Nutrition and Exercise in the Older Person

By Erica L. Estus, Pharm.D., CGP; and
Norma J. Owens, Pharm.D., FCCP, BCPS

Reviewed by Carol Fox, Pharm.D., CGP; Katherine H. Chessman, Pharm.D., FCCP, BCPS, BCNSP; and Anita Patel Rahman, Pharm.D., BCPS

Learning Objectives

1. Analyze an older adult's nutrition status in order to recommend dietary changes.
2. Assess the potential risk factors for and consequences of weight loss or obesity in an older adult.
3. Evaluate the overall risks and benefits of exercise.
4. Design the basic components of an exercise regimen for the older adult with underlying health conditions.
5. Evaluate the appropriateness of a diet and exercise program to meet an older adult's health promotion goals.

Nutrition

Characteristics of Proper Nutrition

Proper nutrition plays a critical role in the prevention of many diseases and conditions associated with aging. Adequate nutrition and maintenance of a normal weight also help maintain optimal physical and mental function as a person ages. The adverse effects of excess weight are different in people older than 65 years than in younger individuals. In the healthy aging adult, body weight tends to peak in the 60s and remains somewhat stable into the 70s. After 70 years, weight tends to decrease slowly.

For the older adult, obesity is not associated with an increase in mortality. For instance, in one large cohort of men and women ages 70 to 75 years that used body mass index (BMI) cutoffs of less than 18.5 kg/m^2 as underweight, 18.5–24.9 kg/m^2 as normal weight, 25–29.9 kg/m^2 as overweight, and 30 kg/m^2 or greater as obese, individuals who were overweight had a risk of death that was 13% lower than individuals of normal weight. The death rate for obese individuals was about the same as for those of normal weight. Data from several studies show a U-shaped mortality curve with minimal mortality risk in patients with a BMI range of 25–34 kg/m^2.

Some literature suggests that body fat distribution is as important a risk factor as being overweight. But, once again, individuals older than 65 years have a mortality risk different from that of younger people when assessing fat distribution. The Third National Health and Nutrition Survey examined the relationship between weight and anthropometric measurements and mortality in 34,000 individuals. Abdominal obesity, assessed by waist-to-hip ratios, was associated with an increased mortality in people younger than 65 years but was unrelated to mortality in people older than 65 years. For

Baseline Review Resources

The goal of PSAP is to provide only the most recent (past 3–5 years) information or topics. Chapters do not provide an overall review. Suggested resources for background information on this topic include:

- U.S. Department of Health and Human Services and U.S. Department of Agriculture. Dietary Guidelines for Americans, 6th ed. Washington, DC: U.S. Government Printing Office, January 2005. Available at *www.cnpp.usda.gov/DGAs2005Guidelines.htm*. Accessed May 8, 2011.
- U.S. Department of Agriculture and U.S. Department of Health and Human Services. Dietary Guidelines for Americans, 7th ed. Washington, DC: U.S. Government Printing Office, December 2010. Available at *www.cnpp.usda.gov/DGAs2010-PolicyDocument.htm*. Accessed May 6, 2011.
- U.S. Department of Health and Human Services, 2008 Physical Activity Guidelines for Americans, October 2008. Available at *www.health.gov/paguidelines*. Accessed May 6, 2011.

Abbreviations in This Chapter

ACSM	American College of Sports Medicine
BMI	Body mass index
DHHS	U.S. Department of Health and Human Services
DRI	Dietary reference intake
USDA	U.S. Department of Agriculture

instance, in women with waist-to-hip ratios greater than 0.85, mortality was markedly higher for women in the 18–65 group but did not rise for women in the older age groups (65–75 years or 75 years and older).

As adults age, there is about a 0.3-kg (0.66 lb) loss of lean body mass each year, beginning in the fourth decade of life. When an older person loses metabolically active muscle tissue, adiposity increases such that total body weight is maintained. Because adipose tissue is less metabolically active than muscle, caloric (energy) requirements decrease with age. *Sarcopenia* is the term for this loss of skeletal muscle mass, which is responsible for a reduction in strength and function that can lead to physical disability. Factors that contribute to the development of sarcopenia include muscle disuse, age-related decreases in several hormones, activation of inflammatory cytokines, and anorexia. Sarcopenia with anorexia, activation of the immune system, and anemia usually lead to the loss of physical mobility and further weight loss, referred to as the *frailty syndrome*. One possible approach to combat this cycle of decline is adequate nutrition and exercise.

Although obesity (measured by BMI) is not correlated with mortality in older adults, it is related to loss of physical function. Obesity (BMI greater than 30 kg/m^2) in the older adult is a serious health care concern because of its relationship to physical disability. In a prospective longitudinal study conducted over 20 years, older adults who were obese at study inception had higher rates of upper and lower body disability. Adults who began the study with a normal BMI but became obese over time also had high disability rates; however, adults who were obese at study inception and who lost weight continued to exhibit high upper and lower body disability. In older obese adults with physical disability, both losing weight and developing a physical exercise program may be needed to restore function.

Weight loss is recommended as a therapeutic intervention in overweight and obese adults with certain diseases such as type 2 diabetes mellitus, coronary artery disease, and obstructive sleep apnea. In one randomized, controlled trial of weight reduction for obese individuals with osteoarthritis (average age 69 years), those randomized to weight loss were half as likely to die at 18 months. Weight loss in young and middle-aged overweight and obese adults is associated with improvements in a variety of health risks.

However, weight loss to achieve improved patient outcomes in the elderly remains controversial. The important variable to assess in weight loss in older people may be whether the loss is intentional. In one prospective cohort of more than 900 community-dwelling people (average age 75 years), factors that were correlated with an increase in mortality at 3 years included being underweight (BMI less than 18.5 kg/m^2) or unintentional weight loss. Individuals with intentional weight loss had the same mortality rate as those who did not lose weight. Distinguishing the etiology of weight loss may be the critical factor in evaluating the mortality impact of weight loss in older people.

In an older adult, unintentional weight loss in 1 month that exceeds 5% of usual body weight requires evaluation. Appetite may decline because of the loss of the sense of smell. In addition, older adults may experience a decrease in taste sensitivity, often developing a preference for sweet and salty flavors. Changes in the gastrointestinal tract can contribute to appetite changes. Aging leads to a loss of compliance of the fundus of the stomach, which causes more rapid antral filling. Distension of the antrum signals the central nervous system to indicate satiety. Cholecystokinin, a satiating agent released in response to fat in the gastrointestinal tract, is released in higher concentrations in older adults. Changes in the oral cavity, including broken or absent teeth or ill-fitting dentures, can also contribute to weight loss.

Loss of lean muscle mass in the mouth and throat can lead to inefficient chewing. Swallowing difficulty occurs with neurodegenerative diseases or cerebrovascular injury. Saliva is not only necessary for proper chewing and swallowing, it also contains calcium and phosphates that help protect the mineral structure of teeth. As many as 40% of older adults have xerostomia. Over-the-counter saliva products can ease dry mouth discomfort; however, discontinuing drugs that may cause dry mouth should be attempted first, if possible. Some drugs and disease states that may contribute to changes in saliva are listed in Table 1-1.

Nutritional Requirements

For several decades, the U.S. Department of Agriculture (USDA) in collaboration with the U.S. Department of Health and Human Services (DHHS) has published updated recommendations for dietary intake for Americans. With each revision of these *Dietary Guidelines for Americans*, controversy has ensued because of disagreement related to the strength of the evidence supporting the recommendations. In many ways, the original (1977) recommendations are still relevant: consume only enough energy to meet expenditure, and increase consumption of complex carbohydrates while

Table 1-1. Saliva Changes in the Elderly

Nondrug-Related Causes of Xerostomia	**Comment**
Emotion: fear, excitement, stress	Saliva secretion is regulated by the autonomic nervous system; affected by both physical and emotional change
Disease/condition: Parkinson disease, Alzheimer disease, depression, stroke, some collagen vascular diseases, dehydration	Salivary amount can be decreased; saliva quality can change and become more viscous; mouth infections are increased
Other: mouth irradiation, poor quality of the dentate state	
Drug-Induced Causes of Xerostomia	
Anticholinergics: antihistamines (diphenhydramine, chlorpheniramine, hydroxyzine), trihexyphenidyl, benztropine, atropine, ipratropium, tiotropium	
Urinary antimuscarinics: oxybutynin, tolterodine, trospium, solifenacin, darifenacin	
Skeletal muscle relaxants and antispasmodics: cyclobenzaprine, methocarbamol, carisoprodol, tizanidine, dicyclomine	
Psychiatric agents: tricyclic antidepressants (amitriptyline, clomipramine, doxepin), antipsychotics (thioridazine), antidepressants (bupropion, duloxetine, lithium, mirtazapine, paroxetine, trazodone, venlafaxine)	
Cardiac agents: clonidine, disopyramide, doxazosin, phenylpropanolamine	
Miscellaneous agents: amantadine, eszopiclone, gabapentin, marijuana	
Drugs That Leave a Bad Aftertaste in the Mouth	**Comment**
Fish oil	Fishy aftertaste commonly reported
Nedocromil	Significant enough to decrease adherence
Intranasal triptans	
Lithium, eszopiclone, metformin, ipratropium, metronidazole, clarithromycin, gallium nitrate, potassium iodine	Metallic aftertaste commonly reported
Methylprednisolone, prednisone	Bitter aftertaste

Table 1-2. Daily DRI for Macronutrients in Older People

Age/Sex	**Estimated Energy Need[a] (kcal)**	**Protein (g)**	**Carbohydrates (g)**	**Fat (g)**	**Fiber (g)**
65 years					
Man	2305	56	259–375	51–90	30
Woman	1897	51	213–308	42–74	21
75 years					
Man	2210	56	249–359	49–86	30
Woman	1828	51	206–297	41–71	21
85 years					
Man	2114	56	238–344	47–82	30
Woman	1759	51	198–286	39–68	21

[a]For men: height, 5′7″; BMI, 24 kg/m^2; and low-active physical activity level. For women: height, 5′4″; BMI, 24 kg/m^2; and low-active physical activity level. To calculate caloric need to maintain weight for women: 655 + (9.6 x weight in kg) + (1.8 x height in cm) – (4.7 x age in years). For men: 66 + (13.7 x weight in kg) + (5 x height in cm) – (6.8 x age in years). To calculate the total daily energy need with an activity adjustment, caloric need is then multiplied by 1.2 for a sedentary lifestyle, 1.375 for low activity that occurs 1–3 days/week, 1.55 for moderate activity that occurs 3–5 days/week, and 1.75 for very active activity that occurs 6–7 days/week.

BMI = body mass index; cm = centimeter; DRI = dietary reference intake; kcal = kilocalorie.

decreasing intake of refined and processed sugars, fat, saturated fat, cholesterol, and sodium.

In 2002, several organizations involved in health policy and nutrition collaboratively published a comprehensive document establishing dietary reference intakes (DRIs) for macro- and micronutrients for healthy Americans and Canadians. The DRIs encompass four different recommended intakes: recommended daily allowance, estimated average requirement, adequate intake, and tolerable upper intake level. Population-specific DRIs were created for certain groups; those for older adults are presented in Table 1-2. Macronutrients, including protein, carbohydrates, fat, and fiber, are discussed in this chapter. Micronutrients are discussed in another chapter of this book.

Energy requirements of older people were determined on the basis of BMI and physical activity level. Age-adjusted caloric values were calculated by subtracting 10 kcal/day for each year older than 30. The 2005 *Dietary Guidelines for Americans* recommends that individuals consume a variety of nutrient-dense foods from the four major food groups and limit the amount of saturated fat, trans fat, cholesterol, added sugars, and salt. Ethanol, if consumed, should be limited to no more than one portion a day for women and two for men.

The focus of the 2010 *Dietary Guidelines for Americans* is to improve eating and physical activity behaviors so that calories are balanced with energy expenditure to manage weight. All individuals are encouraged to maintain their weight within a healthy range (BMI 18.5–24.9 kg/m^2) by consuming about 2 cups of fruit, 2½ cups of vegetables, 3 oz of whole grains, and 3 cups of low-fat milk or other low-fat dairy product each day. For individuals older than 51 years, sodium should be limited to less than 1.5 g/day (about ½ teaspoon of table salt). The recommended daily amount of protein is 0.8 g/kg (10% to 35% of total calories), and the proportion of fat should be no more than 20% to 35% of the total caloric intake with less than 10% of calories from saturated fat. The remaining 45% to 65% of the caloric intake should come from carbohydrates. Half of all grains consumed should be from whole grains, and added sources of sugar should be limited. Older people are encouraged to eat foods fortified with vitamin B_{12} (such as fortified cereals). One pound of weight is associated with a 3500-kcal intake. Individuals wishing to gain or lose weight are advised to increase or decrease their daily caloric intake by 500 kcal/day for a 1-lb weight gain or loss, respectively, in 1 week.

The USDA established an evidence-based nutrition library in 2009, and the most recent Dietary Guideline Advising Committee attempted to answer more than 100 questions on nutrition. This evidence-based publication formed the basis of the 2010 *Dietary Guidelines for Americans*. The focus of the 2010 guidelines is to recommend a portion-controlled, nutrient-dense diet that limits total calories to meet energy expenditures so that the prevalence of overweight and obesity in the United States will decrease. This dietary intake should be accomplished by eating a plant-based diet; adding seafood; increasing consumption of fat-free milk and milk products; moderating consumption of lean meats, poultry, and eggs; and limiting consumption of foods with added sugars and solid fats. In addition, the 2010 guidelines recommend that everyone meet the DHHS 2008 *Physical Activity Guidelines for Americans*.

The 2005 *Dietary Guidelines for Americans* graphically flipped the food pyramid on its side and created an interactive Web page (*www.mypyramid.gov*) to help consumers with diet evaluation and selection. There was controversy with the 2005 release, and in response, faculty members at the Harvard School of Public Health created the *Healthy Eating Pyramid.* This alternative pyramid was developed because of disagreement about some basic nutrition areas. For instance, the *Healthy Eating Pyramid* distinguishes between types of protein and recommends the consumption of fish, poultry, beans, and nuts and a limit on red meat. It also recommends only one or two servings per day of milk or dairy products and suggests supplementation with calcium and vitamin D to meet nutritional requirements. When the *2010 Dietary Guidelines for Americans* were compared with the recommendations in the *Healthy Eating Pyramid,* many of the dietary disagreements were resolved. The manner in which one consumes certain nutrients remains controversial. For instance, the *2010 Dietary Guidelines for Americans* recommends meeting calcium requirements by consuming three servings a day of fat-free milk or milk products rather than taking calcium supplements.

For older adults, uncertainty exists regarding the optimal amount of protein consumption. Both muscle and bone mass decline with aging, leading to sarcopenia and osteoporosis; sarcopenia is estimated to affect 30% of people older than 60 and 50% of people older than 80 years. Osteoporosis is present in about 44 million people in the United States who are older than 50 years. Dietary protein is essential to maintain optimal bone and muscle mass, and increasing the recommended daily amount of protein from 0.8 g/kg to 1–1.2 g/kg may be warranted.

The currently recommended amount of protein was derived from a meta-analysis of nitrogen balance studies. There are several limitations to using nitrogen balance as a method for determining adequate protein intake. First, with changes in protein consumption, there is slow adaptation in urea turnover, and many studies are not of sufficient duration to achieve nitrogen steady state. Second, nitrogen intake and excretion are difficult to measure, and dermal excretion varies greatly. The meta-analyses that confirmed the recommended

daily protein intake included studies mainly performed in young adults.

The laboratory evaluation of protein deficiency is difficult. Serum albumin (half-life of about 20 days) and transferrin (half-life of 8–9 days) decrease with protein deficiency and are useful in situations of chronic protein malnutrition. Functional outcomes such as lean muscle mass or bone mineral density can also be employed. With these alternative measures, it has been shown that older people require more protein (and higher-quality essential amino acids) for optimal muscle anabolism.

The pattern of protein ingestion may be important as well. In older people, the anabolic muscle response is greater with intermittent bolus amino acid supplements than with smaller amounts of supplements spread evenly over time. In addition, ingesting carbohydrates together with protein tends to blunt the anabolic response. Insulin sensitivity declines with age, and protein consumption leads to increased secretion of insulin-like growth factor, which is an important mediator of bone formation. In short-term studies conducted in 2-month intervals, increasing protein consumption led to increased calcium absorption, increased skeletal density, and decreased parathyroid hormone secretion.

There is a potential relationship between high-protein intake and glomerular pressure and filtration. However, in older adults with normal kidney function, a high-protein diet (1.5 g/kg/day) does not lead to loss of kidney function. Increasing the recommended daily protein intake in older adults from 0.8 g/kg to 1.0–1.2 g/kg keeps the proportion of calories from protein within a range of 13% to 16%, which is consistent with the present DRI range of 10% to 35%.

Nutritional Assessment and Intervention

Nutrition screening in the elderly is important because this population is at increased risk of nutritional deficiencies. Simple screening tools can identify individuals who are at risk, and nutrition interventions can improve patient outcomes. An initial nutrition screen should assess for the presence of recent, unintended weight loss of more than 4.5 kg (10 lb) within 6 months, low weight (less than 45.5 kg [100 lb]), and any significant change in appetite or dietary habits. If any of these conditions are present, then calculation of the BMI and laboratory assessment of biochemical markers (e.g., albumin, prealbumin, transferrin, total lymphocyte count, cholesterol) can be performed.

One nutrition screening tool that helps predict situations in which weight loss may occur is the two-part Mini Nutritional Assessment. The first part of this assessment is a quick six-question screen that provides scores between 0 and 14. The questions assess food intake, weight loss, mobility, presence of acute disease, and BMI. A score between 8 and 11 indicates risk of malnutrition, and a score of 7 or less indicates malnutrition. If an individual's score is less than 12, then 12 additional items can be assessed. These additional questions provide a more specific risk assessment with respect to factors such as taking more than three prescription drugs, presence of pressure ulcers, number of full meals consumed daily, method of feeding, and measurement of the arm and calf circumference. These additional questions provide a possible 16 points; added to the screening score, this yields 30 possible points. A score between 24 and 30 indicates a normal nutrition state; a score of 17–23 indicates risk of malnutrition; and a score of less than 17 indicates malnutrition.

In older people, adverse outcomes such as physical disability and death are associated with a low serum albumin concentration (less than 3.5 g/dL), total lymphocyte count (less than 1500 cells/mm^3), and total cholesterol values (less than 150 mg/dL). However, these biochemical markers are often affected by other disease states and lack specificity as indicators of nutritional status. If an individual is found to be at risk on an initial screen, the nutritional assessment should focus on a thorough history to determine the patient's access and means to obtain and cook food, a thorough physical and oral examination, and a thorough drug and medical/surgical history review. Often, a quantitative history of food intake can be obtained by using caloric counts, 24-hour dietary recall, or various food ingestion questionnaires.

Undernutrition (a type of malnutrition that includes an imbalance between food consumption and nutrient need) is common in the community-dwelling older person, with prevalence estimates ranging from 14% to 27%. Higher prevalence rates are seen in the elderly with cognitive impairment, many medical comorbidities, physical limitations, and low socioeconomic status. Even in long-term care institutions where access to or preparation of food is not an issue, protein calorie malnutrition exists in 25% to 85% of residents.

In individuals who are able to eat but who do not consume sufficient calories, other social factors should be identified. In older people who can eat and who appear to consume sufficient calories, the presence of medical conditions that cause or contribute to weight loss (e.g., malabsorption syndromes, thyroid disease) should be assessed. The quality of the diet should also be assessed to ensure the individual is consuming nutrient-dense foods. In individuals who are not eating, it is important to assess mental and medical status and identify excess sedation, dysphagia, acute illness, depression, drug use, and chronic diseases (e.g., cancer, infection, autoimmune disorders) that can lead to appetite loss. Moreover, social isolation, the taste of food, environmental ambience, and the cultural appropriateness of food selections are important considerations. Prescribed restrictive or therapeutic diets (e.g., low sodium or low fat) often limit

food choices and should be avoided in an older person who is underweight and not eating adequately.

The administration of oral supplements (Table 1-3) is one technique often used to increase daily caloric consumption in older people. The effectiveness of this approach depends on the etiology of the nutrition deficit. For example, individuals must be able to purchase and swallow the supplement, digest it, and absorb the nutrients. Oral supplements have been evaluated for nutrition benefit in specific situations with mixed results. In older people undergoing hospitalization and surgical repair of hip fracture, a comprehensive meta-analysis of more than 24 randomized trials found only weak evidence to support their use. Another meta-analysis of 55 trials evaluated the use of oral supplements to improve the clinical outcomes of more than 9187 people older than 65 years who were hospitalized for various conditions including stroke, hip fracture, and chronic obstructive pulmonary disease. Improvements in nutritional status (as assessed by weight gain) were generally seen, but supplement use reduced mortality only when used in undernourished patients during the acute hospital stay. In older adults who have cachexia related to the frailty syndrome, it is unknown whether increasing calories will improve weight or patient outcomes. When oral supplements are added to an older person's diet, food consumption may decrease. Whenever possible, obtaining macronutrients from food, rather than oral dietary supplements, is preferred for several reasons. There could be potentially undiscovered nutrient ingredients in food that are missing in a supplement; the chemical formulation of the nutrient might not be absorbed from a supplement in the same fashion as from food, and there are social and emotional benefits connected with eating a meal.

Exercise

General Goals and Benefits

Exercise, maintenance of a social network, and a positive mental attitude are three characteristic behaviors often associated with individuals who live to be centenarians. Other than caloric restriction, regular physical activity appears to be the most documented lifestyle behavior positively influencing a broad variety of risk factors and physiologic processes. Despite differences in genetic background within an age cohort, physical activity may be a unique factor that distinguishes individuals who have aged successfully from those who have not.

Evidence supports that physical activity and exercise improve metabolic, physiologic, and endurance parameters. In addition, exercise decreases the prevalence of many chronic diseases and conditions such as hypertension, type 2 diabetes mellitus, osteoporotic fractures, depression, and anxiety. Individuals who shift from having a sedentary lifestyle to being physically active or physically fit experience lower disease rates and lower premature mortality compared with those who remain sedentary or unfit. This relationship is applicable from middle through older age, indicating that older adults can expect to benefit from these health changes as well.

Older individuals often experience negative health consequences because of an inactive lifestyle. Findings from the first Surgeon General's Report on Physical Activity and Health, published in 2008 and updated in May 2010, suggest that older adults represent one of the demographic groups at highest risk of inactivity. Physical activity elicits a positive response on the body's musculoskeletal, cardiovascular, respiratory, and endocrine systems and is a proven public health strategy that improves quality of life while reducing disease and disability in older adults. Often, older individuals with many disease comorbidities who would benefit from exercise have minimal access, opportunity, and knowledge of health promotion efforts pertaining to physical activity. Even though evidence shows that physical activity is associated with positive health outcomes and that inactivity yields suboptimal chronic disease management, evidence related to the specific amount, duration, frequency, and type of physical activity that correlates with specific health or disease outcomes for the older population has only recently emerged.

An adequate exercise prescription is an important aspect of caring for older adults, and most should be encouraged to participate in an exercise program because of the potential benefits on both disease outcomes and the aging process. Exercise, nutrition, and pharmacologic interventions, when appropriate, should complement each other in the maintenance of chronic conditions. This combination will improve body composition, modify risk factors for chronic disease, and limit disability.

Assessment Before Exercise Initiation

Exercise prescriptions should be tailored to the individual's physical abilities, comorbidities, and behavioral and neuropsychological demands. Exercise eligibility often depends on stabilization of medical conditions, but there are very few contraindications to participating in some form of exercise. Both medical professionals and trained exercise therapists can determine the appropriate components of an exercise program by following the American College of Sports Medicine's (ACSM) assessment guideline.

Exercise testing protocols individualized to age, health status, current activity level, and desired level of intensity are available. A screening tool should be used before initiating an exercise program to identify individuals with medical contraindications. For example, older adults with arthritis, diabetes, hypertension, obesity, osteoporosis, peripheral arterial disease, and pulmonary disease will require a thorough evaluation before

Table 1-3. Common Oral Meal Replacements and Supplements

Product	Quantity (oz)	Calories	Protein (g)	Carbohydrate (g)	Fat (g)	Fiber (g)	Comments
Boost	8	240	10	41	5.5	0	Similar to other oral meal replacements; lactose and gluten free
Boost Plus	8	360	14	45	15.5	0	Milk based and contains soy; can be used as a sole meal replacement
Carnation Instant Breakfast[a]	8	240	14	38	3.5	0	When reconstituted with low-fat milk, this product is a lower-cost alternative to other meal replacement products; all of this line in powder form is gluten free except the chocolate malt flavor
Carnation Instant Breakfast Lactose Free Very High Calorie	8	560	22.5	49.2	30	–	A high-calorie supplement to help manage low weight and weight loss; lactose and gluten free
Enlive	8	250	9	52	0	0	Fat, lactose, and gluten free; kosher; clear liquid useful pre- and postoperatively
Ensure	8	250	9	40	6	3	Can be consumed as sole source of nutrition on an interim, basis; lactose and gluten free; kosher
Ensure Plus	8	350	13	50	11	3	Can be consumed as sole source of nutrition on an interim basis in those with fluid restrictions; lactose and gluten free, kosher
Ensure Pudding	4	170	4	30	5	3	Useful for those with swallowing difficulty; lactose and gluten free, contains plant-based omega-3 fatty acids; kosher
Glucerna Shake	8	220	9.9	29.3	8.6	2.8	Lower carbohydrate amount to help manage blood glucose response; lactose and gluten free; kosher
Magic Cup	4	290	9	40	11	0	Higher in calories, frozen; useful for those with swallowing difficulties; gluten free
Magic Cup No Sugar Added	4	260	9	35	14	4	Lower carbohydrate version of the product above; gluten free
Mighty Shakes No Sugar Added	4	200	7	20	10	1	Supplement for involuntary weight loss; gluten free and kosher
Pro-Stat sugar free 64	1	60	15	0	0	0	Protein supplement to help with wound healing and malnutrition; provides all essential amino acids; sugar, lactose, and gluten free
Suplena with Carb Steady	8	425	10.6	47.8	22.7	3.7	Sole source of nutrition for those with impaired kidney function; low protein; lactose and gluten free; kosher

[a]Reconstituted with 8 oz of 1% milk.

an exercise program is initiated. Guidelines pertaining to pre-participation health screening and risk stratification for individuals initiating a physical activity regimen on their own or entering primary or secondary prevention exercise programs are available from ACSM, and health professionals should review these documents.

Risks

Most chronic illnesses are indications for exercise, rather than contraindications. If individuals with chronic conditions such as diabetes, hypertension, or osteoporosis are not exercising, their medical management may be viewed as suboptimal. Illnesses that are permanent exclusions from exercise include end-stage congestive heart failure, permanent bed-bound status, severe cognitive impairment or behavioral disturbance, unstable abdominal thoracic or cerebral aneurysm, and untreated severe aortic stenosis. Other medical concerns that are not an absolute contraindication to exercise include uncontrolled hypertension, unstable angina, osteoarthritis exacerbation, or a healing fracture. Individuals with medical concerns should consult with their health care provider and may also benefit from referral to a physical therapist or trainer to ensure that they are using proper exercise techniques. Healthy older adults generally do not need to consult with a health care provider before becoming physically active. Pharmacists can play an active role in helping older adults make informed decisions about participating in exercise programs within any practice setting, especially in the community.

With both aerobic and muscle-strengthening activities, participating above minimal recommended amounts will provide higher levels of physical fitness and greater health benefits for older adults provided there are no prohibitions on this increased activity. Many older adults have avoided resistance training because of potential injury, but the risks are minimal, and in many cases, this form of exercise is more practical for a larger group, including frail elders, than other forms of exercise such as cardiovascular training. Frailty is not a contraindication; instead, it should be viewed as a primary indication for strength-training exercises.

Intensity and Duration

Exercise and physical activity have been the focus of many studies. Not all physical activity can be classified as exercise, but exercise is considered physical activity if it is planned, repetitive, structured, and performed with the goal of health and fitness improvement. Guidelines established by several organizations to assist with determining appropriate recommendations for exercise duration and intensity when developing a program for older adults are listed in Table 1-4.

A potential dose-response curve exists between physical activity and health. For an older person with a specific chronic disease, the precise quantity and type of exercise required to improve outcomes are not known. From a public health standpoint, it is important to balance the practicality of these recommendations, particularly from an age perspective, and to consider that the minimal dose and shape of the dose-response curve may differ for various health conditions.

Intensity of aerobic exercise is defined as the amount of oxygen consumed or the energy expended per minute of activity: 5 kcal/minute for light activity, 7.5 kcal/minute for moderate activity, and 10–12 kcal/minute for heavy activity. Energy expenditure will increase with greater body weight for weight-bearing activities and the use of larger muscle mass and increased work (force x distance) and power output (work/time). The most intense activities simultaneously incorporate use of the arms, legs, and trunk while rapidly moving the full body weight. Monitoring heart rate is often used to measure exercise intensity when direct measurement of oxygen consumption is not available. However, in older adults, there can be arrhythmias, pacemakers, and the use of β-blockers, which can affect the response of the heart to exercise or cause inaccurate heart rate recordings because of arterial pressure fluctuations.

Some points in the DHHS 2008 *Physical Activity Guidelines for Americans* warrant explanation. Aerobic exercise increments should be spread throughout the week; for instance, 3 days/week can achieve benefits, reduce the risk of injury, and prevent fatigue. Increments of 10 minutes can be counted toward meeting the activity goals if performed at moderate to vigorous intensity. The relative intensity of exercise is based on an individual's personal level of cardiorespiratory fitness. Moderate intensity is classified as a 5 or 6 on a scale of 0–10, and vigorous intensity is a 7 or 8 on that same 0–10 scale, with 0 being no intensity and 10 being the highest intensity. In general, 2 minutes of moderate-intensity activity is the same as 1 minute of activity at a more vigorous level. Muscle-strengthening activities can be counted as aerobic if an appropriate intensity is achieved and if the major muscle groups of the body (legs, hips, back, abdomen, chest, arms, and shoulders) are worked. When resistance training is used to strengthen muscles, one set of 8–12 repetitions may be effective, but more may be required to achieve improvement. Development of muscle strength progresses with time. These guidelines are summarized in Table 1-4.

The ACSM and the American Heart Association have recommendations similar to the DHHS 2008 *Physical Activity Guidelines for Americans*, with slight modifications. Moderate-intensity aerobic physical activity is recommended for a minimum of 30 minutes on 5 days/week or vigorous-intensity aerobic activity for 20 minutes on 3 days/week. Moderate- and vigorous-intensity activities can be combined to achieve these goals, and these recommendations are in addition to the

Table 1-4. Physical Activity Recommendations for Older Adults[a]

Physical Activity Goal	Exercise Type	Added Strength Training
Achieve health benefit[b]	150 minutes/week of moderate-intensity aerobic exercise OR 75 minutes/week of vigorous-intensity aerobic exercise OR Combination of above	Muscle-strengthening exercises two times/week (8–10 exercises, using major muscle groups with enough weight/resistance to perform 8–12 repetitions)
Achieve added health benefit[c]	300 minutes/week of moderate-intensity aerobic exercise OR 150 minutes/week of vigorous-intensity aerobic exercise OR Combination of above	Continued as above; more sets of repetitions may provide additional benefits
Balance activities (for older adults at risk of falling)	90 minutes/week of balance and moderate-intensity muscle-strengthening activities weekly plus moderate-intensity walking for about 60 minutes/week Balance training at least 3 days/week and standardized progressive exercises in a validated fall reduction program	
Stretching/flexibility	Stretching can improve flexibility when done properly and is important for regular physical activity. Time dedicated to flexibility does not count toward aerobic or muscle-strengthening guidelines	

[a]Older adults should increase their activity level gradually to safely reach fitness goals. Individuals with low fitness levels should be aware of this when considering the duration and intensity of any regimen. On initiation, older adults should be as physically active as their abilities and conditions allow, even if they are unable to initially achieve the 150-minute/week goal.
[b]Including physical fitness; reduction in premature death; and cardiorespiratory, metabolic, musculoskeletal, and mental health.
[c]Greater benefits from b plus weight maintenance and prevention of obesity.

routine light-intensity activities of daily living. Muscle-strengthening activities and balance exercises are also encouraged. In addition, activities that maintain or increase flexibility are recommended two times/week for at least 10 minutes each. All recommendations are consistent regarding exercise goals in inactive older adults; however, an exercise program for inactive adults should be gradually initiated. It may take months to achieve activity goals for individuals who start with a low level of fitness.

Forms of Exercise

Aerobic Exercise

Cardiovascular endurance training is characterized by large muscle groups contracting against gravity. The intent is to maximize aerobic activity and decrease the physiologic response and perceived difficulty of submaximal aerobic workloads. Gains in exercise capacity occur because of adaptations within the cardiopulmonary system, peripheral skeletal muscle, circulation, and metabolism. The many forms of aerobic cardiovascular exercise include walking, swimming, vacuuming, and dancing. The training method varies on the basis of factors such as personal preference, access, injury potential, or health restrictions.

Older adults who exercise aerobically experience many physiologic and health advantages compared with their age-matched sedentary peers. These advantages include a more favorable body composition profile, greater relative muscle mass, faster nerve conduction velocity, and slower development of disability. Other benefits include an increased ability to use and transport oxygen and less cardiovascular and metabolic stress during exercise. Individuals who exercise have a significantly reduced coronary risk profile, including lower blood pressure, improved insulin sensitivity and glucose homeostasis, lower systemic inflammatory markers, smaller waist circumference, and improved lipid profile. Higher bone mineral density at weight-bearing sites has been shown, especially in women who

participate in weight-bearing aerobic activities. Walking, jogging, and stepping have shown positive outcomes in a variety of studies, whereas non–weight-bearing aerobic activities, such as swimming and biking, have not.

Injury can be avoided by adhering to preexisting disease limitations. Musculoskeletal, cardiovascular, and metabolic complications can occur, but injury is uncommon unless underlying disease states are poorly controlled. It is important that individuals use proper footwear and clothing and avoid outdoor aerobic exercise during extreme weather conditions, during acute illness, or when they have new, undefined symptoms. Appropriate aerobic exercises must be used in this age group. High-impact activities such as hopping and plyometrics – exercises characterized by fast, powerful movements that rapidly stretch and contract muscles – have been linked to knee and ankle injuries and have not been shown to increase bone density. Furthermore, individuals with a fall risk or arthritis are more likely to sustain injuries with higher-impact activities.

Strength Training

Progressive resistance training is recommended either as an exercise prescription or as part of lifestyle modifications. This form of exercise challenges the skeletal muscle with an unfamiliar load so that neural and muscle tissue changes occur. The intent is for the muscles to contract slowly for a few repetitions against a moderate to heavy load. The target is for 8–10 muscle groups to be trained on 2 or more nonconsecutive days each week using the major muscle groups for a functional and balanced outcome.

Many types of equipment may be used for resistance training, from the individual's own body weight to technologically advanced training machines. Muscle-strengthening activities include a progressive weight-training program, weight-bearing calisthenics, and related resistance exercises that use the main muscle groups. Other examples of strength-building exercises are Pilates, some yoga and tai chi exercises, carrying groceries, and yard work.

Most studies of strength training that have resulted in significant gains in strength have used 70% to 80% maximal strength intensity. To maximize strength and development, the degree of resistance should allow 10–15 repetitions for each exercise at a moderate- to high-effort level (5–8 on a 10-point scale). There is no evidence that this intensity is unsafe for any sex, age, or functional ability; however, it has been shown that low-intensity training results in negligible benefits, and it is not recommended if the goal of training is to improve muscle size and strength.

More evidence exists for the benefits of aerobic training than of resistance strength training in older athletes. Compared with their sedentary counterparts, resistance-trained older adults have a higher muscle mass, are generally leaner, and are up to 50% stronger. Compared with their aerobically trained peers, they also have higher bone mineral densities and maintain higher muscle strength and power. Consistent participation in resistance training has clear benefits for maintaining strength and decreasing the loss of muscle and bone mass. These benefits are not as apparent with the use of aerobic exercise alone. Musculoskeletal risks can largely be avoided by paying attention to proper form, limiting range of motion if painful, isolating the targeted muscle group, and observing appropriate rest periods between sets and rest days between training sessions. Contraindications to resistance training include unstable coronary disease, malignant arrhythmias, unrepaired aneurysms, symptomatic hernias, and critical aortic stenosis.

Balance Training

Impaired balance is a risk factor for fall and hip fracture, and it is recommended to include balance exercises in the exercise routine of the general aging population. A balance activity refers to any action that increases an individual's ability to maintain balance when stability is threatened. This threat can involve several stressors including real-life situations (e.g., navigating environmental hazards, drugs that affect central nervous system function) and disease states and physiologic changes that narrow the base of support or move the center of the body away from the vertical. Balance movements should be performed slowly and deliberately to adequately stress the control system and provide maximal physical adaptation. Yoga and tai chi represent structured forms of balance exercises, but backward or sideway walking, toe or heel walking, and standing from a sitting position are other examples of exercises that improve balance.

The appropriate intensity for balance exercises is categorized by the degree of difficulty for the postures or movements performed. Intensity is individualized and refers to the highest level of activity that can be tolerated without increasing the risk of a fall. In a supervised setting, a trainer will ensure that tolerance limits are followed. In an unsupervised situation, the individual should exercise to the level that can be comfortably completed. No evidence-based recommendation exists for the appropriate amount of balance training in an exercise regimen, particularly when looking at its value independently, not as a part of a multimodal program. Recommendations for the frequency of balance training range from 1 to 7 days/week and once to several times daily. Thresholds have not been defined to determine whether a dose-response relationship exists, as with other forms of exercise.

The relationship between age, exercise, and balance has been studied, with most research performed in older people at risk of falling. Balance training exercises, such

as walking over challenging terrain and lower body strengthening, are recommended as part of a comprehensive regimen encompassing balance, strength, flexibility, and walking to reduce the fall risk. Tai chi also has potential benefit in this area. There is no definite improvement in strength or aerobic capacity when using balance training; however, resistance training in some cases may improve balance.

A potential risk of balance training involves an actual loss of balance, with a resulting fall or injury or the increased fear of falling. Musculoskeletal injuries are unlikely unless a fall occurs. Detailed attention to intensity, environment, and supervision can considerably minimize risk. Cardiovascular concerns are unfounded because there is a minimal increase in heart rate and blood pressure with this exercise type.

Flexibility Training

Range of motion in joints decreases with age. Despite age-associated changes in flexibility, mobility, and physical independence, there is minimal research evaluating range of motion exercises on flexibility outcomes in older adults. Improvements in lower back and hamstring flexibility and spinal extension have been reported, as have improved upper and lower body flexibility, when using a combination of stretching and rhythmic movements. Stretching with each exercise session can counteract the decline in flexibility experienced by older adults and may improve overall balance and agility.

Of the exercise modalities, flexibility training is the least studied. In many situations, recommendations are grouped for balance and flexibility, making the commitment each should receive unclear. Stretching exercises help maintain flexibility, improve the performance of everyday activities, and can be successfully performed by almost all older adults. There are no definitive recommendations regarding the frequency and duration of stretching or whether static or dynamic methods are better for safety and effectiveness. General suggestions to incorporate flexibility exercises for older adults include stretching at least 2 days/week for at least 10 minutes/day. It is recommended to stretch the major muscle and joint groups including hip, back, shoulder, knee, upper trunk, and neck regions. Holding the stretching position for 10–30 seconds is advised to avoid strain and injury.

Older adults with disabilities or chronic illnesses can gain significant health benefits by engaging in stretching or other nonstrenuous physical activity. Sufficient regular activity each week is more important than strenuous physical activity, and all exercise plans should be individualized. Low-impact activities, including stretching, swimming, yoga, and tai chi, can promote balance and strength and improve overall flexibility.

The risks expected with flexibility training are limited. However, it should be recognized that decreased range of motion is associated with age or comorbid disease states such as arthritis; therefore, it is important to adhere to individualized limitations and not push the body beyond what is comfortable.

Relationship Between Physical Activity and Nutrition

Nutrition and exercise must be considered together in the overall health status of an individual, especially the older adult. When deciding on a nutrition or exercise prescription, attention must be paid to both areas to achieve maximal benefits. Since the publication of the USDA's 2005 *Dietary Guidelines for Americans*, physical activity has been considered a foundation to establishing appropriate nutrition recommendations. This philosophy was reinforced in the USDA's 2010 update. For instance, on the Web page *www.mypyramid.gov/*, an individual can enter personal data to determine his or her caloric and macronutrient requirements and obtain personalized nutrient requirements on the basis of the activity level entered. Exercise recommendations serve as a guide, but if older adults are able to comfortably exceed these recommendations, they should be encouraged to do so. Minimums are set to establish a standard to maintain health and fitness parameters, but exceeding these goals will help improve individual personal fitness, manage existing conditions or diseases, and reduce mortality risk.

Adherence to Health Promotion Activities

Despite their knowing that exercise is beneficial, more than 60% of American adults are not regularly active, 25% are inactive, and more than 40% of women older than 75 years report no activity. In addition, because it is difficult to sustain participation in an exercise program, promoting physical activity for older adults is imperative because they are the least physically active of any age group.

Declines in physiologic function that are normally associated with aging occur more often because of reduced physical activity and inadequate nutrition than because of the aging process. By striving to maintain an active lifestyle or increasing levels of physical activity if previously sedentary, older adults can expect to maintain high metabolic, cardiovascular, and skeletal muscle function. Women who participated in the Nurse's Health Study who practiced high activity levels in midlife were more likely to survive to age 70 years. In addition, individuals who are physically active throughout their life are less likely to have cognitive impairments as they age.

It may never be too late to begin health promotion activities. In the Physician's Health Study, about 2300 elderly men (age 72 years at study initiation) were prospectively monitored for 20 years to assess the effect of modifiable health behaviors on longevity. Hypertension, obesity, cigarette smoking, and a sedentary

lifestyle were associated with mortality. The results of this study suggest that routine and consistent physical activity adds about 5 years to a person's life.

The Role of the Pharmacist

If we could give every individual the right amount of nourishment and exercise, not too little and not too much, we would have found the safest way to health. Let your food be your medicine, and your medicine be your food. –Hippocrates

Pharmacists have a unique opportunity to play a role in recognizing and addressing the nutrition and exercise requirements of older adults. When formulating pharmacotherapy plans, drug, nutrition, and exercise recommendations should be included. For instance, a patient with hypertension receiving customary drug therapy should also adhere to a diet that is low in sodium and that provides enough calories and protein to maintain a normal weight and skeletal mass, as well as participate in 150 minutes/week of aerobic activity weekly with twice-weekly muscle strengthening. It is important to be familiar with the various forms of exercise and their appropriate place in therapy, together with ideal candidates and potential benefits and risks.

The pharmacist can assist the individual who is underweight or who has experienced weight loss with medication assessment to identify any drug-related causes and with recommendations about cost-effective ways to add supplemental calories. In an institutional setting, orally administered drugs can be given with nutrition supplements rather than with water. In an outpatient or community setting, a cost-effective recommendation is the use of powdered breakfast drinks reconstituted with milk as a supplement versus a premixed formula. It is important for pharmacists working in community settings to refer patients to other health care professionals as needed. Working on an interprofessional team with a dietitian and a physical or exercise therapist is an ideal opportunity for the pharmacist to aid in promoting nutrition and exercise for older adults.

Annotated Bibliography

1. Flicker L, McCaul KA, Hankey GJ, Jamrozik K, Brown WJ, Byles JE, et al. Body mass index and survival in men and women aged 70 to 75. J Am Geriatr Soc 2010;58:234–41.

   This 10-year cohort study, which included more than 10,000 community-dwelling older adults in Australia, evaluated which BMI level is associated with the lowest mortality rate. A BMI of 25–29.9 kg/m^2 (overweight) was associated with the lowest mortality rate; older individuals who were overweight were 13% less likely to die (hazard ratio [HR] = 0.87; 95% confidence interval [CI], 0.78–0.94) than those with a BMI of 18–24.9 kg/m^2 (normal weight). The statistical model used adjusted for smoking and other risk factors associated with early mortality. Exercise was protective for women who were classified as nonsedentary (defined as participation in some vigorous exercise in a usual week), and this group, whose BMI was 25–29.9 kg/m^2, had the lowest mortality. Being sedentary significantly increased mortality risk in women across all BMI levels (HR = 2.08; 95% CI, 1.79–2.41), but in sedentary men, there was only a 28% increase in mortality risk (HR = 1.28; 95% CI, 1.14–1.44).

2. Lang IA, Llewellyn DJ, Alexander K, Melzer D. Obesity, physical function, and mortality in older adults. J Am Geriatr Soc 2008;56:1474–8.

   The English Longitudinal Study of Ageing enrolled 3793 people in a prospective cohort evaluation of the relationship between weight, physical function, and mortality. Individuals were observed for 5 years with both self-reported and measured evaluations of weight and function. On study initiation, about three-fourths of the population had a BMI greater than 29.9 kg/m^2, and the average age was 65 years. A direct relationship was found between increased BMI and increased physical impairment. No association was found between a BMI greater than 29.9 kg/m^2 and mortality. The number of individuals with BMIs greater than 35 kg/m^2 was small, making it difficult to evaluate patients with the highest weights. This study confirms previous work that failed to show a relationship between mortality and overweight in the elderly and establishes a relationship between having loss of physical function and being overweight. These results could have major health care consequences in an aging society.

3. Cruz-Jentoft A, Baeyens JP, Bauer JM, Borie Y, Cederholm T, Land F, et al. Sarcopenia: European consensus on definition and diagnosis. Age Ageing 2010;39:412–23.

   Several European groups working in the areas of nutrition and geriatrics created this uniform definition for sarcopenia. The basis for this diagnosis includes loss of muscle strength, mass, and performance. Older individuals with this condition suffer disability and physical dysfunction that lead to a reduction in quality of life and an increase in mortality. Sarcopenia has many causes and contributing factors that include a decrease in protein synthesis and proteolysis leading to the loss of muscle integrity. Age-associated decreases in hormone production, apoptosis, mitochondrial dysfunction, cachexia, and inadequate dietary intake to maintain energy needs all play a role in this syndrome, which is further accelerated by activation of the immune system with release of inflammatory cytokines. Screening patients with a clinical evaluation of walking speed and grip strength can identify those who may require further measurement of muscle mass through imaging techniques. With uniform criteria for sarcopenia, interventions that target physical exercise, nutrition, and drugs such as hormone replacement can be evaluated.

4. Gaffney-Stomberg E, Insogna KL, Rodriquez NR, Kerstetter JE. Increasing dietary protein requirements in elderly people for optimal muscle and bone health. J Am Geriatr Soc 2009;57:1073–9.

   Significant evidence supports that a large number of older adults in the United States do not consume the minimal recommended daily amount of protein (0.8 g/kg/day). Data further suggest that protein intake is associated with the preservation of lean body mass. To ensure adequate intake for muscle synthesis, adequate amounts of essential amino acids, particularly leucine, are required. Increasing dietary leucine promotes activation of the mTOR (mammalian target of rapamycin) pathway, which increases messenger RNA translation and leads to an increase in protein synthesis. In addition, increasing dietary protein will increase insulin-like growth factor, which is a mediator for bone and skeletal muscle. This article provides a summary of the compelling evidence for increasing the recommended daily amount of protein (and high-quality amino acids) in the diet of older adults from 0.8 g/kg/day to at least 1–1.2 g/kg/day.

5. Cereda E, Gini A, Pedrolli C, Vanotti A. Disease-specific, versus standard, nutritional support for the treatment of pressure ulcers in institutionalized older adults: a randomized controlled trial. J Am Geriatr Soc 2009;57:1395–402.

   In older adults who are immobile, malnourished, and incontinent, the prevalence of pressure ulcer development over bony prominences is high. Oral nutrition products are marketed with a disease-specific formulation to achieve greater consumption of protein, arginine, zinc, and other micronutrients. This study randomized 30 patients with stage II, III, and IV pressure ulcers to a standard oral diet of 30 kcal/kg/day with 16% from protein versus a supplemented diet providing 30 kcal/kg/day but with a greater amount of protein (20%), arginine, zinc, and vitamin C. Wound treatment protocols were consistent between the two groups, and the Pressure Ulcer Scale for Healing instrument was used to measure outcomes. On randomization, patients were similar in baseline variables and were, on average, 82 years old. Both groups had effective healing of pressure ulcers during the 12 weeks of the treatment period; however, the treatment group had a higher rate of healing using the Pressure Ulcer Scale for Healing (-6.1 ± 2.7 vs. -3.3 ± 2.4; $p<0.05$) and a greater reduction in pressure ulcer surface area size (-1140.9 ± 669.2 mm^2 vs. -571.7 ± 391.3 mm^2; $p<0.05$). Further research is required to confirm these results; however, protein supplementation to about 1.5 g/kg/day may be warranted in older people with pressure ulcers.

6. Gariballa S, Forster S. Dietary supplementation and quality of life of older patients: a randomized, double-blind, placebo-controlled trial. J Am Geriatr Soc 2007;55:2030–4.

   Protein energy undernutrition in older people is associated with poor outcomes in various health care settings. This study randomized 225 hospitalized older patients (who could swallow) to the usual institutional house diet or the house diet plus 400 mL of a supplement (additional 995 kcal plus micronutrients daily) for 6 weeks. Patients randomized to the control arm received an identical-appearing placebo supplement with about 60 kcal of additives to make the product tasty. Patients were assessed on randomization with laboratory, weight, other anthropometric measures, and the Short Form-36 quality-of-life questionnaire. Follow-up assessment occurred at 6 weeks and 6 months with the Short Form-36. There were no differences between the control and randomized groups at 6 weeks. At 6 months, patients who received supplements had significantly better results on the Short Form-36 (-8.7 with a 95% CI of -14.4, to -3.0; $p<0.003$). Most changes in the Short Form-36 occurred in the area of improved physical function. Unfortunately, the authors do not report 6-month values for the laboratory, weight, or anthropometric measurements.

7. National Kidney Foundation. Clinical Practice Guidelines for Nutrition in Chronic Renal Failure. 2000. Available at *www.kidney.org/professionals/kdoqi/guidelines_updates/doqi_nut.html*. Accessed May 8, 2011.

   There is a high prevalence of protein energy malnutrition in patients undergoing hemodialysis. Factors that may contribute to protein energy malnutrition include decreased intake, anorexia, uremia, hemodialysis, concomitant illness, hypermetabolic state from chronic inflammation, and acidemia. About 10–12 g of protein is lost with every hemodialysis session. When food consumption is measured in patients on hemodialysis, most individuals consume 0.9–1 g of protein/kg/day, and the quality of protein intake may not be optimal. Two retrospective studies have shown a correlation between protein intake less than 1.2 g/kg/day and low serum albumin concentration. Although these practice guidelines acknowledge the significant lack of research available to help guide dietary protein recommendations, they suggest that individuals on hemodialysis consume at least 1.2 g/kg/day of quality protein. When calculating the amount of protein in a patient's diet, actual body weight is used in this recommendation.

8. Cherkas LF, Hunkin JL, Kato BS, Richards B, Gardner JP, Surdulescu GL, et al. The association between physical activity in leisure time and leukocyte telomere length. Arch Intern Med 2008;168:154–8.

   Telomeres are the end caps on chromosomes that shorten with cell division and aging. Leukocyte telomere length is used as a biologic marker of aging. This study evaluated a history of physical activity and telomere length in 2401 twins from the United Kingdom. Physical activity was assessed through self-report for the previous year on a scale of 1 (no activity) to 4 (heavy activity), and individuals also completed an extensive questionnaire to evaluate the time, intensity, and duration of exercise. Leukocyte telomere length was positively associated with exercise; individuals who did not exercise had telomere lengths that biologically reflected

a 10-year age difference that persisted after adjusting for BMI, age, and sex. The relationship between physical exercise and telomere length was also seen in twins who were discordant for exercise but who had similar medical histories. Regular exercise may be an antiaging strategy as well as a strategy to promote physical and mental function.

9. Byberg L, Melhus H, Gedeborg R, Sundstrom J, Ahlbom A, Zethelius B, et al. Total mortality after changes in leisure time physical activity in 50 year old men: 35-year follow-up of population based cohort. BMJ 2009;338:b688.

This population-based cohort study (n=2200) assessed men during a 35-year span to assess the relationship between change in physical activity level after middle age and mortality risk. For older men, the relative value of adding activity, particularly in line with guidelines and position statements, is unclear. The investigators compared the potential effects of increasing physical activity with another lifestyle change (smoking cessation) so that communication of potential exercise benefit would be consumer friendly. Although not precisely defined, activity from survey data was categorized into low, moderate, and high groups. It was determined that increased physical activity beginning in middle age and lasting for at least 10 years leads to a decrease in mortality (adjusted HR = 0.51; 95% CI, 0.26–0.97), which was consistent with those who were physically active throughout life. This magnitude of mortality risk reduction was comparable with mortality risk reduction rates associated with smoking cessation.

10. Lee I, Djousse L, Sesso H, Wang L, Buring J. Physical activity and weight gain prevention. JAMA 2010;303:1173–9.

In a prospective cohort study of 34,000 women (mean age, 54 years), the relationship between exercise and long-term weight change was evaluated during a 13-year period. Exercise was evaluated through a health questionnaire that categorized different types and lengths of activity (e.g., 10 minutes of jogging) to calculate a metabolic equivalent value in hours per week. Study participants consumed their usual diet. At baseline, BMI was inversely associated with exercise. Age was a significant confounder in this 13-year analysis. Only women younger than 65 years with low exercise amounts gained weight during any 3-year period of analysis; women older than 64 years did not significantly change weight with exercise. For the cohort as a whole, maintenance of weight with aging was attained through sustained moderate-intensity exercise for about 60 minutes/day. The authors suggest that the present physical activity guidelines of 150 minutes/week are sufficient to achieve a reduction in disease risk but are not likely to avoid weight gain without calorie restriction.

11. Whaley M, Brubaker P, Otto R, eds. American College of Sports Medicine's Guidelines for Exercise Testing and Prescription, 7th ed. New York: Lippincott, Williams & Wilkins, 2006.

The seventh edition of this text, originally produced in 1975, describes guidelines related to admitting adults into exercise programs, administering exercise testing, and creating exercise prescriptions. This book is a useful resource for health, fitness, and clinical professionals; it emphasizes the importance of preventing illness through physical activity and exercise in healthy individuals, as well as in those with risk factors and chronic disease. Specific attention is given to older adults, with focus on pre-participation health screening and recommendations for exercise programs. Useful tables and algorithms are included. For example, specific information is given for mode, intensity, duration, and frequency of exercise to achieve cardiorespiratory fitness.

12. U.S. Department of Health and Human Services. 2008 Physical Activity Guidelines for Americans. Available at *www.health.gov/paguidelines/pdf/paguide.pdf*. AccessedMay 6, 2011.

This report is the first set of comprehensive guidelines issued by the federal government addressing physical activity for all Americans. The purpose of this document is for policy-makers, physical fitness educators, health providers, and the public to have a consistent primary source of information on the amount, types, and intensity of physical activity necessary to achieve health benefits across the life span. There is a section that provides guidance for older adults (older than 65 years). For instance, all older adults are encouraged to perform 150 minutes of moderate-intensity exercise every week; those with chronic conditions can modify this recommendation based on ability. It is also useful to view the recommendations for physical activity in other age groups for comparison.

13. Chodzko-Zajko WJ, Proctor DN, Fiatarone-Singh MA, Minson CT, Nigg CR, Salem GG, et al. American College of Sports Medicine Position Stand: exercise and physical activity for older adults. Med Sci Sports Exerc 2009;41:1510–30.

This position statement by ACSM replaces their 1998 publication. This statement is intended to provide an evidence-based overview of issues pertinent to exercise and physical activity in the older adult population. An especially useful section discusses the benefits of exercise and physical activity (both long and short term) on health and functional capacity. For those participating in long-term aerobic exercise, benefits include more favorable body composition, greater relative muscle mass, and higher bone mineral density. For those participating in resistance training, benefits include increases in muscle strength of 25% to 100%. Recommendations in this position paper are consistent with those in other publications, specifically the DHHS 2008 *Physical Activity Guidelines for Americans*, which is written for a much different audience and is more general in scope and focus.

14. Woo J, Hong A, Lau E, Lynn H. A randomised controlled trial of tai chi and resistance exercise on bone

health, muscle strength, and balance in community-living elderly people. Age Ageing 2007;36:262–8.

Tai chi is a suitable form of exercise for balance and leg strength training, and resistance exercise is considered an important intervention in modifying age-induced sarcopenia. Previous studies of the effect of tai chi on falls have reported conflicting results, and the effect on bone mineral density is uncertain in older adults. This 12-month, randomized, controlled trial evaluated the effects of tai chi, resistance exercise, or no exercise on 180 people from Hong Kong, aged 64–74 years. Women in both the tai chi and resistance groups significantly improved bone mineral density compared with the group that did not exercise. No difference in muscle strength, balance, flexibility, or falls was observed. In this trial, exercise adherence was high. Incorporating activities such as tai chi into programming events at senior centers should be encouraged.

15. Sun Q, Townsend M, Okereke OI, Franco OH, Hu FB, Grodstein F. Physical activity at midlife in relation to successful survival in women at age 70 and older. Arch Intern Med 2010;170:194–201.

Inconsistent findings regarding the relationship between midlife physical activity and general health in older adults have been reported. In 1976, 121,700 nurses responded to a questionnaire as part of the initial Nurses' Health Study cohort. In this current analysis, 1456 participants met the criteria for successful survivors at midlife (defined as 60 years old). Midlife physical activity and successful aging were studied and measured by outcomes including chronic disease incidence, physical and cognitive function, and mental status. There was a strong positive association between midlife physical activity and increased odds of exceptional health in women at age 70 or older. For instance, women who were in the 5th quintile of activity were about twice as likely to survive to age 70 compared with the lowest quintile. Walking, in particular, was identified as a way to increase the likelihood of survival. For instance, women who walked a median of 3 hours/week were about 30% more likely to survive than those who did not walk.

16. Yates LB, Djousse L, Kurth T, Burting JE, Gaziano M. Exceptional longevity in men. Modifiable factors associated with survival and function to age 90 years. Arch Intern Med 2008;168:284–90.

Genetics probably accounts for about 25% of the variation seen in studies of life span, with other external factors contributing to the rest of the variation. In this prospective cohort study, 2357 men born on or before December 31, 1915, were enrolled in the Physicians' Health Study from 1981 to 1984. These men were assessed through 2006 for longevity risk factors such as disease history and lifestyle. Forty-one percent of the men lived to at least 90 years. Factors associated with increased mortality included cigarette smoking, diabetes, obesity, and hypertension. Older men who exercised regularly were 30% less likely to die and had better physical and mental function, and 68% rated their quality of life as excellent or very good. This research suggests that, in men, modifiable risk factors contribute significantly to a long and high-quality life.

17. Villareal DT, Chode S, Parimi N, Sinacore DR, Hilton T, Armamento-Villareal R, et al. Weight loss, exercise, or both and physical function in obese older adults. N Engl J Med 2011;364:1218–29.

The controversy that weight loss in obese older people may contribute to loss of lean muscle mass and frailty was assessed by randomizing 107 obese people to a control group, diet group, exercise group, or a diet plus exercise group. Individuals were, on average, 70 years old with a BMI of 37 kg/m^2 at the beginning of this 1-year trial. Participants in the diet group were prescribed a diet that provided 500–750 kcal/day less than their daily energy needs; participants in the exercise-only group were prescribed a diet that would maintain their weight while participating in a three times/week 90-minute exercise program led by a physical therapist. Participants in the exercise plus diet group received both the diet and exercise prescription. The primary outcome was change in the Physical Performance Test, which includes seven tasks to evaluate ability to perform activities of daily living. Individuals in the diet plus exercise group improved the most from baseline (21% vs. 1%, 12%, and 15% in the control, diet-only and exercise-only group, respectively; $p<0.001$). Body weight decreased in both the diet and diet plus exercise groups by almost 10 kg. Measures of lean body mass changed by −0.8, −3.2, 1.3, and −1.8 kg in the control, diet, exercise, and diet plus exercise groups, respectively ($p<0.001$). This study shows that obese older adults who participate in a diet plus exercise program can lose weight while improving their performance of activities of daily living.

Self-Assessment Questions

Questions 1–4 pertain to the following case.
D.B. is a 75-year-old woman who reports a functional decline and a decrease in her physical activity. During her 50s and 60s, D.B. maintained a walking regimen with friends but discontinued this activity when two of her friends could no longer participate. She has hypertension, osteoarthritis in her knees and hips, and osteoporosis. She presently takes hydrochlorothiazide 25 mg/day, lisinopril 10 mg/day, alendronate 70 mg/week, calcium carbonate 500 mg three times/day, and acetaminophen 650 mg four times/day as needed for pain. D.B. was evaluated by a nutritionist who reports the following results: weight 72 kg, height 64″, and body fat 42.4%.

1. **Which one of the following is the most appropriate daily protein intake for D.B.?**

   A. 43 g.
   B. 58 g.
   C. 86 g.
   D. 144 g.

2. **In comparison with a younger patient, which one of the following best describes the effect of D.B.'s weight on her estimated mortality risk?**

   A. Less than expected.
   B. More than expected.
   C. The same as expected.
   D. Cannot be estimated.

3. D.B. asks for your advice about enrolling in a weight reduction program that would limit her caloric intake to about 1200 kcal/day in addition to implementing an exercise program**. Which one of the following is best for D.B. to consume daily?**

   A. About 1200 kcal with 50 g of protein.
   B. Her usual diet.
   C. About 1700 kcal with about 90 g of protein.
   D. About 2000 kcal with about 75 g of protein.

4. **Which one of the following is the best exercise regimen for D.B.?**

   A. 30 minutes/day of brisk walking plus resistance training with weights 2 days/week.
   B. 30 minutes of dancing 3 days/week and 30 minutes of water aerobics 2 days/week.
   C. 30 minutes of plyometrics 2 days/week, 20 minutes of stationary bicycling 5 days/week, and resistance training with weights 2 days/week.
   D. 20 minutes/day of leisurely walking and 20 minutes of Pilates 2 days/week.

5. A 68-year-old man who suffers from chronic venous stasis, hypertension, and benign prostatic hypertrophy describes himself as being in good health and able to perform most activities without limitation. His doctor has recommended that he exercise to maintain his health. **Which one of the following is the best exercise program for this patient?**

   A. Walking for 30 minutes/day.
   B. Participating in a tai chi class 2 days/week.
   C. Strength training with weights for 20 minutes, 2 days/week.
   D. Moderate-intensity walking 150 minutes/week plus yoga and water aerobics 90 minutes/week.

6. A 78-year-old woman who resides in an assisted living apartment has a history of a fall 1 year ago in which she broke her hip. She has not regained her pre-fracture function and requires help managing her drug therapy. She is also partly dependent in bathing and dressing and uses a walker for ambulation. She has Parkinson disease and is being treated with levodopa/carbidopa 250/50 mg four times/day. The assisted living facility has a weight and exercise room in addition to exercise programs directed by a physical therapy assistant. **Which one of the following is the best exercise program for this patient?**

   A. An aerobic routine with a stationary bicycle for 30 minutes 3 days/week.
   B. A supervised exercise program for 30 minutes 3 days/week.
   C. Resistance training with weights in the exercise room every other day.
   D. A walking program of 45 minutes 3 days/week.

Questions 7–9 relate to the following case.
N.Z. is an 82-year-old woman (weight 43 kg, height 62″) with late-stage Alzheimer disease. She resides in a nursing home, is no longer ambulatory, and requires assistance with feeding. Her other medical diagnoses include hypertension, coronary artery disease, insomnia, and dizziness. Her drug regimen includes lisinopril 10 mg/day, furosemide 40 mg/day, metoprolol extended release 100 mg/day, hydroxyzine 25 mg three times/day, trazodone 50 mg at night, docusate 100 mg twice daily, and bisacodyl 10 mg at night as needed for constipation. Her

vital signs are within the normal range, and her laboratory results are as follows: sodium 140 mEq/L, chloride 102 mEq/L, bicarbonate 27 mEq/L, blood urea nitrogen 20 mg/dL, and creatinine 0.6 mg/dL. The dietitian has conducted calorie counts, and a speech evaluation recommends that her diet consistency remain at moist, ground foods. N.Z. is edentulous. A review of her calorie counts shows the consumption of about 50% of her meals or 700 kcal/day.

7. **Which one of the following is best to add to N.Z.'s dietary plan?**

   A. Sugar and butter packets to all foods daily.
   B. 8 oz of a standard (1 kcal/mL) meal replacement twice daily.
   C. 8 oz of an enhanced (1.5 kcal/mL) meal replacement twice daily.
   D. 2 oz of protein supplement daily.

8. **Which one of the following changes to N.Z.'s drug therapy would best improve her ability to chew and swallow?**

   A. Decrease the furosemide dose.
   B. Discontinue hydroxyzine.
   C. Discontinue trazodone.
   D. Add an artificial saliva product.

9. On further evaluation, N.Z. is found to have a stage II pressure ulcer on her lower back. **What targeted daily protein intake would best improve the healing of N.Z.'s pressure ulcer?**

   A. 30 g.
   B. 50 g.
   C. 70 g.
   D. 100 g.

Questions 10–13 pertain to the following case.
A.R. is a 77-year-old widowed woman (weight 59 kg, height 64″) who lives alone. Her diagnoses include osteoporosis, hypertension, vertigo, and asthma. She has seen a nutritionist, and her diet consists of about 1650 kcal/day (15% protein, 60% carbohydrate). A.R. is able to perform most routine activities of daily living but lacks the strength to carry her groceries into her house. She has about six steps to climb from her back door to the kitchen. Her present exercise regimen includes walking 30 minutes 3 days/week and lifting 2-lb weights twice weekly (10 repetitions for one muscle group in the upper body and lower body each).

10. A.R. wishes to improve her functional abilities and asks her pharmacist about the risks of increased exercise. **Which one of the following best describes the risk associated with increasing A.R.'s exercise regimen?**

    A. Increased risk of fracture.
    B. Increased risk of asthma-related shortness of breath.
    C. Additional injury risk because of BMI.
    D. It is outweighed by the benefit of increased exercise.

11. **Which one of the following changes in A.R.'s exercise routine would best enhance her muscle strength?**

    A. Maintain the present weight of the dumbbells, add more exercises with different muscle groups, and maintain the present exercise repetitions.
    B. Increase the weight of the dumbbells to 5 lb, continue with present muscle groups, and continue to complete 10 repetitions.
    C. Maintain the present weight of the dumbbells, continue with present muscle groups, and increase repetitions to 20.
    D. Lower the weight of the dumbbells and increase the frequency of resistance training to three times/week for the present muscle groups.

12. **Which one of the following dietary recommendations is most appropriate for A.R.?**

    A. Increase her caloric consumption to 1850 kcal/day.
    B. Add two 8-oz cans of a standard meal replacement product daily.
    C. Add 2 oz of a protein supplement daily.
    D. Increase her protein consumption to around 30% of total calories.

13. A.R. notes that her local senior center has hired a tai chi instructor. **Which one of the following would most likely result if A.R. were to participate in twice-weekly tai chi?**

    A. Appreciable improvement in strength.
    B. Significant improvement in flexibility.
    C. Benefit of regular social activity.
    D. Improvement in aerobic capacity.

Questions 14–17 pertain to the following case.
L.D. is a 65-year-old man who has just retired and is looking to begin an exercise program. He is not overweight but wants to improve his overall physical fitness. L.D. states that he wants to age well with a high quality of life. He takes furosemide 80 mg/day for hypertension, atorvastatin 40 mg/day for hyperlipidemia, and tiotropium 18 mcg/day for chronic obstructive

pulmonary disease. He has a history of chronic obstructive pulmonary disease exacerbations requiring prednisone for management and is concerned about his bone strength. He has not checked with his physician about his ability to begin an exercise program, but he feels that he is ready and that has been inactive for too long.

14. **Considering his risk profile, which one of the following recommendations is best for L.D.?**
    A. Receive physician approval before beginning an exercise program.
    B. Begin walking 1 hour/day, 5 days/week.
    C. Begin walking 30 minutes/day, 5 days/week.
    D. Begin walking 15 minutes/day, 3 days/week.

15. **Which one of the following types of exercise would be most advantageous for L.D.?**
    A. Walking.
    B. Swimming.
    C. Riding a stationary bicycle.
    D. Stretching.

16. L.D. has decided to add stretching to his exercise regimen. **Which one of the following recommendations is best for L.D.?**
    A. Stretch the large muscle groups.
    B. Use static stretching.
    C. Stretch for 20 minutes every day.
    D. Hold each stretch position for 10–30 seconds.

17. L.D. has been exercising regularly for several months. However, he finds it difficult to maintain his program and asks you why it is important to exercise. **Which one of the following is the best response to L.D.'s question?**
    A. It will improve his respiratory function.
    B. It is associated with a long and high-quality life.
    C. It will help maintain blood pressure in the normal range.
    D. It will help prevent weight gain.

Questions 18–20 pertain to the following case.
R.B. is a 78-year-old woman (weight 95 kg, height 65″) who resides in a long-term care facility. Her medical conditions include hypertension, congestive heart failure, diabetes, and end-stage kidney disease requiring hemodialysis. Her drugs are glargine insulin 75 units at bedtime, atorvastatin 40 mg daily, losartan 100 mg daily, metoprolol 50 mg daily, a renal-specific vitamin daily, lanthanum 1000 mg twice daily, docusate 100 mg twice daily, and bisacodyl 10 mg at bedtime as needed for constipation. After dialysis, serum electrolytes are within reference range, except for a serum albumin concentration of 2.5 g/dL. R.B. is cognitively intact and desires to improve her mobility and weight. Her physician writes an order for a 1500-kcal/day renal diet with no concentrated sweets and provides clearance for her participation in a supervised exercise program at the nursing facility. Nutrition analysis of her diet content reveals about 18% protein and 60% carbohydrates.

18. **In addition to her prescribed 1500-kcal/day renal diet, which daily protein supplement amount is best for R.B.?**
    A. 15 g.
    B. 45 g.
    C. 60 g.
    D. 120 g.

19. **Which one of the following exercise programs is most appropriate for R.B. for her first month of increased physical activity?**
    A. Complete 20 minutes on the recumbent stationary bicycle at light intensity every other day.
    B. Lift 1-lb weights in her room each morning and avoid planned aerobic activity.
    C. Join a cardiac rehabilitation–specific program at a nearby hospital and attend 3 days/week.
    D. Perform chair exercises with other nursing home residents after breakfast Monday through Friday each week.

20. The nurse on the interdisciplinary team asks which type of plan is best for weight reduction in R.B. **Which one of the following responses is best?**
    A. A 1000-kcal/day diet.
    B. A 1500-kcal/day diet with strength and aerobic exercise.
    C. A 2000-kcal/day diet with strength and aerobic exercise.
    D. Aerobic exercise alone.