Chapter 5

Case Study

Because Sam has not been active for the past 15 years, he should seek physician clearance before undergoing maximal exercise testing or beginning a vigorous exercise program. He can, however, safely participate in submaximal exercise testing or low-to-moderate exercise without clearance from a physician because he is apparently healthy and free from symptoms of cardiovascular or pulmonary disease.

Have Sam perform 5 minutes of low-impact, low-intensity walking to prepare the muscles for work. Include limbering movements for the upper extremities. In the initial stages of training, encourage him to engage in 15 minutes of moderate-intensity walking on 3 days per week after the warmup. Gradually increase duration until he reaches 30 to 60 minutes of activity per exercise session. He might also be able to work up to five exercise sessions per week with time. Alternate walking with stationary cycling to maintain interest, but avoid high-impact activities such as running, jumping, or bouncing as these are associated with a greater risk for fracture. Schedule two sessions of strength training per week during which Sam should perform one set of 10 to 15 repetitions of 8 to 10 exercises targeting major muscle groups. See the section on sample exercises for the senior population in this chapter for a variety of exercises. Include at least one exercise for the chest, back, shoulders, biceps, triceps, abdominals, quadriceps, hamstring complex, calves, and shins. Make sure that there is at least 48 hours of rest in between workout sessions to allow for recovery and repair. Encourage flexibility training as well. Static stretching of the hips, back, shoulders, knees, upper torso, and neck can help maintain range of motion around the joints, improve balance, and enhance agility. Each stretch should be held for
15 to 30 seconds with 2 to 4 repetitions each. Flexibility training may be done on 2 to 7 days per week.

**Thinking Critically**

1. Numerous changes occur in the integumentary system during the aging process. The epidermis thins as cell activity declines. As the cell cycle slows, epidermal cells grow larger and produce a somewhat irregular keratin that promotes scaly skin. The dermis also thins as the synthesis of collagen and elastin decreases. The collagen that remains begins to clump more than usual, which makes the skin prone to wrinkling. With reduced elastin, the skin is less capable of recoiling after being stretched. Additionally, subcutaneous fat in certain areas decreases, further promoting wrinkling.

   As a result of its overall thinning, the integument is no longer the impenetrable barrier it once was. Pathogens can, therefore, enter the epidermis more easily and cause damage. Aging skin, therefore, is prone to injury, slow to repair, and susceptible to recurring skin infections. Therefore, seniors must minimize exposure to microbes and other toxins in the environment.

   The number and activity of melanocytes also diminishes with age, so skin cells become more sensitive to UV radiation. To protect themselves, seniors should avoid excessive exposure to sunlight. Because UV radiation is necessary for the body to activate a vitamin D precursor, seniors sometimes become deficient in vitamin D. Low availability of vitamin D leads to inadequate calcium absorption, a condition that makes seniors vulnerable to bone loss. The inability to activate vitamin D coupled with the fact that many seniors avoid dairy products
owing to lactose intolerance makes them prone to osteoporosis. Osteoporotic bone easily breaks with minimal impact, so sufferers must be careful when exercising.

With age, the number of nerve receptors in the integument declines, so sensitivity to cutaneous stimulation diminishes. Older people are, therefore, less responsive to pain, pressure, heat, and cold. Being less aware of potentially threatening external stimuli can certainly lead to problems, particularly for the senior exerciser who might not know when to stop.

The ability to regulate body temperature also diminishes with age. This occurs as the number of sweat glands drops, as sweat gland activity decreases, and as the number of capillaries declines—all of which interfere with the ability to evaporate and radiate heat. Thus, a senior’s risk for overheating during exertion is high. To complicate matters, seniors also have difficulty retaining heat when exposed to cold environments. Because they lose blood vessels in deeper tissues, their bodies cannot divert blood to deeper tissues in the cold. This, coupled with the loss of subcutaneous fat, makes it difficult for seniors to maintain a normal body temperature when temperatures drop.

2. Changes in the nervous system also occur. Brain size decreases by an estimated 10% during an average lifetime with a greater loss of gray matter than white matter. Ultimately, this loss affects memory consolidation, hearing, balance, vision, smell, and taste acuity.

In addition to the actual loss of neurons, the capabilities of remaining neurons diminish as the total number of dendrites drops and neurotransmitter levels decrease. Neurotransmitters allow neurons to communicate with their effectors, so a loss of neurotransmitters interferes with the actions of effectors. In addition, the rate of propagation along axons decreases by 5% to 10%, so reflexes and reaction times also slow. Existing neurons accumulate abnormal intracellular
deposits that also interfere with functioning. Additionally, blood flow to the central nervous system might drop as atherosclerosis develops in the blood vessels supplying nervous tissue. This predisposes an individual to stroke as insufficient oxygen and nutrients are delivered to nerve cells. A diminished fight or flight response also leads to unexpected transient drops in blood pressure. This predisposes a senior to fainting spells that might lead to fracture of fragile bones. Moreover, special sensory receptors in the inner ear deteriorate, so seniors tend to lose balance and become unstable on their feet. This increases the risk for falling. Lastly, elderly individuals often develop insomnia and spend as little as 2 to 3 hours sleeping at night. This definitely affects their ability to exercise because they feel tired and sluggish during daytime hours.

3. Weight-bearing exercise stimulates osteoblasts (bone-building cells) to deposit bone matrix along lines of mechanical stress. In other words, new bone is deposited in areas subjected to increasing demands.

4. Many older adults lose their sense of thirst or consciously reduce fluid intake because of problems with the urinary bladder or the sphincters that regulate urine flow. Furthermore, some take diuretics to control hypertension; diuretics increase water loss through the kidneys. All of these factors increase the likelihood of constipation in seniors. No matter what the cause, if water intake does not match daily water loss, life-threatening dehydration can ultimately result. Experts, therefore, suggest that elderly adults ingest a minimum of six glasses of water per day. If they are active, they should replenish any water weight lost through perspiration. Additionally,
seniors should consume 25 to 30 grams of fiber per day to help maintain regularity. Good sources include legumes, vegetables, fruits, and whole-grain products.

5. Seniors often experience nutrient deficiencies as a result of the following: diminished taste and smell, which make eating unappealing; poor dental health, which makes eating difficult; deterioration of the digestive, urinary, and respiratory systems, which impacts overall health; and use of medications that can affect appetite, digestion, absorption, and nutrient action in the body.

As mentioned in number 4, water intake is often insufficient (see number 4 for more details). Many seniors also consume inadequate protein largely because of changes in the digestive system (loss of teeth makes it difficult to chew many high-protein foods such as meat; lower production of protein-digesting enzymes in the stomach and pancreas makes it more difficult to chemically digest protein). Intake of omega-3 fatty acids is also typically insufficient—as it is for the general population. Because of GI tract problems, the intake of vitamin B₁₂, vitamin D, calcium, vitamin C, and other antioxidants is often well below recommended amounts. Protein deficiencies weaken the immune system and interfere with most cellular processes. Omega-3 fatty acids maintain cardiovascular health, so a deficiency can increase risk. Low vitamin B₁₂ can interfere with new cell synthesis, neuron health, and fatty and amino acid catabolism. More specifically, it can lead to poor cognitive abilities, severe anemia, and major neurologic malfunctioning. Low vitamin D slows dietary calcium absorption. Low calcium intake forces the body to strip calcium from bones (thereby promoting osteoporosis). Low vitamin C leads to fragile bones because this vitamin is necessary to make collagen, an
essential component of the bone matrix. And low antioxidants increase the risk of free radical
damage to body cells.

6. In addition to forming the structure of bone and teeth, calcium is necessary for nerve
impulse propagation and muscle contraction. In fact, these two functions are much more vital to
life than having healthy bone, so the body will sacrifice bone tissue to ensure calcium availability
for these two functions. Therefore, any time the diet is deficient in calcium, the body obtains
calcium from its bone stores. This basically promotes bone loss and increases the risk for
fracture.

7. There are more than 100 forms of arthritis. Osteoarthritis is the most common form. It is
often called wear-and-tear arthritis and results from long-term use of joints that abrades the
articular cartilage. Joints become inflamed, lose flexibility, and are painful. Rheumatoid arthritis
is classified as an autoimmune disorder that occurs as the body’s immune cells attack the
synovial membrane at joints. As a result, the synovial membrane produces a grainy synovial
fluid that eventually affects articular cartilage. It also promotes swelling, pain, and limited range
of motion.

8. Development of atherosclerosis may occur. People are born with clear, smooth blood
vessels, but fatty streaks typically develop by the age of 10. With time, the blood vessel lining is
damaged—perhaps from high blood pressure, cigarette smoking, or viral or bacterial infection.
This damage increases the permeability of the blood vessels and elicits inflammation. Blood flow
to the area increases and delivers white blood cells and building materials to the site where cells
are repairing damage. Simultaneously, fibrous connective tissue accumulates and calcifies in the area, thus leading to the formation of raised lesions that begin a cycle of growth and regression that can last for decades. The lesions also trap circulating LDL molecules, which are then oxidized by free radicals. The LDL and their cholesterol then become a part of the developing plaque. Eventually, the lesions stiffen and permanently narrow affected arteries. In the meantime, platelets migrate to the area to cover damaged tissue and form a clot to prevent excessive bleeding. This increases the size of the deposit on the blood vessel wall, which narrows the lumen even more. Arteries are much more prone to dangerous plaque buildup than veins because veins have relatively large lumens and are not easily obstructed. Some of the most serious cases of blockage involve the coronary arteries, which supply the heart tissue itself. In many cases, narrowing of these arteries goes unnoticed until a major coronary event occurs. Unfortunately, nearly 60% of men older than 60 years and women older than 80 years have at least one narrowed coronary artery.

9. Lactose intolerance results from a deficiency of lactase, the enzyme needed to digest the monosaccharide found in milk products. It usually results from a genetic predisposition to produce insufficient lactase, so it typically exists from birth. However, it can also result from disease, surgery, or drug use that destroys the intestinal lining or interferes with lactase production or action. Additionally, most research finds a positive correlation between age and lactose intolerance.

The problem with undigested lactose is that it remains in the small and large intestines and attracts water from intestinal cells. Excess water in the lumen of these organs predisposes the sufferer to diarrhea. Additionally, bacteria that reside in the intestines ferment lactose and
produce gas as a byproduct; this promotes cramping bloating, diarrhea, and gas. The symptoms can persist for 12 to 48 hours after lactose consumption. Often, people can continue to consume small amounts of lactose at a time and experience no symptoms. Others must make careful decisions about intake and determine their own tolerable upper intake level for lactose-containing foods and beverages. Helpful tips include the following: consume dairy products in moderation; eat other foods along with milk products; take enzyme tablets with meals; consume foods that already have enzymes added; consume fermented products such as yogurt or acidophilus milk; and read food labels because many other products (breads, cereals, salad dressings, and drugs) contain lactose.

Because those who avoid dairy products can become deficient in calcium and vitamin D, those with lactose intolerance need to ensure that they take in appropriate amounts. Inadequate calcium intake promotes bone loss, and excessive bone loss increases the risk of fracture—particularly in the senior population.