Chapter 6
Healthy Aging: Nutrition Concepts for Older Adults

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Key Points

- A lifestyle that includes a healthy diet and regular physical activity, including strength training, delays the appearance of age-related changes and slows the development of chronic disease and disability.
- Age-related changes in nutrient requirements increase or decrease depending on the nutrient; energy needs decline underscoring the importance of nutrient-rich foods.
- Both inappropriate weight gain and debilitating weight loss add to chronic disease and disability; loss of muscle can be prevented or reversed with strength training.
- Nutrient supplements may be needed as energy intake declines, but attention to individual needs, current medications, and food intake avoids toxicity or dangerous interactions.
- Community nutrition programs providing congregate or home-delivered meals help maintain nutrient intake when loneliness, anorexia, limited resources, or disability interfere with obtaining or preparing adequate meals.

Keywords Aging • Anorexia of aging • Sarcopenia • Physiological changes of aging

Introduction

By 2030, one in five persons in the United States will be aged 65 or over [1]. The aging population carries implications for health providers, policy-makers, and programs such as Medicare. The rising prevalence of obesity and the growth in diverse populations, especially those vulnerable to hypertension and diabetes, accentuate the need for lifestyle intervention at all ages. Optimal nutrition and physical activity represent the golden key to good health in a patient's later years. Appropriate amounts and types of food slow the aging process and improve both short- and long-term outcomes. New discoveries continue to affirm the interaction of nutrients with the biology of aging.

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Physiologic Aging and Nutrition

Age-related changes in physical vigor become more pronounced after age 70. Changes in body composition, gastrointestinal function, and renal function follow a similar progression across the population, but occur at different rates within each individual and influence nutrient needs. Accordingly, patients may require individualized nutrition recommendations.

Body Composition

Loss of lean tissue influences health. Loss of muscle (sarcopenia), and to a lesser extent organ tissue, lowers basal needs. A sedentary lifestyle accelerates muscle loss, promoting the risk of physical disability and frailty. Conversely, strength training can restore muscle mass in persons as old as 98 years, giving renewed ability for self-care [2]. Muscle serves as a repository for amino acids for producing immune factors or acute phase proteins or rebuilding tissue following illness or stress. Replacing muscle (75% water) with fat (15% water) lowers total body water, based on their relative water content, and adds to the risk of dehydration. Loss of bone mineral mass contributes to risk of falls and fractures. Increased protein intake coupled with strength training blunts age-related muscle loss.

Gastrointestinal Function

Except for gastric acid, gastrointestinal secretions remain adequate to digest and absorb protein, fat, and carbohydrate. Atrophic gastritis, affecting 30% of older adults, likely results from *Helicobacter pylori* infestation, not normal aging [3]. Reduced gastric acid adversely affects the absorption of vitamin B_{12}, folate, iron, and calcium and permits bacterial overgrowth further lowering vitamin B_{12} availability. If gallbladder dysfunction interferes with fat absorption, fat-soluble vitamin absorption also declines. Intestinal microflora change in number and composition in older versus younger individuals, as influenced by diet, degree of inflammation, and institutionalization [4]. These microorganisms regulate nutrient absorption, modulate gastric motility, and control the growth of pathogenic bacteria. Specific bacterial populations have been linked to chronic disease; prior treatment with antibiotics appears to predispose older individuals to *Clostridium difficile* infection with gastroenteritis. Alterations in gastric hormone activity, a decline in nitric oxide, and the loss of the stomach's ability to stretch when food is received lead to early satiety and anorexia among frail elders [5].

Renal System

Loss of nephrons and changes in the renin–angiotensin–aldosterone system lower the conservation of water and sodium. The renal conversion of vitamin D to its active form is less effective, adding to the risk of bone loss. High protein intakes mandate additional fluid to excrete added nitrogenous waste. Renal changes further heighten the risk of dehydration in patients with reduced thirst and limited fluid intake.

Nutrient Requirements of the Older Adult

Normal aging coupled with chronic disease and medications adds uncertainty to nutrient requirements. The Dietary Reference Intakes (DRI) define two age categories for older adults (51–70 and over 70), addressing the cumulative physiologic and functional changes that occur over adult life [6]. Although food intake and energy needs decline, other nutrient needs do not, emphasizing the need for nutrient-rich foods.

Energy Requirements

Energy intake presents a delicate balance between unwanted weight gain and inappropriate weight loss. Basal calories fall 1–2% per decade over adult life, and for sedentary older adults, basal needs may equal 75% or more of total energy expenditure. Energy intake drops by about 450 kcal in women and 750 kcal in men between ages 20 and 70 [7]. Estimated energy needs for people over age 50 are 2000–2800 kcal for men and 1600–2200 kcal for women, depending on activity level [8], but many persons fall below 1600 kcal, making it difficult to supply required amounts of essential nutrients. At least 130 g of carbohydrate is needed each day to provide glucose for optimum brain function [6]. Fat should make up 20–35% of total energy, with the upper range supplying additional energy if food intake declines. While some patients need to lower fat and energy intake to prevent unwanted weight gain, others are influenced by public health messages directed toward younger overweight individuals and reduce energy and fat to inappropriately low levels.

Protein

Dietary protein supports tissue repair and replacement and counters the progression of sarcopenia. Both the amount of protein consumed and its distribution across all meals are important for preserving muscle. Studies suggest the current DRI of 0.8 g/kg is insufficient to prevent muscle loss in older adults and an intake of 1.0–1.5 g/kg is more appropriate [9]. To stimulate on-going muscle protein synthesis, 25–30 g is needed at each meal. Although protein intake usually reaches or exceeds this amount at lunch and dinner, older adults often consume less than 15 g at breakfast, and, frequently, this is plant rather than animal protein. Adding a serving of milk or yogurt along with an egg or slice of cheese could raise protein intake at breakfast. Protein intakes over two times the DRI can tax the nitrogen and urea removal capacities of less efficient kidneys and are best avoided.

Micronutrients

Micronutrients play a significant role in aging and the etiology of chronic disease. In this section, we discuss selected new aspects and functions of these nutrients.

Fat-Soluble Vitamins (A, E, D, and K)

Preformed vitamin A (retinol) is supplied in animal foods such as milk, butter, and liver, whereas provitamin A, converted to retinol in the liver, is found in fruits and vegetables. Traditionally associated with vision, vitamin A also supports immune function and cell differentiation. Preformed vitamin A is well-absorbed and toxicity can occur with high potency supplements and/or excessive intakes of fortified foods. Excessive vitamin A has been shown to accelerate bone mineral loss [6]. In contrast, provitamin A (e.g., beta-carotene, cryptoxanthin) consumed in food is nontoxic.

Vitamin E, the major body antioxidant, helps prevent the oxidation of LDL cholesterol and neutralizes free radicals from both internal and external sources. However, vitamin E supplements exceeding the DRI are not beneficial and indeed increase mortality risk [10]. Those anticipating surgery need to be alerted to the anticlotting action of vitamin E supplements.

Vitamin K-dependent proteins, required for normal blood-clotting, also help form bone matrix and facilitate its mineralization. Green leafy vegetables are good sources. Patients taking anticoagulants should monitor their intake of vitamin K, as too high an amount can neutralize the action of the drug.

Roles of vitamin D—the "sunshine" vitamin—have expanded from regulation of bone health to cancer prevention, immune response, and muscle metabolism; recent evidence suggests a role in mental function, as older persons with poorer vitamin D status exhibit more rapid decline in memory and cognitive function [11]. Normally, skin synthesis can meet body needs, but changes in skin cells, use of sunscreen, and limited sun exposure put older adults at risk. Those with darker skin produce vitamin D at about one-sixth the rate of Caucasians. Current recommendations for persons aged 30 and over are noted in Table 6.1. Vitamin D-fortified dairy foods, soy milk, juices, and cereals supply about 100 IU (2.5 μg) per serving, but portions are often inadequate to meet the DRI, creating need for a supplement. According to national survey data, mean vitamin D intakes from food and beverages for persons age 60 and over are 5.3–5.6 μg/day for men and 3.9–4.7 μg/day for women [7]. African American and Hispanic elderly have lower serum vitamin D levels than Caucasians [11]. (Further information on vitamin D can be found in Chap. 25)

Water-Soluble Vitamins

Requirements for thiamin, riboflavin, and niacin do not change with age; yet intakes can be low as food intake declines. Alcohol interferes with thiamin absorption and long-term use of diuretics can result in thiamin depletion. Milk and cereals are major sources of riboflavin and intake suffers if these foods are not consumed regularly. Optimum protein supplies both niacin and the amino acid tryptophan for niacin synthesis. Vitamin C as an antioxidant may help prevent senile cataract and preserve immune function.

Vitamin B_6 requirements increase after age 50 and inadequate intake adversely affects immune function and synthesis of neurotransmitters. Vitamin B_6 acts with folate and vitamin B_{12} to modulate plasma homocysteine levels. Megadoses of B_6 (2000-fold the DRI) impair muscle coordination and lead to irreversible neural damage if prolonged.

Table 6.1 Dietary Reference Intakes for vitamin D and calcium

Age	Vitamin D	Calcium
31–50	600 IU (15 μg)	1000 mg (males) 1000 mg (females)
51–70	600 IU (15 μg)	1000 mg (males) 1200 mg (females)
Over 70	800 IU (20 μg)	1200 mg (males) 1200 mg (females)

From Ref. [12]

Current folate (folic acid) fortification policies directed toward the prevention of neural tube defects have implications for older adults. Folic acid (the form added to grain foods) is better absorbed than naturally occurring folate in plant foods (85% vs. 50%), which requires acid for best absorption [6]. High levels of available folate, however, can substitute for vitamin B_{12} in the production of red blood cells. As a result, it delays the appearance and diagnosis of pernicious anemia and B_{12} deficiency, while irreversible neural damage continues [6].

Vitamin B_{12} status is precarious for those with low gastric acid, as acid is needed to release B_{12} from animal food proteins and enable its absorption. Synthetic vitamin B_{12} used in food fortification does not require acid for absorption, so it is best that fortified foods be consumed two to three times a week. Older adults are vulnerable to the harmful effects of B_{12} deficiency based on its effect on cognitive function.

Minerals

In older adults, calcium intakes are well below the recommended amount (see Table 6.1). Dairy foods and calcium-fortified juices, cereals, and soy milk supply 300 mg per serving, and 3–4 servings per day of these foods will adequately meet calcium needs. Increasing evidence points to the risk of inappropriate calcium supplements with reported incidence of gastrointestinal distress, related hospital admissions, and development of renal calculi. Calcium supplement users, when compared with subjects given placebos, had a 27% increase in myocardial infarctions and greater risk of stroke [12]. Older adults should avoid aluminum-containing antacids that bind with phosphorus, leading to phosphate depletion and adult rickets (osteomalacia). It is suggested that calcium helps control blood pressure [11], yet another reason to eat calcium-containing foods.

Based on its role in opposing the pressor action of sodium on blood pressure, the DRI for potassium was set at 4700 mg [6]; however, low food intake, limited resources, and chewing problems can make it difficult to include the five to nine servings of fruits and vegetables needed to reach this goal. Unless kidney function is severely compromised, adding potassium in the form of food does not pose a risk. Potassium supplements require on-going medical supervision.

The optimum intake of sodium continues to prompt debate. As a means of controlling blood pressure, individuals over age 55, African Americans, and persons with heart disease were urged to lower their sodium intake from the Upper Tolerable Intake Level (UL) of 2300 mg to the Recommended Dietary Allowance (RDA) of 1500 mg [13]. A recent report by the Institute of Medicine concluded that sodium intakes below 2300–2400 mg are associated with higher mortality and hospitalization of heart patients and recommended that these individuals follow the guideline of 2300 mg set for the general population [13]. However, many older adults consume well over this amount. About 77% of sodium intake comes from processed foods; about 11% is added in home preparation or at the table; and only 12% is naturally occurring [6]. Elderly persons with limited mobility depend on canned or frozen items that are often high in sodium. Salt substitutes often exchange potassium for sodium.

Magnesium has an important role in forming bone mineral crystals. Dairy products are a major source and persons avoiding those foods can have low intake. Poor magnesium status has been associated with renal wasting related to diuretic therapy [6]. Hypermagnesemia is a threat for those abusing magnesium-containing antacids or cathartics.

Iron needs are minimal in older adults (8 mg daily), but risk of deficiency is increased by poor absorption related to low gastric acid, chronic use of aspirin, or other pathological conditions resulting in blood loss [6]. Once iron is absorbed, it is poorly excreted, so iron overload is a danger with regular use of iron supplements. Highly fortified cereals containing 18 mg of iron per serving pose a risk if multiple servings are eaten regularly. Alcohol enhances iron absorption.

Zinc deficiency causing loss of taste and impaired wound healing sometimes occurs in older people. Normal function is dependent on adequate zinc, but age-related changes or other nutrient deficiencies may play a part.

Fluid and Electrolyte Homeostasis

Changes in hormonal secretion coupled with cardiovascular disease and medications can upset a delicate fluid balance, increasing the risk of dehydration or fluid retention. Reduced ability of the kidneys to conserve fluid and changes in the hypothalamus that lower voluntary fluid intake increase risk of dehydration. Various medications interfere with thirst, and incontinent elderly may self-limit fluid intake. Dehydration can result in drug toxicity and heat stroke in uncontrolled environments. Conversely, inappropriate secretion of antidiuretic hormone leads to water intoxication or hyponatremia.

Electrolyte disorders are not uncommon among community-living older adults [14]. Hyponatremia is associated with changes in postural balance, falls, and bone fractures. Thiazide, loop diuretics such as furosemide, and potassium-sparing diuretics require special attention to electrolyte balance.

Current fluid recommendations call for 9 cups/day for women and 13 cups/day for men and include fluid from all beverages and high-fluid foods such as soup [6]. The debilitated older adult following the mandate to "drink eight cups of water a day", in addition to other fluids, is at risk of water intoxication. Elderly individuals should monitor their fluid intake and not depend on thirst as a guide.

Nutrition and Dementia

The role of nutrients other than vitamin B_{12} in preventing age-related cognitive decline is poorly understood. However, a recent report suggests that fish and its n-3 polyunsaturated fatty acids (PUFAs), particularly docosahexanoic acid, lower the risk of future cognitive impairment [15]. A meta-analysis of 21 studies involving nearly 182,000 participants revealed that one serving of fish per week reduced the risk of dementia and Alzheimer's disease; increased intakes may lower the risk of mild cognitive impairment and Parkinson's disease. Fatty fish such as herring, sardines, mackerel, trout, salmon, and tuna are good sources of these fatty acids. Two servings of fish per week may also help prevent cardiovascular disease.

Special Benefits of Plant Foods

The dietary fiber found in whole grains, fruits, and vegetables helps lower blood cholesterol, prevent constipation, and improve intestinal health. Older adults with diets low in fiber should be encouraged to *gradually* increase their fiber along with additional fluid. Phytochemicals (plant chemicals) such as lycopene and polyphenols act as antioxidants and may protect against chronic disease; however, to be effective, they must be consumed in food, not supplements, suggesting they interact with each other or other unidentified substances in food.

Dietary Supplements

Individual requirements and circumstances govern the need for dietary supplements. When energy intake is low, it is less likely that all vitamin and mineral requirements can be met from food alone. In that case, a multivitamin–mineral supplement, with a composition approximating the DRIs, is helpful [16]. Supplements containing more than 100% of the DRI of any nutrient can lead to adverse interactions or total intakes that exceed the ULs. Iron and folic acid supplements require medical supervision.

To the extent possible, food is the preferred way to supply nutrients. Unfortunately, herbal, botanical, and other supplements are being marketed to older adults who need to be aware of potentially dangerous interactions with medications. The problem of dishonest marketing of supplements is discussed by Temple in Chap. 32.

Body Weight in the Older Adult

Body weight management poses particular problems in the elderly. Involuntary weight loss and decreasing muscle mass lower functional capacity, whereas ill-advised weight gain aggravates any existing disabilities and chronic disease. Age-related changes in food intake regulation preclude appropriate responses to short-term changes in food intake [17]. Weight lost during serious illness or emotional distress is unlikely to be regained; conversely, weight gain associated with short-term overeating is likely to become permanent.

Low Body Weight

The anorexia of aging is complex in nature. Age-related changes in the hypothalamus controlling the food drive and delayed gastric emptying lead to early satiety. Many common medications, such as digoxin, influence appetite. ACE inhibitors bring changes in taste such that even favorite foods become unpleasant. Various diuretics result in dry mouth, affecting taste and making swallowing more difficult. Cachexia arising from chronic inflammation and the subsequent release of cytokines is resistant to even aggressive nutritional intervention. A body mass index (BMI) which falls from a higher level to <21 might indicate a need for intervention [18].

Overweight/Obesity

The optimum body weight for a person of a given height appears to differ between older and younger individuals, resulting in a U-shaped curve with excess mortality at very high or low body weights. Although the BMI range of 18.5–24.9 represents normal weight, a recent meta-analysis of deaths in persons aged 60 and over indicated that hazard ratios were higher at BMIs below <23, were lowest between 23 and 32, and rose again at a BMI >33 [19]. Weight-loss interventions should balance any functional benefits with the need for appropriate intakes of nutrients. It is vital that weight loss does not bring about loss of muscle tissue that further compromises mobility and self-care. Rapid weight loss likely reflects an occult medical problem rather than a successful weight-loss regimen.

Factors Influencing Food Intake in Older Adults

Socioeconomic Factors

Changes in social relationships influence food intake. Eating alone can be a difficult adjustment for a widow(er). Loss of close friends or nearby family, changes in the neighborhood, or fear of the future reduce interest in eating. Financial losses and rising prices present difficult choices on a fixed income

that must cover living expenses and medications. Food choices can be dictated more by available money than need for nutrients. Many older adults are eligible for the Supplemental Nutrition Assistance Program (the food stamp program), but relatively few apply.

Health Factors

Physical infirmity makes food shopping challenging, and if transportation or food delivery is infrequent, access to fresh produce and milk is curtailed. Severe arthritis interferes with food preparation and opening packages of pre-prepared foods. Attempting to manage chronic conditions with a highly restrictive diet is most often counterproductive. Meal patterns including familiar foods with attention to frequency and portion control are more successful. Chewing is painful for edentulous elderly with ill-fitting dentures or periodontal disease, and left untreated, periodontal disease leads to systemic infection.

Loss of taste and smell or distorted taste related to normal aging, radiation therapy, or medications discourage eating. Bitter medications delivered to the taste receptors via the blood may flavor the saliva and affect appetite. The interaction of nutrition and drugs is discussed more completely in Chap. 34.

Dry mouth (xerostomia) makes eating and swallowing difficult. The loss of saliva associated with this condition enables rapid bacterial growth with ulceration if continued. Dysphagia or difficulty swallowing and fear of choking influence the types of food that can be handled comfortably. Swallowing can be troublesome for those with neurological impairment as occurs with Parkinson's disease, diabetes, or radiation treatment.

Evaluating Nutritional Risk

Community programs providing congregate meals in a social environment or delivery of meals to the homebound provide nutritional support and promote independent living. Most are subsidized with local and federal funds and target elderly persons who have limited resources. Questions in Table 6.2 can assist in identifying those at risk who could benefit from such programs. For an expanded assessment tool that can be self-administered (SelfMNA® Mini Nutritional Assessment), see Suggested Further Reading. Contact information for community food programs can be found on web sites or telephone listings of county and state departments for the aging.

Health Promotion for the Older Adult

Positive changes in the quality or amount of food consumed are never without benefit, regardless of age or physical status. Increased intakes of fruits, vegetables, and whole grains, and good food sources of calcium, protein, and vitamin D add important nutrients and phytochemicals for resisting chronic

Table 6.2 Identifying risk factors for inadequate food intake

Do you ever have problems obtaining the food you need? (could relate to problems with shopping or lack of money to buy food)
Do you have any problems that make it difficult to eat? (may involve chewing, loss of taste, problems with swallowing)
Do you eat at least two meals every day? (amount of food eaten)
Have you gained or lost 10 pounds over the last 6 months? (involuntary weight loss or unwanted weight gain)

disease and enhancing immune response. Regular physical activity to the extent possible, including walking and strength training, helps maintain bone and muscle mass and extend independence. Small changes add up to make a significant difference in the well-being of the aging adult.

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