severe examples of lack of support or of the variability or precariousness of their support. Thus, it has been difficult to obtain the details that are needed to understand more fully the relation of social support to food insecurity in this population.

Many low-income elders also experience a monthly financial cycle that results in a food insecurity cycle—having less food insecurity and anxiety at the beginning of the month when they receive their monthly checks and experiencing greater food insecurity and anxiety at the end of the month when their money has been spent (Wolfe et al., 1996). Some low-income elders are so accustomed to this monthly cycle that they do not talk about these difficulties (even when asked) unless they happen to be interviewed during that time. It is unclear, however, how various management strategies relate to this monthly cycle.

Thus, the ways that both formal and informal social support serve to improve the food security of elders are not well understood, partly because of

methodological limitations in research designs. In general, understanding the biological, psychological, and social dynamics of events, needs, practices, and help-seeking and other behaviors of elders is important to assessing and interpreting their experiences. It is, as well, important to understanding how food assistance programs and other formal actions might contribute to improving food security. For example, 1 of the 10 recommendations about health outcomes developed by an Institute of Medicine (1996) committee was to determine "the impact on health outcomes when older individuals make transitions between types of care, treatment settings, and health plans." Acquiring such understanding requires new research approaches that allow for describing and sorting out complex, dynamic patterns of each elder's experience across an appropriate time-frame (Lee & Frongillo, 2001c). For similar reasons, and in the absence of randomized intervention trials, new research approaches are also needed for assessing the effect of programs, such as home-delivered meals and home-care services.

Time-intensive, event-focused approaches may be particularly valuable for understanding complex, dynamic patterns (Tuma & Hannan, 1984; Blossfeld & Rohwer, 1995), because they are used to study transitions across a set of discrete states, including the length of time intervals between entry into and exit from specific states (e.g., well vs. ill). The transitions are studied in relation to other discrete events and changes in continual states. These event-focused approaches hold advantages for causal inference over both cross-sectional and traditional longitudinal approaches because of the detailed knowledge of the occurrence and timing of events. These approaches are particularly suited for research with elders because of the highly dynamic nature of factors

that affect their nutrition and health (Lee & Frongillo, 2001c).

This study tested an innovative, events-focused, qualitative research approach to understand better the relationships between social support and food insecurity of low-income elders. This new concurrent events approach involved studying a small group of food-insecure elders intensively for a prolonged period to help understand the intricacies of the variability and uncertainty of social support as well as other events experienced in relation to food insecurity. The approach is referred to as "concurrent" because the researchers monitored study participants frequently over time (Gordis, 2000).

Methods

We previously conducted a study of 53 food-insecure low-income elderly men and women who lived in their own homes in three large cities in Upstate New York. In this earlier study, we completed two in-depth interviews with each elder. The purpose of the earlier study was to understand better the experience of elderly food insecurity and thus contribute to previous research of food insecurity among elders (Wolfe et al., 1996, 1998). For the study reported here, we selected a subset of nine of these elders.

When we conducted the earlier study, six of the nine elders in the study reported here were food insecure and three, relying heavily on social support strategies for food, were marginally food secure. The sample consisted of seven Caucasian women, one Caucasian man, and one African-American man whose ages ranged from 59 to 76 (an average of 68 years). Four had impaired mobility (two in wheelchairs) and one had occasional dizzy spells. Six lived alone; one with

her daughter and husband, who died during the study; one, with her elderly boyfriend; and one, with her teenaged grandson. Two received both food stamps and home-delivered meals. Three of the elders received home-delivered meals only—one, not because she needed them, but because she helped deliver these meals. Of the nine elders, only two participated in congregate meals and received food from food pantries; two did not participate in any food programs. Monthly incomes of the elderly participants ranged from $400 to $900, averaging $738 each month. Six lived in subsidized housing; all had been employed most of their lives; two had not completed high school, five were high school graduates, and two attended some college.

Each participant was interviewed weekly by telephone for 4 months (December 2000 to March 2001) by one of the authors who performed all of the interviews by using an interview guide and a tape recorder. Participants were asked about the past week: their food situation (i.e., how they obtain their groceries, whether they had any help with meals, whether they attended any food programs, or whether they had problems accessing food), their use of social networks, frequency of family contacts, changes in their health or social support, and events of the past week. Rapport was established quickly during the telephone conversations, because the same interviewer had interviewed each participant twice in his or her home during the previous year. The weekly contact helped to increase rapport further, which is important for gathering this type of sensitive information. Informed consent (to participate and to tape record the telephone interviews) was obtained in the first interview.

Analysis was ongoing: Each week prior to the next telephone interview, the interviewer listened to, took detailed notes from, and analyzed the interview of the previous week. From this analysis, the interviewer developed follow-up questions to probe more fully for emerging issues. Following the final interviews, these records were further analyzed, summarized, reviewed, and discussed by all three authors.

Results and Discussion

Usefulness of the Concurrent Events Approach for Understanding Social Support and Food Insecurity

As expected, the time-intensive telephone interviews produced a fuller understanding of some issues that arose in our earlier research with this population. One finding was the surprising extent and importance of food exchange as a source of social and food support among elders, a finding that had not been captured in the in-depth interviews. For example, one woman took home-delivered meals to others in her building and sold Avon products, both of which placed her in situations where people gave her food they had received from the home-delivered meal program, food pantries, or restaurants. These food gifts, plus the free home-delivered meals she received for working for them, were important to her food security.

Another woman, with very low mobility, lived alone and relied on her family for support. Because this was not always reliable, this participant became a member of a food network in her apartment building for seniors. This network included elaborate food-trade and food-access strategies. For example, in addition to receiving half-pint cartons of milk from a neighbor's home-delivered meals, this study participant received food from a woman who did not use all the food that her

The weekly telephone calls provided good rapport between the elderly food-insecure participants and the interviewer and a fuller understanding of food insecurity, social support, other events, and experiences among these elderly participants.

children brought to her. In return, our participant made homemade soup and brought portions to others.

Another person received food from the "bread fairy," an elderly neighbor who went regularly to the food pantry to get and then distribute loaves of day-old bread to various needy residents. A fourth elderly woman was diabetic and had recently begun sharing the food she prepared with others. The foods included items such as diabetic desserts that she shared with a diabetic neighbor whom she also took food shopping. Extensive food-sharing among elders has been elucidated by others (e.g., Quandt, Arcury, Bell, McDonald, & Vitolins, 2001).

The study was intended to produce a better understanding of the variability and uncertainty of social support in relation to food insecurity, since the findings from the earlier in-depth interviews suggested that social support was important for food security but often was not consistent or reliable in many cases. What we found, however, was that at least in this group, the social support of most participants did not change over the 4 months of the study (e.g., elders maintained routine patterns regarding who took them shopping).

In fact, having non-changing situations was important to these elders. The only exception was the elderly participant who reported both in the in-depth and telephone interviews that her daughter took her shopping once a month. However, this supposed routine help did not occur during the first 2 months of our weekly telephone interviews. As a result, this participant had to borrow food from her neighbors and had to order canned food from a drug store that delivered—although she preferred fresh food. This situation also made her home-delivered meals more vital than ever. Another participant who

experienced a major life event during the study—the loss of her husband—did not lose her social support or food insecurity as might have been expected because she also lived with her daughter.

Results such as these suggest that a longer follow-up period may be needed to understand the effects of variability in social support for most elders. Perhaps, when changes in social support occur for most elders, the changes are over a longer period, such as those associated with climatic seasons.

Usefulness of the Concurrent Events Approach for Understanding Other Events and Experiences Related to Food Insecurity

The weekly telephone interviews were valuable for gaining a fuller understanding of the daily lives of these food-insecure elders. By talking with the participants weekly, the researchers found that the interviews also helped with obtaining a better understanding of the elders' "monthly cycle" of food insecurity and also allowed good rapport and confidence to be established. The telephone interviews also allowed the researcher to ask more direct questions and the elderly participants to share additional personal information. Some examples follow.

(1) One elderly woman was not classified as food insecure based on the earlier study, but the weekly contacts helped to elucidate how much she actually relied on food stamps—particularly at the end of the month. Her food money began to be depleted during the third week of the month; during the end of the month, her food situation actually changed. For example, she had to substitute foods like french toast for dinner rather than eating meals

that included meat. Because of the rapport established between the interviewer and another participant, the elderly woman making these substitutions was comfortable enough to describe one of her food-access strategies: smuggling food from the congregate lunches to be eaten for her dinner. Although this was not allowed (because of concerns for food safety), she regularly brought containers for extra food.

(2) The weekly interviews helped researchers understand the support system of one African-American man who had very little family support, but he seemed to have a number of friends that took him shopping. Later in the study, however, he revealed that he often paid these friends for rides and therefore was reluctant to call them as much as he needed.

(3) The concurrent events approach was intended to allow us to understand and describe what and how events occurred on a week-to-week basis, as well as how these events affect elders' food insecurity. We previously found that major sicknesses and other stressful events affected the food situation of the elders and, thus, their food insecurity (Wolfe et al., 1996). Although few participants endured very stressful events during the 4 months of study, Christmas turned out to be one such event. The weekly interviews provided an understanding of the importance of Christmas and the stress it may cause because of the need to have extra money to buy special food, presents for grandchildren, and other items. Christmas, therefore, sometimes resulted in greater food insecurity. For example, one woman who wanted to bake for her family and friends bought extra staple foods and saved some money during the fall so that she could purchase extra baking supplies. Unfortunately, she was forced to use this stocked food when her

money started to become depleted because of extra Christmas expenses. The interviews also highlighted the importance of charitable food baskets at Christmas for some participants.

(4) Another event occurred when the Caucasian male participant—on the recommendation of others in his building—decided to try food shopping rather than eating out at a snack bar each evening. By following this recommendation, he spent more money than he would have spent otherwise. The result: Before the end of the month, this elderly participant needed to borrow money and use credit to eat. Perhaps this was because he was not used to shopping for groceries.

(5) One elderly woman's health, social support, and food situation changed dramatically during the 4-month study. This participant was on a diet described as lowfat, low-cholesterol, low-sugar, low-sodium, and limited-greens. (The latter was due to a history of blood clots and medication for it. Based on her interpretations, she believed she was not allowed to eat anything "green.") The weekly telephone contact produced a greater under-standing of how complicated it was for this participant to follow her diet—especially given her low income. In addition, during the time that the telephone interviews were conducted, this elderly participant experienced several major life changes. After having heart surgery, she moved in with her elderly boyfriend so that he could take care of her. At the same time, she continued to pay for her own house, which caused financial difficulties. (She did not feel secure enough with her new situation to sell her house.) Living with her boyfriend who had no diet limitation made it even more difficult for her to follow her fairly strict diet. Our previous work showed that the ability to eat the "right foods for health" was an important aspect of food

security among the elderly, and her new social situation seemed to make this woman even more food insecure. Then, just before our study ended, she was diagnosed with breast cancer. This new life-altering event—plus the negative effect of living with someone with very different food habits—caused her to conclude that her diet really did not matter anyway. As a result, she stopped following her diet. It's likely that her food situation changed further after her cancer surgery, which was scheduled after the end of our study.

Thus, using the new concurrent events approach, compared with the two in-depth interviews alone, produced a fuller understanding of changes as they occurred. This fuller under-standing probably would not have been achieved with retrospective in-depth interviews or event histories (Tuma & Hannan, 1984; Blossfeld & Rohwer, 1995). During the 4-month timeframe, however, there were not many substantial changes. The approach was relatively easy and inexpensive to implement, requiring only about 10 minutes to interview each participant each week.

Conclusions

The weekly telephone calls provided good rapport between the elderly food-insecure participants and the inter-viewer and provided a fuller under-standing of food insecurity, social support, other events, and experiences among these elderly participants. These calls added to what was achieved in the two prior in-depth interviews. The concurrent events approach was not efficient for understanding the vari-ability of social support or the effect of stressful events on food insecurity, however, because these events did not occur very often. The approach might be more efficient (for the same amount of interviewer time input) by first

The concurrent events approach is likely to be useful for investigation following an event or transition such as participating in the home-delivered meals program, moving into senior housing, loss of a spouse, moves by family members, or a change in health condition.

interviewing a new person in his or her home once or twice, followed by weekly telephone calls for a month, and then monthly telephone calls for at least several months or up to a year. When an important event or change is identified, weekly telephone calls can be made for several weeks to investigate that event or change.

The concurrent events approach is likely to be useful for investigation following an event or a transition such as participating in the home-delivered meals program, moving into senior housing, losing a spouse, moves by family members, or a change in health condition. The concurrent events approach could identify the early effects of programs and provide much-needed evidence about whether and how being a program participant (e.g., Meals on Wheels recipient) is helpful. For example, one could investigate whether elders receiving home-delivered meals eat the meals, establish a relationship with the delivery person, or have changes in their mental state. Participants could be recruited by using either a formal or an informal surveillance system (such as through contacts in housing offices or through home-delivered meals programs) that provides prompt notification when someone is making a transition. Soon after this notification, the participant could be interviewed, as frequently as once a week or once a month, to obtain a more detailed and accurate assess-ment of any changes in food status and social support.

This study has demonstrated the usefulness of an innovative, feasible, and inexpensive concurrent events research approach for investigating nutrition issues in the elderly. The two key elements of the approach are the initial establishment of rapport by using one or two in-depth, in-person, qualitative interviews and then frequent follow-up qualitative interviews via telephone. Variants of this approach might involve brief in-person follow-up interviews or incorporation of some quantitative questions.

Acknowledgments

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Measuring the Food Security of Elderly Persons

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This study assessed the appropriateness of the U.S. Food Security Scale for measuring the food security of elderly persons and, in particular, whether measured prevalence rates of food insecurity and hunger among the elderly were likely to be biased, relative to those of the nonelderly. The findings, based on analysis of 3 years of data from the Current Population Survey Food Security Supplement, consistently indicated that the Food Security Scale fairly represented the food security status of elderly persons, compared with the food security status of nonelderly persons. Statistical analysis of the multiple-indicator scale found no indication that the scale underrepresented the prevalence of food insecurity or hunger among the elderly because they interpreted or responded to questions in the Food Security Scale differently than did the nonelderly. Responses to questions other than those in the scale indicated that some elderly did face food-access problems other than insufficient resources to buy food—most notably problems getting to a food store. However, these problems were no more likely for the elderly than for the nonelderly to be so serious that desired eating patterns were disrupted or food intake was insufficient. A small proportion of elderly households classified as food-secure obtained food assistance from Federal and community programs, suggesting that some of these households were less than fully food-secure and that some may, indeed, be food-insecure. However, food-secure elderly-only households were less likely than the food-secure nonelderly households to rely on food assistance programs that are accessible to both.

E lderly persons are more food-secure than are nonelderly persons, according to recent nationally representative food security surveys sponsored by the U.S. Department of Agriculture (USDA) (Nord, 2002; Nord et al., 2002; Guthrie & Lin, 2002; Andrews, Nord, Bickel, & Carlson, 2000; Bickel, Carlson, & Nord, 1999). In these surveys, food security—defined as access at all times to enough food for an active, healthy life for all household members—is measured by a series of questions about behaviors and experiences known to characterize households that are having difficulty meeting their food needs (Fitchen, 1981; Fitchen, 1988; Radimer, Olson, & Campbell, 1990;

Radimer, Olson, Green, Campbell & Habicht, 1992; Wehler, Scott, & Anderson, 1992). The U.S. Food Security Scale, calculated from responses to these questions, measures the food security of the household and classifies each as food-secure, food-insecure without hunger, or food-insecure with hunger (Bickel, Nord, Price, Hamilton, & Cook, 2000; Hamilton et al., 1997a; 1997b). Concerns have been raised about whether this measurement method, based on self-reported food-access conditions and behaviors, fairly represents the food security of elderly persons, compared with that of non-elderly persons. Food insecurity is known to be associated with poor nutrition and health

outcomes for elderly people, and age aggravates the negative effects of poor nutrition on the elderly; so accurate, reliable measurements of the food security of the elderly are important both for monitoring and research purposes (Sahyoun & Basiotis, 2000; Guthrie & Lin, 2002). In this study, I assess the appropriateness of the U.S. Food Security Scale for measuring the food security of elderly persons and, in particular, whether prevalence rates of food insecurity and hunger are comparable between households with and without elderly persons present.

Statistics based on the September 2000 Food Security Survey Module—the most recent food security data available—indicate that 94 percent of households with an elderly person (i.e., age 65 or over) present were food-secure throughout the year (Nord, 2002). Thus, the remaining 6 percent of households with elderly persons were food-insecure, meaning that at some time during the previous year, these households were either uncertain of having or unable to acquire enough food to meet basic needs of all their members because they had insufficient money or other resources for food.

One in four of the food-insecure elderly households (1.5 percent of all elderly households) were food-insecure to the extent that one or more household members were hungry at least some time during the year because they could not afford enough food. The other three-fourths of food-insecure elderly households obtained enough food to avoid hunger by using a variety of coping strategies such as eating less varied diets, participating in Federal food assistance programs, or getting emergency food from community food pantries. These rates of food insecurity and hunger were about half those of households with no elderly members, and this relationship was observed at

all income levels, including households with incomes below the Federal poverty line. The extent of food insecurity and hunger among elderly households remained almost unchanged from that of 1995 (when the first nationally representative food security survey was conducted) through 2000. The corresponding prevalence rates for the nonelderly, on the other hand, declined substantially during this period of economic growth.

There are two areas of greatest concern regarding application of the standard methods for measuring food security to the elderly. The first is whether the questions in the Food Security Scale are understood similarly by the elderly and the nonelderly and whether they experience and respond to food in-security in similar ways. The standard method depends on self-reported conditions and behaviors related to food access and, as such, may be subject to differences in how people understand and interpret the questions and may be subject to biases in the direction of perceived social desir-ability. For example, ethnographic findings have suggested that the least severe question in the Food Security Scale, which asks whether respondents worried that their food would run out before they received money to buy more, might be less sensitive for elders. Some elderly persons, at least, report that they just do not worry about such things.

The second area of concern is whether the Food Security Scale is appropriately sensitive to obstacles that particularly affect elders' ability to get adequate, nutritious meals. The Food Security Scale measures, specifically, food insecurity and hunger that are caused by insufficient money or other resources for food. Each question in the scale specifies this resource constraint as a reason for the behavior or condition—

for example: "In the last 12 months, did you ever cut the size of your meals or skip meals *because there wasn't enough money for food?*" Factors other than economic resource constraints (e.g., health problems, mobility limitations, and lack of transportation) may be obstacles to elders' ability to obtain adequate nutritious meals, and food-access problems caused by such factors might not be registered by the Food Security Scale (Guthrie & Lin, 2002).

Data and Methods

Data to assess these concerns about measuring the food security of elderly persons were drawn from the August 1998, April 1999, and September 2000 Current Population Survey Food Security Supplements (CPS-FSS). The CPS-FSS is an annual, nationally representative survey of about 42,000 households, which is conducted as a supplement to the monthly CPS labor force survey. In each household, the person most knowledgeable about the food purchased and eaten in the home responds to the questions in the Food Security Supplement. Annual statistics on household food security in the United States are published by the USDA and are based on data from the CPS-FSS.

Separate analysis files were constructed for households in which all persons were age 65 or older (i.e., elderly-only households) and households in which no person was age 65 or older (i.e., nonelderly households). Households with mixed elderly and nonelderly— about 7 percent of all households— were excluded from the analysis.

Scaling Analysis: Do the Elderly and Nonelderly Experience and Respond Similarly to Food Insecurity?

To assess whether the questions in the Food Security Scale are understood similarly by the elderly and the non-elderly and whether they experience and respond similarly to food insecurity, I compared response patterns of elderly-only and nonelderly households. To do so, I used statistical methods based on the Rasch measurement model—the methods originally used to develop the Food Security Scale. This analysis exploits one of the strengths of multiple-indicator measures such as the Food Security Scale: associations among the indicators comprising the scale provide evidence of its validity and reliability.

Furthermore, if the patterns of association among the items in a multiple-indicator measure are similar in two populations, this suggests that the items relate similarly in the two populations to the underlying phenomenon that accounts for their interrelationships; *that is, the items measure the same phenomenon in the two populations.* These methods of scale assessment are more widely used in psychometric research and educational testing than in nutrition and economic research, so I present first a brief summary of the Rasch model and the scale assessment statistics based on it. More detailed information on the Rasch model and associated statistics is available elsewhere.[1]

[1] See Wright (1977; 1983), Wright & Masters (1982), Baker (1992), Hambleton, Swaminathan, & Rogers (1991), and Fischer & Molenaar (1995), and the Website of the MESA psychometric laboratory at the University of Chicago at www.rasch.org. Information about applications of Rasch methods to the development and assessment of food security scales is available in Hamilton et al. (1997a; 1997b), Ohls, Radbill, & Schirm (2001), Bickel et al. (2000), and Nord (2000).

An essential characteristic of the Food Security Scale is that the items comprising it vary across a wide range of severity of food insecurity. The precise severity level of each item (the "item calibration" or "item score") is estimated empirically from the overall pattern of response to the scale items by the interviewed households. However, the range of severity of the conditions identified by the items is also intuitively evident from inspection of the items. For example, not eating for a whole day is a more severe manifestation of food insecurity than is cutting the size of meals or skipping meals. These differences in severity are observed in two ways in the response patterns of surveyed households.

First, more severe items are less frequently affirmed than less severe items. Second, households that affirm a specific item are likely to have also affirmed all items that are less severe, while households that deny the item are likely to also deny all items that are more severe. These typical response patterns are not universal, but they are predominant, and among households that do deviate from the typical patterns, the extent of deviation tends to be slight.

The Rasch model formalizes the concept of severity-ordering of items and provides standard statistical methods to estimate the severity level measured by each item and the severity level experienced by each household. The model also assesses the extent to which the response patterns observed in a data set are consistent with the severity-order concept. The food security of households can be thought of as a continuum, which is represented by a graduated scale, from fully secure to severely insecure with hunger evident. The Rasch model links the severity of items to this same scale as follows: Imagine a household becoming progressively more food-insecure. At

very low levels of food insecurity, the household denies all items in the Food Security Scale. As insecurity increases, the household reaches a level where it begins to report, "We worried whether our food would run out before we got money to buy more" (the least severe item in the scale), while continuing to deny the more severe items. That low level of insecurity is the severity score of the "worried" item.

At some more severe level, the household begins to report, "The food we bought didn't last, and we didn't have money to get more," while continuing to affirm the "worried" item but denying all of the more severe items. This higher severity level is the severity score of the item "Food we bought didn't last." Of course, not all households experience or report food security in exactly the same manner, so these relationships are only probablistically true. Technically, half of all households with severity scores equal to that of an item will affirm that item. That is, the average household at this level of severity is right on the edge, equally likely to say "yes" or "no" to the item.

As a household becomes more food-insecure, it is progressively more likely it will affirm each item. The Rasch model is based on a specific mathematical function that relates the probability of a household affirming an item to the difference between the severity-level of the household and the severity score of the item (box 1). Average item discrimination and item-fit statistics, used in this study to compare response patterns of elderly and nonelderly households with questions in the Food Security Scale, are based on the consistency with which households' responses conform to this expected pattern. These statistics are based on the proportions of expected and unexpected responses. Expected responses are denials of an item by households with severity scores below

Box 1. The Rasch Model: Ordering severity level of items and severity level experienced by households

The single-parameter Rasch model, which is used to create the Food Security Scale, assumes that the log of the odds of a household affirming an item is proportional to the difference between the "true" severity level of the household and the "true" severity level of the item. That is, the odds that a household at severity-level h will affirm an item at severity-level i is expressed as: $P_{h,i}/Q_{h,i} = e^{(h-i)}$ where P is the probability that the household will affirm the item, Q is the probability the household will deny the item (that is, 1-p), and e is the base of the natural logarithms.

Item infit is an information-weighted fit statistic that compares the observed responses of all households with the responses expected under the assumptions of the Rasch model. It is calculated as follows:

$$INFIT_1 = SUM\ [(X_{i,h} - P_{i,h})^2]\ /\ SUM\ [P_{i,h} - P_{i,h}^2]$$

where:

$X_{i,h}$ is the observed response of household h to item i
(1 if response is yes, 0 if response is no);
$P_{i,h}$ is the probability of an affirmative response by household h to item i under Rasch assumptions, given the item calibration and the estimated level of severity of food insecurity in the household.

The expected value of each item's infit statistic is 1.0 if the data conform to Rasch model assumptions. Values above 1.0 indicate that the item discriminates less sharply than the average of all items in the scale.

Item outfit is an outlier-sensitive fit statistic that compares the observed responses of all households with the responses expected under the assumptions of the Rasch model. It is calculated as the average across households of the squared error divided by the expected squared error.

$$OUTFIT_i = SUM\ [(X_{i,h} - P_{i,h})^2\ /\ P_{i,h} - P_{i,h}^2]\ /\ N$$

where:

$X_{i,h}$ is the observed response of household h to item i
(1 if response is yes, 0 if response is no);
$P_{i,h}$ is the probability of an affirmative response by household h to item i under Rasch assumptions, given the item calibration and the estimated level of severity of food insecurity in the household;
N   is the number of households.

The expected value of each item's outfit statistic is 1.0 if the data conform to Rasch model assumptions. Values above 1.0 indicate a higher than expected proportion of "erratic" responses—affirmative responses to a severe item by households that affirmed few other items or denials of a low-severity item by households that affirmed many other items.

For further information on these item-fit statistics, see Wright and Masters (1982, pp. 94ff.), Bond and Fox (2001, pp. 176ff.).

that of the item and affirmations of the item by households with severity scores higher than that of the item. Unexpected responses are the opposite. An item with high discrimination has fewer unexpected responses than does an item with low discrimination. Thus, if the same set of items is found to have higher average discrimination in one population than in another, this indicates that the responses were more consistently ordered, and the underlying phenomenon was measured more precisely, in the first population.

The Rasch model assumes that all items discriminate equally and that items discriminate equally for all subpopulations. Comparing average item discrimination between scales fitted separately for the elderly and the nonelderly tests empirically whether the latter assumption is true. Lower item discrimination in a subpopulation would mean either that the behaviors and conditions indicated by the items were less consistently ordered in that subpopulation or that respondents' answers to the questions were less consistently related to the behaviors and conditions in question. The latter condition would occur if the questions were not well understood by the respondents or were not understood to mean the same thing by all respondents.

Item-fit statistics compare the extent of unexpected responses for each specific item to those of the average of all items in the scale. The two most commonly reported item-fit statistics "infit" and "outfit" are used in this study to assess whether the elderly responded less consistently or more erratically than did the nonelderly to specific items in the scale (box 1). For both statistics, a value of 1 indicates that the extent of unexpected responses to the item is at the average for all items in the scale. Values above 1 indicate a disproportionate share of unexpected responses

and, therefore, lower discrimination of the item; values below 1 indicate a smaller proportion of unexpected responses and higher discrimination of the item. Infit is "information-weighted" so that it is sensitive to responses by households with severity scores in the range near the severity level of the particular item. Outfit is sensitive to unexpected responses from households with severities much higher or lower than that of the item—that is, to highly improbable or erratic responses (outliers). Outfit is calculated as the sum of squared errors divided by the sum of squared errors expected under model assumptions.

I conducted separate scaling analyses for elderly-only and nonelderly households and compared the results. Households that affirm none of the scale questions, typically nearly 80 percent of all U.S. households and a larger proportion of elderly-only households, and those few households that affirm all questions to which they respond do not provide any information about the *relative* severity of the items in the scale. Households with these "extreme" responses must be excluded from scaling analyses. After these necessary exclusions, the sample of households available for the scaling analysis from the combined CPS-FSS for the 3 years consisted of 2,036 elderly-only households and 17,033 nonelderly households, sufficiently large samples to provide stable, reliable scale statistics.

I recoded responses to the food security questions into dichotomous scale items by following standard editing procedures, as described in the *Guide to Measuring Household Food Security, Revised 2000* (Bickel et al., 2000). Child-referenced items were excluded from both scales in order to maximize comparability, because the elderly-only households were not asked these questions. Data for the two age groups

were fitted separately to the Rasch model by using joint-maximum-likelihood methods implemented by ERSRasch (a set of SAS programs developed by ERS for Rasch analysis of food security data).

The elderly-only and nonelderly scales were standardized to the same metric (that of the standard 18-item household scale described in Bickel et al., 2000) so that discrimination parameters and item severities could be meaningfully compared between the two scales. The scales were standardized by applying a linear transformation to each scale's item scores so that means of the item scores could be equated to mean absolute deviation of item scores in the two scales. This particular standardization is justified by the assumption that the scale characteristic most likely to be the same between the two populations is the average severity of the items.

The additive constant in the linear transformation simply provides identification. (Rasch scales are unique only up to an additive transformation, so an identifying constant is supplied arbitrarily in the process of model estimation.) The multiplicative constant in the linear transformation adjusts for any differences in the average item discrimination in the two subpopulations. The Rasch model assumes that item discrimination is the same in all subpopulations. However, we also assume that any given item represents the same level of food insecurity for respondents in both subpopulations. Comparing the discrimination parameters required to obtain the same item dispersion in scales fitted separately to elderly and nonelderly household response data allows one to test whether these two assumptions are compatible.

Alternatively, average item discrimination in the two subpopulations can be

compared by estimating item scores separately for each group with discrimination coefficients set at 1 and then comparing the mean absolute deviations of item scores in the two scales. The two methods are exactly equivalent. The multiplier required to equate mean absolute deviation is the inverse of the discrimination coefficient that would have to be specified to achieve the same mean absolute deviation of item scores. Adjusting the item scores has the advantage of facilitating comparison of relative item severities between the two subpopulations.

I compared average item discrimination, item-fit statistics, and relative item severity scores of the elderly-only scale with those of the nonelderly scale. Average item discrimination and item-fit statistics provide information about the consistency of ordering of responses to the questions in the scale. If elderly-only responses were less consistently ordered or more erratic, then the average item discrimination for their scale would be lower, and item-fit statistics of affected items would be higher, than the corresponding statistics for the nonelderly scale.

If the two age groups understood a question differently, or if the behavior or condition in question related differently to food insecurity for the two groups, then the severity score of that item relative to those of other items would differ between the scales for the two groups. On the other hand, similar relative severity scores across all items for the two age groups would suggest that the items are understood similarly by the two groups and that the two groups experience and respond to food insecurity similarly.

Other Indications of Food Problems Faced by the Elderly

CPS-FSS asked respondents several questions additional to those that constitute the Food Security Scale. These other questions identified various food problems that may have been encountered. One of these questions, the so-called *food sufficiency* question, has been used for many years in food consumption and health surveys. It asks: "Which of these statements best describes the food eaten in your household—(1) enough of the kinds of food we want to eat, (2) enough but not always the *kinds* of food we want to eat, (3) sometimes not enough to eat, or (4) often not enough to eat?" This question does not explicitly specify a resource constraint as the cause of the food condition and may, therefore, be sensitive to food-access problems that are not caused directly by insufficient money to buy food.

I compared the proportions of elderly-only and nonelderly households reporting in each category of this question to assess whether food problems other than insufficient resources to buy food were more prevalent for elderly than nonelderly households. I also cross-classified households in each age group by their food sufficiency status and food security status to assess whether the Food Security Scale was less sensitive to food problems revealed by the food sufficiency question for elderly than for nonelderly households.

Households responding "We had enough but not always the *kinds* of food we want to eat" were then asked the following: "Here are some reasons why people don't always have the kinds of food they want. For each one, please tell me if that is a reason why YOU don't always have the kinds of food you want to eat." Reasons presented for a yes or no response were

- Not enough money for food
- Kinds of food we want not available
- Not enough time for shopping or cooking
- Too hard to get to the store
- On a special diet

Households responding that they sometimes or often did not have enough to eat were asked a similar follow-up. "Here are some reasons why people don't always have enough to eat. For each one, please tell me if that is a reason why YOU might not always have enough to eat." Reasons presented for a yes or no response were

- Not enough money for food
- Not enough time for shopping or cooking
- Too hard to get to the store
- On a diet
- No working stove available
- Not able to cook or eat because of health problems

I compared the proportions of the elderly-only and nonelderly households reporting selected problems to examine whether food problems other than insufficient resources to buy food affected the elderly more so than they did the nonelderly. The food security status of households reporting each food access problem was also examined to assess whether the Food Security Scale is less sensitive to other food access problems for the elderly than for the nonelderly.

Only data from the 1999 and 2000 CPS-FSS were used for the analysis of the food sufficiency question and its follow-ups because a somewhat different set of follow-up questions was asked in 1998. Mixed-age households (elderly and nonelderly living together) were excluded from the analysis as were those who did not respond to the

food sufficiency question (3.9 percent). Unlike the scaling analysis, however, this analysis included households that denied or affirmed all scale items, so the sample sizes were large in spite of restricting the analysis to 2 years of data: 13,078 elderly-only households and 59,203 nonelderly households.

Other Indicators of Unmet Food Needs Among Food-Secure Elderly and Nonelderly Households

Some households turn to Federal or community food assistance programs when they have insufficient money and other resources for food. Households that use these programs and are classified as food-secure may either have underreported the extent to which they are food insecure or may have depended on these programs to get enough food to be food-secure. To assess the extent of these conditions, I compared the proportions of food-secure elderly-only and nonelderly households that used four food assistance programs that are available to elderly-only households and are reported in the CPS-FSS: the Food Stamp Program, senior meals (either Meals on Wheels or meals at a senior center), getting emergency food from a food pantry, and eating meals at an emergency soup kitchen.

CPS-FSS data from the 1998, 1999, and 2000 surveys were combined for this analysis. Most households with annual incomes above about 185 percent of the Federal poverty line were not asked questions about their use of food programs, so the analysis was restricted to households with incomes below this level. The 3-year CPS-FSS sample of low-income food-secure households consisted of 7,072 elderly-only households and 14,524 nonelderly households. For the analysis of food stamp participation, the analysis was further restricted to households with

annual incomes below 130 percent of the Federal poverty line to exclude most households that were not income-eligible for food stamps. This sample consisted of 3,467 elderly-only households and 9,152 nonelderly households.

Results

Scaling Analysis

The response patterns of elderly-only households reflected greater consistency with the severity order of the items than did those of nonelderly households. With the dispersion of item scores equated, the discrimination parameter was 1.25 for elderly-only households versus 1.02 for nonelderly households (table 1). This indicates somewhat greater consistency in the way in which the elderly experience and manage food insecurity and may also indicate more consistent understanding of the questions by elderly respondents.

Item-fit statistics confirm that the greater consistency of elderly-only responses was generally true for all items in the scale. There are no hard-and-fast rules for assessing item-fit statistics, but infits in the range of 0.8 to 1.2 are generally considered to be quite good, and 0.7 to 1.3 may be acceptable (Hamilton et al., 1997b; Linacre & Wright, 1994). Infit statistics for both samples were within an acceptable range and were remarkably similar between the two age groups for corresponding items.[2] The outfit statistic for "Worried food would run out" was somewhat high (indicating erratic responses) in both samples but less so in the elderly sample. The most

Results of the scaling analysis allay concerns that the standard scale underreports the prevalence of food insecurity and hunger among the elderly because of differences in how they interpret and respond to the questions in the Food Security Survey Module.

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[2] The lower-than-expected infits for the two pairs of mutually dependent items (the frequency-of-occurrence follow-up items and their base items) in both scales are artifacts of the statistical dependence of these items.

Table 1. Item severity scores and fit statistics for elderly-only and nonelderly Food Security Scales

Item	Elderly-only households (n=2,036)			Nonelderly households (n=17,033)		
	Severity score[1]	Infit[2]	Outfit[3]	Severity score[1]	Infit[2]	Outfit[3]
Worried food would run out	1.74	1.05	4.30	1.29	1.10	8.41
Food bought didn't last	2.64	.85	1.80	2.57	.98	3.83
Couldn't afford balanced meals	2.83	1.22	12.70	3.61	1.23	4.07
Cut size of meal or skipped meal	5.54	.77	.60	5.29	.71	.55
Ate less than felt should	5.53	.96	.71	5.52	.87	.77
Cut size of meal or skipped meal, 3+ months	6.16	.76	.39	6.43	.77	.48
Hungry but didn't eat	8.06	.86	.32	7.56	.95	.70
Lost weight	8.45	1.11	1.26	8.74	1.04	.60
Didn't eat for whole day	9.53	.95	.42	9.28	.87	.53
Didn't eat for whole day, 3+ months	10.01	.83	.19	10.21	.79	.23
Mean	6.04			6.05		
Mean absolute deviation	2.39			2.39		
Standard deviation	2.81			2.81		
Discrimination coefficient[4]	1.25			1.02		

[1]The severity score of an item reflects the level of severity of food insecurity in households that are equally likely to report or to deny that the condition existed during the year. The metric of the severity scores is logistic (log-odds), and the zero point is arbitrary.

[2]Infit is a measure of the extent to which responses of all households to an item deviate from expectations based on the statistical measurement model used to create the scale (the Rasch model). Infits higher than 1 indicate a higher proportion of inconsistent responses (i.e., lower discrimination) than the other items in the scale. Infits lower than 1 indicate a lower proportion of inconsistent responses (higher discrimination) than the other items in the scale.

[3]Outfit is similar to infit except that it is more sensitive to highly erratic responses (outliers). Values higher than 1 indicate a higher-than-expected proportion of erratic responses (e.g., denial of a low-severity item by a household that affirms many higher-severity items). Values lower than 1 indicate fewer such responses than would be expected under model assumptions.

[4]Discrimination parameters were adjusted to equate the mean absolute deviation of item scores for each scale to that of the corresponding items in the standard scale as described in *Guide to Measuring Household Food Security, Revised 2000* (Bickel et al., 2000). A constant was then added to each scale to equate the mean of the item scores to that of the corresponding items in the standard scale.

notable outfit statistic was the high value (12.7) for "Couldn't afford balanced meals" in the elderly subsample. This indicates that elderly-only responses to this item were more erratic than their responses to other items and more erratic than responses of the nonelderly to this item. Because "Couldn't afford balanced meals" is a low-severity item (2.83), these erratic or improbable responses would have been denials of this item by households that affirmed many other items. It is not known whether these reflect genuine differences in how food insecurity is experienced by different elderly households, misunderstanding of the item by some elderly respondents, or coding errors by interviewers. Outfits this high can result from highly unexpected responses by just a few

discrepant cases (three or four cases in a sample of this size), so further research is warranted prior to drawing conclusions about the suitability of the item for assessing food security of the elderly.

Relative item severities were generally consistent between the elderly-only and nonelderly scales (fig. 1). This is evidence that the scale measures the same underlying phenomenon in both populations: that the questions are understood similarly by elderly and nonelderly persons and that the two groups experience and respond to food insecurity similarly. An underlying assumption of the Rasch model is that the inter-relationships among the indicator items result from the relationships of each individual item

to the underlying phenomenon (in this case, food insecurity). Thus, similar patterns of relationships among the indicator items in two populations are evidence that the items relate similarly to the underlying phenomenon in the two populations. If elderly people underreport food insecurity and hunger, then they do so with remarkable consistency across almost all of the items. The item about worrying is somewhat more severe (less often reported at similar levels of severity) on the elderly-only scale, as suggested by ethnographic research findings, but the difference is only about 0.45 logistic units, corresponding to an odds ratio of 0.64 (calculated by exponentiating the difference in item scores; 90 percent confidence interval is 0.58 to 0.70).

Figure 1. Comparison of item severity scores,[1] elderly-only households versus nonelderly households
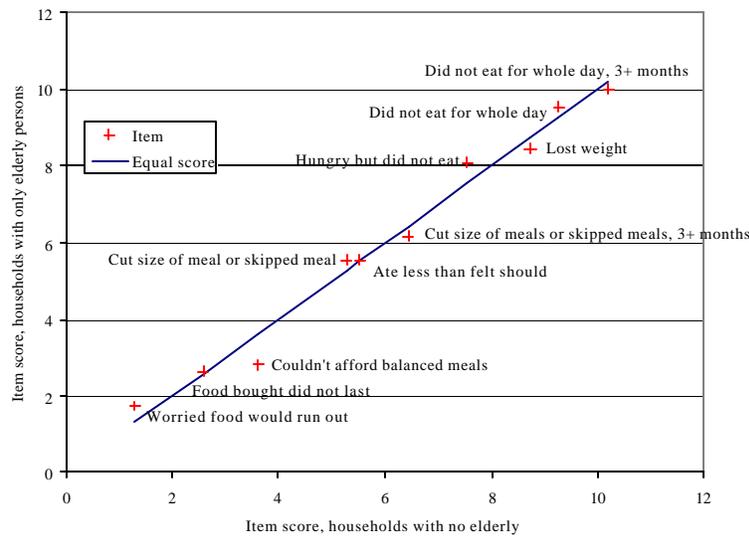
[1]The severity score of an item reflects the level of severity of food insecurity in households that are equally likely to report or to deny that the condition existed during the year.
Note: An item falling on the "equal score" line would represent the same level of food insecurity in households with only elderly persons as in households with no elderly person present.

The most notable difference in item scores of elderly-only households, compared with the nonelderly, is the lower item severity (more frequently reported at similar levels of severity) on the elderly-only scale of the item "We couldn't afford to eat balanced meals." This item was 0.78 logistic units less severe for the elderly, corresponding to an odds ratio of 2.2 (90 percent confidence interval 2.01 to 2.39). That is, elderly-only households were more than twice as likely to report this condition as were nonelderly households at the same overall level of food insecurity. It is possible that this occurs because the elderly's perceived standard of what a balanced meal consists of is more stringent than is true of the nonelderly. Thus it is harder to achieve, and they are more likely to report being unable to afford a balanced meal.

The item about balanced meals is the threshold item for classifying house-holds as food-insecure. That is, it is the third item in severity order, and households must affirm at least three items to be classified as food-insecure.[3] Therefore, its lower severity in the elderly scale would result in a slight *upward* bias on the prevalence of food insecurity among the elderly, compared with the nonelderly, as measured by the standard methods. This bias occurs because each group of households with the same raw score actually includes households with a range of "true" food security severity levels. If all of the items except the balanced meals item have the same item scores in elderly and nonelderly households, and if the

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[3] Under Rasch assumptions, a raw score for the number of affirmative responses is an ordinal measure of the underlying construct (food insecurity in this case), provided households respond to the same set of questions. Thus, classification of households as to their food security status is based on their raw scores. Households that affirm 3 or more of the 10 items in the scale assessed in this article are classified as food insecure irrespective of which 3 items they affirm. Households that affirm 6 or more of the items are classified as food insecure with hunger.

balanced meals item has a lower severity score for the elderly than for the nonelderly, then some elderly households with "true" food security just below the food insecurity threshold will, nevertheless, affirm the balanced meals item and therefore be mis-classified as food insecure by the standard food security classification procedures.

The severity scores of items near the hunger threshold (cut size of meals or skipped meals in 3 or more months) were almost the same for the elderly-only and nonelderly scales. Therefore, estimates of the prevalence of hunger among the elderly are not likely to be biased and can be meaningfully compared with those of the general population.

Other Indications of Food Problems Faced by the Elderly

Elderly-only households were about half as likely as nonelderly households to register food problems in response to the food sufficiency question, a ratio consistent with their relative rates of food insecurity and hunger based on the Food Security Scale. About 10 percent of elderly-only households indicated any problem (they did not always have enough to eat or they did not always have the kinds of food they wanted to eat), compared with nearly 20 percent of the nonelderly (table 2). Among elderly-only households, 1.7 percent reported that they sometimes or often did not have enough to eat, compared with 4.2 percent of nonelderly households. On both measures, the elderly/nonelderly differences could reflect a general stoicism of the elderly with regard to food needs, but the similar pattern across the two measures suggests, at least, that food-access problems *other than insufficient resources to buy food* do not affect the elderly in substantially larger proportions, compared with the effect on the nonelderly.

Table 2. Food sufficiency status versus food security status of elderly-only and nonelderly households, average 1999-2000

Food sufficiency status	Elderly-only households (n=13,078)	Nonelderly households (n=59,203)
	Percent	
Enough of the kinds of food we want to eat	89.89	80.46
Food-secure	88.76	78.09
Food-insecure without hunger	1.03	2.06
Food-insecure with hunger	.10	.30
Enough to eat but not always the kinds of food we want	8.44	15.30
Food-secure	6.09	9.65
Food-insecure without hunger	1.81	4.43
Food-insecure with hunger	.54	1.22
Sometimes not enough to eat	1.39	3.49
Food-secure	.23	.58
Food-insecure without hunger	.57	1.46
Food-insecure with hunger	.58	1.45
Often not enough to eat	.29	.75
Food-secure	.05	.07
Food-insecure without hunger	.04	.13
Food-insecure with hunger	.20	.54

Note: All percentages were calculated using sample weights provided by the Census Bureau so that the interviewed households represent the U.S. noninstitutionalized population.

Specific food problems other than insufficient resources to buy food were no more prevalent among elderly-only households than among nonelderly households (table 3). Not surprisingly, lack of time for shopping or cooking was much less of a problem for the elderly-only than for the nonelderly households. The prevalences of other problems were remarkably similar for the elderly and nonelderly households. This was true even of problems such as "too hard to get to the store" and "not able to cook or eat because of health problems," which might be thought of as being more problematic for the elderly. These problems account for a greater proportion of those elderly-only house-holds that reported *any* problem than was true for nonelderly house-holds. For example, 1.68 percent of elderly-only households reported that they sometimes or often did not have

enough to eat (table 2). Included among these households were 0.66 percent who said this was because it was too hard to get to the store. Thus, this problem accounted for 39 percent of elderly-only households who sometimes or often did not have enough to eat. The corresponding statistic for nonelderly households was 19 percent.

Other Indicators of Unmet Food Needs Among Food-Secure Elderly and Nonelderly Households

Food-secure elderly-only households relied less on Federal and community food assistance programs than did nonelderly households, with the exception of meal programs that are specifically intended for senior citizens (table 4). Among food-secure house-holds with annual incomes below 130

Table 3. Other food problems reported by elderly-only and nonelderly households, average 1999-2000

Food problem	Elderly-only households (n=13,078)	Nonelderly households (n=59,203)
	Percent	
Enough to eat but not always the kinds of food we want because:		
Not enough time for shopping or cooking	0.95	5.93
Food-secure	.79	4.34
Food-insecure (with or without hunger)	.16	1.59
Too hard to get to the store	2.48	2.62
Food-secure	1.56	1.62
Food-insecure (with or without hunger)	.92	1.00
On a special diet	2.12	1.90
Food-secure	1.61	1.35
Food-insecure (with or without hunger)	.51	.55
Sometimes or often not enough to eat because:		
Not enough time for shopping or cooking	.18	.72
Food-secure	.06	.22
Food-insecure without hunger	.08	.26
Food-insecure with hunger	.05	.25
Too hard to get to the store	.66	.79
Food-secure	.13	.10
Food-insecure without hunger	.24	.28
Food-insecure with hunger	.29	.41
On a diet	.23	.34
Food-secure	.03	.10
Food-insecure without hunger	.08	.11
Food-insecure with hunger	.12	.12
No working stove available	.01	.15
Food-secure	0.00	.02
Food-insecure without hunger	.01	.04
Food-insecure with hunger	0.00	.09
Not able to cook or eat because of health problems	.23	.29
Food-secure	.06	.02
Food-insecure without hunger	.09	.09
Food-insecure with hunger	.09	.18

Note: All percentages were calculated by using sample weights provided by the Census Bureau so that the interviewed households represent the U.S. noninstitutionalized population.

percent of the Federal poverty line, about 12 percent of elderly-only households reported receiving food stamps during the previous 12 months, compared with about 22 percent of nonelderly households. Food-secure elderly-only households with income below 185 percent of the Federal poverty line also were less likely to receive food from a church, food pantry, or food bank than were their counterparts: food-secure nonelderly households. Use of emergency (soup) kitchens by food-secure households in both age groups was rare and did not differ substantially. These findings suggest that elderly households with unmet food needs, or who are meeting some of their food needs from food assistance programs, are no more likely to be classified as food-secure than are nonelderly households.

About 8 percent of food-secure elderly-only households with annual incomes below 185 percent of the Federal poverty line received assistance from community meal programs. This assistance included either prepared meals eaten at community programs or senior centers or meals delivered to their homes by programs such as "Meals on Wheels." About 14 percent of low-income food-secure elderly-only households received assistance from one or more of the four food assistance programs analyzed. This suggests that some elderly households with unmet food needs, or who were meeting part of their food needs from food assistance programs, were classified as food secure. The food security of these households may have been tenuous or marginal at times, or they may, indeed, have been food-insecure. Similar, or even higher, reliance on these programs by nonelderly households, however, suggests that any questionable classification or misclassification is no more prevalent for the elderly than for the nonelderly.

Table 4. Use of Federal and community food assistance programs by low-income, food-secure, elderly-only and nonelderly households, average 1998-2000

Food assistance	Elderly-only households	Nonelderly households
	Percent	
Food-secure households with annual income below 130 percent of the Federal poverty line		
Received food stamps	12.4	21.7
Food-secure households with annual income below 185 percent of the Federal poverty line		
Senior meals (delivered to home or in center)	7.7	NA
Received emergency food from church, food pantry, or food bank	2.2	3.2
Ate a meal at a soup kitchen	.3	.4
Received assistance from any of these four programs	14.4	17.2
Number of cases, income below 130 percent of Federal poverty line (unweighted)	3,467	9,152
Number of cases, income below 185 percent of Federal poverty line (unweighted)	7,072	14,524

Note: All percentages were calculated by using sample weights provided by the Census Bureau so that the interviewed households represent the U.S. noninstitutionalized population.

Conclusions

The U.S. Food Security Scale fairly represents the food security of the elderly, compared with that of the nonelderly. Results of the scaling analysis allay concerns that the standard scale underreports the prevalence of food insecurity and hunger among the elderly because of differences in how they interpret and respond to the questions in the Food Security Survey Module. With one exception, relative item severities were similar for elderly-only and nonelderly households, and the exception would lead to a slight *upward* bias on measured food insecurity (but not hunger) among the elderly. Overall, response patterns of the elderly, compared with the nonelderly, were more consistent with the severity-order of the items, and this was true of all items except, possibly, the item about balanced meals, to which the elderly responded somewhat more erratically than did the nonelderly. It cannot be ruled out that elders underreport all indicators of food insecurity and hunger, but this underreporting would have to be remarkably consistent across almost all items to result in the similarity of relative item severities observed in this study.

Responses to the food sufficiency question indicate that the elderly do face food-access problems other than insufficient resources to buy food—most notably problems getting to a store. However, these problems are no more likely for elderly than nonelderly households to be so serious as to disrupt desired eating patterns or result in having insufficient food to eat.

A small proportion of elderly households classified as food-secure obtain food assistance from Federal and community programs. Some of these households probably are less than fully food-secure, and some may, indeed, be food-insecure. However, food-secure elderly-only households are less likely than are food-secure nonelderly households to rely on programs that are accessible to both.

Clearly, the Food Security Scale is not a perfect or complete measure of food security. It measures primarily the main dimension of food security—assured access to sufficient and adequate food. It does not measure food safety and only indirectly measures the dimension of social acceptability of methods used to acquire enough food. Furthermore, not all food problems faced by the elderly (or by the nonelderly) are usefully considered as food security problems. Nutrition security, a somewhat broader concept that includes food security as well as other factors affecting the nutrition of those who are food secure, may be a useful framework for assessing and interrelating the range of issues that affect nutritional adequacy of the diets of the elderly, as well as the nonelderly (Garrett & Ruel, 2000).

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A Statewide Educational Intervention to Improve Older Americans' Nutrition and Physical Activity

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The goal of "Take Charge of Your Health for Older Adults," a community-based, statewide intervention program, was to improve the nutritional status, functional ability, and physical activity of older adults participating in Title III congregate meal programs in Georgia. A pre-test, a series of nutrition education and physical activity sessions, and a post-test were completed by 501 older adults. Results showed that the responses to several measures significantly improved after the intervention. For example, the percentage of older adults with knowledge that 5 daily servings of fruits and vegetables are recommended almost doubled (34 to 64 percent); whereas, those knowing that saturated fat increases the risk of heart disease rose from 55 to 77 percent. Consumption of vegetables—not including potatoes, carrots, or salad—increased from 1.6 to 1.8 average servings a day. Older adults also improved their walking speed from 9.8 to 9.1 seconds, and a greater percentage of the participants (from 55 to 82 percent) reported performing leg exercises during the previous week.

A dequate nutrition and physical activity are essential for health maintenance, functional independence, and quality of life. Messages designed to prevent disease and improve the health and quality of life for all Americans have been promoted by national public policies such as Healthy People 2010 (U.S. Department of Health and Human Services [DHHS], 2000), the *Food Guide Pyramid* (U.S. Department of Agriculture [USDA], 1996), the *Dietary Guidelines for Americans* (USDA & DHHS, 2000), and the Surgeon General's Report on Physical Activity and Health (DHHS, 1996). Despite the surge in social marketing campaigns, many Americans— particularly older adults—are not meeting these recommendations. Data from the Behavioral Risk Factor Surveillance System, for example, showed that in 1998 only 21.2 percent

of adults age 65 and older in Georgia consumed 5 or more daily servings of fruits and vegetables (Behavioral Risk Factor Surveillance System, 1998). In an additional report in 1999, data from this Surveillance System indicated that in the past 30 days, 41.5 percent of Georgians age 65 or older were not involved in any leisure-time activity, that is, nonoccupational physical activity (1999).

The Administration on Aging's Older Americans Nutrition Program, formerly known as the Elderly Nutrition Program, was established in 1972 to fund nutrition and social service programs for adults age 60 and older. Also known as the Title III Nutrition Program, this service, based on factors such as low income, physical disability, and social isolation, is intended to improve the dietary intakes of older adults, with emphasis given to those

at greatest risk of developing nutrition problems. The Older Americans Nutrition Program also provides numerous services that emphasize preventive intervention programs through the use of nutrition screenings and education, as well as other health-related and social support services (Millen, Ohls, Ponza, & McCool, 2002). It is also the largest U.S. community nutrition program for older adults, serving over 3 million meals daily across the Nation, including meals to almost 32,000 Georgians in 2000 (Georgia Department of Human Resources, 2002).

An Executive Summary of Title III programs reported significant health problems within the U.S. population of older adults (Millen et al., 2002, Ponza, Ohls, & Millen, 1996). Many of these health problems—such as cardiovascular disease, hypertension, diabetes mellitus, and obesity—are related to poor nutrition and physical activity and therefore could be lessened by interventions related to nutrition and physical activity. Data from other national sources (Millen et al., 2002; Ponza et al., 1996) and from within Georgia (Accettura, 2000; Aspinwall, 2001; Brackett, 1999) indicate that participants in the Title III Nutrition Program are at high nutritional risk and have physical impairments included within the list of activities of daily living.

Prior research by the University of Georgia's Department of Foods and Nutrition has exposed the high-risk status of many older adults in northeast Georgia who participate in the Older Americans Nutrition Program and has provided a snapshot of the probable characteristics of the program's participants across the State. These studies found that more than 50 percent of participants were at high nutritional risk and that more than 30 percent were obese, had self-reported

diabetes or poor glucose control, and were hypertensive (Accettura, 2000; Brackett, 1999). These results indicate that this population is at increased nutritional risk, are at increased risk for poor health overall, and could benefit greatly from nutrition intervention programs. Thus, a great need exists to develop, implement, and evaluate nutrition and health education programs to determine gains in knowledge and behavior changes. Hence, the goals of this study were to evaluate the effect of a nutrition education curriculum and an intervention program (leg exercises) designed to enhance older adults' knowledge about nutrition and fitness and to improve their behaviors related to diet, physical activity, and overall health and well-being.

National recommendations indicate that facilities with Older Americans Nutrition Programs are ideal settings for nutrition and health promotion programs in older adult populations (Millen et al., 2002). Most research with these program participants focused on documenting poor nutritional status and nutritional risk factors (Millen et al., 2002). The evaluation of combined nutrition and physical activity interventions targeted to older adults in this program in the Southeast is lacking. Therefore, this evaluation is of great value for both the well-being of the older adults served and for the State in its quest to provide nutrition and health promotion activities and services for this population.

Methods

The first phase of the study consisted of training the staff, followed by recruiting the participants, obtaining approvals from institutional review boards and informed consent from participants, and administrating the pre-test, which consisted of a

questionnaire and two fitness batteries. The second phase consisted of the intervention: nutrition education and leg-exercise programs. The last phase was the post-test.

Participant Recruitment and Criteria

The directors of centers for senior citizens, county Extension agents, health educators, and staffs of Area Agencies on Aging helped to recruit participants, schedule interviews, and remind participants when they were to take part in the study. Depending on the particular site, one or more of these individuals were responsible for conducting the pre- and post-tests and for disseminating the nutrition education curriculum. Staff devoted to implementing the study received training from the University of Georgia's Department of Foods and Nutrition staff who were also available throughout the study to answer questions or address problems.

Two criteria were used to determine whether individuals were eligible to participate in the study: (1) they had to be age 60 or older, and (2) they had to receive congregate meals provided by the Georgia Older Americans Nutrition Program. Along with information about informed consent, an oral description of the study, including information about the requirements, procedures, and benefits of participation, was given to all interested persons. We received written, informed consent from 655 men and women from 28 counties representing the 12 Planning Service Areas (geographic and programmatic regions) in Georgia that are served by the Area Agencies on Aging.

Intervention Programs

The nutrition education and physical activity intervention program was called "Take Charge of Your Health for Older Adults." These commercially available materials were developed by

the Georgia Division of Aging Services and Wellness, Inc., and focused on correcting risk factors for poor nutrition in older adults and facilitating the voluntary adoption of eating behaviors that promote health and well-being for older adults. The key themes of this curriculum—centering on the program's three campaign messages: Take 5 a Day, Take Down Fat, and Take Action—were established by the Georgia Coalition for Physical Activity and Nutrition (Georgia Coalition for Physical Activity and Nutrition, 2002) and followed the principles of the *Food Guide Pyramid* (USDA, 1996) and the *Dietary Guidelines for Americans* (USDA & DHHS, 2000).

The 12 lessons of "Take Charge of Your Health for Older Adults" included topics such as heart disease and high blood pressure, calcium and osteoporosis, diabetes, and nutrition and cancer prevention. The five leg exercises consisted of toe raises for the calf muscles, side-leg lifts for the abductor muscles, leg curls for the hamstring muscles, knee extensions for the thigh muscles (quadriceps), and isometric straight-leg lifts for both hip flexors and the quadriceps (National Institute on Aging, 2001). Modifications were also included for elders in wheelchairs or for those otherwise unable to stand. These exercises were graphically depicted on a placemat to help encourage participation and to provide visual cues. Classes were given one to two times a month, and participants were encouraged to perform the leg exercises on a daily basis either at home or at the senior center.

Assessment Instruments

Dietary intakes of fruits and vegetables, for both the pre- and post-test questionnaires, were assessed by using six questions taken from the State-based Behavioral Risk Factor Surveillance System, administered in collaboration with the Centers for Disease Control and Prevention (Behavioral Risk Factor Surveillance System, 1999). Information from this Surveillance System is used to track trends in behavior changes among the population, to determine priority health issues and develop plans to address them, and to monitor the effectiveness of interventions. We used the six questions to assess the frequency of consumption of certain fruit and vegetable groups according to daily, weekly, monthly, or yearly timeframes. For our study, we calculated fruit and vegetable consumption by summing the frequency of consumption of the six items from the Surveillance System's core food-frequency instrument. Knowledge and behavior questions that related to dietary intake, food behaviors, and exercise/physical activity were also addressed by selected questions from this Behavioral Risk Factor Surveillance System. Other questions that focused on older adults' consumption of milk, knowledge about fat consumption and health, and whether they read nutrition labels were adapted from Elbon (1998).

Following the questionnaire, the participants' fitness level was assessed with a short-battery form of the Established Populations for Epidemiologic Studies of the Elderly (EPESE) (Guralnik et al., 1994) and the Fullerton Functional Fitness Test for Older Americans (Rikli & Jones, 1999). The EPESE test assessed older adults' mobility by measuring three categories—balance, strength, and gait speed—as they performed the following tasks: standing balance, chair stands, and an 8-foot walk, respectively. Performance on each of the three categories was scored on a scale of 0 to 4. A summary performance score was calculated by summing each of the three category scores (range from 0 to 12), with increasing values representing

Whereas total mean intake of fruits and vegetables and the percentage of people who consumed 5 or more servings per day did not increase . . . knowledge that 5 or more servings of fruits and vegetables should be consumed each day did increase significantly: from 34 to 64 percent.

functional performance. We designated the functional categories based on the literature (Guralnik et al., 1994), which reported a strong association with measures of self-reported disability. For example, 48 to 91 percent of the study participants who reported that they needed help to walk one-half mile had a performance summary score ranging from 0 to 5, an indication of low functional ability. In comparison 15 to 36 percent of those who reported needing help scored from 6 to 9, an indication of average functioning; and 3 to 9 percent of participants had a summary performance score of 10 to 12, indicating high functional ability.

The fitness test, also used to assess the functional ability of program participants, was designed to obtain normative data regarding physical and functional performance of community-dwelling older adults and to identify criterion-reference standards needed by the older adults to maintain the ability to perform "desired activity goals." The six components to the Fullerton Functional Fitness Test for Older Americans each reflect a physical parameter of functional fitness and activities of daily living. For two tasks—Sit and Reach and Back Scratch—participants scored 0 if they were able to reach their toes or touch their fingertips of both hands. Reaching past these points resulted in a positive score while not being able to reach these points resulted in a negative score.

The tests included in this battery are based on the guidelines established by the American College of Sports Medicine (Roitman, 2001) and are safe for most community-dwelling older adults to perform without receiving prior medical screening; however, we did not use the 6-minute walk test because of concerns about obtaining approval from the institutional review boards and because of

the lack of space to perform this test at some senior centers.

Statistical Analysis

We used the Statistical Analysis System, Version 8.2 (SAS Institute, 2001) to analyze the data. Paired t-tests and chi-squares were used to determine whether pre- and post-test results were statistically significant ($p<0.05$).

Results

Of the 655 older adults who enrolled in the study, 501 completed both the pre- and post-test measures. Those completing both measures had an average age of 76; Caucasian comprised 65 percent of the sample, and women, 83 percent. Differences between participants and nonparticipants, by age, gender, and ethnicity, were not statistically significant.

Table 1. Self-reported general health status of older adults[1] in Georgia

Question description	Pre-test	Post-test
	Percent	
Would you say that in general your health is:		
Excellent	6	8
Very good	18	20
Good	44	43
Fair	28	25
Poor	4	4
How much do your health troubles stand in your way (of doing things)?		
Not at all	36	37
A little	48	48
A great deal	16	15
How important is it to your health to be active all or most days of the week?		
Not at all	2	1
Somewhat	16	16
Very	63	61
Extremely	18	22

[1]Age 60 or older who received congregate meals provided by the Older Americans Nutrition Program.

Table 1 describes three measures of the elders' self-reported general health characteristics. During the pre-test phase, 44 percent of the elders believed their general health was good; whereas, 18 percent characterized their general health as very good. During the post-test phase, 43 percent said their health was good; whereas, 20 percent believed it to be very good, an indication of more favorable views of their general health status. Changes in elders' responses related to health troubles that prevented them from performing tasks and the importance of activity to their health were not statistically significant before and after the intervention.

Of the six questions examining fruit and vegetable intake, responses to only one increased significantly from the pre-test to the post-test phases (table 2). The mean servings per day

Table 2. Fruit and vegetable intake, knowledge, and behaviors of older adults[1] in Georgia

Question description	Pre-test	Post-test
	Mean	
How often did you drink fruit juices such as orange, grapefruit, or tomato? (servings/day)	0.91	0.96
Not counting juice, how often did you eat fruit? (servings/day)	1.06	1.09
How often did you eat green salad? (servings/day)	0.43	0.39
How often did you eat potatoes, not including french fries, fried potatoes, or potato chips? (servings/day)	0.37	0.36
How often did you eat carrots? (servings/day)	0.35	0.32
*Not counting carrots, potatoes, or salad, how many servings of vegetables did you usually eat? (servings/day)**	1.63	1.78
Total fruit and vegetable intake (servings/day)	4.73	4.83
	Percent	
How are your vegetables usually prepared?		
Fried	2	3
Steamed/boiled	96	95
Uncooked/raw	2	2
Consume 5 or more servings of fruits and vegetables per day	*37*	*37*
*How many servings of fruits and vegetables should people eat each day?**		
0	0	0
1	14	4
2	21	9
3	22	16
4	9	6
5 or more (correct answer)	34	64

[1]Age 60 or older who received congregate meals provided by the Older Americans Nutrition Program.
* Difference between pre-test and post-test is significant at $p < 0.05$.

These participants also reported an increase in behaviors that reduce the risk of developing heart disease or stroke. For example, the percentage of older adults eating fewer high-fat or high-cholesterol foods improved from 74 at the pre-test to 85 percent at the post-test.

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of vegetables—not including carrots, potatoes, or salad (which were included in other questions)—increased from 1.63 to 1.78. Whereas total mean intake of fruits and vegetables and the percentage of people who consumed 5 or more servings per day did not increase significantly over the period, knowledge that 5 or more servings of fruits and vegetables should be consumed each day did increase significantly: from 34 to 64 percent. Usual cooking methods for vegetables did not change significantly, with steaming/boiling being the method of choice by 96 percent at the pre-test and 95 percent at the post-test.

From the pre-test to the post-test, participants' knowledge and behaviors regarding dietary fat changed, as measured by six of the seven questions.

Mean daily milk consumption improved significantly (1.29 vs. 1.37 cups/day) from the pre-test to the post-test phase. The type of milk consumed improved, although not significantly: 66 percent of participants drank 2%, 0.5-1%, or skim milk at pre-test versus 73 percent at the post-test (table 3).

These participants also reported an increase in behaviors that reduce the risk of developing heart disease or stroke. For example, the percentage of older adults eating fewer high-fat or high-cholesterol foods improved from 74 at the pre-test to 85 percent at the post-test. Knowledge regarding fat and heart disease improved. At the pre-test, 55 percent of the participants knew that saturated fat increases risk of heart disease. At the post-test, 77 percent knew this to be the case. Participants, as well, reported exercising more (73 vs. 86 percent) from the pre-test to the post-test.

A significant change was also seen in the methods participants used to cook meat, chicken, or fish. More people switched from frying to broiling and baking. Twenty percent of the participants fried their meat, chicken, or fish at the time of the pre-test; 3 percent broiled and baked these items. At the post-test, 17 percent fried these foods, while 8 percent chose broiling and baking instead. The percentage of participants who read nutrition labels increased, as well: moving from 58 to 66 percent.

Many dimensions of physical activity among the elderly participants improved significantly between the pre- and post-test phases of the study (table 4). Participants who engaged in *any* type of physical activity in the past month increased from 82 to 87 percent, and those who performed leg exercises in the last week or last month increased from 55 to 82 percent and 54 to 88 percent, respectively. Not only did

activity increase, so did elders' knowledge about physical activity. After the intervention, significantly more of the participants knew that 30 minutes of physical activity should be done most days of the week: 53 versus 68 percent. Participants who reported

being active most days of the week also increased from 80 to 88 percent. In addition, higher percentages of elders disagreed that they did not have time to be active most days, did not like being physically active, and believed it was not safe to be physically active.

Table 3. Dietary fat knowledge and behaviors of older adults[1] in Georgia

Question description	Pre-test	Post-test
	Percent (mean)	
On average, how much milk do you usually drink each day?		
0 cups	17	14
1	47	48
2	26	27
3 or more	10	12
Mean*	(1.29)	(1.37)
What type of milk do you usually drink?		
Don't drink milk	11	7
Whole	23	21
2%	42	47
0.5-1%	6	8
Skim	18	18
*To lower your risk of developing heart disease or stroke, are you eating fewer high-fat or high-cholesterol foods?***		
Yes	74	85
No	18	11
Don't know	8	4
*What kind of fat increases the risk of heart disease?***		
Saturated fat	55	77
Unsaturated fat	8	5
Don't know	37	17
*To lower your risk of developing heart disease or stroke, are you exercising more?***		
Yes	73	86
No	27	14
*How is your meat, chicken, or fish usually prepared?***		
Fried	20	17
Broiled/grilled	36	36
Baked	41	39
Broiled and baked	3	8
*I read the nutrition labels on food packages before I buy.***		
No	42	34
Yes	58	66

[1]Age 60 or older who received congregate meals provided by the Older Americans Nutrition Program.
* Difference between pre-test and post-test is significant at $p < 0.05$.

Many of the participants' performance on the fitness batteries improved significantly after the intervention. The mean score of the short-battery form of the Established Populations for Epidemiologic Studies of the Elderly improved significantly (8.0 to 8.3), with more participants moving toward the higher end of the functional spectrum. The percentage of participants in the low category of the short-battery test remained the same at 17 percent (pre- and post-test), while the average category decreased from 51 to 41 percent and the high category increased from 32 to 42 percent. The performance on all measures of the Fullerton Functional Fitness Test improved significantly.

Discussion

"Take Charge of Your Health for Older Adults"—a nutrition and health promotion program for older adults in Georgia—proved to be successful, with major outcomes that included positive changes in knowledge related to nutrition and physical activity, improvements in some health behaviors related to diet and physical activity, and decreases in possible barriers to physical activity.

Each of the three key areas of the "Take Charge of Your Health for Older Adults" campaign message—Take 5 a Day, Take Down Fat, and Take Action—improved significantly, especially the participants' knowledge of health-promoting behaviors. Although knowledge of appropriate health behaviors helps improve health-related behavior, skill development and instructional knowledge are almost always necessary to produce behavior changes (Krinke, 2001).

While there were gains in knowledge, not all of these resulted in corresponding improvements in behavior. For example, although fruit and vegetable knowledge improved markedly, this improvement resulted in a significant increase in self-reported intake of vegetables (excluding carrots, potatoes, and salad) only—just one of the questions related to fruit and vegetable intake. Other researchers have reported similar changes in fruit and vegetable intake following community-based interventions (Ciliska et al., 2000). Cohen and colleagues (1998) found an inverse relationship between perceived barriers to fruit and vegetable intake and income and education, the result of which was lower consumption of fruits and vegetables. The results of our evaluation highlight the need for future programs to target and address the perceived barriers to fruit and vegetable intake in this population.

Increases in knowledge about the types of fat and the need to decrease dietary fat intake resulted in improved dietary behaviors. Our findings are similar to those reported in other samples. For example, Goldberg and colleagues (1990) found that many older adults reported making modifications in their diet to reduce risk factors associated with chronic diseases. Others also reported improved intake in targeted foods, such as lowfat dairy foods and fruits and vegetables, after participation in an educational community gardening project (Hackman & Wagner, 1990).

This intervention was successful in addressing and dispelling some of the myths and misconceptions associated with perceptions of three barriers to physical activity—time constraints, not liking to be active, and safety concerns—which led to a significant increase in the percentage of participants who reported being active on most days of the week. King (2001) suggests that effective interactions for promoting regular physical activity by older adults are dependent on

Many dimensions of physical activity among the elderly participants improved significantly between the pre- and post-test phases of the study.

understanding the factors that influence activity and then taking steps to address them. Performance scores for functional ability on the test battery of the Established Populations for Epidemiologic Studies of the Elderly improved significantly. Poor performance on this test battery has been associated with greater self-reported disability. Scores below 5 have predicted placement in nursing homes and mortality (Guralink et al., 1994). The mean score of 8 for the participants of this study indicates that the older adults in the program are on the verge of losing their independence. Interventions that improve physical function, such as "Take Charge of Your Health for Older Adults," may prolong independence in a group that is clearly at risk. Therefore, the continued use of this test battery may provide valuable information concerning changes in the functional status of this population.

This study had some limitations. First, self-reported dietary intake is difficult to assess in this population because of factors such as low literacy and education levels, low socioeconomic status, age-related declines in sensory functions such as hearing and sight, and possible declines in memory and cognitive functioning. While efforts were made to modify the curriculum to meet the varying educational levels of participants, further adaptations remain necessary to facilitate the most effective teaching and learning methods for this population. Second, coordinating a large statewide program with numerous people who possess varied experience in applied research settings may have affected data collection. Providing training in data collection methods for staff at all sites involved in the intervention minimized this potential limitation. The educators consisted mainly of Area Agency on Aging staff, including registered dietitians, nurses, county Extension agents, fitness instructors and health

Table 4. Physical activity, knowledge, behaviors, and fitness of older adults[1] in Georgia

Question description	Pre-test	Post-test
	Percent	
How many blocks can you walk without stopping? (1 block = 1/8 mile)		
0	11	10
1	22	20
2	15	15
3	11	12
4 or more blocks	41	44
During the past month, did you participate in any physical activities or exercises such as running, calisthenics, golf, gardening, or walking for exercise?*		
No	18	13
Yes	82	87
During the past week, did you do leg exercises (as shown in this picture)?*		
No	45	18
Yes	55	82
During the past month, did you do leg exercises (as shown in this picture)?		
No	46	12
Yes	54	88
How much physical activity should people do most days of the week? (minutes)*		
1-5	3	3
6-10	8	5
11-15	14	7
16-20	15	10
21-25	6	4
26-29	1	2
30 or more (correct answer)	53	68
Do any of the following keep you from being active on all or most days of the week?		
I already am active on all or most days of the week.*		
No	20	12
Yes	80	88
I have a health condition that keeps me from being active.		
No	72	77
Yes	28	23
It costs too much.		
No	99	98
Yes	1	2
I don't have time.*		
No	84	95
Yes	16	5

Table 4. Physical activity, knowledge, behaviors, and fitness of older adults[1] in Georgia (cont'd)

Question description	Pre-test	Post-test
	Percent	
I don't like to.*		
No	82	91
Yes	18	9
It's too late to improve my health.		
No	97	97
Yes	3	3
It's not safe.*		
No	85	95
Yes	15	5
EPESE[2] functional category scores[3]		
Category 1 (low: 0 to 5)	17	17
Category 2 (average: 6 to 9)	51	42
Category 3 (high: 10 to 12)	32	41
	Mean	
EPESE summary score*	8.0	8.3
Fullerton Functional Fitness Test		
Chair stands (number in 30 seconds)*	10.8	11.3
Arm curls (number in 30 seconds)*	13.9	15.9
Sit-and-reach (inches)*[4]	-1.3	-0.5
8-foot Up-and-Go (seconds)*	9.8	9.1
Back scratch (inches)*[4]	-4.8	-3.8

[1]Age 60 or older who received congregate meals provided by the Older Americans Nutrition Program.
[2]Short-battery form of the Established Populations for Epidemiologic Studies of the Elderly (EPESE).
[3]Scores relate to elders' mobility in terms of balance, strength, and gait speed while performing certain tasks.
[4]Scoring: Zero: reaching toes or touching fingertips of both hands, positive score: reaching beyond these points, and negative score: not being able to reach these points.
* Difference between pre-test and post-test is significant at p < 0.05.

While the program was successful, improvements can be made in future interventions, especially in the area of facilitating behavior changes related to diet. National public policy, such as Healthy People 2010, has emphasized the role of nutrition education and physical activity in maintaining health in people of all ages (DHHS, 2000). Therefore effective nutrition education and physical activity intervention strategies are essential for improving health, nutrition, and functional ability in the older population. These reasons, in combination with the documented success of this program, support the continuation and expansion of nutrition education and physical activity intervention programs to other older adults.

educators, as well as senior center directors. However, not all of the educators may have had formal training in *both* nutrition and physical activity. An effort was made to minimize this potential barrier by providing training on the use of the curriculum. Also, professional staff from the Division of Aging Services, the University of Georgia's Department of Foods and Nutrition, and Wellness, Inc., were available to answer questions. Third, this was the first statewide attempt to evaluate functional status with direct measures by using well-validated methods designed specifically for assessment of older adults, measures such as the Fullerton Functional Fitness Test for Older Adults (Rikli & Jones, 1999) and the short-battery form of the Established Populations for Epidemiologic Studies of the Elderly (Guralink et al., 1994). In the future, additional training should be conducted before these measures are used in combination: 15.8 percent of the data for the 8-foot-Up-and-Go and for the 8-foot walk were eliminated because of concerns about reliability.

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Estimation of Portion Sizes by Elderly Respondents

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This two-phase study assessed the cognitive strategies used by the elderly (individuals 65 years of age and older) and the accuracy of their estimates of reported dietary intake. In phase I of the study, we conducted interviews with 118 elderly respondents who were asked to "think aloud" while estimating the portion size of solid, liquid, and amorphous (i.e., nonspecific) foods they had eaten the previous day. Respondents were given one of four sets of estimation aids, although most chose not to use these and appeared confident in estimating amounts. In phase II, 90 different elderly participants ate lunch at a university facility. Food items were pre-weighed or measured before being served, and amounts consumed were calculated after each meal. The following day, researchers interviewed participants by using one of three randomly assigned methods: by telephone with mostly 2-dimensional aids, by telephone without aids, or in person with 3-dimensional aids. Participants were asked to recall what they had eaten at the meal and to estimate the amount eaten. Findings from phase I suggested that elderly respondents generally chose not to use an aid to estimate portion sizes. For most foods consumed in phase II, those participants who used an aid did not have reduced estimation errors, because these commonly exceeded ±25 percent.

A n understanding of food consumption and the challenges associated with changing consumption patterns are critical to improving human health and well-being. One barrier to understanding consumption is the difficulty in measuring what people eat. Dietary recall studies, such as the National Health and Nutrition Examination Survey (NHANES) and the Continuing Survey of Food Intakes by Individuals (CSFII), have been used extensively (Thompson & Byers, 1994) to estimate food consumption and to give insight into dietary inadequacies. However, some nutrition researchers have questioned the accuracy and validity of portion-size estimation to quantify dietary intake (e.g., Cypel, Guenther, & Petot, 1997). It is important that dietary data such as portion-size estimation be as accurate as possible (McGuire,

Chambers, Godwin, & Brenner, 2001; Mertz, 1992; Young & Nestle, 1995). Other authors have suggested that the accuracy of information obtained from older respondents may be lower than that obtained from younger ones (Taylor-Davis & Smiciklas-Wright, 1993). If this is true, the data used to determine the critical diet-related issues facing the elderly population may be less accurate than desired. This is of added importance because the proportion of elderly in the population is rising annually (U.S. Bureau of the Census, 1994).

Dietary recall places substantial cognitive demands on the respondent—requiring an in-depth search of memory, estimation, and judgment skills (Baranowski & Domel, 1994; Fries, Green, & Bowen, 1995). Until recently, little has been known about

these cognitive demands (Buzzard & Sievert, 1994). Hence, the National Center for Health Statistics (NCHS) has cited the need for additional research in this area (U.S. Centers for Disease Control, 1994). A better understanding of cognitive strategies (i.e., the ways in which people access and recall information) used during the recall process could help to design survey questions and interview procedures—and improve recall. These strategies, however, are not well understood, especially in older population groups. Recent information suggests that adults age 18 to 65 use various cognitive strategies when recalling portion sizes of foods eaten the previous day (Chambers, Godwin, & Vecchio, 2000). Understanding the cognitive strategies for estimating portion size is important information to have when developing effective estimation methods for procedures such as the 24-hour dietary recall, a technique used in many nutrition studies. Currently, there is little information about the cognitive strategies used by the elderly and how accurately they estimate portion sizes.

It is unclear whether using aids to help respondents estimate portion sizes increases accuracy for the elderly. Although these aids have the potential to provide an accurate, convenient means of estimating food portions, some research has indicated the accuracy of estimations may not improve with certain foods when aids are used (Godwin et al., 2001). The purpose of this research, therefore, was to gain a better understanding of the process that elderly respondents use to estimate portion sizes and to determine if aids used to estimate portion sizes improve these respondents' accuracy in saying how much they had eaten.

Methods

Phase I
Four highly trained interviewers conducted one-on-one interviews with 118 respondents age 65 years or older. Respondents were recruited from existing consumer-testing databases; by referral from associates; and through advertisements posted in health departments, churches, schools, and businesses. Of the 118 respondents, 75 percent were women; 65 percent were White, 32 percent were Black, and 3 percent were of other racial origins.

Because strategies for estimating portion size could be affected by the aids shown to participants, four sets of aids were used, with about 30 respondents assigned to each specific set. The aids represented various 2- and 3-dimensional aids for estimating portion sizes that have been used in the CSFII and NHANES studies as well as new aids that have been available to nutritionists, such as a book of photographs of portion sizes (Hess, 1997). The first set consisted primarily of 2-dimensional aids in a booklet that included full-size drawings of bowls, cups, plates, and glasses; three diagrams of geometric shapes—a muffin-shaped grid, cylindrical diagram, and circles; and a tool for estimating portions of wedges. Actual measuring cups and spoons and a ruler also were included.

The second set included mostly 3-dimensional aids such as actual bowls, cups, plates, glasses, measuring cups and spoons, bean bags in four sizes, a ruler, and sticks for estimating thickness. Also included in this set were a muffin diagram, the cylindrical diagram, and the tool for estimating portions of wedges. The third set included photographs (Hess, 1997) of portions of 35 representative foods

(e.g., cooked mixed vegetables were used to represent any cooked vegetable), a ruler, the muffin and cylindrical diagrams, the wedge tool, and measuring cups and spoons. The fourth set included photographs (Hess, 1997) of household vessels (e.g., bowls, cups, plates, and glasses), a ruler, the muffin and cylindrical diagrams, the wedge tool, and measuring cups and spoons. During interviews, the aids from one of the four sets were arranged randomly in front of respondents, to avoid having the position of the aid create bias.

We used the respondents' age, gender, and race to balance their assignment to a test group of portion-size aids. Interviewers were trained to use any of the portion-size aid sets in an interview. To enable researchers to categorize the cognitive processes used in remembering portion sizes, respondents used a think-aloud process (Ericsson & Simon, 1984) during the interview, with them verbally describing their strategies for deciding how much of each food they ate. To facilitate the procedure and to help respondents understand the task and become acquainted with the procedure, we asked each respondent to complete two practice think-aloud activities—arranging five cards of various shapes from smallest to largest and matching colors to shapes. Respondents were reminded to think aloud if they were not doing so—to verbalize everything they were thinking. If a respondent hesitated, the interviewer asked nonsuggestive questions that would help the person describe his or her thought process.

Procedures for the initial dietary interview were adapted from those used in the CSFII (Tippett & Cypel, 1998). The multi-pass approach we used gave respondents several opportunities to provide details about the foods they had consumed. In the first pass, respondents were asked to recall foods they

consumed the previous day. For further questioning, the interviewer used the information from the first pass to select at least two foods, if possible, from three categories (solid shapes such as steak or cornbread, liquids such as water or juice, and amorphous[1] shapes such as cooked vegetables or macaroni and cheese). The interviewer then uncovered and introduced the set of aids assigned to that respondent. The interviewer showed the respondent each aid, briefly described its use, and informed the respondent that he or she could use any of the aids during the interview or could express in any other way the amounts of food consumed.

In the second pass, the interviewer asked a series of questions about each selected food, including the amount consumed. During or immediately after the question on the amount consumed, interviewers used several questions to help respondents think aloud to describe how much was eaten. Questions such as the following were used: "What were you thinking when you were remembering the amount you ate/ drank? What made you choose that aid? I see you picked up an aid, then put it back down and selected another. What was going through your mind as you did that?"

Next, the interviewer reviewed the respondents' response for each food item consumed and followed up with more specific questions. Cognitive think-aloud techniques were also used during this pass when the interviewer tried to obtain information about the usefulness of various food estimation aids. If the respondent used an aid, it was removed by the interviewer, who then asked the respondent, "If that aid was not available, was there anything else that could be used, either another

aid in the set or something else, to help you describe how much you ate/drank of the food/drink?" The interviewer kept the respondent talking about his or her thoughts and the reasons certain aids were used and others were not. In addition, respondents were asked to describe other aids that would be helpful; however, none did.

Data Coding and Analysis
Each interviewer recorded the aids that the respondents used during the interview to describe the amount of each food consumed the previous day; the reviewer also kept notes about both verbal and nonverbal cognitive strategies used by respondents. Each interview was audiotaped also. Using a modified ethnographic approach (Stewart & Shamdasani, 1990; Morgan, 1990), we developed a list of potential cognitive strategies or "themes" after debriefing the interviewers and listening to tapes from 10 preliminary interviews. Those strategies were compared with the ones described by Chambers et al. (2000); no new strategies were found.

Each audiotape of phase I interviews was replayed and compared with the data recorded by the interviewer. Cognitive recall strategies were then classified (table 1) by using the criteria established by Chambers et al. (2000), and the aids used for each food item were recorded and coded for summary. Content analysis was conducted by counting the responses that fit the identified strategies. Because qualitative research generally is perceived to be more exploratory than quantitative, the numerical data presented is less important than the themes that emerge from the research (Betts, Baranowski, & Hoerr, 1997).

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[1]Amorphous foods were semisolid or solid foods for which amounts of the food do not have a specified shape; consequently, the foods mound or take the shape of the container.

Phase II

In this phase, 90 different participants, age 65 and over, ate lunch from a limited buffet selection at a university research facility. Food items, consisting of roast beef, mashed potatoes, gravy, green beans, macaroni and cheese, tossed salad, cornbread, cake, iced tea, and appropriate condiments, were pre-weighed or measured before being served to the participants.

Before phase II began, actual weight equivalents for measured foods were determined. Because leftover foods were measured at room temperature, weight equivalents for hot foods also were taken at room temperature to account for evaporative losses. Amounts eaten were calculated after each meal by weighing leftovers and subtracting that amount from the original or cooled weight.

Participants were interviewed the day after having consumed lunch at the facility. During these interviews, researchers used a similar procedure to that described in phase I, but without the cognitive probing. Participants were asked to recall what they had eaten at lunch the previous day and to estimate the amounts and were then randomly assigned to one of three interview groups.

Participants assigned to group A were interviewed by telephone and did not use portion-size aids to recall the amounts eaten. Participants assigned to group B were interviewed by telephone and used aids appropriate for that type of interview. These included a 2-dimensional food model booklet (USDA, 2001) containing life-size drawings of glasses, cups, bowls, and shapes (e.g., mounds, a wedge tool with a moveable arm to denote size, and a grid), measuring cups and spoons, and a ruler. Participants assigned to group C were interviewed and used aids

appropriate for in-person interviews—mostly 3-dimensional aids such as glasses, bowls, measuring cups and spoons, bean bags, sticks to estimate thickness, a ruler, the wedge with moveable arm, and size grid. The participants in groups B and C were guided to aids that they might find appropriate for estimating portion sizes of foods. For example, participants were guided to bowls, mounds, and measuring cups for estimating the portion size of mashed potatoes. The groups of aids for phase II were determined based on results from phase I. Aids that were unused or clearly not liked by the elderly were eliminated.

Table 1. Strategies elderly respondents used to report portion size

Strategy[1]	Liquids		Solid foods		Amorphous foods	
	First[2]	Follow-up[3]	First[2]	Follow-up[3]	First[2]	Follow-up[3]
	Percent					
Known amount purchased	15	0	2	1	3	1
Known amount measured	10	6	0	1	13	5
Estimation based on a known amount	20	8	4	3	5	3
Estimation based on a previous amount	1	0	0	0	3	0
Estimation (guess)	2	4	1	2	2	5
Counting number of items	9	5	28	5	14	5
Visualization of size	0	0	45	24	2	2
Visualization of volume	14	26	2	5	24	21
Visualization of container	19	20	3	7	17	12
Visualization of action[4]	10	0	13	12	17	1
Visualization, compare size to aid[5]	0	3	1	34	0	1
Visualization, compare volume to aid[5]	0	28	1	5	0	34
Visualization, compare container to aid[5]	0	0	0	1	0	10

[1]Strategies are described by Chambers et al. (2000) and were re-evaluated for this study during development of the methods.
[2]First strategy identified by respondents without the interviewer probing for additional information.
[3]Follow-up strategy identified by respondents after the interviewer probed for additional information.
[4]Motions used to help determine the number of pieces, scoops, or spoonfuls eaten.
[5]Strategies that used a portion-size estimation aid.

Data Analysis

We calculated percentage estimation errors[2] and used procedures outlined by SAS (2001) to analyze variance with least significant differences[3] for mean percentage estimation error, frequencies, and Pearson correlation coefficients. Outliers beyond three standard deviations of the overall average for a particular food were not included in analyses for mean percentage estimation error for that food, an important consideration, because large deviations in a single respondent's data could have a major effect on the mean data for that food. Removal of these outliers resulted in less than 1 percent of the data being excluded from the analysis.

[2]Percentage estimated errors = ((estimated weight (g) - measured weight (g))/measured weight (g)) x 100.

[3]General Linear Model and Probability of Difference procedures.

Results and Discussion

Phase I

Respondents used numerous strategies to assist in recalling the foods they had eaten and in estimating the portion sizes (table 1). In this study, the methods used for estimation were categorized into 13 distinct strategies, illustrating the diversity of cognitive approaches used to estimate portion size.

For the first portion estimation (without follow-up questions from the interviewer), respondent use of the aids was minimal—using aids to estimate portion sizes for only 2 percent of the estimations for solid foods. Aids were not used as a first strategy for recalling portions for liquids or amorphous foods. Respondents' comments during the interviews indicated that the minimal use of aids was related to several factors: extensive food preparation knowledge, considerable experience with special diets, or the use of easily identified portions. Comments were made such as: "I have cooked all my life and know what ½ cup is," "I'm on a special diet and used to have to measure my salad dressing, so I have a pretty good idea how much to put on," and "I know I ate half a can of tuna because I made the tuna salad from one can and ate half yesterday and half today."

These findings are different from those reported for younger respondents in a study by Chambers et al. (2000). In that study, younger respondents indicated that aids used to estimate portion size represented a good way of reporting amounts that were hard to describe without aids. Perhaps, the elderly are better at estimating portion size because they are less likely than are younger Americans to eat away from home (Wilson et al., 1997). Shatenstein, Payette, Nadon, and Gray-Donald (2002) suggest that food-related

memory appears to be linked to dietary knowledge, food preparation experience, and prior acquaintance with the foods. Collectively, these findings suggest that, when given the choice, elderly individuals do not believe they need to use aids to estimate the portion size of the foods they have consumed; whereas, younger individuals think these aids are helpful in some cases.

For all types of foods, visualization of portions without use of an aid was common for the initial estimation by elderly respondents. When interviewers used probing questions to solicit an exact portion, the elderly simply gave amounts such as 16 ounces of iced tea, 1 cup of green beans, 1 slice of "brand x" cheese or bologna, and a 2"x3" "square" of cake. However, the follow-up strategy for elderly respondents was to use the estimation aids for portion sizes. This suggests that the use of these aids was comfortable for most elderly respondents; they just did not believe they needed one.

For liquids, the strategy used most commonly for determining portion size was estimation based on known amount. An example of this strategy includes the following: "I bought a 12-ounce can and drank half of it." Almost half of estimations for liquids involved known amounts either purchased or measured (25 percent) or estimations based on known amounts (20 percent) (e.g., "I used to have to measure how much water I drink, but now I just always use the same set of glasses that I know hold 16 ounces"). Estimations based on known amounts are good for reporting portion size and do not require an aid, but they cannot be used in many situations where the original volume is unknown. For the follow-up estimation, an aid to estimate portion size was the most popular reporting strategy used by the elderly respondents to visualize the amount of foods they had consumed.

For all types of food, average estimation errors ranged from –29.9 (no aids for cornbread) to +29.3 percent (3-D aids for cake) . . . , indicating that, depending on the food and procedure (e.g., aids or no aids), portion sizes of foods may be under- or overestimated.

Figure. 1. Distributions[1] of percentage errors for representative solid foods
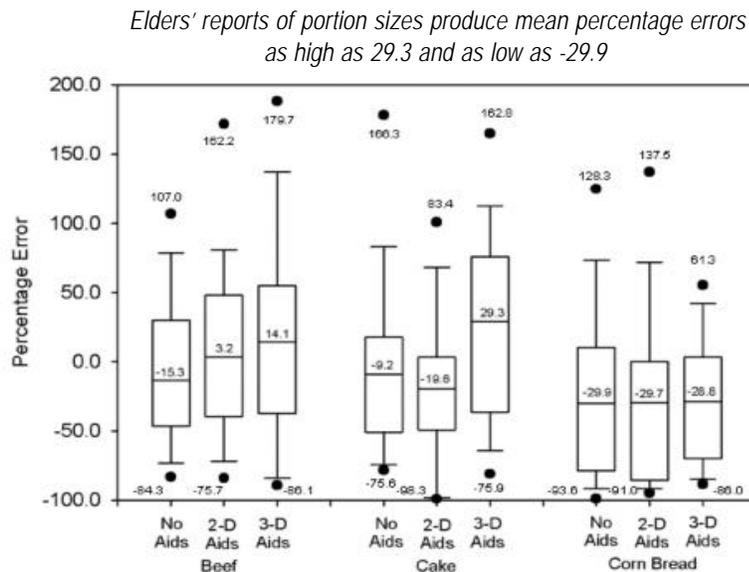
Elders' reports of portion sizes produce mean percentage errors as high as 29.3 and as low as -29.9

[1] From bottom to top: The horizontal lines represent the 10th and 25th percentiles, mean, and 75th and 90th percentiles, respectively. Points represent the 5th and 95th percentiles, respectively.

The first strategy for reporting the portion size of solids involved visualizing the size: 45 percent of all estimation of solids. This strategy often involved the respondents using their hands as a reference for estimating the portion size. Another 28 percent of the respondents used a counting strategy (e.g., 1 slice of bread or cheese, 2 "brand x" hot dogs, and 1 "brand x" biscuit. Although counting also was used by nonelderly adults in a study by Chambers and colleagues (2000), it may be more prevalent with elderly respondents who tended to eat smaller portions, ate more defined food (i.e., fewer mixtures with unknown recipes), and ate pre-portioned food from larger packages. For the follow-up estimation for solid foods, one in three elderly respondents chose to use an estimation aid to assist in visualizing the portion size of the foods they had consumed. Usually, those aids were the size grid, ruler, or the wedge estimation aid—all of which were used to estimate the

dimensions of the food. This strategy, using aids to visualize portion sizes, was similar to that reported for younger adults (Chambers et al., 2000).

For amorphous foods, about one-fourth (24 percent) of the elderly respondents' first estimations involved visualizing the volume and another 17 percent involved visualizing the container. Respondents who used either of these two methods then compared the visualizations with a mental picture of a measuring utensil (e.g., an image of a measuring cup) to estimate and report amount. For the follow-up, 34 percent used one of the available aids such as a measuring cup or bowl, as a comparison for volume estimation.

The differences in respondents' strategies between the first and follow-up estimations suggest that the prevalence of aids used by the elderly to estimate portion sizes may be dependent on whether a guided

interview is used. Findings suggest that the elderly might use these aids if guided to do so. Based on this study, using aids to estimate portion sizes as part of an unguided interview may be ineffective with the elderly because most of the respondents did not choose to use them. These respondents stated that the aids were unnecessary because they already could estimate the portion size of the foods they consumed. In follow-up questions by the interviewers, elderly participants were more likely to use a 3-dimensional aid or a grid than a 2-dimensional photograph or drawing. The elderly in this study particularly disliked the photographs of food, because the photographs were of "representative" foods and not necessarily the food the participant had consumed. This belief could limit severely the use of photographs with elderly respondents, because of the possible difficulty of having photographs of every food respondents may have eaten.

During phase I, we did not determine whether the elderly were more accurate when using estimation aids than when they did not. Because the accuracy of the estimations associated with using aids for portion estimation is an important factor in developing the most effective data collection methods for elderly individuals, we conducted phase II of this study to determine accuracy of estimation when various interview techniques and aids to estimate portion size are used.

Phase II

For all types of food, average estimation errors ranged from –29.9 (no aids for cornbread) to +29.3 percent (3-D aids for cake) (fig. 1), indicating that, depending on the food and procedure (e.g., aids or no aids), portion sizes of foods may be under- or overestimated. Individually, participants had difficulties accurately estimating portion sizes of each food.

Figure. 2. Distributions[1] of percentage errors for representative amorphous foods

Elders' reports of portion sizes produce mean percentage errors as high as 25.2 and as low as -26.7
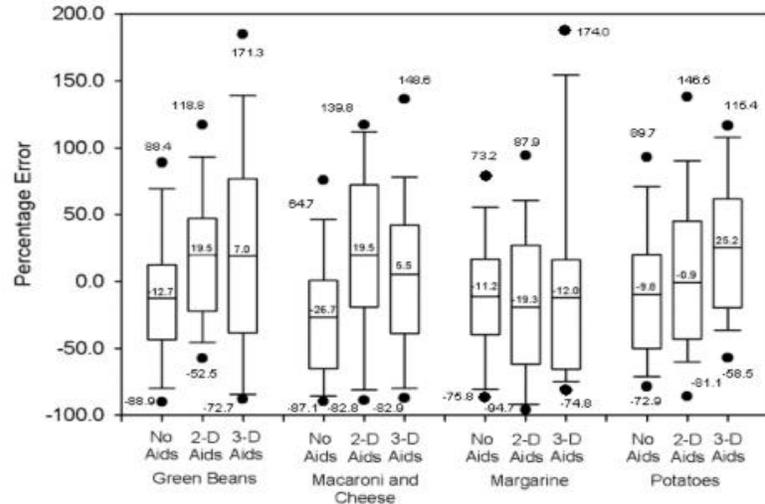
[1]From bottom to top: The horizontal lines represent the 10th and 25th percentiles, mean, and 75th and 90th percentiles, respectively. Points represent the 5th and 95th percentiles.

Of the more than 100 individual estimates of portion sizes reported in this study, more than 75 percent exceeded estimation errors of ±20 percent (data not shown). Some individual estimation errors approached –100 percent or +200 percent (figs. 1 and 2). Average estimation errors generally were lower for the beverages (data not shown), compared with the solid and the amorphous foods (figs. 1 and 2), but the range of response inaccuracy still was high.

Overall, the use of either 2- or 3-dimensional aids to help elderly participants determine food portion sizes did not significantly improve the accuracy of their estimations. This suggests that providing commonly used aids may not be a particularly effective method for obtaining portion-estimation information from the elderly. In phase I, elderly respondents chose not to use an aid to estimate the portion size of the food they consumed for more than 95 percent of the first-interview estimations. In phase II, their use of either 2- or 3-dimensional aids did not consistently increase the accuracy of their estimations. Therefore, other strategies may be necessary for the elderly to estimate portion sizes.

A cautionary note is warranted in the interpretation of these findings: It is likely that using a non-home environment (in this case, a university research facility) for testing affected the portion-estimation strategy used by the respondents and the accuracy of their estimations. A common strategy used by the elderly—"known amounts" based on purchase, preparation, or measurement—could not be used when the participants came to the facility to eat a meal. Because the "known amounts" strategy may help with accuracy, results from "at-home" testing could show greater accuracy.

This research did not, however, investigate that possibility. Further research that uses in-home testing will need to be conducted to understand this issue better.

Conclusions

In this research, elderly respondents used numerous strategies to estimate portion sizes of the foods they consumed, but almost all (more than 95 percent) of the respondents in phase I chose *not* to use an aid to help with that estimation when first asked about portion size. Guiding participants to aids increased their use of aids in phase II but did not consistently increase the accuracy of their estimations for any type of food consumed. These findings suggest that for elderly respondents, aids that often have been used to estimate portion size may not be needed. To provide greater accuracy, new techniques for portion-size estimation or new aids may be needed. The use of alternative techniques, such as estimations using an expanded category scale (e.g., 5- to 10-point scales for small, medium, and large), may be effective and is one idea that needs to be investigated.

Acknowledgments

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Healthy Eating Index Scores and the Elderly

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This study explored the positive relationship between advanced age and scores on the Healthy Eating Index (HEI). It did so by comparing component as well as total HEI scores of different age groups and by estimating the independent effect of age, among other demographic variables, on HEI scores. The elderly, compared with younger age groups, had higher HEI scores on the fruits, sodium, and cholesterol components. Results also showed that the independent effect of advanced age upon component scores, as well as upon the total HEI scores, is notably strong. Results provide insight into the relationship between age and healthful eating.

The Healthy Eating Index (HEI) provides a numerical yardstick of diet quality based on the *Food Guide Pyramid* (U.S. Department of Agriculture [USDA], 1996) and the *Dietary Guidelines for Americans* (USDA & U.S. Department of Health and Human Services [DHHS], 1995). It was designed to evaluate diets according to a more contemporary understanding of healthful eating, one that recognizes the role of over-consumption and poor diet choice as contemporary public health problems (Kennedy, Ohls, Carlson, & Fleming, 1995).

Previous study of HEI scores among demographic groups reports that age may be associated with more careful choices of nutritious foods (Basiotis, Hirschman, & Kennedy, 1996; Gaston, Mardis, Gerrior, Sahyoun, & Anand, 2001). In fact, healthful eating as it is currently defined is highest among those in the oldest age categories (McDonald & Webster, 1998; Bowman, Lino, Gerrior, & Basiotis, 1998). This result is surprising given the potential impediments to a nutritious diet such as lower average nutrition knowledge and diet-health awareness (McDonald & Webster, 1998), reduced mobility, lower average educational attainment, financial resources (Administration on Aging, 2003), and even receptiveness (Bernheim, 1990) to new information among the elderly.

Further exploration of the HEI and its components is needed to understand better the relationship between advanced age and higher HEI scores. Gaston et al. (1999) note that mean scores among the elderly may be attributed to reduced consumption of food energy, which leads to better scores for components (e.g., fat, saturated fat, cholesterol, and sodium) that penalize for overconsumption. Compared with younger groups, the elderly also appear to consume more fruits. Identifying the independent effect of age on HEI components may provide insight into elderly nutrition and ultimately into the factors leading to variation in HEI scoring.

The HEI score comprises 10 components that represent different aspects of a healthful diet. The first five components measure adherence to the food groups of the *Food Guide Pyramid*: grains, vegetables, fruits, milk, and meat. Components 6 and 7 measure total fat and saturated fat consumption,

respectively, as a percentage of total food energy intake. Components 8 and 9 measure total cholesterol and sodium intake, respectively, and component 10 examines the variety in a person's diet. Scores for each component range from 0 to 10; thus, 100 is the highest HEI score attainable. According to the USDA Center for Nutrition Policy and Promotion (CNPP), an HEI score at or below 80 suggests that one's diet needs to improve, a score below 51 rates a diet as poor, and a score above 80 is considered a good diet (USDA, 1995).

This study compares average scores and CNPP ratings of diet quality for the total HEI as well as for component scores among age groups. A multivariate analysis is also performed on the total HEI and each component to estimate the independent effect of age upon scores.

Methods

HEI mean scores for each of the 10 components were compared among five age groups: less than 35, 35-49, 50-64, 65-79, and 80 and above. Those age 65 and above were considered elderly in this analysis. To conduct the comparison, we used CNPP's categorical scoring system for overall diet quality to determine the proportion of diets designated "poor," "needs improvement," or "good." Each person's HEI component was also graded according to guidelines as outlined by Variyam, Blaylock, Smallwood, and Basiotis (1998). For the first five components (grains, vegetables, fruits, milk, meat), a score of 10 was awarded if the respondent met the recommended servings for that component. If the respondent had no servings, a score of 0 was assigned. For all other servings, proportional points were awarded based on the number of servings consumed.

Similarly, points were awarded to components 6 through 10 according to certain thresholds or awarded proportionally for scores between the cutoff points of 0 and 10. A score of 10 was awarded to each respective HEI component if a respondent's intake met the following standards: total fat equaled or was less than 30 percent of total calories, saturated fat was less than 10 percent, cholesterol intake was 300 milligrams (mg) or less, sodium intake was 2,400 mg or less, or eight or more different foods were consumed in a day (variety). A score of 0 was awarded to each respective component when an individual's intake of total dietary fat equaled or exceeded 45 percent of total calories, saturated fat was 15 percent or more, cholesterol was 450 mg or more, sodium intake was 4,800 mg or more, or when the person consumed three or fewer different foods in a day.

To estimate the extent to which age contributes independently to each component score and total HEI score, we used 11 multiple regressions. In addition to controlling for age (35-49, 50-64, 65-79, 80 and above, less than 35=reference), the multiple regressions also controlled for region (Midwest, Northeast, West, and South=reference), urbanization (rural, suburban, city= reference), gender, race (Black, Asian, other=reference), log of income, and total food energy. Food energy was included to capture potential underreporting or physiological differences that were not accounted for in other demographic variables that may contribute to higher or lower HEI scores. We report the regression results for age only.

Data

This study used data from USDA's 1994-96 Continuing Survey of Food Intakes by Individuals (CSFII) and HEI data. The CSFII, which is nationally

Compared with other age groups, the elderly do not appear to be more at risk based on their consumption of foods in any HEI component.

representative, contains information regarding Americans' food intake as well as data regarding their demographic and socioeconomic characteristics. The CSFII uses the 24-hour dietary recall method to collect data about food and nutrient intakes of each respondent. This information is collected over 2 nonconsecutive days. The HEI data provides a summary measure of overall diet quality and is computed for people with complete food intake records for the first day of the CSFII (USDA, 1995; Bowman et al., 1998).

This study examined a sample of 9,925 respondents who were 18 years of age and older, who had completed the CSFII, and were represented in the HEI. For purposes of this research, the data were grouped by age: 2,558 respondents were 18 to 34 years old, 2,572 were 35 to 49 years old, 2,539 were 50 to 64 years old, and 2,256 were age 65 and older. Among those age 65 and older, 1,776 were 65 to 79 years old; the remaining 480 respondents were 80 years old or older.[1]

Results

The main demographic differences between the elderly and younger respondents were education and income (table 1). The proportion of those who were age 65 to 79 and who had less than a high school education was three times—36 vs. 12 percent—that of those between age 35 and 49. Also, 17 percent of those who were 65 to 79 years old, compared with 30 percent of respondents age 35 to 49, had a college degree. Even fewer of the oldest age group—80 and above—had a college degree (12 percent). The average income for respondents age 65 to 79 was $28,028; for those age 80 and above, $4,525 less. For the 35- to 49-year-olds, the average income was

Table 1. Descriptive statistics for the whole sample and by age group

Variables	All	<35	35-49	50-64	65-79	80+
			Age groups			
Sample	9,925	2,558	2,572	2,539	1,776	480
			Percent			
Education						
Less than high school	22	15	12	23	36	49
High school	35	35	35	38	32	25
Some college	21	28	23	17	15	13
College	23	22	30	22	17	12
Region						
Northeast	18	15	18	18	21	23
Midwest	24	22	23	25	28	28
South	36	39	35	38	34	29
West	21	25	24	19	17	20
Urbanization						
Rural	26	21	25	27	29	29
City	30	38	27	27	29	30
Suburban	44	41	48	46	42	41
Gender						
Male	51	50	51	51	52	52
Female	49	50	49	49	48	48
Race						
White	81	76	80	82	86	88
Black	12	12	11	12	11	10
Asian	2	4	3	2	1	1
Other[1]	5	8	6	4	2	1
Diet rating						
Poor	20	21	23	21	15	17
Needs improvement	69	73	69	65	66	66
Good	11	6	8	14	19	17
			Mean			
Food energy (kcal)	2003	2315	2108	1895	1684	1521
Age	49	26	42	57	71	84
Income	$37,778	$35,973	$44,844	$41,959	$28,028	$23,503

[1]American Indians, Alaskan Native, and other races.

$44,844. Other notable differences were the greater proportion of the elderly, versus other age groups, living in the Northeast (23 percent), Midwest (28 percent), and rural areas (29 percent) and those more likely to be White, 86 and 88 percent (65 to 79 years old and 80 and older, respectively), compared with 76 and 81 percent (less than 35 years old and 35 to 49, respectively).

HEI Scores

The total HEI score ranged from 61.03 (for those less than age 35) to 66.68 (for those age 65 to 79) (table 2). The lowest average score for all respondents was for the fruits component (3.78); the highest score was for cholesterol and variety (7.57 each). Compared with the younger groups, respondents age 65 to 79 had higher than average component scores for the fruits, total fat, saturated fat, cholesterol, sodium, and variety components (5.07 to 8.11). Those age 80 and over, compared with those less than age 65, had higher than average scores for the fruits, cholesterol, and sodium components (5.10 to 8.21). However, only the scores for fruits, cholesterol, and sodium were at least 0.50 points higher, on average, for respondents between age 65 and 79 and for those over 80 years of age, compared with all other age groups.

Percentage of Respondents Meeting the Recommendations

Meeting recommended consumption within individual components corresponded to a score of 10. Respondents were separated into groups based on whether they scored 0 (high risk), between 0 and 10 (needs improvement), or 10 (met recommendations) (table 3). A higher proportion of elderly respondents met recommendations for fruits and cholesterol than did any other age group. Whereas 24 to 25 percent of the elderly age groups met the recommendation for fruits, only 11 to 19 percent of the younger groups met this recommendation. Close to three-fourths of the

Table 2. Healthy Eating Index scores for whole sample and by age group

| Variables | Age groups | | | | | |
	All	<35	35-49	50-64	65-79	80+
Sample	9,925	2,558	2,572	2,539	1,776	480
	Means					
Total HEI	**62.91**	**61.03**	**61.14**	**63.48**	**66.68**	**65.39**
Components						
Grains	6.40	6.53	6.20	6.53	6.49	5.82
Vegetables	6.45	6.39	6.23	6.76	6.46	6.27
Fruits	3.78	2.92	3.13	4.13	5.07	5.10
Milk	4.99	5.10	5.13	4.74	5.07	4.89
Meat	6.79	6.79	6.80	7.14	6.46	6.11
Total fat	6.60	6.80	6.47	6.26	6.94	6.82
Saturated fat	6.53	6.38	6.43	6.52	6.87	6.62
Cholesterol	7.57	7.44	7.41	7.44	8.01	8.21
Sodium	6.22	5.44	5.90	6.34	7.21	7.77
Variety	7.57	7.25	7.44	7.62	8.11	7.79

elderly age groups met the recommendation for cholesterol; about two-thirds of the younger age groups met this recommendation. A greater proportion of those age 65 to 79 also met recommendations for total fat, saturated fat, sodium, and variety than did any other age group. Compared with other age groups, the elderly do not appear to be more at risk based on their consumption of foods in any HEI component.

While those in the two oldest age groups had higher total HEI scores (65.39 to 66.68) than average (62.91) (table 2), only 19 percent of respondents 65 to 79 years old and 17 percent of respondents age 80 and above meet the threshold of having a "good" diet, as defined by CNPP (table 3). An equal proportion of those 80 years old and older (17 percent) had a "poor" diet, while a slightly smaller percentage (15 percent) of those between 65 and 79 years old and older had a "poor" diet. Two of three respondents in both eldest age groups had a diet that "needs improvement." Only 6 and 8 percent of respondents in the two youngest age groups had a "good" diet, and 23

percent of those between 35 and 49 years old had a "poor" diet.

Although the percentage of elders (age 65 and above) consuming enough fruit to meet the recommended level of the fruit component was higher on average than those in younger age categories, only one in four elders met the recommendation (table 3). Fewer than one in ten of those age 65 or older fell within the "high risk" threshold for sodium, compared with one in four (24 percent) of those under age 35. While three of four of those age 80 or older met cholesterol recommendations, only 11 percent, compared with 23 percent of those under age 35, consumed the recommended amount of grains. The only notable deficiency among HEI categories for respondents age 65 or older was a lower proportion (less than one in four) meeting the recommended level of meat consumption.

The comparatively strong independent effect of age upon HEI scores is shown in table 4, where the reference age category is respondents under age 35. Being in the 65 to 79 age group was

Table 3. Diet rating of the Healthy Eating Index for whole sample and by age group

Variables		Age groups				
	All	<35	35-49	50-64	65-79	80+
Sample	9,925	2,558	2,572	2,539	1,776	480
Percent						
Total HEI rating[1]						
Poor	20	21	23	21	15	17
Needs improvement	69	73	69	65	66	66
Good	11	6	8	14	19	17
Component rating[2]						
Grains						
High risk	1	1	1	1	1	<1
Needs improvement	80	76	81	79	82	89
Met recommendation	19	23	18	20	18	11
Vegetables						
High risk	5	4	5	5	6	5
Needs improvement	62	63	65	57	62	68
Met recommendation	33	32	30	38	32	27
Fruits						
High risk	25	31	28	23	15	14
Needs improvement	59	58	59	58	60	62
Met recommendation	17	11	13	19	25	24
Milk						
High risk	10	9	11	11	10	7
Needs improvement	68	68	65	68	69	75
Met recommendation	22	23	24	20	21	18
Meat						
High risk	2	3	2	2	2	2
Needs improvement	66	65	65	62	73	76
Met recommendation	31	32	33	36	25	21
Total fat						
High risk	11	9	11	13	8	8
Needs improvement	53	54	55	52	51	54
Met recommendation	36	37	34	35	41	38
Saturated fat						
High risk	16	17	16	16	14	17
Needs improvement	42	43	43	41	40	39
Met recommendation	42	40	41	43	46	44
Cholesterol						
High risk	18	19	19	20	14	11
Needs improvement	14	15	15	13	14	14
Met recommendation	68	66	66	67	72	74
Sodium						
High risk	17	24	20	16	10	7
Needs improvement	48	48	51	50	47	45
Met recommendation	34	28	31	35	43	34
Variety						
High risk	6	7	6	5	4	4
Needs improvement	42	46	44	42	35	43
Met recommendation	52	47	51	53	61	54

[1] *Poor* = a total HEI score below 51; *Needs improvement* = a total HEI score between 51 and 80; *Good* = a total HEI score over 80.
[2] *High risk* = a score of 0 on the HEI component; *Needs improvement* = a score between 0 and 10 on the HEI component; *Met recommendation* = a score of 10 on the HEI component.

Although most respondents in every age group had total HEI scores within the "needs improvement" range, respondents age 65 and above were more than twice as likely to meet the threshold for a "good" diet, compared with respondents under age 50.

Table 4. Regression coefficients for age groups by HEI variables

Dependent variables	Age groups[1]			
	35-49	50-64	65-79	80+
	Parameter estimate (rank[2] in parentheses)			
Total HEI	-0.010	3.810*** (6)	8.530*** (1)	8.270*** (5)
Grains	-0.005	0.730*** (4)	1.114*** (2)	0.742*** (6)
Vegetables	-0.000	0.865*** (2)	0.964*** (3)	1.069*** (6)
Fruits	0.226** (14)	1.621*** (3)	2.904*** (1)	3.176*** (4)
Milk	0.203** (14)	0.172* (15)	0.797*** (4)	0.854*** (7)
Meat	0.274*** (9)	0.856*** (2)	0.459*** (4)	0.325** (12)
Total fat	-0.440*** (5)	-0.637*** (3)	-0.003	-0.162
Saturated fat	-0.051	0.086	0.470*** (5)	0.233
Cholesterol	-0.480*** (8)	-0.681*** (3)	0.274** (10)	-0.209
Sodium	-0.081	-0.191** (7)	0.135	0.250* (10)
Variety	0.344*** (3)	0.991*** (4)	1.966*** (2)	1.990*** (5)

[1]Reference category = <35.
[2]Ranking determined by standardized parameter estimates.
N=9,925.
*Significant at 0.10 level.
**Significant at 0.05 level.
***Significant at 0.001 level.

the strongest independent predictor, by rank, of the fruits and the total HEI scores and the second strongest predictor of the grains and variety scores. Overall, being in the 65 to 79 age group was positively and significantly associated with higher scores for eight of the components and was associated with an 8.53 unit estimated increase in total predicted HEI score—a 13-percent increase over the mean HEI for all respondents. Similarly, being age 80 or older was significantly and positively associated with 7 of the 10 components and a 10-percent

increase over the mean total HEI score for all respondents. This positive association between advanced age and the HEI, and the slight decline in HEI scores among the oldest respondents are also noted in Basiotis et al. (1996). Neither of the oldest respondent groups was associated with a significant reduction in scores for any of the 10 components of the HEI.

Conclusions

Older Americans have higher HEI scores, on average, because of higher average consumption of fruits and lower average consumption of sodium and cholesterol. The proportion of respondents age 65 and older meeting the recommended HEI score for fruits was twice that of those under the age of 50 (table 3), and a greater proportion of respondents age 80 and over consumed a recommended amount of sodium than did any other age group. Only one in six respondents age 65 and older consumed a "poor" diet, compared with nearly one in four respondents between age 35 and 50. Although most respondents in every age group had total HEI scores within the "needs improvement" range, respondents age 65 and above were more than twice as likely to meet the threshold for a "good" diet, compared with respondents under age 50.

A nonlinear relationship appears to exist between age and HEI scores. The lowest scores occurred among those between age 35 and 49;[2] the highest scores, among those between age 65 and 80. The youngest age groups ate slightly better than did the subsequent generation, and the oldest group ate slightly worse than the previous age groups. This finding suggests the separation of age into categories dictated either by generation cohort or physiological stage, particularly in empirical analyses of the HEI.

A strong relationship between HEI scores and nutrition knowledge and educational attainment was found in Variyam et al. (1998). Given lower

[2]This age group corresponds to those in this sample who were born between 1945 and 1960—the baby boomers. The low scores among this age group need further exploration, given the significance of this generation being able to meet aggregate public nutrition objectives.

average educational attainment and nutrition knowledge and higher HEI scores among the elderly, it is not surprising that when each of these independent factors was taken into account, the positive effect of age upon HEI scores was magnified. Results show that the 65 to 79 age category was among the four strongest independent predictors for 6 of the 10 HEI components and the strongest predictor of the total HEI score.

Factors related to lifestyle, resources, or cohort effects among the elderly have a strong influence on healthful eating. Increased consumption of fresh fruits and vegetables may be associated with ease of preparation, availability within traditional retirement areas, or even cohort-related familiarity and habit. Higher scores for other groups seem to indicate a more balanced diet overall, which is confirmed by higher variety scores. Evidence shows that a higher HEI score is associated with a reduced risk of disease, particularly cardiovascular disease among men and women (McCullough et al., 2000; Hann, Rock, King, & Drewnowski, 2001). The elderly may also be the group best able to envision the ultimate effects of poor eating upon health. As suggested by Becker and Mulligan (1997), experience improves the ability to imagine one's vulnerability.

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Factors Affecting Nutritional Adequacy Among Single Elderly Women

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Data from the 1994-96 Continuing Survey of Food Intakes by Individuals and the Diet and Health Knowledge Survey were used to assess the relative importance of factors associated with the quality of the diet of single women age 65 and older. Findings indicated that higher levels of nutritional adequacy were associated with Midwest residence, daily intake of a multivitamin/multimineral, higher levels of income, and the presence of circulatory disease. Lower levels of nutritional adequacy were associated with employment, receipt of food stamps, and rural residence. Results confirm the importance of providing healthful meal options to single elderly females who may be faced with fewer financial resources, reduced mobility, or higher costs associated with obtaining food.

N utritional adequacy among the elderly interests an aging U.S. population. In 1996, 12 percent of Americans were over age 65. By 2050, this elderly population is projected to more than double as members of the large baby-boom generation reach their elder years. Within this population, the fastest growing segment is expected to be those over age 85 (U.S. Department of Commerce, 1995).

For elderly individuals, inadequate nutrition can increase the incidence and severity of disease and also hasten loss of independence. But, the ability to choose a diet with sufficient quality and variety to meet daily nutrient needs may be affected adversely by the pathological, physiological, economical, and social factors that accompany aging. Reduced physical activity and lean body mass decrease requirements for food energy and increase the need for nutrient-dense foods (Haller, 1999). Gradual loss of health due to the effects of chronic diseases, such as arthritis or diabetes,

can impair the ability to obtain, prepare, and enjoy nutritious foods (Hendy, Nelson, & Greco, 1998). Quandt and Chao (2000) note that women, more so than men, report chronic problems with oral health and digestion, the need for special diets, diseases interfering with eating, and anemia.

Background

Lower levels of economic resources are associated with a greater risk of experiencing hunger and food insufficiency (Brown, 1987; Sahyoun & Basiotis, 2001). Quandt and Rao (1999) found that having an income less than 150 percent of the poverty level was a relatively strong predictor of food insecurity for Appalachian Kentucky residents age 65 and older. Hendy et al. (1998) noted that food cost was frequently mentioned as a barrier to obtaining adequate nutrition for rural elderly in the Eastern United States. Low economic resources can also affect the quantity and quality of food purchased, especially if an

increasing portion of the budget must be devoted to health care and prescription medications (Quinn, Johnson, Poon, Martin, & Nickols-Richardson, 1997).

While assistance is available through the U.S. Department of Agriculture's (USDA) Food Stamp Program to help the economically disadvantaged, concern exists that all those who are eligible do not participate and that benefit levels are low, compared with need (Shotland & Loonin, 1988). Some research has suggested that it costs more to eat a more healthful diet (Blaylock, Smallwood, Kassel, Variyam, & Aldrich, 1999); thus, low income can restrict not just the quantity but the nutritional quality of food purchased as well. Low income can also reduce consumers' ability to substitute market-produced meals for home-cooked versions as their desire and ability to shop and prepare meals decline.

Lower levels of education have been associated with inadequate nutritional intake in the elderly (Bianchetti, Rozzini, Carabellese, Zanetti, & Trabucchi, 1990; Dewitt, Douglas, & Matre, 1989). Nutrition knowledge has been found to have a weak, but positive, association with diet adequacy (Howard, Gates, Ellersieck, & Dowdy, 1998).

Schoenberg (2000) identified four "pathways" of nutritional risk for rural Black elderly: (1) changes in the physical and social importance of food, (2) lack of access to necessary resources, (3) increased physical limitations, and (4) misinformation about diet and nutrition. Lee, Templeton, Marlette, Walker, and Fahm (1998) discovered nutritional deficiencies in food energy, dietary fiber, and calcium among southern Black rural elderly. Diet variety appears to be lower for Blacks, compared with

other racial groups (Dewitt et al., 1989). In addition, Blacks are also more likely than Whites to have inadequate nutritional intake because of weight changes, illnesses, and oral problems that interfere with appetite and eating (Nickols-Richardson, Johnson, Poon, & Martin, 1996).

Loneliness due to death of spouse or friends can diminish the social reasons for, and pleasures associated with, eating (Shifflett & McIntosh, 1983; Walker & Beauchene, 1991). Eating regular meals and having an adequate diet have been found to depend, at least in part, on eating with others (Doan, 1990; Shifflett & McIntosh, 1983; Walker & Beauchene, 1991). Having few shared meals has been associated with higher levels of nutritional risk among rural elders in eastern Pennsylvania (Hendy et al., 1998) and with higher risk of food insecurity in rural Appalachia (Quandt & Rao, 1999). Fewer than a third of a nationally representative sample of elders experiencing food insufficiency were married, compared with more than half of those consuming a sufficient diet (Sahyoun & Basiotis, 2001).

Vitamin and mineral supplementation can offset some of the nutritional deficiencies in the elderly. A study of healthy, independent-living Canadians age 65 to 74 revealed that vitamin C supplements were used most often by both genders, but about three times as many women, compared with men, took a calcium supplement. In general, use of supplements significantly increased nutrient intake; and the risks for deficiency were eliminated for vitamin A, vitamin B_{12}, folacin, and zinc (Donald et al., 1992).

This current study uses nationally representative data on single women age 65 and older from the 1994-96 Continuing Survey of Food Intakes by

Individuals (CSFII) and the Diet and Health Knowledge Survey (DHKS) conducted by USDA. Single women are of interest because the incidence of food insufficiency is relatively greater for the single elderly population (Sahyoun & Basiotis, 2001). They are also of interest because of their generally longer lifespans and consequently their prolonged risk of experiencing the pathological, physiological, economical, and social losses associated with poorer diet quality. In addition, women's longer average lifespan means that they are more likely to experience the life changes associated with a decrease in the quantity and quality of food intake (Nickols-Richardson et al., 1996; Quandt & Chao, 2000).

Research indicates that health problems related to inadequate nutrition are more prevalent in rural areas (Quandt & Chao, 2000; Schoenberg, 2000; Shotland & Loonin, 1988). Rural residents also mention transportation to and from food markets as a structural barrier to obtaining adequate food (Hendy et al., 1998; Lee et al., 1998; Wallace, Pascarella, & Campanella-Voica, 1997). Consequently, the effect of rural residence on single elderly women achieving adequate nutrition is considered in this research.

This study evaluates nutrient intake among single elderly women residing in rural and nonrural areas and examines the relative importance of single elderly women's resources, health status, attitudes, and practices related to food procurement and processing, as well as demographic characteristics in achieving adequate nutrition.

Method

Data and Sample

The CSFII 1994-96 is a nationally representative sample of individuals of all ages living in the United States. Information regarding food and nutrient intakes of each respondent was gathered over 2 nonconsecutive days by using dietary recalls. Individuals age 20 and older also completed the DHKS, which contains information regarding the dietary health knowledge and attitudes of each individual. Included are questions about the knowledge of specific health risks associated with foods, personal health information, and the frequency of use of information on food labels. The DHKS sample consists of 5,765 respondents, from which 732 single women age 65 and older residing in rural (n=218) and nonrural (n=514) areas were selected for this study.

The method used to collect the dietary recall information in these surveys may lead to underreporting, particularly among older participants. It could also place some participants' nutritional status below the U.S. Recommended Dietary Allowance (RDA) threshold for one or more of the specific components of nutritional adequacy considered in this study (Dixon, Cronin, & Krebs-Smith, 2001). Unfortunately, it is not possible to ascertain the extent to which underreporting might be a problem for the sample used in this study. Thus, the possibility of underreporting is simply acknowledged as a limitation of these data.

Conceptual Framework

The Deacon and Firebaugh (1988) systems model of resource management provides the basic conceptual framework used in this study. According to this model, through the managerial actions of planning and implementing, resources are transformed in ways that meet value-based goals. In the transformation process, constraints and facilitating conditions can be present. Constraints limit means of reaching a goal or restrict access to or use of resources. Facilitating conditions, in contrast, ease the process of goal attainment.

When this conceptual framework is applied to the current study, the goal to be met is obtaining adequate nutrition—defined as intake of given nutrients that meet or exceed the RDAs. Resources consist of level of education, nutrition knowledge, income (measured as a percentage of the poverty level), and receipt of food stamps. Attitudes and behavior related to food procurement and preparation comprise the managerial actions of planning and implementing. Several factors could help or constrain obtaining adequate nutrition. For example, diet restrictions and disease can constrain food choices; work commitments can constrain time for food shopping and preparation; rural residence can limit access to less expensive, higher quality foods, which raises the costs associated with obtaining adequate nutrition. Taking a daily multivitamin/multimineral would facilitate meeting the RDAs for vitamins and minerals. Other variables in the conceptual framework are age, race, and region of residence, which enter the model as controls.

Empirical Model

To ascertain the importance of the factors considered in this study, we used an ordinary least squares regression to compute standardized betas:

$$\text{RDA index} = \alpha + \Sigma\beta_{ii} \text{ resources} + \Sigma\beta_{ii} \text{ management} + \Sigma\beta_{ii} \text{ constraining factors} + \Sigma\beta_{ii} \text{ facilitating factors} + \varepsilon$$

An RDA index was constructed to measure the degree to which study participants met RDA requirements for food energy, protein, and 14 essential vitamins and minerals. The threshold level for each component of the index is based on the 1989 RDAs (National Academy of Sciences, 1989). These RDAs were used rather than the recently published Dietary Reference Intakes (DRIs) because the RDAs were current at the time the data used in this study were collected.

Resources consisted of measures of both general and nutrition-specific knowledge and economic resources. General knowledge was measured by a set of categorical variables indicating highest grade completed. Nutrition-specific knowledge was measured by the number of items from a total of 13 that a study participant answered correctly on a test of nutrition knowledge administered in the original survey. Economic resources consisted of income, which was measured as a percentage of poverty and receipt of food stamps.

Attitudes and behavior related to food procurement and preparation were indicative of plans and actions associated with achieving nutritional adequacy (management). Whereas attitudes were indicated by the importance of nutrition, proper food storage, ease of preparation, and taste, behavior was denoted by study participants' use of nutrition labels and whether they had the main responsibility for preparing meals.

Constraints on food choices were measured by the presence of diet restrictions and diseases prevalent among the elderly. These consisted of lowfat, low-calorie, low-sodium, high-fiber, or diabetic diets and circulatory disease, diabetes, cancer, or osteoporosis. Work was considered a time constraint to shop for and prepare food. Although incidence of employment among the elderly is low,

women often continue working past age 65 (Herz, 1988). This trend is expected to continue as members of the baby-boom generation reach their elder years (Purcell, 2000).

Rural versus nonrural (urban and suburban) residence also was included in the empirical model, as were multivitamin/multimineral intake, age, race, and region of residence.

Results

Results indicated that the rural and nonrural samples were similar (table 1). Respondents typically had less than a high school education (40 percent for the total sample, 45 percent for rural residents, and 37 percent for nonrural residents). Average age of the sample was close to 74 years. The largest proportion of rural residents lived in the South (43 percent), while about an equal proportion of nonrural residents lived in the Northeast, South, or Midwest (28, 28, and 27 percent, respectively). Close to 90 percent of both rural and nonrural respondents were White, did not receive food stamps, and were not employed.

Regarding attitudes and behavior related to food procurement and preparation, close to three-fourths of both rural and nonrural respondents indicated that nutrition, taste, and food not spoiling were very important. A little over half of each group did not consider easy preparation to be very important, most did not use nutrition labels, and about 90 percent of each group had primary responsibility for preparing meals. Slightly less than half (44 to 47 percent) of each group took a daily multivitamin/multimineral supplement. Study participants seemed to have adequate but relatively low economic resources: income was, on average, near 180 percent of the poverty level. Each group answered

Table 1. Descriptive statistics for single elderly women

Variables	Total[1]	Rural[1]	Nonrural[1]
		Mean	
Continuous			
Nutrition knowledge test (number correct of a possible 13)	8.0	8.2	7.9
Income (% of poverty level)	184.9	182.4	185.9
Age (years)	73.6	74.7	73.2
		Percent	
Categorical			
Education			
Less than high school	40	45	37
High school	30	26	32
Some college	17	14	18
College	13	15	13
Race			
White	85	94.5	81
Black	13	5	16
Asian and Pacific Islander	0.5	0	1
Other[2]	1.5	0.5	3
Region			
Northeast	23	11	28
South	33	43	28
Midwest	30	38	27
West	14	8	17
Employment			
Full-time	2	1	2
Part-time	8	11	7
Not working	90	88	91
Receipt of food stamps			
Yes	8	5	9
No	92	95	91
Importance of nutrition			
Very important	74	75	73
All other responses[3]	26	25	27
Importance of taste			
Very important	86	87	85
All other responses[3]	14	13	15
Importance of food not spoiling			
Very important	73	78	70
All other responses[3]	27	22	30
Importance of easy preparation of food			
Very important	42	39	43
All other responses[3]	58	61	57
Use nutrition labels			
Use often (always)	34	35	38
All other responses[4]	66	65	62
Main responsibility for meals			
Yes	90	91	90
No	10	9	10
Take vitamins daily			
Yes	46	44	47
No	54	56	53

[1]Sample size: total = 732, rural = 218, and nonrural = 514.
[2]Native American, Alaskan Native, and other races.
[3]Somewhat important, not too important, not at all important, don't know.
[4]Sometimes, rarely, never.

Table 2. Components of the RDA Index for single elderly women

Nutrient percent RDA	Total[1]		Rural[1]		Nonrural[1]	
	Mean percent of RDA	Percent of sample meeting RDA	Mean percent of RDA	Percent of sample meeting RDA	Mean percent of RDA	Percent of sample meeting RDA
Food energy (kcal)	84	27	84	27	84	27
Protein (g)	148	69	146	65	149	71
Vitamin A (μg)	165	48	143	40	175	51
Vitamin E (mg)	86	28	84	28	86	28
Vitamin C (mg)	167	57	135	50	180	61
Thiamin (mg)	138	65	142	64	137	66
Riboflavin (mg)	145	66	144	64	145	67
Niacin (mg)	146	68	148	65	146	70
Vitamin B_6 (mg)	102	42	99	39	103	44
Folate (μg)	158	60	153	56	161	61
Vitamin B_{12} (μg)	287	71	281	69	290	72
Calcium (mg)	90	36	85	33	92	38
Phosphorus (mg)	138	71	137	69	139	72
Magnesium (mg)	99	34	97	33	100	35
Iron (mg)	140	60	143	62	138	60
Zinc (mg)	76	20	78	21	75	21
RDA Index (of a possible 16)	8.3		7.9		8.4	

[1]Sample size: total = 732, rural = 218, and nonrural = 514.
Note: Means under 100 percent indicate underconsumption according to the RDA; means at or above 100 percent indicate adequate consumption. Underreporting, if present, would understate the true value.

> **Rural residents had lower average nutrient consumption levels, measured as a percentage of RDA, for protein, seven vitamins (A, C, E, B_6, B_{12}, riboflavin, and folate) and three minerals (calcium, phosphorus, and magnesium).**

8 of the 13 nutrition knowledge items correctly.

Nutrient scores as a percentage of the RDAs were lower for rural residents, compared with those of nonrural residents (table 2). Rural residents had lower average nutrient consumption levels, measured as a percentage of RDA, for protein, seven vitamins (A, C, E, B_6, B_{12}, riboflavin, and folate) and three minerals (calcium, phosphorus, and magnesium). The proportion of the rural sample that met the RDA for specific nutrients lagged behind that of the nonrural sample for protein and the same vitamins (except vitamin E) and minerals, plus thiamin and niacin. For many of these nutrients, however, the differences between rural and nonrural residents were rather small in practical terms. The average score on the RDA index was lower for rural residents,

compared with the average score for nonrural residents: 7.9 vs. 8.4 (of a possible 16). However, the general pattern of average nutrient consumption levels, measured as a percentage of the RDAs, was the same for both rural and nonrural residents. For example, the percentage of the RDA for protein for both groups was over 100, while the percentage for vitamin E was less than 100 for both groups.

A slightly higher proportion of nonrural residents, than their rural counterparts, reported low-calorie, low-sodium, or high-fiber diet restrictions, whereas, an equal proportion of rural and nonrural residents reported having a lowfat or diabetic diet (table 3). A larger proportion of rural residents had been diagnosed as having heart disease, cancer, or osteoporosis, while a slightly larger proportion of nonrural

Table 3. Diet and disease restrictions for single elderly women

Variable	Total[1]	Rural[1]	Nonrural[1]
	Percent		
Diet restrictions	26	23	26
Lowfat	4	4	4
Low calorie	14	12	14
Low sodium	9	7	10
High fiber	3	1	3
Diabetic	7	7	7
Diagnosed diseases			
Circulatory	69	71	68
High blood pressure	51	51	51
Heart disease	23	27	21
High blood cholesterol	30	29	31
Stroke	7	6	8
Diabetes	14	14	15
Cancer	12	17	9
Osteoporosis	13	13	12

[1]Sample size: total = 732, rural = 218, and nonrural = 514.

Study findings indicate that single elderly women's economic resources are more important than knowledge resources in attaining adequate nutrition.

residents reported diagnosis of high blood cholesterol, stroke, or diabetes. Both rural and nonrural residents had equal rates of diagnosed high blood pressure (51 percent).

Results of the multivariate analysis indicate that economic resources, and various constraining and facilitating conditions were significant in explaining variation in nutritional adequacy among single women age 65 and older (table 4). In rank order of importance, the significant factors were Midwest residence, taking a daily multivitamin/multimineral, employment (full or part time), income as a percent of poverty, presence of circulatory disease, receipt of food stamps, and rural residence. In terms of direction of association, Midwest residence, taking a daily multivitamin/ multimineral, higher levels of income, and presence of circulatory disease were associated with higher levels of nutritional adequacy. Employment, receiving food stamps, and rural residence, however, were associated with lower levels of nutritional adequacy.

Discussion and Implications

Study findings indicate that single elderly women's economic resources are more important than knowledge resources in attaining adequate nutrition. The positive relationship between income and nutrition adequacy is consistent with previous research (Brown, 1987; Sahyoun & Basiotis, 2001; Hendy et al., 1998; Quandt & Rao, 1999; Quinn et al., 1997) and with the idea that a higher quality diet costs more (Blaylock et al., 1999). It is reasonable to expect that those with limited resources would benefit from the Federal Food Stamp Program. Thus, the negative relationship between receipt of food stamps and nutrition adequacy is contrary to what would be expected. It could be that, as Shotland and Loonin (1988) contend, benefit levels are too low to really meet the need. It certainly appears that, for whatever reason, food stamp participants in this sample still do not acquire the quantity and quality of food necessary to get adequate

nutrition. Further research is needed to examine why this is the case.

As might be expected, nutritional adequacy is improved by taking supplemental multivitamins/ multiminerals. Among disease diagnoses, the strong and significant effect of circulatory disease upon improved diet may reflect the enhanced potential benefit from changing behavior in the present, in contrast to the nonsignificant (and negative) effect of a cancer diagnosis on diet quality. Diet restrictions and disease diagnoses other than circulatory disease were not significant factors in this study.

Rural and lower income single elderly women were significantly less likely to eat a nutritionally adequate diet than were their nonrural and higher income counterparts. Lack of nearby super-markets with an adequate selection of healthful foods or access to support programs such as Meals-on-Wheels may also serve as important constraints to healthful eating for the rural elderly. Insufficient funds constrain purchase of more foods and better quality foods. Single elderly women who work are less likely to eat a nutritious diet—perhaps because of constraints on time and lower levels of economic resources. It is not known whether employment of survey respondents is by choice or necessity. This issue warrants further research given expectations that aging baby boomers will maintain some attachment to the labor market as they enter their elder years. The negative relationship between receiving food stamps and meeting the RDAs may be attributed to low levels of accumulated financial resources—since eligibility is a function of both income and wealth. It also may reflect the quality of food obtained.

Table 4. Regression results, RDA index value for single elderly women

Variables	Parameter estimate	Standardized estimate	Rank order
Resources			
Education (reference category < high school)			
High school	-0.5051	-0.0496	
Some college	0.8317	0.0661	
College	0.6752	0.0494	
Nutrition knowledge test score	0.0095	0.0051	
Income (% of poverty)	0.0044*	0.0828	4
Food stamp recipient	-1.2451*	-0.0708	6
Management			
Attitudes			
Importance when selecting foods			
Nutrition	0.0683	0.0064	
Food not spoiling	0.2239	0.0213	
Ease of preparation	-0.2048	-0.0216	
Taste	-0.1951	-0.0146	
Behavior			
Always use nutrition labels	-0.3505	-0.0363	
Responsible for preparing meals	0.0483	0.0031	
Constraints/Facilitators			
Diet restrictions			
Lowfat	-0.0541	-0.0040	
Low-calorie	0.1590	0.0069	
Low-sodium	-1.0314	-0.0640	
High-fiber	1.8519	0.0630	
Diabetic	0.5415	0.0300	
Diagnosed with disease			
Circulatory	0.7937**	0.0788	5
Diabetes	0.5065	0.0380	
Cancer	-0.5059	-0.0347	
Osteoporosis	-0.2433	-0.0173	
Work (full time or part time)	-1.4574**	-0.0945	3
Rural	-0.7232*	-0.0707	7
Take daily vitamins	0.9385**	0.1000	2
Control variables			
Age	-0.0235	-0.0335	
Black	-0.6682	-0.0480	
Region (reference=South)			
Northeast	-0.1499	-0.0135	
Midwest	1.2323**	0.1210	1
West	0.4313	0.0319	
Intercept	8.3533**	R^2=0.0916	

*Significant at 0.10 level.
**Significant at 0.05 level.
***Significant at 0.001 level.
n=732.

In 1994, Midwest consumers faced food prices that were 7.7 percent lower than those in the Northeast, 3.9 percent lower than those in the West, and less than 1 percent lower than those in the South (U.S. Department of Labor, 2002). This may help explain the strong relationship between Midwest residence and meeting the RDAs. The availability of nutrient-dense foods, proximity to local farmers' markets, as well as cultural and social differences within the region, also may help account for more nutritious diets.

Our study suggests that single elderly women can be found on at least one of the four "pathways" to nutritional inadequacy—namely lack of access to necessary resources—as identified by Schoenberg (2000). Results confirm the importance of providing healthful meal options for single elderly women who face fewer financial resources, reduced mobility, or higher costs associated with obtaining food.

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Reduction in Modifiable Osteoporosis-Related Risk Factors Among Adults in the Older Americans Nutrition Program

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The purpose of this study was to determine the prevalence of low bone mineral density, the prevalence of modifiable osteoporosis-related risk factors, and the effectiveness of a nutrition and bone health education intervention that is tailored for a multiethnic (Caucasian and African American), low-income, low-literacy elderly population. The six risk factors were low intake of eight calcium-rich foods (less than 3 servings/day), nonuse of calcium supplements, nonuse of vitamin D-containing supplements, low physical activity (less than 5 times/week and less than 150 minutes/week), one or more of four risks for falling in the home, and current tobacco use. The 71 participants were a convenience sample from the Northeast Georgia Older Americans Nutrition Program who received Title III-C or Title III-D services. Fifty-nine completed heel bone mineral density tests at baseline and osteoporosis risk assessment questionnaires both at baseline and post-intervention. At baseline, 60 percent of the adults had either osteoporosis or osteopenia, and African-American women had more osteoporosis-related risk factors than did Caucasian women. After the intervention, the number of risk factors decreased significantly by 0.8, and over half of the participants decreased at least one risk factor. Additionally, the number of participants who consumed 3 or more servings of calcium-rich foods daily or used a calcium supplement more than doubled.

O steoporosis is a major public health threat that is largely preventable (National Institutes of Health [NIH], 2001). In the United States, 10 million people have osteoporosis, and another 18 million have osteopenia—low bone mass that increases the risk for osteoporosis (NIH, 2001). Consequences of osteoporosis include chronic pain, bone fractures, need for placement into long-term care facilities, and death (NIH, 2001).

Because of the high prevalence and debilitating consequences of osteoporosis and bone fractures, we developed an educational intervention related to nutrition and bone health that was targeted to participants in the Older Americans Nutrition Program (OANP). Formerly known as the Elderly Nutrition Program, OANP is the largest community nutrition program for older adults in the Nation, serving about 7 percent of the older population overall and about 20 percent of the poor elders (Administration on Aging, 2002; Millen, Ohls, Ponza, & McCool, 2002). This program provides nutrition education, as well as congregate and home-delivered meal services.

The educational messages in this intervention were developed from recommendations of the 2000 NIH

Consensus Development Panel on Osteoporosis Prevention, Diagnosis, and Therapy (NIH, 2001). From a review of 2,449 references from 1995 to 1999, the panel identified several modifiable risk factors for osteoporosis and bone fractures, including smoking, a low level of physical activity, risk of falling, and low intakes of calcium and vitamin D. Further evidence that smoking and use of smokeless tobacco are risk factors was recently reviewed (Spangler, Quandt, & Bell, 2001).

Although NIH did not make a specific recommendation for physical activity and the prevention of osteoporosis and fractures, several health organizations and experts recommend 30 minutes or more physical activity most days of the week (about 30 minutes on 5 days of the week and about 150 minutes weekly) (American College of Sports Medicine, 2002; U.S. Department of Health and Human Services [DHHS], 2000; DiPietro, 2001; USDA & DHHS, 2000). The NIH panel (2001) emphasized that exercise may decrease the risk of falling. This focus on exercise is critical because most (90 percent) hip fractures are associated with a fall (Carter, Kannus, & Khan, 2001). Both the NIH (2001) and the National Osteoporosis Foundation (NOF, 2002) recommend fall-prevention techniques in the home such as: removing throw rugs, anchoring rugs with nonskid tape, installing grab bars and stair rails, and using night-lights. These types of interventions have reduced the number of falls (Plautz, Beck, Selmar, & Radetsky, 1996).

Vitamin D is unique because it can be obtained both via skin exposure to sunlight and through food or supplements. Like all other vitamins and minerals, calcium is available only through food or supplements. Although calcium- and vitamin D-rich foods (e.g., dairy products) are the preferred source of dietary calcium

and vitamin D, several organizations suggest that older people may need supplements to meet their high needs for these nutrients (NAS, 1997; NIH, 2001; USDA & DHHS, 2000). The ability to synthesize vitamin D in the skin by sun exposure declines with age and is blocked by sunscreen in people regardless of their age (NAS, 1997).

The Adequate Intake (AI) level for vitamin D (600 International Units [IU] or 15 mg) for those over 70 years old is often difficult to achieve. With the exception of milk, which is fortified in the United States with 400 IU of vitamin D per quart (Institute of Medicine, 1997), very few foods contain vitamin D in significant quantities. Consequently, relying on milk alone would require 6 cups of milk per day to meet the recommendation. Perceived milk intolerance—defined as experiencing stomach ache, flatulence, or diarrhea after drinking milk—is much higher in African Americans than in Caucasians and is a significant predictor of low milk intake in older adults (Elbon, Johnson, & Fischer, 1998). The 2000 *Dietary Guidelines for Americans* states that "people who seldom eat dairy products or other rich sources of calcium need a calcium supplement" and that "older adults and people with little exposure to sunlight may need a vitamin D supplement" (USDA & DHHS, 2000).

NIH notes that the effects of most medications for osteoporosis are evaluated in conjunction with calcium and vitamin D supplements. Clinical trials confirm that increased milk consumption to 3 to 4 servings per day slows bone loss in older men and women (Heaney et al., 1999; Storm et al., 1998). Clinical trials also confirm the effectiveness of vitamin D (700 to 800 IU/day) and calcium supplements (500 to 800 mg/day) for preventing fractures in older people (Chapuy et al., 1992;

Dawson-Hughes, Harris, Krall, & Dallal, 1997).

Based on a review of the literature, we have found no systematic evaluation of osteoporosis risk or health promotion programs designed to reduce that risk among OANP participants. However, others have found that nutrition education intervention results in changes in knowledge and beliefs about osteoporosis (Blalock et al., 2000), nutrition (McCamey et al., 2003), and calcium and vitamin D intakes (Rolnick , Kopher, Jackson, Fischer, & Compo, 2001).

This study investigated the prevalence of low bone mineral density (BMD) as estimated by the heel BMD test; the prevalence of modifiable osteoporosis-related risk factors; and the effectiveness of an educational intervention related to nutrition and bone health that is tailored for a multiethnic (Caucasian and African American), low-income, and low-literacy elderly population. For the purposes of this study, the primary measurable outcome was a change in these six risk factors. These include the factors identified previously by NIH.

Methods

Data and Sample

This was a convenience sample of participants from senior centers in four counties in Georgia, with no exclusion criteria. Counties were included because of interest in the project and availability of participants. Potential sample size was limited because these were small centers located in rural areas. Participants were recruited through the directors of the senior centers who helped with advertising and enrollment.

Baseline

At baseline, heel BMD, weight, and height were assessed, and participants answered nutrition and health questions (in no particular order). Heel BMD was determined with an ultrasound bone densitometer.[1] A T-score[2] was derived by comparing each participant's BMD with the optimal and peak BMD of a 30-year-old healthy adult. Each participant received a copy and an explanation of his or her BMD results (low risk, moderate risk, or high risk for osteoporosis) and was strongly encouraged to take the results to his or her healthcare provider. Because heel BMD takes 2 to 3 years to demonstrate improvement by using the ultrasound bone densitometer, it was assessed at baseline only and thus not used as an outcome measure.

Health Education Curriculum

The health education curriculum, developed and modified by five nutrition and pharmacy experts at the University of Georgia, consisted of three lessons. The first lesson covered the definition of osteoporosis, key nonmodifiable and modifiable risk factors for osteoporosis and bone fractures (including tobacco use), and balance exercises. The second lesson covered sources of calcium and vitamin D, including foods that are naturally rich in calcium, low-lactose dairy foods and use of the lactase enzyme, calcium-fortified foods, and calcium and vitamin D supplements. To encourage a possible new food source of calcium, those presenting the lessons gave participants the opportunity to taste calcium-fortified orange juice. The third lesson reviewed ways to reduce falls, as well as medications that may be beneficial for bone health.

All participants performed balance exercises from the NIH Osteoporosis and Related Bone Diseases National Resource Center at each lesson.[3]

The four messages of this educational intervention were emphasized in each lesson: (1) Talk to Your Doctor: tobacco and smoking cessation, medications, and heel BMD results; (2) Increase Sources of Calcium and Vitamin D: dietary sources, fortified foods, and dietary supplements; (3) Take Action: increase physical activity; and (4) Take Care: fall-prevention measures.

Post-Intervention

We administered a post-test about 1 month after completion of the third lesson to assess participants' behavioral changes. The questionnaire contained items that were based on past nutrition questionnaires developed for this population (Brackett, 1999; Johnson et al., 2003), as well as issues related to nonmodifiable and modifiable risk factors for osteoporosis and bone fractures (NIH, 2001). The questionnaire included items that were used to calculate a score for the modifiable osteoporosis-related risk factors score:

(1) Low intake of calcium-rich foods—consuming less than 3 servings of eight calcium-rich foods[4]/day.

(2) Nonuse of calcium supplements—not taking a supplement with calcium. For the purposes of this study, a multivitamin supplement was *not* considered a calcium supplement.
(3) Nonuse of vitamin D-containing supplements—not taking any supplement containing vitamin D.
(4) Low physical activity—exercising less than 5 times/week and less than 150 minutes/week, regardless of intensity or type of exercise.
(5) High risk of falling at home—at least one of the following risks: not anchoring throw rugs, not having grab bars in bathroom, not having nonskid tape or nonskid mat in tub or shower area, or not turning on the light or using a night-light when getting out of bed at night.
(6) Current tobacco use.

Other items assessed were medication history, family history of osteoporosis and bone fractures, medical conditions, medications, illnesses, osteoporosis-related knowledge questions, menstruation history, and results from an orientation-memory-concentration (i.e., cognition) test. A panel of nutrition and pharmacy experts reviewed the questionnaire to increase face validity; modifications were made based on their recommendations. To help determine the reliability of the questionnaire for this population, we administered it twice to the same participants both before and after the intervention.

Participants were given a test to determine whether cognition was related to scores for modifiable osteoporosis-related risk factors. The cognition measure is a validated 6-item tool that discriminates cognitive function as being normal or minimally impaired (score of 8 or less), moderately impaired (9 to 19), or severely impaired (20 or more) (Katzman et al.,

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[3]The lesson plans are available on the Nutrition for Older Adults' Health Website: www.arches.uga.edu/~noahnet. The free, downloadable lesson plans consist of text and script for the lessons, handouts, materials for overhead transparencies, pre- and post-tests, as well as references for additional reading about nutrition and bone health.

[4]The eight calcium-rich foods consisted of milk as a beverage; milk with cereal; yogurt; cheese; mustard, turnip, or collard greens; canned salmon; calcium-fortified orange juice; and calcium-fortified cereals.

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[1]Hologic Sahara Clinical Bone Sonometer, Bedford, MA, 2000.

[2]T-score expresses the number of standard deviations from the mean score for the young adult population (Hologic, 2000).

Table 1. Baseline assessments of heel bone mineral density, T-score, and osteoporosis: Adults in the Older Americans Nutrition Program

	Total sample	Men	Women	Caucasian women	African-American women
Sample size	70	7	63	42	21
			Mean		
Heel BMD	0.47	0.51	0.46	0.45	0.49
T-score	-1.03	0.67	-1.07	-1.20	-0.83
			Percent		
Osteoporosis risk					
Low risk[1]	23	29	22	17	33
Moderate risk[2]	17	29	16	17	14
High risk[3]	60	43	62	67	52

[1]T-score > 0.
[2]T-score $\leq$ 0 and > -1.0.
[3]T-score $\leq$ -1.0.
Notes: Percentages may not add to 100 percent because of rounding. Data were not statistically associated with gender or ethnicity.

1983). Trained staff from the University of Georgia's Department of Foods and Nutrition read the questions to the participants and recorded their responses. During the interview, the trained staff used food models to help the participants determine portion sizes and give a more accurate estimate of the amount of calcium- and vitamin D-rich foods they consumed.

Statistical Analysis

To ensure consistency in coding, only one person coded all questionnaires. After coded data were entered twice in two different files, discrepancies were corrected to reflect the participants' responses. Baseline and post-intervention data were compared by using Chi-square analyses and paired *t*-tests to determine the statistical significance of changes in risk factors and other variables of interest; regression analyses were used to identify possible predictors of changes in risk factors scores.

Results

Of the 71 participants who enrolled at baseline, 70 had their heel BMD assessed, and 59 completed the intervention and the post-intervention questions. Of those who did not complete the post-intervention questions, 5 were out of town, 4 stopped going to the senior center, 1 was not a regular senior center participant, 1 refused to complete the questionnaire, and 1 died. Among the 59 participants who completed the post-intervention questions, 10 percent attended no lessons, 25 percent attended one lesson, 29 percent attended two lessons, and 36 percent attended all three lessons. The demographic characteristics of the attendees and non-attendees reflected those of the overall sample (77 years old, 90 to 93 percent female, 66 percent Caucasian, and 34 percent African American).

The mean BMI for these groups was 29.2 (data not shown). According to Government guidelines, a BMI of 29.2 is on the cusp of being overweight

(BMI = 25 to 30) or obese (BMI greater than 30) (USDA & DHHS, 2000). Based on the BMD T-score, 60 percent of participants had either osteopenia or osteoporosis, 17 percent had moderate risk for a future bone fracture; 23 percent, a low risk (table 1). These measures, however, were not significantly associated with gender or ethnicity.

At baseline, all participants had at least one of the six modifiable osteoporosis-related risk factors (table 2). The most prevalent was low intake of calcium-rich foods (86 percent), and the least prevalent was current tobacco use (17 percent). At baseline, the various indices of risk factors were not significantly different between the total sample and the subgroup that completed the intervention. After the intervention, the total risk factors score (3.4), consumption of less than 3 servings of eight calcium-rich foods daily (69 percent), and non-use of calcium supplements (53 percent) significantly decreased; more than half (52 percent) of the participants reduced one or more risk factors. Although

Table 2. Baseline and post-intervention prevalence of modifiable osteoporosis-related risk factors: Adults in the Older Americans Nutrition Program

	Baseline, total sample	Baseline, completed intervention	Post-intervention
Sample size	71	59	59
	Mean		
Number of risk factors*	4.0	4.2	3.4
Weekly frequency of exercise*	4.2	4.6	5.4
	Percent		
Low intake of calcium-rich foods[1]*	86	88	69
Non-use of a calcium supplements*	77	83	53
Non-use of a vitamin D-containing supplements	65	68	54
Low physical activity [2]	83	85	80
High risk of falling at home[3]	75	78	71
Current tobacco use	17	17	12
Number of risk factors*			
0	0	0	0
1	6	3	12
2	8	7	10
3	15	14	34
4	28	29	17
5	32	40	25
6	10	8	2
5 or more risk factors	42	48	27

[1]Less than 3 servings per day.
[2]Less than 5 times per week and less than 150 minutes per week.
[3]Equal to or greater than one of four risks for falling.
* Statistically significant difference between baseline and post-intervention at p = .05.
Note: Percentages may not add to 100 percent because of rounding.

The major findings at baseline were that a substantial number of participants had osteopenia or osteoporosis based on their heel BMD results. After the intervention, participants significantly decreased their osteoporosis-related risk factors score and were more likely both to consume calcium-rich foods and to use calcium supplements.

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there was no change in exercise risk after the intervention, more than half (55 percent) of participants reported doing the balance exercises at home (table 3), and the frequency of exercise increased significantly by about 1 time per week (from 4.6 to 5.4 times per week) (table 2). In a multivariate stepwise regression model, change in risk factors score was not significantly associated with age, gender, ethnicity, attendance at lessons, cognition, or whether participants had been told by their doctor that they had osteoporosis (data not shown).

We also explored ethnic differences between Caucasian and African-American women at baseline; there were too few men to make comparisons by gender. Compared with Caucasian women, African-American women had a significantly higher BMI (31.3 vs. 28.2) and were more likely to exercise less than 5 times per week and for less than 150 minutes per week (100 vs. 79 percent) (table 4). African-American women were also significantly more likely than Caucasian women not to use supplements: calcium (95 vs. 67 percent) or vitamin D-containing (86 vs. 50 percent). Thus, African-American women had significantly

more risk factors than did Caucasian women (4.7 vs. 3.9).

After the intervention, participants were asked whether they had made any changes related to osteoporosis risk since attending the educational lessons (table 3). Four of 10 reported that they had talked with their doctor about issues such as their heel BMD results and osteoporosis (41 percent each), a quarter had discussed prescription medications for osteoporosis, and about a quarter had discussed exercises for their bone health. A large number of participants increased their physical activity, practiced the balance exercises at home, and adopted at least one fall-prevention measure. Additionally, there were substantial increases in diet and supplement use, including eating more calcium-rich and calcium-fortified foods, and starting to take supplements with either calcium or vitamin D. Despite a detailed discussion of low-lactose dairy foods, very few participants started using commercially available low-lactose milk (5 percent) or tried using lactase tablets or drops (2 percent).

Discussion

The nutrition and bone health curriculum that was designed for low-literacy, low-income older adults reduced the number of modifiable osteoporosis-related risk factors and was associated with other self-reported behavioral changes. The major findings at baseline were that a substantial number of participants had osteopenia or osteoporosis based on their heel BMD results. After the intervention, participants significantly decreased their osteoporosis-related risk factors score and were more likely both to consume calcium-rich foods and to use calcium supplements. However, the consumption of calcium-rich foods increased by a statistically significant,

Table 3. Self-reported post-intervention changes related to modifiable osteoporosis-related risk factors: Adults in the Older Americans Nutrition Program

	Percent reporting risk factor
Talked with doctor about	
BMD results	41
Osteoporosis	41
Prescription medications for osteoporosis	25
Exercises for bone health	27
Increased physical activity	39
Practiced balance exercises at home	55
Adopted at least one fall-prevention measure	34
Dietary and supplement changes	
Ate more calcium-rich foods	30
Ate more calcium-fortified foods	20
Started taking calcium supplement	23
Started taking vitamin D supplement	11
Changed to low-lactose milk	5
Tried lactase tablets or drops	2

Note: n=59.

but nutritionally small amount (2.5 servings/week), translating to minor increases in daily calcium intake.

There is a heightened awareness that African-American women are at risk for osteoporosis (Bohannon, 1999). Even though the mean heel BMD of women did not differ by ethnicity, it is possible that, compared with the Caucasian women, the African-American women in this study may be at somewhat higher future risk for osteoporosis for two reasons: they were less likely to take a calcium supplement or any vitamin D-containing supplement, and they were more likely to have signs of lactose intolerance. However, our sample size was small, and it is not possible to reach a definitive conclusion on ethnic differences in the osteoporosis-risk profile of these participants.

In addition to small sample size, there were other limitations in this study.

The curriculum may not have accommodated varied levels of comprehension among the participants. Although we did not assess the educational level of this sample, we have found that the mean level of education is eighth grade in older adults receiving congregate meals from this same Area Agency on Aging (Brackett, 1999). To address concerns associated with comprehension, the educators reviewed and modified the curriculum before it was implemented. A question-and-answer period was included at the end of every lesson to allow participants to have their questions answered and to address issues that were not covered in the lessons. Also, not everyone attended all the lessons. To minimize the effect of absenteeism on behavior modification, instructors gave participants handouts that repeated important concepts and emphasized self-empowerment.

Table 4. Ethnic differences between Caucasian and African-American women at baseline: Adults in the Older Americans Nutrition Program

	Caucasian women	African-American women
Sample size	42	22
	Mean	
Age	76	76
BMI*	28.2	31.3
	Percent	
Osteoporosis-related risk factors		
Low intake of calcium-rich foods[1]	86	95
Non-use of calcium supplements*	67	95
Non-use of vitamin D-containing supplements*	50	86
Low physical activity [2]*	79	100
High risk of falling at home[3]	83	63
Current tobacco use	12	23
Mean number of risk factors*	3.9	4.7

[1]Less than 3 servings per day.
[2]Less than 5 times per week and less than 150 minutes per week.
[3]Equal to or greater than one of four risks for falling.
*Statistically significant difference between Caucasian and African-American women, at $p = .05$.

As in most behavioral change studies, another limitation was that the behavioral changes were self-reported. Objective biological measures of nutrition and bone health were beyond the scope of this study but would be important for future study. Future studies are needed to determine the long-term effect of educational interventions and behavioral changes on osteoporosis, bone mass, and incidence of bone fractures in older adults. Based on the limitations of this study, interpretation of the findings should not be applied to all Older Americans Nutrition Program participants, but can be used in planning, implementing, and evaluating similar future studies.

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Federal Studies

The Older Population in the United States: March 2002

In 2002, 59.6 million people in the civilian noninstitutionalized U.S. population were age 55 and over. This report by the Census Bureau presents a statistical portrait of selected social and economic characteristics of this older population, based on the results of the Annual Demographic Supplement to the March 2002 Current Population Survey. These characteristics, which are shown by age and sex, include race and Hispanic origin, marital status, educational attainment, labor force status, income, and poverty status.

Women outnumber men among older adults

Of the 59.6 million older people, 33.0 million were women and 26.6 million were men, resulting in a sex ratio of 81 men per 100 women. This ratio dropped steadily with age: In the 55 to 64 age group, the sex ratio was 92; in the 85 years and over age group, the ratio was 46.

Sex ratio of older population, by age

Men per 100 women
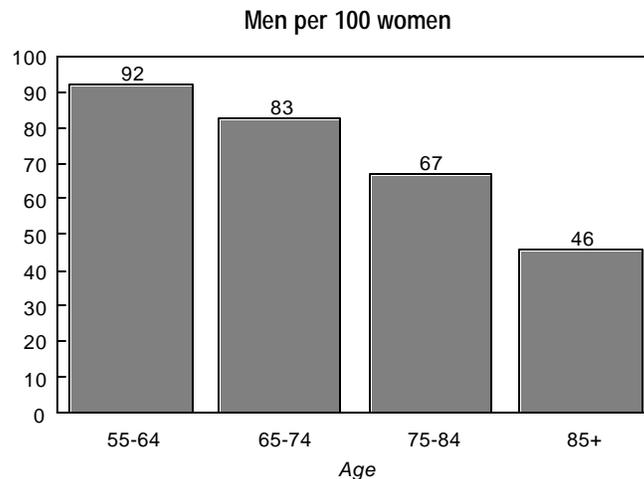
Less diversity among older than younger population

Non-Hispanic Whites accounted for 69 percent of the total population in 2002. This proportion varied greatly with age—66 percent of people under age 55 and 81 percent of those age 55 and over. The percentage of non-Hispanic Whites increased with age: 79 percent for those 55 to 64 versus 87 percent for those 85 and over.

Racial/ethnic composition of population by age

Other ▇ Non-Hispanic White ▨
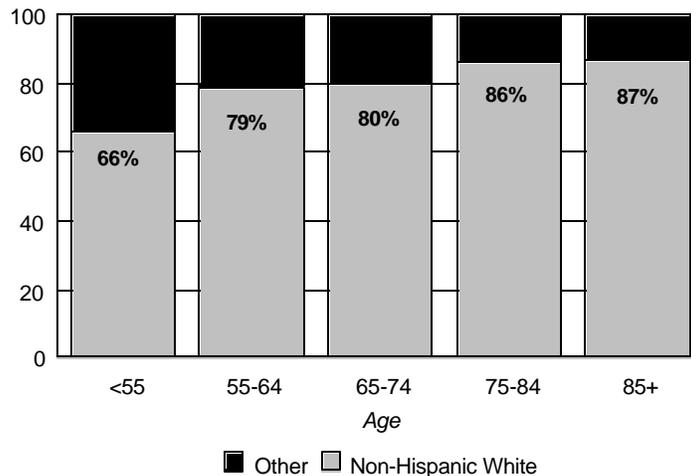
More older men than older women likely to be working

Men age 55 and over were more likely than women to be in the labor force, and that proportion declined with age for both sexes. For men age 55 to 59, 77 percent were in the labor force, compared with 63 percent of their female counterparts. Among people age 65 and over, 18 percent of men and 10 percent of women were in the labor force.

Percentage of older men and women in the labor force, by age
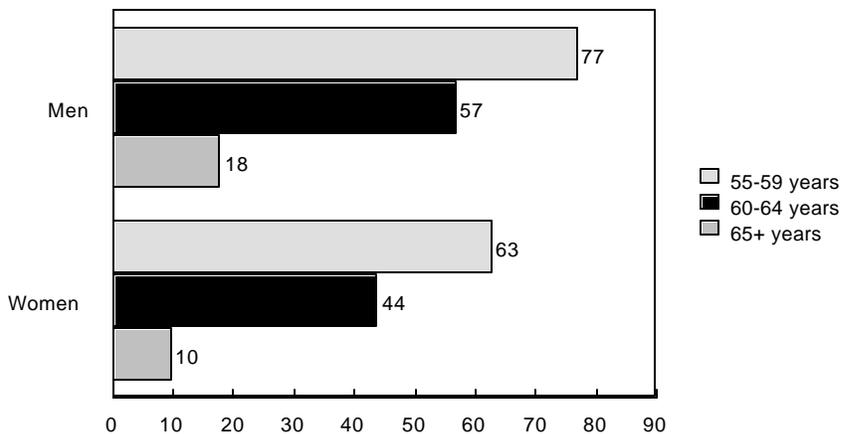
Poverty increases with age for older population

Of the total older population, 9.8 percent were below the poverty level in 2001. The poverty rate was 9.4 percent for those age 55 to 64 and 10.1 percent for those 65 years and over. Older women, in general, had a higher poverty rate than did older men.

Percentage of older population in poverty, overall and by age
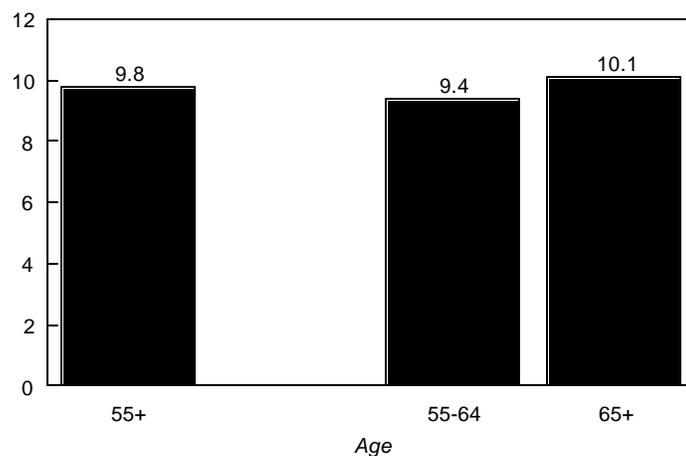
Source: Smith, D. (2003). The Older Population in the United States: March 2002. U.S. Census Bureau Current Population Reports, P20-546. Washington, DC.

School Lunch Program: Efforts Needed to Improve Nutrition and Encourage Healthful Eating

A recent study by the Federal Government's General Accounting Office found that although schools are moving toward meeting school lunch requirements, more improvements are needed. Lunches meet requirements for nutrients such as protein, vitamins, calcium, and iron, but they do not meet the standards for dietary fat. Also, efforts to encourage healthful eating could be increased. Most students have access to foods of little nutritional value, such as soft drinks and candy, at school. Students may need more exposure to nutrition education to make positive changes in behavior. Barriers to providing nutritious meals and encouraging healthful eating included budget pressures and competing time demands. However, schools had taken a variety of innovative steps to overcome barriers.

School lunches contain more vitamin A and C

In 1991-92 and 1998-99, the mean nutrient content of elementary and secondary school lunches met the National School Lunch Program standards for vitamin A (300 mcg RE or more for secondary school lunches) and vitamin C (18 mg or more for secondary school lunches). For both of these vitamins, the mean school lunch content increased over this time. In secondary schools, the mean vitamin A and C content of school lunches increased 24 percent.

Mean vitamin A and C content of secondary school lunches
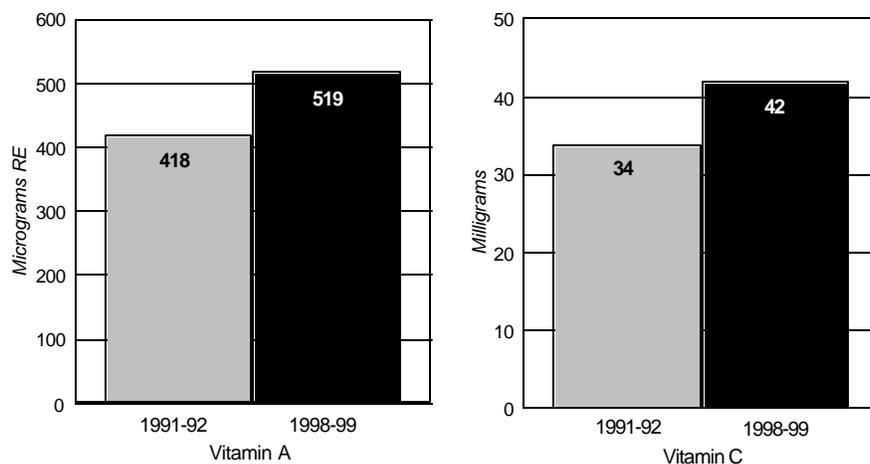
However, school lunches do not meet standards for dietary fat

In 1991-92 and 1998-99, elementary and secondary school lunches did not meet the dietary standards for total and saturated fat: 30 percent or less of calories from total fat and 10 percent or less of calories from saturated fat. School lunches had been moving toward the standards over this time. In secondary schools, the average percentage of calories from total fat in school lunches declined 4 percentage points and from saturated fat, 3 percentage points.

Average total and saturated fat content of secondary school lunches
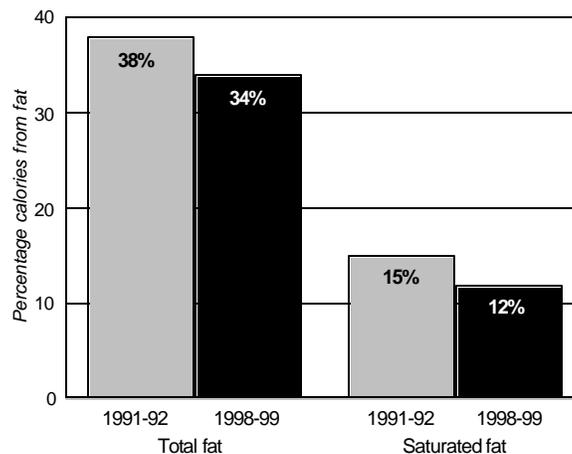
Schools offer a mix of foods in addition to school lunches

Those parts of the school nutrition environment not regulated by the government (e.g., a la carte cafeteria items and food and beverages in vending machines) offered a mix of foods. Although many schools offered lowfat foods (including fruits and vegetables) in these unregulated places, many also offered foods and beverages of limited nutritional value. In 2000, 36 percent of elementary schools served lowfat baked goods a la carte, while 49 percent served baked goods classified as not low in fat.

Percentage of elementary schools offering a la carte lowfat and non-lowfat cookies, crackers, and pastries
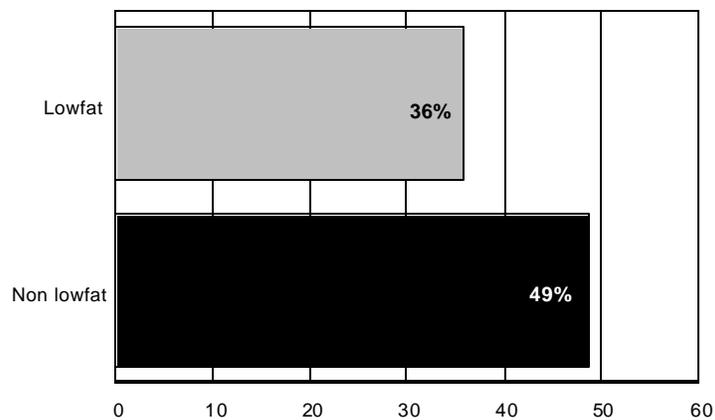
Nutrition education offered a few hours in most elementary schools

Nutrition education is one way to promote good dietary habits among youth. In 1996-97, most kindergarten through fifth-grade teachers presented lessons about nutrition. Although time and intensity of the instruction mattered, the average total amount of time that teachers devoted to nutrition education was 13 hours per school year.

Percentage of elementary school teachers presenting lessons about nutrition
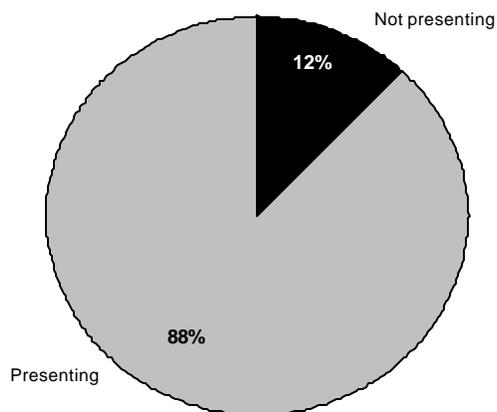
Recent Changes in U.S. Family Finances

There has been a striking pattern of growth in family income and net worth between 1998 and 2001 according to a Federal Reserve Board study, which was based on data from the Survey of Consumer Finances. Generally, inflation-adjusted incomes of families rose; although growth was fastest among families whose income was higher than the median. The median value of family net worth grew faster than that of income, but as with income, the growth rates of net worth were fastest for the group above the median. The level of debt carried by families rose over the period, but the expansion in equities and the increased values of principal residences and other assets were sufficient to reduce debt as a proportion of family assets. For groups with relatively low levels of income and wealth, a concurrent rise in the frequency of late debt payments indicated that their ability to service their debts had deteriorated.

Income growth faster at top and bottom

Between 1998 and 2001, income grew at different rates in different parts of the income distribution between 1998 and 2001, with faster growth at both the top and bottom of the ranges than in the middle. During this period, the median income of all families grew from $36,400 to $39,900 (in 2001 dollars). For families in the lowest 20 percent of the income distribution, income grew from $9,000 to $10,300; for families in the top 10 percent, income grew from $142,200 to $169,600 (in 2001 dollars).

Real income growth (1998-2001), by percentile of income
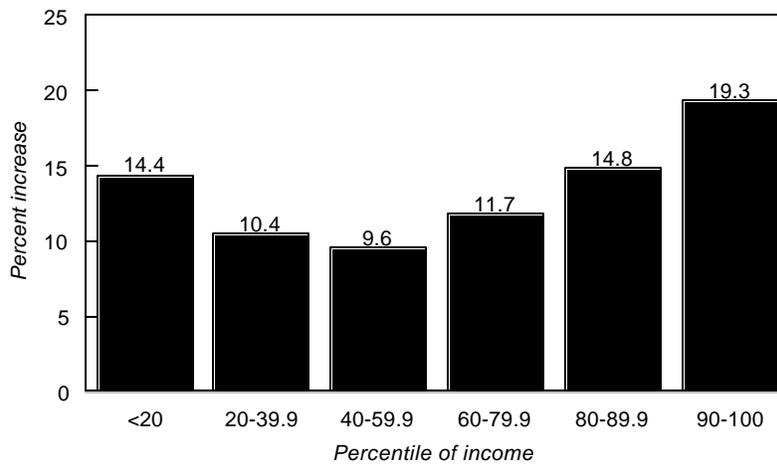
Net worth rises strongly

From 1998 to 2001, families' median net worth (wealth)—the difference between their gross assets and liabilities—rose from $78,000 to $86,100 (a 10.4-percent gain). The net worth of racial and ethnic groups differed substantially. White, non-Hispanics had a higher net worth than did non-Whites or Hispanics ($120,900 vs. $17,100 in 2001). Whereas White, non-Hispanics saw an increase in their net worth over 1998-2001, non-Whites or Hispanics saw a slight decrease.

Family net worth, by race/ethnicity
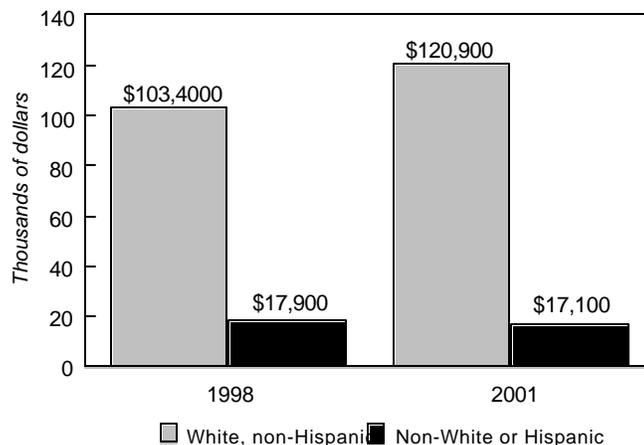
More families own stock

Families may hold stocks in publicly traded companies directly or indirectly, such as through mutual funds or retirement accounts. In 2001, 52 percent of families held stock in some form, 3 percentage points above that in 1998. Over the 3-year period, ownership rates rose for most families, particularly those headed by someone less than age 35.

Percentage of all families and those headed by someone less than age 35 who own stock

□ All families ■ Families headed by <35-year-old
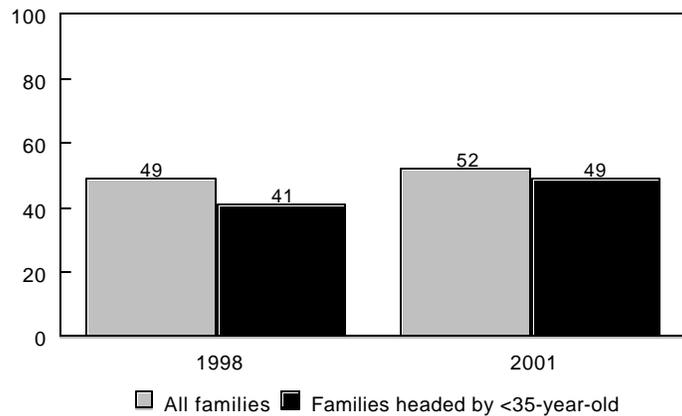
Debt burden declines

The ability of families to service their loans is a function of the level of their loan payments and the income and assets they have available to meet those payments. The greater the ratio of debt payments to family income the greater the burden on families. From 1998 to 2001, the ratio of debt to income declined 1.9 percentage points. This debt burden fell for both homeowners and renters.

Ratio of debt payments to family income, by all families and housing status

□ All families ■ Homeowners □ Renters
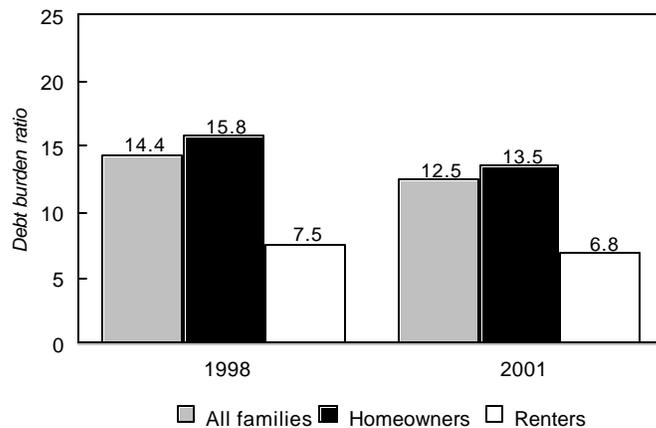
Source: Aizcorbe, A.M., Kennickell, A.B., & Moore, K.B. (2003, January). Recent changes in U.S. family finances: Evidence from the 1998 and 2001 Survey of Consumer Finances. Federal Reserve Bulletin, pp. 1-32.

Consumer Expenditures in 2001

Consumer units spent $39,518 on average in 2001, an increase of 3.9 percent over the previous year. Expenditures rose 2.8 percent in 2000 and 4.1 percent in 1999. The increase in spending in 2001 was more than the 2.8-percent annual average rise in general price levels over the year, as measured by the Consumer Price Index. This report shows the latest results from the Bureau of Labor Statistics Consumer Expenditure Survey. The Survey collects information on the buying habits of American consumers and consists of two components: A Diary or recordkeeping survey completed by participating consumer units for two consecutive 1-week periods; and an Interview survey, in which expenditures of consumer units are obtained in five interviews conducted at 3-month intervals. Results in this report are based on integrated data from both surveys.

Housing is the major expense

Housing accounted for the largest expense by consumer units in 2001, making up 33 percent of total expenditures. Transportation was the second largest at 19 percent of total expenses and food the third, 13 percent of total expenses. Other expenses (e.g., personal care products, education, alcohol and tobacco) comprised 10 percent of total expenditures.

Total expenses ($39,518) of consumer units by budgetary component
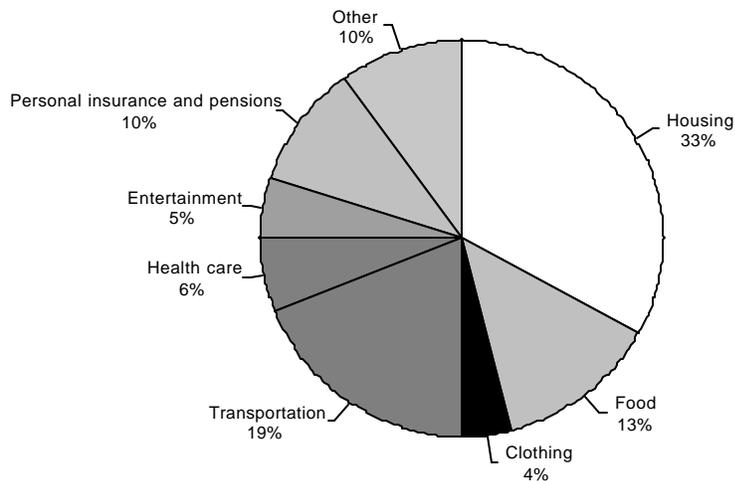
Food away from home a significant share of total food expenses

Food away from home accounted for 42 percent of total food expenses for all consumer units in 2001 ($2,235 out of $5,321). Whereas food at home expenses grew 2.2 percent over the 2000-2001 period, food away from home expenses rose 4.6 percent. Consumer units spent $349 on alcohol in 2001, a 6.2-percent decline from 2000.

Food and alcohol expenses of consumer units
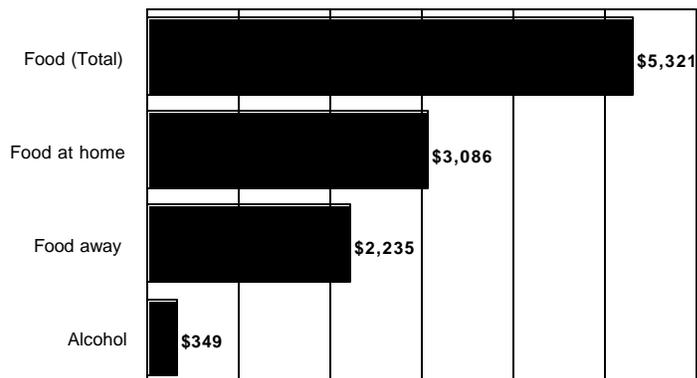
Expenditures vary by age

Expenses of consumer units vary by age of the head. Units headed by a 35- to 44-year-old had total expenses of $46,908, compared with $23,099 for units headed by a 75-year-old and over. Housing accounted for 34 to 35 percent of expenses for both groups. Health care, however, made up 4 percent of expenses for units headed by a 35- to 44-year-old and 15 percent for those headed by a 75-year-old and over.

Total expenses of consumer units by budgetary component, by age of head
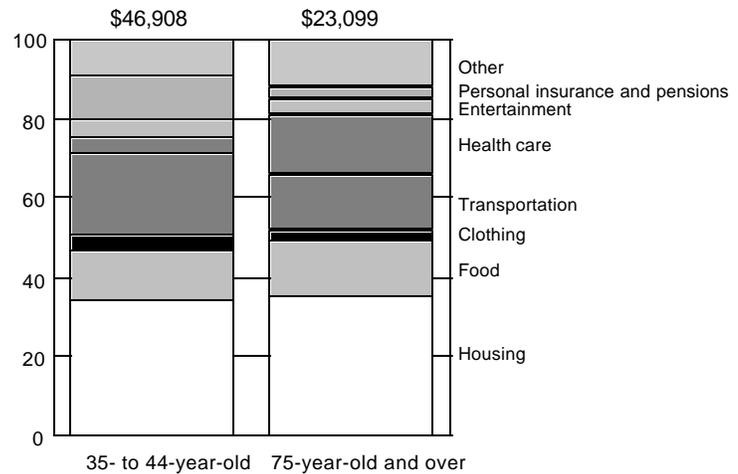
Expenses higher in the West

Consumer units in the West had the highest total expenditure ($43,261) and units in the South the lowest ($36,285). Housing contributed to this regional expense difference, being $15,000 for consumer units in the West and $11,375 for units in the South. Consumer units in the West and South spent similar amounts on health care ($2,129 and $2,194, respectively).

Total expenses of consumer units, by region
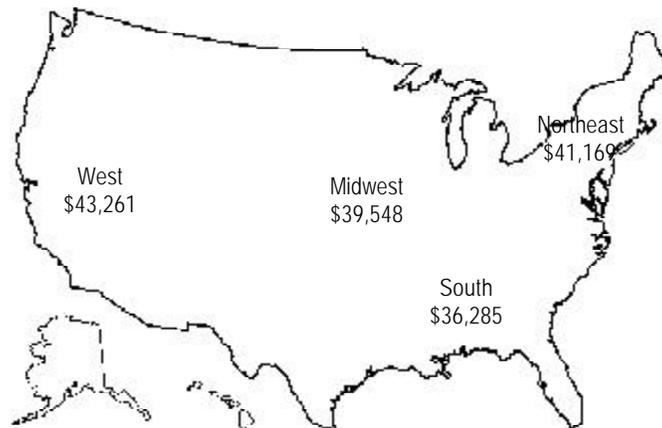
Source: U.S. Department of Labor, Bureau of Labor Statistics. (2003, April). Consumer Expenditures in 2001. Report 966.

Official USDA Food Plans: Cost of Food at Home at Four Levels, U.S. Average, September 2003[1]

AGE-GENDER GROUPS	WEEKLY COST				MONTHLY COST			
	Thrifty plan	Low-cost plan	Moderate-cost plan	Liberal plan	Thrifty plan	Low-cost plan	Moderate-cost plan	Liberal plan
INDIVIDUALS[2]								
CHILD:								
1 year	$17.00	$21.20	$24.80	$30.10	$73.70	$91.90	$107.50	$130.40
2 years	17.00	21.00	24.70	30.10	73.70	91.00	107.00	130.40
3-5 years	18.60	23.10	28.50	34.30	80.60	100.10	123.50	148.60
6-8 years	23.20	30.90	38.20	44.50	100.50	133.90	165.50	192.80
9-11 years	27.30	34.90	44.50	51.70	118.30	151.20	192.80	224.00
MALE:								
12-14 years	28.30	39.40	48.70	57.40	122.60	170.70	211.00	248.70
15-19 years	29.30	40.60	50.60	58.60	127.00	175.90	219.20	253.90
20-50 years	31.30	40.50	50.40	61.30	135.60	175.50	218.40	265.60
51 years and over	28.40	38.60	47.40	57.00	123.10	167.30	205.40	247.00
FEMALE:								
12-19 years	28.30	34.00	41.20	49.80	122.60	147.30	178.50	215.80
20-50 years	28.30	35.30	43.10	55.40	122.60	153.00	186.80	240.00
51 years and over	27.80	34.30	42.70	51.10	120.50	148.60	185.00	221.40
FAMILIES:								
FAMILY OF 2[3]:								
20-50 years	65.60	83.40	102.90	128.40	284.00	361.40	445.70	556.20
51 years and over	61.80	80.20	99.10	118.90	268.00	347.50	429.40	515.20
FAMILY OF 4:								
Couple, 20-50 years and children—								
2 and 3-5 years	95.20	119.90	146.70	181.10	412.50	519.60	635.70	784.60
6-8 and 9-11 years	110.10	141.60	176.20	212.90	477.00	613.60	763.50	922.40

[1]Basis is that all meals and snacks are purchased at stores and prepared at home. For specific foods and quantities of foods in the Thrifty Food Plan, see *Family Economics and Nutrition Review*, Vol. 13, No. 1 (2001), pp. 50-64; for specific foods and quantities of foods in the Low-Cost, Moderate-Cost, and Liberal Plans, see *The Low-Cost, Moderate-Cost, and Liberal Food Plans, 2003 Administrative Report* (2003). All four Food Plans are based on 1989-91 data and are updated to current dollars using the Consumer Price Index for specific food items.

[2]The costs given are for individuals in 4-person families. For individuals in other size families, the following adjustments are suggested: 1-person—add 20 percent; 2-person—add 10 percent; 3-person—add 5 percent; 5- or 6-person—subtract 5 percent; 7- (or more) person—subtract 10 percent.

[3]Ten percent added for family size adjustment.

Consumer Prices

Average percent change for major budgetary components

Group	Annual average percent change from December of previous year to December:			Percent change 12 months ending with September 2003
	1990	1995	2000	
All Items	6.1	2.5	3.4	2.3
Food	5.3	2.1	2.8	2.4
Food at home	5.8	2.0	3.0	2.8
Food away from home	4.5	2.2	2.4	2.0
Housing	4.5	3.0	4.3	2.4
Apparel	5.1	0.1	−1.9	−2.1
Transportation	10.4	1.5	4.3	3.5
Medical care	9.6	3.9	4.2	4.0
Recreation	NA	2.8	1.4	1.4
Education and communication	NA	4.0	1.2	1.3
Other goods and services	7.6	4.3	4.5	1.0

Price per pound for selected food items

Food	Price per pound unless otherwise noted (as of December in each year)			September 2003
	1990	1995	2000	
Flour, white, all purpose	$ .24	$ .24	$ .28	$ .32
Rice, white, long grain, uncooked	.49	.55	NA	.46
Spaghetti and macaroni	.85	.88	.88	.87
Bread, white	.70	.84	.99	.99
Beef, ground, uncooked	1.63	1.40	1.63	2.02
Pork chops, center cut, bone-in	3.32	3.29	3.46	3.09
Chicken, fresh, whole	.86	.94	1.08	1.02
Tuna, light, chunk	2.11	2.00	1.92	1.79
Eggs, grade A, large, per dozen	1.00	1.16	.96	1.26
Butter, salted, grade AA, stick	1.92	1.73	2.80	2.86
Apples, red delicious	.77	.83	.82	1.02
Bananas	.43	.45	.49	.49
Oranges, navel	.56	.64	.62	NA
Potatoes, white	.32	.38	.35	.44
Lettuce, iceberg	.58	.61	.85	.90
Tomatoes, field grown	.86	1.51	1.57	1.44
Broccoli	NA	.76	1.52	1.30
Orange juice, frozen concentrate per 16 oz.	2.02	1.57	1.88	1.90
Sugar, white, 33-80 oz. pkg.	.40	.39	.40	.41
Margarine, stick	.87	.79	NA	1.00
Peanut butter, creamy	2.09	1.78	1.96	1.89
Coffee, 100% ground roast	2.94	3.75	3.21	2.92

NA = Data not available.

Selected items from CPI Detailed Reports, Bureau of Labor Statistics, various issues. Price changes are for all urban consumers. Food prices are U.S. city average.

U.S. Poverty Thresholds and Related Statistics

Poverty Thresholds in 2002, by size of family and number of related children under age 18

Size of family unit	Related children under age 18								
	None	One	Two	Three	Four	Five	Six	Seven	Eight or more
One person									
Under age 65	$9,359								
Age 65 and over	8,628								
Two people									
Householder under age 65	12,047	$12,400							
Householder age 65 and over	10,874	12,353							
Three people	14,072	14,480	$14,494						
Four people	18,556	18,859	18,244	$18,307					
Five people	22,377	22,703	22,007	21,469	$21,141				
Six people	25,738	25,840	25,307	24,797	24,038	$23,588			
Seven people	29,615	29,799	29,162	28,718	27,890	26,924	$25,865		
Eight people	33,121	33,414	32,812	32,285	31,538	30,589	29,601	$29,350	
Nine people or more	39,843	40,036	39,504	39,057	38,323	37,313	36,399	36,173	$34,780

Source: U.S Census Bureau, February 2003.

Poverty rate by region, 2001

West 12.1%

Midwest 9.4%

Northeast 10.7%

South 13.5%
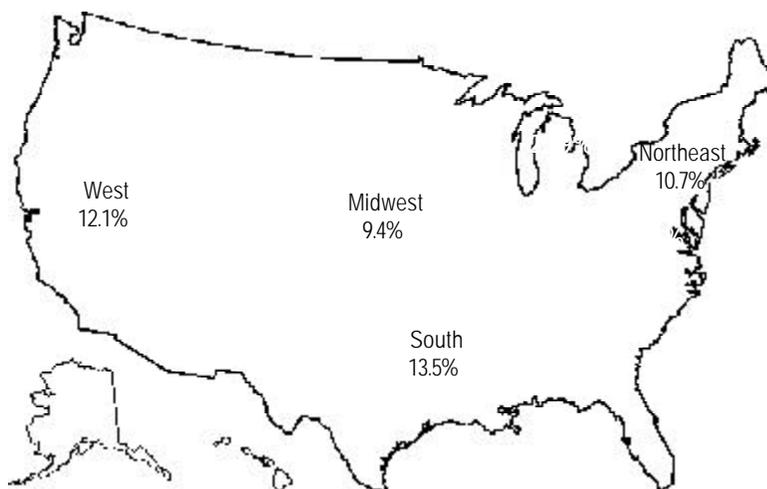
Source: U.S Census Bureau.

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- Interactive Healthy Eating Index
- Nutrient Content of the U.S. Food Supply
- Interactive Food Supply
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- Nutrition Insights
- Web-Based Training
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