Micronutrients and The Older Adult, Part 2: Early Interventions to Prevent Micronutrient Deficiencies

Vijaya Jain, MSc, MS, RD, CDN

ABSTRACT
The ongoing increase in the number of older adults worldwide makes addressing their nutritional needs more challenging. Aging is associated with numerous changes and factors that affect the lives of older adults. The nutritional status of older adults is an important determinant of quality of life, morbidity, and mortality. Although good nutrition and healthy lifestyle habits must start early in life to achieve wellness later in life, dietary modifications are often necessary to adjust to the physical and metabolic changes that occur with age. Appropriate and timely interventions are essential for enabling older adults to achieve these goals.

INTRODUCTION
Older adults constitute the fastest-growing population segment worldwide. In the United States, the population segment of those aged 65 and older reached 43.1 million in 2012, and it is projected to increase to 79.7 million by 2040.1 The process of aging is characterized by diminished functionality of organ systems, changes in body composition, and weakened homeostatic controls; all of which are influenced by genetic and environmental factors. Aging is also associated with physiological and economical changes that compromise nutritional status. Additionally, the aging population is diverse, exhibiting large ranges in age, activity level, fitness, dependency, and frailty. While today’s older adults have an increased life expectancy of approximately 30 years relative to that of previous generations,2 many continue to be affected by chronic health and medical conditions such as undernutrition, heart disease, hypertension, and dementia.3 These conditions all impact the micronutrient status of older adults, resulting in deficiencies of vitamins and minerals.4 The age-related changes in adults’ nutritional needs are well documented.5,6 The food intake of older adults tends to decrease with advancing age to compensate for the diminished energy needs associated with lower energy expended in physical activity and basal metabolic rate.7 The need for micronutrients, however, remains constant or increases. Thus, it is particularly challenging for older adults to maintain optimal nutritional status, health, and well-being.

Access to food is a basic human right and a necessity. However, 8.1% of households with older adults are reported to have food insecurity.8 Micronutrient deficiencies continue to be a major health problem for older adults in many developing countries lacking health and nutrition supplementation programs available to Americans. Adequate access and availability of nutrient-dense foods, paired with a varied diet, is essential for older adults to lead healthy lives. In fact, a general consensus already exists in support of the concept that a healthy dietary pattern, including foods that provide micronutrients in adequate amounts, supports the health and survival of older adults. In light of the importance of providing adequate nutrition care to older adults, it is the position of the Acad-

Editor’s note: The Spectrum is pleased to present the second installment of this two-part series about the micronutrient needs of older adults. The Healthy Aging DPG and the Women’s Health DPG worked closely with author Vijaya Jain (MSc, MS, RD, CDN) to make this series relevant to the needs of both our memberships. Special thanks to the editorial teams of Women’s Health Report and The Spectrum for their invaluable guidance and hard work.

— Robin Dahm, RDN, LDN
Editor in Chief, The Spectrum
Micronutrients
Continued from page 1

emy of Nutrition and Dietetics that all Americans aged 60 years and older receive appropriate nutrition care; have access to coordinated, comprehensive food and nutrition services; and receive the benefits of ongoing research to identify the most-effective food and nutrition programs, interventions, and therapies.9

Micronutrients of importance to older adults, their requirements, deficiencies, sources, and nutritional status in older adults has been described in the first article of this two-part series: “Micronutrients and the Older Adult, Part 1: Micronutrients of Importance to Older Adults.” Part 2 of this series discusses appropriate interventions to reduce micronutrient deficiencies during the aging process.

STRATEGIES TO REDUCE THE INCIDENCE OF MICRONUTRIENT DEFICIENCIES

The numerous changes associated with the normal aging process increase nutritional risks for older adults. An older adult’s nutritional needs are determined by multiple factors, including specific health problems and related organ-system compromise, activity level, energy expenditure, and caloric requirements; the ability to access, prepare, ingest and digest foods; and personal food preferences. Strategies to reduce the impact of these age-related changes are discussed below.

Sarcopenia

Sarcopenia, a reduction in muscle mass and function, not only results in decreased functional ability and strength,10,11 but also has an impact on a person’s ability to chew food properly (particularly in frail older people), thus limiting their food choices and contributing to an inadequate and poor-quality dietary intake.12 While a decreased dietary intake of protein leading to sarcopenia is well documented, literature examining the influence of non-protein nutrients on sarcopenia is less common. Carotenoids are reported to have a possible protective effect against oxidative stress, and subsequently sarcopenia.13 In Canadian adults aged 60 to 75 years, the odds for sarcopenia were greater in those who reported failing to meet recommended dietary allowances for the antioxidants selenium and vitamins A, C, and E.14 In the Women’s Health and Aging Study (WHAS) of nearly 700 community-dwelling women aged 70 to 79 years, a high plasma carotenoid and α-tocopherol (a form of vitamin E) status were associated with reduced odds for low muscle strength15 and frailty.16 Diets high in fruits and vegetables may be beneficial due to increased potassium intake, which may reduce metabolic acidosis. Magnesium may also be preventative in limiting skeletal muscle decline by contributing to adenosine triphosphate and cell structure. Additionally, vitamin D may play an important role in the maintenance of muscle function for older adults.10

Chronic Illness and Disease

Increasing levels of chronic illness and disease can lead to and exacerbate poor nutritional status. The presence of chronic illness and disability increases with age. Most older adults have one or more chronic diseases, with 85% having at least one chronic disease affecting the absorption, transport, metabolism, and excretion of nutrients.4,17 For many older adults, this will result in a reduced ability to complete normal activities of daily living, and it is more of a problem particularly for those living alone or with a disabled or ill partner. Promoting a healthy diet and lifestyle among older adults is the optimal approach for the prevention and incidence reduction of chronic diseases.

Mental Health

Mental health problems are common in the aging population. They include depression, anxiety, dementia, cognitive decline, and alcohol/substance abuse. Some of the symptoms (such as apathy, anorexia, and refusal of food and fluid) can cause a deteriorated nutritional status and micronutrient deficiencies in older adults. Identifying mental health problems and helping older adults get connected with necessary medical and counseling services are effective strategies.

Anorexia of Aging

Anorexia of aging, defined as loss of appetite and/or reduced food intake, affects a significant number of older adults. It is more prevalent among frail elderly individuals, especially among nursing-home residents and hospitalized patients, increasing the risk for undernutrition and micronutrient deficiencies. The main strategy is to optimize nutritional status by including small, frequent, nutrient-dense meals. Oral nutrition supplements are a good intervention for older adults who are unable to obtain their nutrient needs with meals and snacks, and the use of megasterol acetate (an appetite stimulant that may promote weight gain) may also be helpful.4

Smell and Taste Disorders

Changes in smell and taste occur as a natural part of the aging process, but age-related loss in taste sensitivity is most common in older adults on prescribed medications.19 Changes in flavor perception begin to diminish around 50 years of age, with the sense of taste continuing to decline with the passage of time. In addition, olfaction (the sense of smell) declines with age, with more than 70% of adults over the age of...
80 years having a major olfaction impairment. Some of the reasons for decline in olfaction are gradual losses of the nasal nerve cells that detect aromas, hormonal changes, a decline in nerve signals to the brain, and reduced mucous production in the nose. Losing the sense of smell may impact a person’s enjoyment of food, leading to a reduced food intake and therefore a decreased nutrient intake. Taste disorders (including loss of taste) are more common among older adults with chronic conditions who are consequently taking multiple medications; this polypharmacy often leads to loss of appetite, changes in body physiology and malnutrition. A declined ability to detect sour taste can lead to a failure to recognize unripe or spoiled foods. Adding appropriate spices and herbs can enhance a food’s flavor, increasing its appeal to an older palate. Similarly, improving the visual presentation by incorporating bright colors, a variety of shapes, and suitable textures can help increase intake as well.

Impaired Vision
Impaired vision can result from age-related eye changes or from diseases that affect the eyes, such as cataracts, glaucoma, diabetes, or macular degeneration. Loss of visual acuity may lead to less physical activity or a fear of cooking, especially of using the stove. Inability to read food prices, nutrition labels, or recipes may affect the ability to grocery shop, prepare food, and eat. Research has concluded that people with a higher intake of green, leafy vegetables and foods that contain antioxidants (including carotenoids but not vitamin E) are associated with a reduced risk for macular degeneration. The National Eye Institute’s Age-Related Eye Disease Study (AREDS) found that taking a specific high-dose formulation of antioxidants and zinc (beta-carotene; vitamins A, C, and E; copper; and zinc) significantly reduces the risk of advanced age-related macular degeneration and its associated vision loss. However, later studies reported inconclusive findings. Older adults who need assistance with performing daily activities such as cooking, shopping, and reading instructions must be provided with the necessary help by family members and caregivers, and/or get connected with community support services.

Oral Health Problems
Oral health problems may limit food choices, diminish the pleasure of eating, and impair the ability to bite and chew foods. These problems can negatively affect the nutritional and health status of the aging population. Older adults who have missing teeth, gum problems, or wear dentures usually avoid eating foods such as raw vegetables, whole fruits, and meats. Foods most commonly avoided by older adults are whole apples, whole nuts, raw carrots, and grilled or fried meats. A decrease in dietary intake due to oral health problems reduces the variety of foods available, which can lead to weight loss and deficiencies of essential micronutrients in older adults. Modifying the texture and consistency of foods by chopping, grinding, pureeing, or blending foods may help older adults who have chewing or swallowing problems. These modifications must provide the same nutritive value of solid foods and can be just as tasty and appealing. Foods modified into a thickened liquid are often required for older adults with dysphagia. Older adults and their family members must seek the guidance and advice of a registered dietitian nutritionist, speech therapist (for patients with dysphagia), and/or an occupational therapist for the planning and preparation of special meals and foods. For more information about oral health and older adults, see “The Relationship Between Oral Health, Nutritional Status, and Food Intake in Older Adults” in the fall 2014 edition of The Spectrum.

Table 1 lists the micronutrients impacted by changes during the process of aging.

<table>
<thead>
<tr>
<th>Changes in Body Physiology and Functions</th>
<th>Impact on Micronutrient Need</th>
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<tbody>
<tr>
<td>Decreased bone density</td>
<td>Increased need for calcium, vitamin D</td>
</tr>
<tr>
<td>Decreased immune function</td>
<td>Increased need for vitamin B6, vitamin E, zinc</td>
</tr>
<tr>
<td>Increased gastric pH</td>
<td>Increased need for vitamin B12, folic acid, calcium, iron, zinc</td>
</tr>
<tr>
<td>Decreased calcium bioavailability</td>
<td>Increased need for calcium, vitamin D</td>
</tr>
<tr>
<td>Decreased hepatic uptake of retinol</td>
<td>Decreased need for vitamin A</td>
</tr>
<tr>
<td>Increased levels of homocysteine</td>
<td>Increased need for folate, vitamin B6, vitamin B12</td>
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<tr>
<td>Increased oxidative stress</td>
<td>Increased need for vitamin C, beta-carotene, vitamin E</td>
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continued on page 4
Food Insecurity

Food insecurity has a significant impact on the nutritional status of older adults in the United States. It is the position of the Academy of Nutrition and Dietetics that systematic and sustained action is needed to achieve food and nutrition security for all Americans.\(^{31}\) Older adults experiencing food insecurity have lower intakes of micronutrients and calories in spite of age-related, normal reductions in caloric needs; more health problems; and functional limitations related to loss of independence.\(^{35}\)

Data analyzed from NHANES III and the Nutrition Survey of the Elderly in New York State in 1994 showed that food-insecure older-adults had significantly lower intakes of macronutrients, and the micronutrients niacin, riboflavin, vitamins B\(_6\), and B\(_{12}\); magnesium, iron, and zinc.\(^{33,34}\) Older adults who are identified as being food-insecure must be referred to nutrition assistance programs and other support services to help reduce malnutrition and micronutrient deficiencies.

Medications

Impact of medications on food intake and nutritional status is common among older adults, as they are more likely to be taking more prescription medications than are younger adults. Polypharmacy, unnecessary and/or excessive use of both prescribed and over-the-counter medications, is a common problem among older adults. Over-the-counter and prescribed medications can potentially cause side effects that can impact dietary intake and the nutrient status of older adults. These side effects include altered sense of taste and smell, fatigue, diarrhea, and other symptoms. A number of medications also interact with food and result in a reduced absorption of nutrients, and can have an adverse effect on the nutritional status of older adults. Care providers of older adults must be aware of these interactions and monitor the intake of medications by older adults. Another critical part of intervention for older adults is frequent, thorough reviews of all medications with discontinuation of nonessential therapies.

DIETARY PATTERNS AND MICRONUTRIENT INTAKE OF OLDER ADULTS

Numerous studies have been conducted to determine the dietary patterns and nutrient intakes of older adults. Data from 1999–2000 intakes of many micronutrients by older adults in the United States suggest that older Americans may be deficient, either marginally or more severely, in a few micronutrients due to low intake.\(^{36}\) Older Americans who take multivitamin and mineral supplements have considerably higher circulating levels of practically all micronutrients compared to non-users.\(^{37}\) Older adults from low-income households eating convenient, nutrient-sparse foods have higher energy and lower nutrient intakes.\(^{38}\) Several studies indicate that although older adults consume more fruits and vegetables (excellent sources of vitamins and minerals) than do younger adults, only 21–26% of men and 29–37% of women ages 65 and over actually met the recommended number of servings per day.\(^{39–42}\) Healthy lifestyle factors, such as being physically active, not smoking, and using vitamin/mineral supplements is strongly associated with more frequent consumption of fruits and vegetables.\(^{43}\)

OTHER INTERVENTIONS TO PREVENT MICRONUTRIENT DEPLETION IN OLDER ADULTS

Many older adults do not obtain sufficient amounts of micronutrients.\(^{44-45}\)

Nationwide surveys have shown that a large percentage of older adults do not meet their nutrient needs from their daily food intakes and need other options that help bridge the nutrition gap.\(^{46}\) Multinutrient supplements and/or oral supplements are often necessary to improve the nutritional status of older adults, especially during illness or after surgery.

Oral Nutrition Supplements

Older adults unable to obtain adequate nutrition from consuming a regular diet often need commercially prepared oral supplements (liquid, pudding, and/or powder) to bridge the nutrient gap. Oral supplements are usually formulated to provide an array of micronutrients along with the macronutrients and calories to meet the nutritional needs of older adults experiencing or recovering from illness, surgery, unintentional weight loss, cancer, and other medical conditions. A variety of supplements is available, including those formulated

Continued on page 5
Micronutrients
Continued from page 4

for specific conditions such as chronic obstructive pulmonary disease, diabetes, renal disease, and other medical conditions. A liquid nutrition supplement can be thin, moderately thick (a milkshake), or very thick (a pudding). Powdered supplements are designed to be mixed into liquid or solid foods such as soups, juices, and puddings. These supplements are not designed to replace meals; they should be included in between meals and as snacks to increase nutrient intake, improve dietary compliance, and avoid satiety that would result in poor intake during mealtimes.

Vitamin/Mineral Supplementation

Inadequate micronutrient intake among older adults is common despite the increased availability of fortified foods in the American diet. Dietary sensitivities such as lactose intolerance, food preferences, and other factors previously discussed necessitate the need for dietary supplements to obtain the needed micronutrients. Micronutrient deficiencies have been reported in nursing-home populations, and it has been suggested that all institutionalized older adults receive a multivitamin supplement for general nutritional prophylaxis. When considering the addition of vitamin/mineral supplements for older adults, it is important to make sure that the chosen supplement does not exceed the upper limits of recommended allowances. It is vital that caretakers and health professionals review toxicity side effects from excess intakes of all fat-soluble vitamins.

Supplementation can improve micronutrient status in healthy older adults to levels above those obtained with a fortified diet alone. This improvement in micronutrient status is helpful in reducing the risk for chronic diseases and current nutritional deficiencies among older adults. Specific nutrients of concern include calcium, zinc, iron, and B-vitamins. Vitamin A

Vitamin A requirements for older adults are reduced because of compromised hepatic function. Large doses of vitamin A consumed over a long period of time can overwhelm the liver’s capacity to store vitamin A, eventually leading to liver disease. Sebastian et al. reported that 25% of older adults studied had inadequate intakes of vitamin A from foods alone; however, 5%–9% of women exceeded the upper limits for vitamin A from both foods and dietary supplements. As part of intervention efforts, older adults should be encouraged to consume at least one serving daily of a carotenoid-rich food, and avoid taking multivitamin supplements that provide vitamin A solely as a pre-formed compound; a safer alternative is to provide a portion as beta-carotene or as mixed carotenoids.

Vitamin C

Many older adults take a vitamin C supplement in conjunction with a daily multivitamin supplement in the belief that the additional dose of vitamin C will prevent colds and reduce the risk of infections. The additional vitamin C supplementation has not been shown to be effective in clinical trials. It is recommended that older adults include foods rich in vitamin C to best meet their requirements for this vitamin. Foods rich in vitamin C are a superior choice over vitamin C supplements, as whole foods provide additional nutrients, calories, and possibly fiber. Caretakers and health professionals should encourage older adults to include several servings of fruits and vegetables in their daily diet to meet their daily vitamin C needs.

Vitamin B12

Vitamin B12 deficiency affects 30% of older adults over 60 years of age. Many older adults are unable to consume animal proteins (the main source of dietary B12) because of poor dentition, the high cost of animal protein foods, or dysphagia. Since the synthetic vitamin B12 added to fortified foods is more easily absorbed and may be the best source of this micronutrient, both the Institute of Medicine and the National Institutes of Health Office of Dietary Supplements recommend that older adults be encouraged to consume B12-fortified foods.

Folic Acid

Folic acid (also known as folate or folacin) is rarely found naturally in foods and is typically used in vitamin supplements and fortified foods. Folate levels among older adults have improved since 1998, when the Food and Drug Administration (FDA) mandated folate fortification of breakfast cereals and other grain products. Folate and vitamin B12 status should be assessed in older adults with or suspected of having depression, and also among those using medications such as histamine-2 blockers, proton-pump inhibitors, and antibiotics. Multivitamin/mineral supplementation can improve B-vitamin status and reduce plasma homocysteine concentration in older adults already consuming a folate-fortified diet.

Vitamin D

Vitamin D insufficiency is now widely recognized as a global epidemic, especially among older adults. Given the current increase in recommendations to 20 micrograms per day, especially for older adults over age 70, dietary sources of vitamin D alone may not be adequate; supplements providing vitamin D and vitamin D3 are recommended. Encouraging older adults to increase physical activity and exposure to sunlight is also important. Vitamin D toxicity, which occurs from excessive consumption of supplements, results in hypercalcemia, loss of bone mass, and loss of appetite. (Part 1 of this two-part series discusses vitamin D in detail.) Caretakers must monitor their patients’ intakes of vitamin D supplements and have their vitamin D levels checked regularly.

Calcium

An older adult’s calcium availability typically decreases with age. Vitamin D absorption decreases as part of the aging process, and a reduced production of skin cholecalciferol means that the skin cannot produce as much vitamin D from
Micronutrients
Continued from page 5

sunlight exposure. For optimal health, the Institute of Medicine’s recommended calcium intake for adults 51 years of age and older is 1,200 mg/day, with the maximal dose of elemental calcium not to exceed 500 mg at any time.53 The most effective form of calcium is calcium carbonate, as it is well absorbed and tolerated by most people when consumed with a meal. However, calcium citrate is the preferred form to be used for older adults with intestinal problems, such as achlorhydria or inflammatory bowel disease. Supplementation of both calcium and vitamin D can help reduce fractures in older adults. Adequate nutrition and regular participation in physical activity are important interventional factors in achieving and maintaining optimal bone mass.

Magnesium
Magnesium along with calcium and vitamin D is essential for maintaining bone health. A few studies have assessed the impact of supplemental magnesium on bone metabolism. Improvements in bone mineral density were noted in osteoporotic postmenopausal women who received magnesium supplementation.54,55

Sodium
Sodium is usually consumed in excess of what is needed by older adults. Reduction of dietary sodium reduces hypertension and the risk of cardiovascular disease, congestive heart failure, and kidney disease. Salt added at the table and in cooking provides only a small proportion of the total sodium intake. Most dietary sodium actually comes from the consumption of restaurant foods and processed foods, since salt is added during food processing. More than 40 percent of sodium intake comes from the following ten types of foods: breads and rolls; cold cuts and cured meats; pizza; fresh and processed poultry; soups; sandwiches such as cheeseburgers; cheese; pasta mixed dishes (not including macaroni and cheese); mixed-meat dishes such as meatloaf with tomato sauce; and snacks such as chips, pretzels, and popcorn.54 This is a concern since the food choices for many older adults include soft and easy-to-eat foods such as rolls and soups. Additionally, the Dietary Approaches to Stop Hypertension (the DASH diet) is a healthy alternate for many older adults who need to reduce their blood pressure, as it is rich in potassium, magnesium, and calcium, with a few other restrictions.57 However, low-sodium diets are often not well tolerated by older adults, especially by frail elderly adults, and may lead to hyponatremia, loss of appetite, and confusion. Decreases in dietary intakes resulting from the intake of a low-sodium diet may lead to deteriorated nutritional status, weight loss, and other medical complications. The 2002 position paper of the Academy of Nutrition and Dietetics states that the quality of life and nutrition status of older residents in long-term-care facilities may be enhanced by a liberalized diet.58 Older adults must be encouraged to read food labels for information about foods’ sodium content, reduce their consumption of processed foods, use less salt in cooking, add flavoring with spices, and increase their intake of fresh foods and home-cooked meals. Additionally, older adults receiving foods from Meals on Wheels or another nutrition program must select low-sodium meals if they are hypertensive or need to reduce dietary sodium because of other medical conditions.

Iron
Iron requirements for women decrease slightly after menopause. Although somatic iron stores are thought to increase with age, absorption of iron from foods is impaired in older adults with atrophic gastritis. Oral iron supplementation is effective for the treatment of iron-deficiency anemia, and can replenish total iron body stores after a few months of therapy. Iron is available in several forms, of which ferrous sulfate is the most commonly used form. Ferrous iron is best absorbed in an acidic environment; hence vitamin C is often added to iron supplements to enhance the absorption of iron. Consumption of iron-rich foods must also be encouraged among older adults.

Zinc
Zinc adequacy is important among older adults to prevent or reduce infections, and for wound healing. Zinc supplementation reduced the frequency of infections among older adults.59 Zinc has also been identified as a factor in the development of age-related macular degeneration (AMD). As mentioned earlier, zinc supplementation in combination with antioxidant vitamins reduced the incidence of AMD.24 The zinc Estimated Average Requirement (EAR) for males over 50 years is 11 milligrams per day, and for females over 50 years the EAR is 8 milligrams per day. The best way to obtain adequate zinc in the diet is to eat a wide variety of foods.

IMPROVING DIETARY INTAKE
Improving dietary intake is one of the most optimal interventions for promoting health, preventing diseases, reducing the risks for chronic conditions, and preventing micronutrient deficiencies. Several organizations including the Academy of Nutrition and Dietetics, U.S. Department of Agriculture (USDA), National Cancer Institute, and American Heart Association all promote common guidelines to achieve goals to increase lifespan and improve life quality. The Dietary Guidelines for Americans, 201060 outlines the basic strategies for healthy living and also encourages older adults to include foods fortified with vitamin B12.

NUTRITION EDUCATION
Nutrition education can be a successful intervention when the methods and messages are targeted and simple.61 Nutrition education must be offered to older adults in familiar venues with easy access.

Nutrition Screening and Assessments
Older adults typically have one or more chronic health conditions that

Continued on page 7
can affect their dietary intakes and micronutrient statuses. It is recommended that nutrition screening be a mandatory part of the geriatric health screening process. Additionally, pertinent assessments for possible deficiencies of select micronutrients (namely vitamins D, B₁₂, B₉; and the minerals calcium, iron, and zinc) must also be included as an intervention in the screening process.

Medical Nutrition Therapy (MNT)
Providing MNT to older adults by registered dietitian nutritionists is a very cost-effective and result-oriented intervention. MNT includes conducting a nutrition assessment; establishing a nutrition diagnosis; and selecting appropriate nutritional interventions, counseling, and management of nutrition therapy for older adults. MNT can be provided in home settings, as part of residential health care, and in assisted-living facilities. MNT interventions enable older adults to make necessary dietary modifications, manage the treatment of chronic diseases, and reduce malnutrition and micronutrient deficiencies.

Several models used for transitional care and ongoing community care for older adults are effective interventions as part of the total care for older adults. Table 2 describes some of these models and the services offered, and includes the roles of nutrition professionals.

Older Americans Act Nutrition Programs (OAA)
OAA is the largest community nutrition services program for older adults administered by the Administration on Aging of the U.S. Department of Health and Human Services, through Title III-C. These programs include congregate meals, Meals on Wheels (which provides home-delivered meals), nutrition screening and nutrition education, and other services. This program serves as an excellent intervention service for older adults, as the meals provide at least one-third of the Dietary Reference Intakes for older adults, thus reducing the gap for nutritional deficiencies that might otherwise occur. Other programs such as SNAP and the Senior Farmers’ Market Nutrition Program enable older adults to purchase fruits, vegetables, and other healthy foods that provide necessary micronutrients and boost the nutritional status of their meals.

Although nutrition education is recommended in most federal food and nutrition programs for older adults, it is not routinely provided. The OAA programs reach fewer than 5% of all older Americans, but the Supplemental Nutrition Program for Women, Infants, and Children (WIC)
<table>
<thead>
<tr>
<th>Program</th>
<th>Purpose</th>
<th>Appropriation</th>
<th>Target Population</th>
<th>Services</th>
<th>Participation</th>
<th>Eligibility</th>
<th>Eligible Older Adults Served</th>
</tr>
</thead>
<tbody>
<tr>
<td>Older Americans Act Titles I–VII</td>
<td>Grants to state, tribal and community programs (e.g., research; demonstration projects)</td>
<td>$1.49 billion total Fiscal year (FY) 2009</td>
<td>Age ≥60 y in greatest economic and/or social need, with particular attention to low-income minorities, those in rural areas, those with limited English proficiency</td>
<td>Nutrition, array of other supportive and health services; protection of vulnerable older Americans</td>
<td>9.5 million older adults FY 2006</td>
<td>Age is sole requirement (see also Target population column)</td>
<td>18.5%</td>
</tr>
<tr>
<td>Older Americans Act Titles I–VII</td>
<td>Nutrition services to older adults</td>
<td>$649 million FY 2009</td>
<td>Age ≥60 y; age ≥60 y and disabled living in elderly housing, disabled living at home and eating at congregate sites or receive home-delivered meals with older adults, volunteers during meal hours</td>
<td>Congregate and home-delivered meals; nutrition screening, assessment, education, counseling</td>
<td>2.6 million older adults; 236 million meals FY 2007</td>
<td>Same as above but only homebound eligible for home-delivered meals</td>
<td>5.1% of all eligible older adults</td>
</tr>
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<td>Older Americans Act Titles I–VII</td>
<td>Tribal and native organizations for aging programs and services</td>
<td>$36 million FY 2009</td>
<td>Age requirement determined by Tribal organizations or Native Hawaiian Program</td>
<td>Congregate and home-delivered meals; nutrition screening, education, counseling; array of other supportive and health services</td>
<td>70,000 older adults; 4 million meals FY 2006</td>
<td>Age is sole requirement</td>
<td>Not available</td>
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<tr>
<td>Nutrition Services Incentive Program</td>
<td>Provides proportional share to states and tribes of annual appropriation based on number of meals served prior year</td>
<td>$161 million FY 2009</td>
<td>Same as Title III</td>
<td>Cash and/or commodities to supplement meals</td>
<td>Same as Title III</td>
<td>Not available</td>
<td></td>
</tr>
<tr>
<td>US Department of Agriculture—Food and Nutrition Service</td>
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<tr>
<td>Supplemental Nutrition Assistance Program</td>
<td>Assists low income families to buy food that is nutritionally adequate</td>
<td>$40 billion FY 2008</td>
<td>US citizens and legal residents who are most in need; gross income ≤130% federal poverty level; up to $2,000 countable resources, $3,000 if age 60+ y or disabled</td>
<td>Coupons or electronic benefits to purchase breads, cereals, fruits, vegetables, meats, fish, poultry, dairy products; seeds and plants that produce food for households</td>
<td>28.4 million (47%) 51% children 41% adults 8% age ≥60 y FY 2008</td>
<td>≤130% of the federal poverty guidelines</td>
<td>30% of eligible older adults participate; 75% of these live alone, 8% of all Supplemental Nutrition Assistance Program participants are older adults</td>
</tr>
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<td>Commodity Supplemental Food Program</td>
<td>Food and administrative funds to states and tribes to supplement diets. Available in 33 states and two tribes</td>
<td>$140 million FY 2008</td>
<td>Pregnant and breastfeeding women, mothers up to 1-y postpartum, infants, children up of age 6 y</td>
<td>Participants receive a monthly food package</td>
<td>466,180 433,000 older adults 33,000 women, infants, children 92% of those are age 60 y and older</td>
<td>≤130% federal poverty guidelines</td>
<td>Not available</td>
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<tr>
<td>Seniors’ Farmers Market Nutrition Program</td>
<td>Grants to states and tribes to provide fresh foods and nutrition services while providing the opportunity for farmers to enhance their business</td>
<td>$20 million FY 2008</td>
<td>Low income older adults: at least aged 60 y and who have household incomes of not more than 185% federal poverty</td>
<td>Coupons or vouchers to be exchanged for fresh fruits and vegetables at local farmers markets</td>
<td>46 agencies FY 2006 825, 691 older adults FY 2006</td>
<td>≤185% federal poverty guidelines</td>
<td>Not available</td>
</tr>
<tr>
<td>Child and Adult Care Food Program</td>
<td>Healthy, nutritious meals for children and adults in day centers</td>
<td>$2.4 billion FY 2008</td>
<td>Children &lt;12 y; homeless children, migrant children &lt;15 y; Disabled citizens regardless of age. Age ≥60 y; functionally impaired; reside with family members</td>
<td>Nutritional meals and snacks</td>
<td>1.9 billion meals FY 2008 2.9 million children 86,000 older adults FY 2007</td>
<td>≤185% federal poverty guidelines</td>
<td>Not available</td>
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</tbody>
</table>
serves more than 60% of needy women, infants, and children. The success of the WIC program has been attributed to its strong emphasis on targeted and effective nutrition education, the provision of nutritious foods as prescribed by trained nutritionists, cost-effectiveness, and the provision of necessary resources and support to the participants. Adequate funding and resources are essential for increasing older adults’ participation in senior nutrition programs. These include extensive outreach efforts, referral systems, educational programs, and effective program management.

Table 3 includes a summary of federal food and nutrition assistance programs for older adults.

Food Fortification and Enrichment
Over the years, specific micronutrients have been added to foods and beverages around the world as public-health measures, and as cost-effective ways of reducing proven micronutrient deficiencies and ensuring the nutritional quality of the food supply. Among the best examples of these interventions are the addition of vitamin D to milk to prevent rickets, iodization of salt to prevent goiter, and fluoridation of water to prevent dental caries. In other intervention measures, multiple micronutrients are added to foods such as cereals to improve micronutrient intake and prevent deficiencies. Older adults must be encouraged to consume some of these fortified and enriched foods to reduce and prevent micronutrient deficiencies.

Biofortification
Biofortification is a newer technology that combines the best traditional breeding practices and modern technology to enable the delivery of micronutrients via micronutrient-dense crops. Biofortification is a cost-effective way of using cutting-edge plant-breeding methods and genetic modifications to deliver adequate micronutrient levels inside the edible parts of crops. Efforts to produce and accumulate carotenoids, iron, zinc, and other micronutrients in staple foods such as rice, cassava, and even some fruits and vegetables are underway in Africa and Asia. Biofortification may offer cost-effective and sustainable solutions to reduce micronutrient deficiencies.

SUMMARY

While good nutrition is a key factor at every stage of life for maintaining good health and personal productivity, it is especially important for older adults because of the numerous changes that occur during the aging process. The process of aging generally increases the risk of not obtaining adequate nutrition due to the onset of illnesses, chronic diseases, decline in physical abilities and cognitive skills, and other socioeconomic factors. Undernutrition along with chronic conditions that interfere with the maintenance of health and nutrition status is fairly common among older adults. Micronutrient deficiencies are also referred to as “hidden hunger” for a very good reason: They do not occur because of a lack of calories, but rather from a chronic lack of vitamins and minerals in the diet. Older adults have a difficult time obtaining adequate levels of several micronutrients, namely the vitamins A, D, E, K, B₁₂, B₉, and folate; and the minerals calcium, magnesium, iron, and zinc. Nutrition interventions must be designed to meet all aspects of the needs of older adults, including food preferences, coping skills, food insecurity, and the current health and nutritional statuses of older adults. Although a varied diet containing nutrient-dense foods can meet daily micronutrient requirements, a daily multinutrient supplement specifically designed for older adults may be necessary to help meet the RDAs. The current community-based nutrition programs for older adults play a vital role in helping to meet the nutritional needs and address nutritional gaps for older adults. Easy access to these programs, along with adequate nutrition services, will go a long way toward helping to reduce micronutrient deficiencies among older adults and help them lead healthy lives.

ABOUT THE AUTHOR

Vijaya Jain, MSc, MS, RD, CDN, is currently a nutrition consultant in New York and an active board member of the New York State Women, Infants and Children (WIC) Association. As a registered dietitian since 1979, she has over 30 years of experience in planning, directing, and coordinating nutrition programs in diverse settings. At the University of Illinois, Ms. Jain served as the director of the Graduate Internship Program and as a senior nutrition specialist. She has led the efforts to enhance school lunch programs with soy-protein foods in India and Central America, in partnership with the World Initiative for Soy in Human Health, the primary goal of which is to create sustainable solutions to the problem of protein malnutrition around the world. Ms. Jain also coordinated research and education efforts in Central America for the introduction of soy and whey-based multi-micronutrient supplements, and for the development of microenterprise projects for families afflicted with HIV/AIDS. She was actively involved with Illinois Soy, which aims to improve the nutritional profile of the Illinois elementary and secondary school lunches and reduce obesity among school-aged children. As a clinical nutritionist at the New York Presbyterian Hospital of Columbia and Cornell Universities, Ms. Jain provided nutrition counseling to nutritionally vulnerable groups and individuals. At the Ossining Open Door Health Center in New York, she was Director of the WIC program.

Continued on page 10
She received her MSc degree from the University of Madras, her MS degree from the University of Illinois at Urbana-Champaign, and her BSc degree from the University of Bangalore. Ms. Jain is the recipient of Distinguished Service Awards from the New York State WIC Association (2005) and the New York State Metropolitan WIC Association (2000). She is also a certified cardiovascular nutritionist and has served as co-chair of the nutrition committee of the American Heart Association.

REFERENCES


Continued on page 11
Micronutrients
Continued from page 10


55. Stendig-Lindberg G, Tepper R, Leichter I. Trabecular bone density in a two year controlled trial of per oral magnesium

Continued on page 12


**Free Guideline! Prevention of Type 2 Diabetes**

The Academy of Nutrition and Dietetics' Evidence Library has released the Prevention of Type 2 Diabetes guideline.

The focus of this project is on medical nutrition therapy (MNT) for individuals who are at high risk for type 2 diabetes, focusing on individuals with prediabetes (including children and adolescents) and adults with metabolic syndrome.

Highlights of this project include:

- Seventeen (17) evidence-based recommendations
- Evidence analysis under eleven (11) topic areas
- A unique look at separate MNT interventions, without the influence of weight loss
- Confirmation that the RDN plays a key role in the prevention of type 2 diabetes

Available at www.andeat.org.

**Call for Information: Conferences and Events**

The Healthy Aging DPG calendar contains events of interest to RDNs and NDTRs who work with older adults. If you would like to suggest a conference or event for our calendar, please email Robin Dahm (dahmRD@gmail.com) with your information. The event must focus on the nutritional and physical health of older adults.
Vijaya Jain, MSc, MS, RD, CDN, has focused the majority of her career on improving the nutritional status of women, infants, children, and vulnerable populations both in the United States and in several developing countries. She is currently a nutrition consultant in New York and an active board member of the New York State Women, Infants, and Children (WIC) Association. Vijaya is a member of several Academy groups, including the Women’s Health, Healthy Aging, and Vegetarian Nutrition DPGs. Additionally, she is a member of the Asian Indians in Nutrition and Dietetics member interest group (MIG), as well as the Fifty Plus in Nutrition and Dietetics MIG.

**Please tell us about your professional background and the path that led to your incredibly diverse, international dietetics career.**

As an undergraduate and graduate student in India, I was fortunate not only to receive a very comprehensive education, but also to participate in numerous community programs. We students were required to implement appropriate nutrition projects and develop educational materials. Some of these projects were in rural areas, and we had the opportunity to learn first-hand the challenges people of all ages faced in terms of meeting their nutritional needs. These challenges included the lack of potable water and electricity; inadequately equipped health clinics; chronically ill infants, children, and older adults; and food shortages. Learning how to find both practical and economical solutions to resolve some of these problems was one of the most valuable lessons for me as a young student. This life-changing experience inspired me to focus on strategies for reducing malnutrition both in domestic and international settings.

My graduate education at the University of Illinois provided me with research training, and in my thesis work I studied the nutritive value and acceptability of soy foods. I went on to complete my internship in San José, California, worked as a supervisor in a clinical setting, and ended up with the Visiting Nurses Association as a nutrition consultant in California and then in New York. This last position challenged me to create sustainable strategies for meeting the nutritional needs of homebound older adults. I learned the incredible value of teamwork in delivering comprehensive, effective home health care. Later, as director of a WIC program in Ossining, NY, I focused more intensively on practical ways to develop nutrition-education tools and then train instructors about these tools. I also advocated at the policy level for the broad needs of the WIC population. Most recently, at the University of Illinois, my work involved planning, coordinating, and implementing school lunch and complementary feeding programs. In this role I also conducted intervention studies using a soy- and whey-based micronutrient supplement aimed at reducing malnutrition in several countries. I have also served as a mentor and preceptor to both graduate and undergraduate students at San José State University, New York Medical College, the University of Illinois, and several other institutions. My varied work experiences have sustained my dedication to reducing micronutrient deficiencies and malnutrition in vulnerable populations.

**What are some of your current roles as a nutrition consultant?**

I work with several non-profit organizations that can benefit from the expertise of a nutritionist, and am a guest speaker for different community organizations. I also work with daycare centers and schools to improve their meals and food service, and to incorporate nutrition education activities for children and parents. After having spent a significant part of my career with WIC, I now serve as a board member and advocate for the New York State WIC Association. I am actively involved in improving and advocating for the policies of WIC at both the state and federal levels. I am also working with several international organizations dedicated to serving the needs of groups vulnerable to malnutrition.

**What are your goals for the future?**

Following my international work investigating micronutrient supplements, I have continued to collaborate with professional colleagues and organizations. Their focus is to improve the nutritional profile of meals and snacks being provided to children and adults. A major goal of these efforts is to improve the micronutrient intake of older adults in the home setting. Comprehensive education helps people make better optimal choices, and simpler food preparation is crucial to achieving better nutritional status. This is a goal to which I am dedicated on an ongoing basis.

**How do you feel dietetics practitioners can improve the quality of care and health outcomes for an aging population?**

Dietetics practitioners can play a critical role by acquiring adequate science-based knowledge and practical training, and also by actively participating in the special field of geriatric nutrition as the nutrition expert in a team setting. They should:

Continued on page 14
Spotlight: Jain
Continued from page 13

• Strive to review and keep up to date on the latest science on geriatric nutrition.
• Participate as much as possible in community settings that work with older adults and need nutrition expertise.
• Participate actively in the realm of advocacy and promoting policy changes.

What do you want dietetics practitioners to learn from your professional experiences?
We work in a profession that is growing rapidly and will continue to do so. It is very important that dietetics practitioners keep up with new information, be able to demonstrate their knowledge of geriatric nutrition, and translate this knowledge into practical, evidence-based recommendations that are easy to implement. In addition, we should continually learn from the experiences of our colleagues and mentors, and strive to work in teams.

Are there any other lessons you have learned during your career that you would like to share?
I have learned that we can achieve more when we take the initiative, stay focused on a project’s mission, and remain persistent. These approaches help us find appropriate solutions to eliminate barriers and accomplish our endeavors successfully. *

Nutrient Supplementation Project Now Available

The Academy of Nutrition and Dietetics’ Evidence Analysis Library has released the Nutrient Supplementation Project.

This project, updated from 2008, focuses on Vitamin E and Vitamin D supplementation in the adult population.

Highlights from this project include:
• Vitamin E and anti-coagulant interaction
• Vitamin D and bone health in adult and older populations

The Academy’s Nutrient Supplementation Position Paper is being developed and will be available from this site when it is published in the Journal of the Academy of Nutrition and Dietetics.

Available at www.anddeal.org.

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Improving Quality of Life for Older Adults: A Resource List

Jamillah-Hoy Rosas, MPH, RD, CDN, CDE

Myriad physical, biological, and psychosocial changes accompany the aging process. Understanding these normal changes, their relationships to disease and disability, and how best to help older adults avoid or cope with these issues is essential for healthcare practitioners and researchers. Dietetics practitioners can keep abreast of these topics by being attuned to various resources, a few of which are listed below.

PROMOTING GOOD NUTRITION AND AGE-APPROPRIATE PHYSICAL ACTIVITY

An essential task for dietetic practitioners is connecting older-adult patients with resources that address key nutrition and physical activity messages specific for this age group.

- The National Institute on Aging provides an interactive resource, “What’s on Your Plate: Smart Food Choices for Healthy Aging.”
- The “Go for Life” campaign includes physical activity ideas and videos for the older adult.

CLEAR COMMUNICATION BETWEEN PATIENTS AND HEALTHCARE PROVIDERS

It is vital for patients to choose healthcare providers with whom they can communicate comfortably. Clear communication improves patient-provider relationships and patient outcomes.

- On its Clear Communications website, the National Institutes of Health provides a variety of resources about how patients can better communicate with their healthcare providers.
- The National Women’s Health Institute offers a simple handout on the topic.
- The Conversation Project is a public engagement campaign launched in collaboration with the Institute for Healthcare Improvement specifically to promote “kitchen table” conversations with family and friends about wishes for end-of-life care. It offers a starter kit for initiating this difficult but important conversation.

IMPROVING MEDICATION ADHERENCE AND HEALTH LITERACY

As patients grow older, they are more likely to be diagnosed with multiple illnesses and have large medication burdens. Limited health literacy is associated with a number of health disparities, poor health outcomes, and medication errors.

- In 2009 the CDC developed a panel report with recommendations for improving health literacy in older adults.
- The U.S. Department of Health and Human Services created the useful Quick Guide to Health Literacy and Older Adults specifically designed for those practitioners working with older adults on health and aging issues.
- To improve the likelihood that patients understand their medication regimens and stick to them, there are tools, reminders, and resources available at Script Your Future.
- The Institute of Medicine has a roundtable on health literacy with an ongoing series of meetings and reports.

SMOKING CESSATION

Quitting smoking is one of the best things people can do to prolong their lives and improve their healthcare outcomes. Smoking cessation will also save the aging smoker thousands of dollars every year that could be better spent on healthy activities, such as buying nutritious food or increasing physical activity.

- The American Cancer Society provides a flyer that discusses the hidden costs of smoking.
- Those looking to quit the habit can visit the National Cancer Institute or call 1-877-44U-QUIT. Trained counselors are available to provide information and help in English and Spanish.

IMPORTANT HEALTH-RELATED LAB VALUES

A person’s blood sugar, blood pressure, and blood cholesterol numbers give vital information about disease risk.

- The American Diabetes Association and the American Heart Association both provide excellent resources on ways to reduce risk and improve health through lifestyle changes.

HIV STATUS

Adults aged 55 years and older are one of the fastest-growing populations to be newly infected with HIV. In older individuals, these infections are often diagnosed when the virus is already in the later stages, which results in delayed treatment and the potential for poorer prognoses. Getting tested and beginning treatment as soon as possible helps both the affected individuals and the overall spread of the disease.

- Information about reducing risky behaviors and proper condom use is available at the Administration on Aging’s website, whose HIV Testing Sites and Care Services Locator tool allows one to search for testing centers and service providers close to home.

ADVANCE DIRECTIVES

There are two types of advance directives. A living will allows a healthy person to document his or her wishes concerning end-of-life medical treatments. A healthcare proxy is a person designated to honor another person’s wishes for medical treatments in the event that he or she is unable to make these decisions.

- The National Cancer Institute provides a very informative fact sheet, as well as additional resources and contacts to help individuals complete their advance directives.
- State-specific information about completing a living will and/ or healthcare proxy is available at the Caring Connections website.
Navigating the Urban Food Environment: Challenges and Resilience of Community Dwelling Older Adults

Corrine E. Munoz-Plaza, MPH; Kimberly B. Morland, PhD; Jennifer A. Pierre, DrPH; Arlene Spark, EdD, RD; Susan E. Filomena, BA; Philip Noyes, MPH, MA

We thank the Journal of Nutrition Education and Behavior for allowing The Spectrum to reprint this continuing-education article. We welcome these kinds of partnerships that let us provide our members with quality CPE opportunities.

ABSTRACT

Objective: Identify factors involved in food shopping among older urban adults.

Design: A qualitative study of 30 in-depth interviews and 15 “tagalong” shopping trip observations were conducted.

Setting: Brooklyn, New York.

Participants: Black, white, and Latino men and women aged 60-88 years.

Main Outcome Measure: Transcripts were coded inductively to identify emergent themes.

Results: Older adults shopped at multiple stores to obtain the quality of foods preferred at prices that fit their food budgets. Participants often traveled outside their neighborhoods to accomplish this, and expressed dissatisfaction with the foods locally available. Adaptive food shopping behaviors included walking or the use of public transit to purchase food in small batches, as well as reliance on community resources and social network members.

Conclusions and Implications: Participants identified a number of multilayered factors and challenges involved in procuring food. These factors conform to elements of ecological behavioral models described as intrapersonal, social, and environmental level influences and have resulted in adaptive behaviors for this population. These findings provide evidence that can be used to develop more effective programs, as well as promote testable interventions aimed at keeping older adults independent and capable of acquiring food that meets their age-specific needs.

INTRODUCTION

Previous studies indicated that environmental factors influence individual behaviors, specifically food intake patterns. Different features of local food environments, such as variations in the costs of foods and the types of foods available within markets, as well as the distance traveled to obtain food, are of increasing interest to researchers. In addition, the presence or absence of particular types of retail food outlets is known to be a function of the racial and economic makeup of some areas, particularly in the United States (US).

Moreover, public health professionals and clinicians alike are increasingly weighing how environmental obstacles influence the ability of adults to meet recommended nutritional guidelines. This is a particular concern for older adults, many of whom are managing diet-related chronic diseases such as hypertension, diabetes, and heart disease. Furthermore, more than a third of older adults in the US had a disability in 2010. Research on the elderly in New York City public housing documents both the health challenges and vulnerability of this population. The authors report that approximately two thirds of the older adults in their study indicated a health status of fair or poor; most suffer from one or more chronic diseases; roughly a third had a diabetes diagnosis or experienced limitations in activities of daily living; and one in five reported food insecurity. In addition to physical limitations, many older adults rely on a fixed income, which is also likely to influence their food choices, behaviors, and consumption patterns. For instance, an analysis of the baseline data from the Women’s Health and Aging Study for 1,002 disabled women aged ≥ 65 years residing in Baltimore, Maryland, indicates that 49.5% of minority women and 13.4% of white women reported financial difficulty obtaining food.

To date, most US studies that describe the relationship between local food environments and health behaviors or health status focus on children or middle-aged adults, whereas research related to older adults in this arena remains sparse. Recognizing the lack of understanding surrounding factors that influence older adults and food access, Wolfe et al suggested a conceptual analysis of food insecurity among older adults based on in-depth interviews with older adults from upstate New York. The researchers defined a model that includes the concept of community characteristics—such as grocery store availability and prices, transportation services, and the availability and features of food programs—as factors that relate to older adults’ ability to obtain and prepare food. In addition, research from Canada suggests that the elderly have unique needs and tend to confine their shopping to their local environment, which leaves them at a disadvantage for obtaining competitively priced food items available elsewhere. More recent research includes a study linking food insecurity among older adults to the walkability of their immediate neighborhood.

To better understand the challenges older adults face, qualitative interviews with older New York City residents were conducted to explore their experiences navigating local urban neighborhoods to obtain food. Participants shared their perspectives...
Navigating continued from page 16

on a number of complex challenges that they face when shopping for food and/or using food-related community resources, including income, transportation, functional mobility, and social support. Study participants also shared their attitudes and perspectives about the sources of food that are available in their neighborhoods, such as food stores, restaurants, community centers, and food banks or pantries.

METHODS

Participants and Recruitment

Participants (n = 30) were selected from a larger prospective cohort of 1,453 older adults enrolled in the Cardiovascular Health of Seniors and the Built Environment study (CHBE), in which men and women aged 59–99 years were enrolled between January, 2009 and June, 2011. Participants for the CHBE study were recruited from New York City community social service centers located in all areas of Brooklyn. Participants were eligible for the study if their reported race/ethnicity was black, white, or Latino; they spoke English or Spanish; and they were judged able to understand the purpose of the study and the respondent’s burden (n = 1,453). The population enrolled reflects the race/ethnicity of the base population of older adults from the neighborhoods sampled within 10%.

A list of eligible cohort members was used for block sampling by geographic area across Brooklyn, New York. Although it was not feasible to sample older adults from every Brooklyn neighborhood in this qualitative study, attention was paid to recruiting participants from a number of distinct neighborhoods, both to capture the diversity of experiences across Brooklyn and to sample enough participants to likely achieve saturation in the data, as defined by the point at which ongoing data collection does not continue to yield new information within the conceptual categories of interest.45–47 Participants were recruited purposefully for their heterogeneity in terms of the neighborhood in which they resided at that time (i.e., racial/ethnic makeup and wealth of the neighborhood). Thus, the 30 participants completing the first qualitative interview represent 17 Brooklyn neighborhoods, or 30% of the total neighborhoods in the borough.

Eligibility criteria for inclusion in this qualitative component required that each individual be fluent in English, have completed the baseline measurements for the parent study, have reported in the baseline interview that they were the primary food shopper in their household, and have consented to be contacted for the qualitative interview. Informed consent was obtained from eligible participants at the first scheduled interview. Once a sample of 30 individuals agreed to participate, no additional cohort members were contacted. The Mount Sinai School of Medicine Institutional Review Board reviewed and approved the qualitative research component, which included both the baseline and tag-along interviews.

Instruments and Procedures

In-Depth Qualitative Interviews

Face-to-face, audiotaped interviews were conducted at participants’ homes between September, 2010 and April, 2011. A semi-structured guide directed the discussion during each interview. The interview guide contained four key sections with a series of questions and probes exploring participants’ shopping, cooking, and eating habits (Table 1, next page). Participants also listed the members of their social network (including individuals and institutions) and the types of support provided by each network member, including informational, emotional, instrumental, and appraisal support.48–50 Interviews lasted one to two hours. Sociodemographic information was collected as part of the baseline exam from the CHBE study (parent study), as was the food security index (calculated from standardized questions from the US Department of Agriculture).51 Participants’ real names were not reported anywhere in the data; instead, pseudonyms were substituted for all of the names (selected from a list of common male and female names).

Qualitative Observations

Information about participants’ home environments and immediate neighborhoods, as well as their personal affect, demeanor, and physical resilience, were documented in the form of observational field notes at the time of the first interview. These observations were dictated onto audiotape immediately post-interview.

Shopping-Trip Observations

Approximately four to six weeks after the first interview, participants were asked to allow the researcher to shadow them during a regularly scheduled food shopping trip at the establishment that they had previously identified as their “primary” food store. Half of the original cohort (n = 15) agreed to participate in this component of the study (the “tagalong” shopping trip). Reasons for refusal included illness, time constraints, and competing priorities, as well as changes in shopping patterns (some individuals were no longer the primary shoppers in their household because of declining health or illness). The purpose of this component of the research was to: (1) identify modes of transportation to the food or shopping location(s); (2) observe store characteristics; (3) describe purchasing patterns; and (4) document the total bill and source of payment (i.e., Supplemental Nutrition Assistance Program debit card, cash, credit). Observational data were collected through descriptive field notes, which were dictated onto audiotape immediately post interview. Each tagalong trip lasted 1.5-2 hours.

Data Analyses

All audiotapes were transcribed verbatim. Dialogue of the discussions related to social networks was recorded but not transcribed. Social network lists were coded for the number and types of network

Continued on page 19
### Where do you regularly shop for groceries and food? Please be specific and tell me all the places that you shop.

(Probe: grocery stores, food charts, food pantries, bodegas, corner grocery stores, etc.) Related questions:

- How often do you shop at each location?
- Where are each of these stores/bodegas located?
- Which of them would you say that you use most often to get your groceries/food?
- Why do you prefer this bodega to others?
- How do you get to each store?
- How hard is it for you to get to the store?
- Why is it hard for you to get to the store?
- Are there family concerns?

### What types of food/groceries do you typically purchase at each store? Related questions:

- How do you decide what to buy? (Probe: cost, seasonality, freshness, quality, etc.)
- Do you have dietary restrictions related to any medical conditions?
  If so, what are the medical condition(s) and what are your dietary limitations?
- How do these restrictions affect your ability to shop for groceries and food?
- Can you read the food ingredients on the labels? Do you read these labels to decide what to buy?
  If so, what is it on the label that will make you decide whether or not to buy the item?

### How often do you eat outside your home? Please be specific and tell me all of the places that you eat food outside the home.

(Probe: restaurants, fast food, prepared foods from bodegas or stands, senior centers, etc.) Related questions:

- How often do you eat at each location?
- What types of food does each location provide?
- What do you typically get to eat at this location?
  Why do you select the particular dish or dishes?
  (Probe: cost, portion size, flavor, specialty at that location, etc.)
- Does anyone go with you to eat or do you typically go there by yourself?
- Who goes with you?
- When you eat out with this person, who typically pays for the meal?
- How much do you usually spend at each location when you eat there?

### To what extent do you prepare meals at home? Related questions:

- Do you prepare meals by yourself or does someone help you and/or cook for you?
  In what ways does that person help you prepare food specifically?
- What types of food/dishes do you typically cook?
  What are your favorite things to prepare at home?
- Whom do you eat with at home?
  Do they have dietary restrictions? If so, what?
- To what extent do you prepare meals based on recipes?
  Where do those recipes come from?
  (Probe: handed down from family/friends, cookbooks, magazines, Web sites, etc.)
- Are there certain foods that you eat based on family traditions or religious reasons?
- Besides for medical reasons, are there certain foods that you DO NOT eat for any reason, such as religious restrictions?
  (Probe: cultural taboos, grew up in another country where certain foods were not available, etc.)
- Are there certain foods you would prepare, but cannot because you do not think you can afford to purchase them at the store?
- Did your doctor ever put you on a diet?
  What kind of diet?
  Was it hard for you to follow the diet? Why or why not? How long did you stay on the diet?
Navigating
Continued from page 17

members, as well as for the types of food-related support provided by each network member. All data were stored securely on Mount Sinai School of Medicine servers. Transcripts, including those obtained from both the interviews and observations, were prepared and imported into ATLAS.ti qualitative software (version 4.1, Scientific Software Development GmbH, Berlin, Germany, 1997) to assist with the analysis. Initial coding categories, more descriptive in nature, were generated from our preliminary research questions and key domains of inquiry to create a start list of codes.52 Next, repeated review and coding of the transcript data was conducted, relying on a grounded theory approach to generate additional coding categories (known as “open” and “in vivo” codes in ATLAS.ti) and highlight thematic patterns, including areas of divergence and convergence in participants’ responses.52–57 Observations obtained during the tagalong shopping trips provided additional information, as well as an opportunity to triangulate the data during the analysis.58 The data were coded initially for predetermined thematic content, and then for emergent thematic trends. Data were repeatedly coded and categorized by the researcher, and areas of convergence and divergence in participant responses were determined, as well as salient patterns in the data.

RESULTS
Characteristics of Participants

Most participants were women (80%) and were 60–88 years of age. Two thirds were black or Latino and most were unmarried and living alone. In addition, most of the older adults had annual incomes of < $30,000, although only 26.7% received government income assistance (Table 2). Nearly all participants reported eating at least one daily meal at home. Furthermore, one third of participants reported finding healthy foods more expensive, and only half experienced high food security (Table 2).

Older Adults and Food
Shopping: “It Is a Struggle”

This population of older adults addressed a myriad of challenges when navigating their local environments to acquire food. Foremost, they relied on their ability to shop for groceries and prepare their own meals at home. Successfully accomplishing these tasks was important to their sense of identity, because it epitomized their ability to function independently. Barbara (age 84 years) offered an example of an older adult with just this perspective. She used a walker to get around, yet could carry up to four bags of groceries home from a single trip to the grocery store. Describing her motivation, she explained, “I tell you something. It is difficult, but I don’t want to have an aide. I want to do everything myself.”

Transportation: Getting To and From The Food Market

Few older adults reported that they drove a vehicle or wanted to spend their resources on delivery or cab fare to grocery shop; therefore, most of them depended on public transportation or walking as their mode of travel to food stores. Rarely did these older adults rely on store delivery services as a strategy to overcome the physical challenges posed by having to carry their groceries home by hand or in a wheeled shopping cart. The majority of those who did not take advantage of this service said they wanted to avoid the delivery fee (stores typically require a minimum purchase to waive the fee). Older adult men tended to cite their desire to remain independent as the reason they avoided delivery. Bill (age 80 years) observed a kosher diet and was proud of the fact that he did all of the shopping for his household. He chose not to have the store deliver his groceries because “to exercise is to do something” and he wanted “to keep myself occupied.”

Food Shopping Frequency and Patterns

Older adults described typically shopping (at least once a week) and purchasing items in small batches. Buying fewer items, with more frequency, was a food-shopping strategy participants employed to avoid purchasing more groceries than they could carry and minimize the chance that their food would spoil. The total amount spent on groceries by each participant at the tagalong visits ranged from $21.29 to $164.42, with an average bill of $54.00. Final bills were not

Table 2: Community and transitional-care models. (Reprinted with permission from the Academy of Nutrition and Dietetics.)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Mean (Range)</th>
</tr>
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<tbody>
<tr>
<td>Age, y</td>
<td>73 (60–88)</td>
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<tr>
<td>Race</td>
<td></td>
</tr>
<tr>
<td>Black</td>
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<tr>
<td>White</td>
<td>12 (40)</td>
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<td>Latino</td>
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<tr>
<td>Women</td>
<td>24 (80)</td>
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<tr>
<td>Married or living with a partner</td>
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<tr>
<td>Annual income &gt; $30,000</td>
<td>7 (23)</td>
</tr>
<tr>
<td>Participation in government economic assistance programs</td>
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<td>At least one meal eaten at home per day</td>
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</tr>
<tr>
<td>Perceptions of food cost</td>
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</tr>
<tr>
<td>Healthy foods are more expensive</td>
<td>11 (37)</td>
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<tr>
<td>Healthy foods are more expensive in their neighborhood</td>
<td>12 (40)</td>
</tr>
<tr>
<td>Never worry about the cost of food</td>
<td>11 (37)</td>
</tr>
<tr>
<td>Avoid some food stores because of cost</td>
<td>13 (43)</td>
</tr>
<tr>
<td>High food security</td>
<td>16 (53)</td>
</tr>
</tbody>
</table>
Navigating
Continued from page 19

confirmed for 2 of the 15 tagalong shopping trips (n = 13), and the average bill calculation was rounded to the nearest whole number.

Functional Limitations Challenged

The Food Shopper

Loretta (age 67 years) had lived in a New York housing project for more than two decades. Citing numerous health conditions that compromised her mobility, including diabetes, a back injury, and chronic knee pain, she used a cane and was in visible discomfort when moving around her apartment. Even with these significant mobility issues, she regularly walked seven blocks to a vegetable and fruit market for produce, even though there was a grocery store adjacent to her apartment complex. She traveled the extra distance to the vegetable and fruit market because she preferred the cast, quality, and variety of the produce at this store. During the tagalong shopping trip, Loretta struggled to walk and push her shopping cart, and she frequently stopped to lean against a tree or sit at a bus stop to rest. Her physical ailments and the bumpy, uneven sidewalks made traveling to the store difficult, and she expressed fear of falling.

Like Loretta, other participants described or exhibited the physical challenges of walking and taking public transit when shopping for food. As was typical of many of the older adults who were observed shopping, Abigail (age 66 years) used a small shopping cart to transport her groceries. Pushing her cart home, loaded with her purchases, Abigail almost tripped when she caught the front end of the cart on a strip of raised concrete. She used the opportunity to tell the researcher about a friend of hers who severely injured her arm after tripping and then falling over her grocery cart on the way home from shopping.

Nathaniel (age 75 years) walked about a quarter of a mile (five city blocks) to his primary food store, but also frequented several other smaller produce markets near his neighborhood to purchase fresh fruits and vegetables at more affordable prices. He shopped “European style” for the freshest food and the best deals, but said that walking to multiple stores was becoming increasingly difficult as he aged and his legs became weaker. He also reported heart problems and said that he experienced labored breath whenever he exercised. Getting winded in this way upset him, because he used to pride himself on being able to walk briskly. He felt frustrated at having to avoid the full service grocery store that was located closest to his apartment because it was too expensive and carried fruits and vegetables he believed were of poor quality.

Dissatisfaction with Food Sold
At Local Markets Complicates
Shopping Behaviors

One of the most challenging issues participants faced in trying to obtain food was the need to shop at multiple stores to obtain the quality of foods they wanted at prices they believed fit their food budgets. Every participant shopped at a minimum of two food stores, and most regularly purchased food at $3 establishments (range, 2–6). Whereas all participants identified a primary store at which they shopped most frequently, the main reason cited for shopping at multiple stores mirrored the rationale articulated by Nathaniel, who avoided the supermarket closest to his home—namely, that the availability, quality, and/or prices of at least one major food category (i.e., fruit, vegetables, meats, fish, and/or dairy) was unacceptable at their primary store.

Rebecca (age 83 years) followed a strict kosher diet. She pointed out that she and her husband made a concentrated effort to eat more fresh vegetables about a year ago, after she resolved to lose 30 pounds. When asked why she did not purchase fresh produce at her primary store, she remarked, “The [local stores] know that they can charge more.” During her interview, Emily (age 77 years) mentioned that there were foods she could not find in the stores near her home. Asked to further explain what specific types of food she had trouble finding, she stated, “Nice, fresh vegetables!” Similarly, Louise (age 64 years), who was proud of her authentic Italian cooking, stopped buying meat at both her local butcher and one of the local chain supermarkets near her home because of the poor quality.

Participants, especially those individuals living in less affluent neighborhoods, commonly reported that some or all of the stores they shopped at regularly were located outside their immediate neighborhoods. One participant pointed out that she was different from many of her friends her age or older, because she had no chronic health conditions that limited her mobility. Chanelle explained:

I drive. But I know others who don’t drive. They take the bus. They say I am not buying my meat in Coney Island, they get on the train, they get on the bus … They’ll tell me I go to Flatbush to get fresh fish … I said, wow. They are old, they get on the train and then you got to carry these bags. What? But that is how serious [they are] … they are black and Hispanic, and they will go … to whatever neighborhood they have to go to … [to get food] fresh! … not stale stuff. Not beat-up looking chicken.

Finally, African American and Latino participants, in particular, reported that grocery and supermarket chains located in their neighborhoods offered poorer quality produce and meat compared with the same stores located in neighboring and more affluent white neighborhoods. A number of participants became visibly upset when they talked about the historically poor quality of fruits and vegetables sold at food stores in their neighborhoods. Janet (age 61 years) expressed frustration when she shared a story about the chain supermarket located directly across the street from her apartment. She explained that her son eventually

Continued on page 21
Navigating
Continued from page 20

spoke to the manager at the store because
That [junk before] should have been in the garbage! And they shouldn’t sell that to you. I mean, I ain’t trying to be funny or smart, you may be poor people, but you don’t give people [food like that].

Later in her interview, Chanelle connected the quality of food in neighborhoods to the racial makeup of the community. Explaining that she frequented a store outside her own neighborhood because of the better quality of merchandise, she said, “[That store]—they cater to a different level of people, I notice. And I would, well, let me just put it to you like this—that is more of a white neighborhood.”

Researcher observations during the tagalong trips also documented differences in the food stores in terms of cleanliness and organization, as well as the quality of food sold. For instance, a few stores were observed selling food with expired sell-by dates. More commonly, stores displayed fruits and vegetables out on the floor that were visibly wilted, bruised, and/or moldy; of the 20 stores visited, 6 (30%) were observed to have multiple produce items for sale that fell into this category. In addition, a number of the stores appeared dirty and unorganized because of the presence of food, debris, and litter on the floors, as well as having produce sections that smelled of mold, disorganized shelves, unmarked items and poor signage, and barren shelves.

Distrusting the Business Practices of Neighborhood Food Stores

Several participants suspected their local neighborhood markets of deceptive sales practices, such as purposefully avoiding ringing up advertised sale items at checkout; bundling fruits and vegetables in bulk packaging that hides old, withering, and/or molding produce under a top layer of the food item that appeared fresh; and selling food at or past the printed sell-by dates on the packaging. Sarah (age 77 years) and her friends started noticing a suspicious pattern at her local supermarket regarding advertised sale items. Specifically, sale prices and store specials were not ringing up at the register. Suspecting wrongdoing, Sarah spoke repeatedly to the store manager about the problem. Reflecting on the experience, she noted:

They would just say things like, oh we didn’t put it in the computer. But you heard that over and over again, [and] that sounds like a gyp to me.

Researcher observations of participants’ shopping style and behavior during these trips also documented that some participants distrusted the stores where they shopped. These participants typically checked the sell-by dates on items while shopping and/or reviewed their sales receipts before leaving the store, to ensure they were not charged full price on sale items. Louise was one of those shoppers; she casually commented to the researcher while selecting sale items. Louise was one of those shoppers; she casually commented to the researcher while selecting a box of oatmeal squares that she “religiously” checks sell-by dates on merchandise because she had purchased expired food in the past.

Food Shopping on a Fixed Income

Because the majority of the participants were no longer employed, their reliance on a fixed monthly income had a reverberating effect on their food shopping patterns and purchasing decisions. Relying mostly on Social Security income (a few participants receive pensions as well), they generally received a check at the beginning of the month and sometimes struggled to budget their food-shopping resources. Participants spoke in depth and often about the need to be mindful of what groceries they purchased, as well as the amount they spent on particular items. In addition, during tagalong grocery trips, the researcher observed many participants making the majority of their purchasing decisions based on which food items were listed as sale items in the weekly store circulars or advertised as such at the point of sale. In addition, observations of the checkout process during these same trips indicated that the Supplemental Nutrition Assistance Program, coupons, and store “rain check” vouchers were heavily relied upon to purchase food.

Restaurants as a Source of Food

Older adults in this study consistently said that restaurant meals do not make up a large proportion of their food intake each month. In fact, they claimed to limit the frequency with which they ate at restaurants because eating out was expensive and they could not control the nutritional content of the food served (e.g., sodium). In addition, some participants said that there were few, if any, restaurants located in their neighborhoods that offered healthy food options. Janet mentioned that she had lived in her Brooklyn neighborhood for more than 35 years. She had cut way back on going out to restaurants for both cost and health reasons, and lamented the lack of “decent” places to eat in her neighborhood, exclaiming, “Honey! What! I am telling you, you find fast food around here before you find a decent gallon of milk.” Wilma (age 65 years) felt similarly about the restaurant choices near her home. As opposed to the fast food restaurants that dominated her local food environment, she said that she dreamed of a neighborhood establishment where she could order a piece of baked chicken with “no skin” and a salad.

Older Adults Rely on Community Resources and Support to Stretch Their Food Dollars

Food Banks and Pantries

About 15% of the older adults reported relying on food pantries for food. A 66-year-old woman, Ellen, proudly reported she spends only $50–$100 each month on groceries because the food pantry in her neighborhood helped her stretch her food dollars. However, other participants who similarly relied on food pantries for as-
Navigating
Continued from page 21

istance expressed concerns about these programs as a source of food for older adults. For example, Nina (age 60 years) commented that most food pantries “give only shelf or canned stuff, or pasta...unfortunately a lot of the foods from the food pantries are not conducive to weight loss or to keep you fit.” Marcie (age 73 years) also frequented several of the local food pantries in her neighborhood and was disappointed that most food pantries did not provide “nothing fresh” and gave away “a lot of canned stuff.”

Meal Programs at Community Centers
In addition to food pantries, meal programs at local community centers were another source of food. Almost all of the participants reported taking at least one meal each week at a senior center, and half (50%) said that they regularly ate at their center at least three times a week. For most of the participants, the primary reasons they took advantage of the meals at their center were the value and the social interaction. When asked how much centers charge, participants said that they paid $1.00–$1.50 for a meal consisting of a protein (meat or fish); starch (e.g., rice or potato); vegetable and/or fruit; and milk, tea/coffee, or juice. Several participants also stated that some community centers sold leftover plates of food each day, which they purchased to take home and eat for dinner or a meal the following day.

Despite the regularity with which the older adults in this study reported eating at local community centers, they described a number of limitations to relying on these organizations as sources of food. First, the center meals were not available on the weekends, when centers are closed, and meals were typically only offered once a day during the week. Lunch was the most common meal provided at these organizations, although a few older adults said their center offered a light breakfast as well. Second, individual food preferences varied and it was common for participants to complain about the taste, quality, and lack of culturally appropriate meals provided, even when they reported eating at their respective senior centers regularly. Third, several participants expressed concern that their local community centers frequently served pasta and other carbohydrate-rich foods, which they wanted or needed to avoid because of health concerns (e.g., diabetes) and/or concerns about maintaining their weight.

Sources of Food-Related Assistance And Support from Individuals
The number of individuals named in social networks ranged 1 to 10, with an average of 5 network members. Independent of the size of social networks, two thirds of the participants reported food assistance as one of the areas supported by their networks. For instance, the daughter of one of the male participants (age 74 years) “prepares and brings meals that I can heat and eat,” whereas a female participant (age 69 years) had a friend who “shops or brings food or things that I might need.” The sister of another older adult (age 63 years) is described as not always having the resources to help, but “if she has it, she will give [me] food.” Overall, friends and neighbors were just as likely as family members to be credited with having provided this type of instrumental support. A smaller proportion of the participants pointed out that they depended on family and/or friends for help obtaining food only when they were ill.

Summary of Key Findings
Factors that were reported by participants as influencing their related shopping, cooking, and eating behaviors were summarized into intrapersonal, social, and environmental categories in Table 3.

Intrapersonal issues that influence food purchases described by the older adults in this study include concerns related to their physical and mental health, as well as attitudes and perception about food available to them. The participants also described struggling with fixed incomes. Social level influences identified as important included help in obtaining and preparing meals, as well as social contact during meals. The environmental factors can be summarized into two categories: transportation to places to obtain

Table 3: Multilevel factors related to food acquisition for older urban adults.

<table>
<thead>
<tr>
<th>Intrapersonal Factors</th>
<th>Social and Cultural Factors</th>
<th>Environmental Factors</th>
<th>Adaptive Behaviors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical health</td>
<td>Physical aid in meal</td>
<td>Transportation</td>
<td>Shop frequently</td>
</tr>
</tbody>
</table>
| Functional limitations | preparation                 | Walking               | Shop where prices |}
| Comorbid conditions   | Social support in sharing   | Public transportation | and quality are   |
| Mental health         | meals                       | Food stores           | desirable         |
| Resilience for        | Social support purchasing   | Variation in availability of | Travel out of     |
| independence          | food                        | foods sold            | immediate area    |
| Challenges with food   |                             | Variation in cost and  | for food          |
| prices                |                             | quality of foods sold | Limit visits to   |
| Dissatisfaction with   |                             | Community centers     | restaurants       |
| healthy food availability |                           | Provide affordable meals | Use food pantries  |
| Dissatisfaction with   |                             | Limited availability   | Use community centers for |}
| food quality          |                             | Meals vary in taste and desirability | meals |}
| Deceptive sales       |                             |                       | Help from social network |}
| practices             |                             |                       | members for meals  |}

Continued on page 23
Navigating
Continued from page 22

food and the types of foods available. Whether obtaining prepared foods at community centers or preparing foods at home, this population reported relying on the ability to walk to these places or use public transportation. Issues related to the quality and cost of foods varied, and therefore shopping and eating where foods are affordable and of good quality, even if those places are far away, was an important behavioral theme identified by this group of older adults.

In addition to identifying factors that influence the behavior of food shopping, the participants also described specific behaviors used as strategies to respond to these factors. For instance, their functional limitations resulted in more frequent, shorter shopping trips. Dissatisfaction with the price and quality of foods at local markets resulted in shopping at food stores farther away. Foods served within social service settings that were not perceived as culturally sensitive or tasteful led to underuse of these services. Understanding the interdependencies between the intrapersonal, social, and environmental factors that influence obtaining food and eating for older adults will lead to more sensitive programs by local and state governments, as well as provide the preliminary evidence needed to develop testable interventions.

DISCUSSION

Throughout the interviews, participants’ responses to questions with regard to their shopping, cooking, and eating behaviors were complex and multilayered. The issues described can be applied to ecological models of health behavior, which can be useful in developing future health behavior interventions for this population. The application of these models to eating behaviors has been described previously. The multilevel themes identified in this research are similar to several other studies that have been conducted to date, both in the US and abroad. For instance, other researchers have documented challenges to food acquisition among this population that include transportation barriers, difficulty food shopping because of functional limitations, and problems with the grocery store environment, as well as older adults’ reliance on both informal and formal community food programs and services to bridge these gaps. Studies also indicate that a lack of access to competitive prices within the limited confines of their immediate environment contributes to food insecurity in the elderly population, and similar to our findings, that some older adults experience a monthly cycle such that they tend to run low on financial resources for food toward the end of the month.

These data are robust in the exploratory nature of food shopping practices of older adults living in urban environments well into their eighties. Nevertheless, there are some limitations to this study that should be raised. First, qualitative research is by its nature naturalistic and exploratory, and therefore, is typically driven by central research questions, rather than by a specific hypothesis or theory. Thus, although the findings from this study nicely conform to ecological models, they must be interpreted as exploratory. Second, the participants sampled for this qualitative component were from a larger cohort of older adults. This cohort of seniors was obtained from social service settings and is representative of the base population (older adults living in Brooklyn, New York). Therefore, reported concerns regarding food prices, as well as the need to use social services to procure food, may be a function of the economic realities of aging. The issues related to shopping at multiple stores, including stores located outside participants’ neighborhoods, may promote secondary beneficial effects by keeping older adults active. In fact, some of the older adults in this study stated the desire to conduct these activities of daily living to remain active and independent. Nevertheless, as has been shown with other populations, individuals are more likely to have healthy diets if nutritious foods are available more conveniently. Therefore, considering how multiple levels of influence interact and lead to complex behaviors of eating among older adults may inform clinical care, as well as the expansion of future nutrition programs for older adults.

ACKNOWLEDGMENTS

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Navigating
Continued from page 23

pated in this research for graciously sharing their time, experiences, and stories. In addition, they thank the directors and staff at participating senior centers for their important contributions to the study.


Continued from page 25


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Clearing the Confusion on Probiotics, Prebiotics, and Flavonoids for Healthy Aging

Christine Rosenbloom, PhD, RDN, FAND; Sarah Romotsky, RDN

OVERVIEW
Aging is a global phenomenon. In the near future, people aged 65 years and older will outnumber children under the age of 5 years for the first time in history. By 2040 the world population will contain an estimated 1.3 billion older adults (about 14% of the population), which is double the current percentage. Maintaining the health of older adults will be a challenge to healthcare practitioners, and nutrition and physical activity will continue to be the cornerstones of good health. Functional foods such as probiotics, prebiotics, and flavonoid-containing foods provide the macro- and micronutrients that older adults need; older adults who utilize these functional foods may also benefit from improved health outcomes.

The International Food Information Council (IFIC) Foundation conducts online surveys of U.S. consumers in order to gauge consumer perception and behavior on food and health issues. The 2014 Food and Health Survey revealed that older consumers (ages 65 or older) are the most likely to be influenced by the healthfulness of a food when making purchasing decisions. When trying to consume specific ingredients or food components, older consumers look for functional components such as whole grains, fiber, and omega-3 fats. They are not considering other important components such as probiotics, prebiotics, and flavonoids. This population clearly desires to seek out healthful foods, but there may be an awareness gap about the role these types of functional foods can play in healthy aging and improving overall health.

This article provides dietetics practitioners with recent research on the health benefits of prebiotics, probiotics, and flavonoid-containing foods.

GUT MICROBIOME
One of the hottest topics in health and wellness is the gut microbiome. The human gastrointestinal tract is host to one of the most complex ecosystems on the planet, containing more than 100 trillion individual microorganisms. The “healthy” microbiome is largely dominated by three bacteria phylas: Bacteroidetes, Actinobacteria, and Firmicutes. A number of factors influence the gut microbiome, including genetics, age, diet, and medical treatments such as drug therapies. Changes in the gut microbiome, called dysbiosis, has been linked to inflammatory gastrointestinal disorders including irritable bowel syndrome, inflammatory bowel disease, cancer, cardiovascular disease, and obesity. Gastrointestinal issues, motility disorders, and constipation are among the most common complaints heard by physicians from their older adult patients. Because probiotics and prebiotics support a healthy microbiome, they should be tools in an older adult’s nutritional arsenal.

PROBIOTICS
Consumption of foods and beverages containing probiotics and prebiotics is growing. Consumer market-
Probiotics
Continued from page 28

- Decreased gastrointestinal inflammation.
- Reduced risk of allergic diseases when consumed during early life.
- Reduced symptoms of lactose intolerance.
- Reduced colonization of pathogenic bacteria.
- Improved inflammatory bowel conditions.
- Reduced incidence of antibiotic-associated diarrhea.

Some of these health benefits are salient for older adults. For example, complaints about bowel habits and gastrointestinal distress are common in older females.7 Age-related functional gastrointestinal issues include decreased motility, bacterial overgrowth, and constipation, which could all be helped with probiotic use.8

**SOURCES OF PROBIOTICS**

Today many products claim to contain probiotics, but too often they do not meet the minimum criteria.11 The ISAPP consensus panel recommends that the term probiotic be used only for products that deliver live microorganisms with a suitable viable count of well-defined strains. These strains should have a reasonable expectation of delivering clinical benefits for the individual consuming these products.11

The foods with the highest amounts of live, active cultures are those that are naturally fermented. The following foods are rich in naturally fermented probiotics: buttermilk, kefir, kimchi, kombucha, microalgae, miso, sauerkraut, tempeh, and yogurt.

There is still uncertainty regarding the dose of a probiotic and the length of time needed to see a health benefit. This uncertainty is attributed to the lack of a standardized dose, the different probiotic sources, and an individual’s unique microbiome. For these reasons, it is best to recommend consumption of a wide variety of probiotic foods as part of an over-
the goal of optimizing the effect of probiotics on the gut microbiome. \(^{20}\)
Examples of meals that are symbiotic are found in Table 1.
Supplements may be an alternate way for clients to obtain probiotics and prebiotics in their diets. In a meta-analysis of 11 clinical trials, probiotic supplements decreased intestinal transit time, with the greatest effects seen in older adults with constipation. \(^{21}\) However, a food-first approach guarantees the delivery of other nutrients needed by older adults for good health. For example, yogurt contains probiotics and is also a good source of protein, calcium, B vitamins, zinc, and vitamin D (if fortified). \(^{22}\) Moreover, the 2010 Dietary Guidelines for Americans recommends increasing the intake of fat-free or low-fat milk and milk products, such as milk, yogurt, cheese, or fortified soy beverages, which may contain these beneficial components. \(^{23}\)

### FLAVONOIDS
Dietetics practitioners working with the older population already know that fruits and vegetables are good for our clients, but there may be even more reason to encourage clients to eat these foods on a daily basis. They contain flavonoids, a large and diverse group of compounds naturally present in a variety of plant-based foods. Emerging science associates their consumption with a range of health benefits.
Flavonoids are one of the most common and largest groups of phytonutrients found in the diet, and to date more than 4,000 varieties have been identified. \(^{24}\) Flavonoids share a common chemical structure, and in the context of the human diet, they can be divided into six primary subclasses: flavonols, flavones, flavanones, flavan-3-ols (or flavanols, as simple forms and more-complex chains known as proanthocyanidins), isoflavones, and anthocyanidins. Though these subclasses share common structural features, each class has unique chemical and biological properties. Thus it is important to know not only that a food or beverage contains flavonoids, but also what forms are present. The United States Department of Agriculture (USDA) has created several comprehensive, public-access databases of flavonoids that provide a detailed view of some of the most common flavonoid-containing foods in the human diet:
- USDA Special Interest Databases on Flavonoids
- USDA Database for the Proanthocyanidin Content of Selected Foods—2004
- USDA Database for the Isoflavone Content of Selected Foods, Release 2.0.
As evidenced by these databases, significant amounts of flavonoids are found in a variety of foods, as shown in Table 2.

### Table 1: Meals that combine probiotics and prebiotics. Consuming beneficial microbes simultaneous with their food sources encourages synbiosis.

<table>
<thead>
<tr>
<th>Meal</th>
<th>Combinations</th>
</tr>
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</table>
| Breakfast | • Yogurt with live and active cultures  
              • Pancakes topped with flavored yogurt and fresh fruit  
              • Oatmeal prepared with buttermilk and honey  
              • Bananas and yogurt |
| Lunch    | • Peanut butter and honey sandwich on whole grain bread  
              • Spinach, leek, and artichoke dip with whole wheat pita bread |
| Dinner   | • Garlic tomato sauce with fortified whole wheat penne pasta  
              • Hamburger on a whole grain bun with sauerkraut slaw  
              • Kabobs with onions, pineapple, peppers and lean beef |
| Snack    | • Banana with drizzled honey  
              • Smoothie with yogurt, orange juice, honey and banana |

### Table 2: The major classes of dietary flavonoids, and some common food sources.

<table>
<thead>
<tr>
<th>Flavonoid Group</th>
<th>Food Sources</th>
<th>Food and Beverages That May Be Enjoyed by Older Adults</th>
</tr>
</thead>
</table>
| Anthocyanidins  | Berries, cherries, eggplant, red onion, red potatoes | • Cherries covered in dark chocolate  
              • Roasted red potatoes and onions  
              • Eggplant parmesan  
              • Mixed-berry fruit salad |
| Flavan-3-ols, Flavanols | Dark chocolate, natural cocoa powder, black tea, green tea, cherries | • Dark-chocolate squares  
              • Iced black or green tea  
              • Cherry compote |
| Flavonols       | Apples, kale, leeks, onions | • Vegetable soup with kale, leeks, or onions  
              • Applesauce or baked apples |
| Flavanones      | Citrus fruits and juices (orange, grapefruit, lemon) | • Orange juice  
              • Orange or grapefruit sections  
              • Lemon wedges served with hot vegetables |
| Flavones        | Celery, cherries, parsley, strawberries | • Diced celery in potato or macaroni salad  
              • Strawberry and cherry shortcake |
| Isoflavones     | Soybeans, soy flour, soymilk | • Vanilla soymilk lattes  
              • Veggie burger or soy sausage |
Epidemiological evidence strongly supports that the consumption of at least five servings of fruits and vegetables a day is associated with a lower risk of mortality from a variety of causes.\textsuperscript{25,26} While the mechanisms underlying these benefits are not fully understood, it may be in part due to the flavonoids commonly found in these foods.\textsuperscript{25,26} Many studies have shown that the consumption of higher levels of flavonoids is associated with a range of benefits to human health, including a lower risk of cardiovascular disease mortality and stroke.\textsuperscript{27,28} Emerging research also suggests that flavonoids, specifically those found in berries, may be associated with a reduced rate of cognitive decline in older adults.\textsuperscript{29}

CONCLUSION

From cosmetics to food, products associated with healthy aging has been receiving increased attention and promotion. As dietetics practitioners working with older adults, we are well positioned to educate clients on the scientifically proven benefits of foods such as prebiotics and probiotics for healthy aging. Even though we may not be able to “turn back the clock,” providing clients with the knowledge of how to seek out and eat foods with health-promoting components may help improve overall health going forward.

ADDITIONAL RESOURCES

Visit these sites to learn more about the information discussed in this article:

\begin{itemize}
  \item The International Scientific Association for Probiotics and Prebiotics.
  \item Functional Foods Fact Sheet: Probiotics and Prebiotics, available from the International Food Information Council Foundation.
\end{itemize}

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Sarah Romotsky, RDN, is employed by the International Food Information Council (IFIC) Foundation. The Foundation is dedicated to the mission of effectively communicating science-based information on health, nutrition and food safety for the public good. It receives support from government agencies; other foundations and associations; and the broad-based food, beverage, and agricultural industries. The Foundation does not lobby or promote any company, brand, or product. It brings together, works with, and provides information to consumers, health and nutrition professionals, educators, and government officials; as well as food, beverage, and agricultural industry professionals. We have established partnerships with a wide range of credible professional organizations, government agencies, and academic institutions to advance the public understanding of key issues.

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Continued on page 31
Continued from page 30


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