9.7: Risk Factors for Osteoporosis

Skills to Develop

- Discuss risk factors for osteoporosis.
A risk factor is defined as a variable that is linked to an increased probability of developing a disease or adverse outcome. Recall that advanced age and being female increase the likelihood of developing osteoporosis. These factors present risks that should signal doctors and individuals to focus more attention on bone health, especially when the risk factors exist in combination. This is because not all risk factors for osteoporosis are out of your control. Risk factors such as age, gender, and race are biological risk factors and are based on genetics that cannot be changed. By contrast, there are other risk factors that can be modified, such as physical activity, alcohol intake, and diet. The changeable risk factors for osteoporosis provide a mechanism to improve bone health even though some people may be genetically predisposed to the disease.

### Non-modifiable Risk Factors

#### Age, Sex, Body Type, and Heredity

As noted previously, after age forty, bone mass declines due to bone breakdown exceeding bone building (osteoblasts...
decrease). Therefore, any person over the age of forty has an increased probability of developing osteoporosis in comparison to a younger person. As noted, starting out with more bone (a high peak bone mass) enables you to lose more bone during the aging process and not develop osteoporosis. Females, on average, have a lower peak bone mass in comparison to males and therefore can sustain less bone tissue loss than males before developing a low BMD. Similarly, people with small frames are also at higher risk for osteoporosis. Being of advanced age, being a woman, and having a small frame are all biological risk factors for osteoporosis. Other biological risk factors that are linked to an increased likelihood of developing osteoporosis are having low estrogen levels, or another endocrine disorder such as hyperthyroidism, having a family member with osteoporosis, and being Caucasian or Asian. Caucasians have the highest risk of fractures while Asians have an intermediate risk and African Americans the lowest risk. Risk is correlated with bone density with Caucasians having the lowest bone mineral density and African Americans the highest.

**Estrogen Level**

Estrogen is the primary female reproductive hormone and it stimulates osteoblast-mediated bone building and reduces osteoclast activity. Any condition in which estrogen levels are reduced throughout a woman’s life decreases BMD and increases the risk for osteoporosis. By far the most profound effect on estrogen occurs during female menopause. Around the age of forty-five or fifty, women stop producing estrogen. The rapid decline in estrogen levels that occurs during menopause speeds up the bone resorptive process, and as a result, the loss of bone tissue in menopausal women lasts for a period of five to ten years. Up to 3 percent of bone tissue is lost annually during menopause and therefore potentially 30 percent of peak bone mass can vanish during this time, leading to a substantial increase in the risk of developing osteoporosis in postmenopausal women.

**Medications**

Some medications, most notably glucocorticoids (used to treat inflammatory disorders such as rheumatoid arthritis and asthma), are associated with an increased risk for osteoporosis. A side effect of glucocorticoids is that they stimulate bone resorption and decrease bone building. Other medications linked to an increased risk for osteoporosis are certain anticancer drugs, some antidiabetic drugs, and blood thinners.

**Other Diseases**

Diseases that predispose people to osteoporosis include those that disrupt nutrient absorption and retention, such as anorexia nervosa, chronic kidney disease, and Crohn’s disease; diseases that influence bone remodeling such as hyperthyroidism and diabetes; and diseases that are characterized by chronic inflammatory responses such as cancer, chronic obstructive pulmonary disease, and rheumatoid arthritis.

**Modifiable Risk Factors**

**Physical Inactivity**

Bone is a living tissue, like muscle, that reacts to exercise by gaining strength. Physical inactivity lowers peak bone mass, decreases BMD at all ages, and is linked to an increase in fracture risk, especially in the elderly. Recall that
mechanical stress increases bone remodeling and leads to increased bone strength and quality. Weight-bearing exercise puts mechanical stress on bones and therefore increases bone quality. The stimulation of new bone growth occurs when a person participates in weight-bearing or resistance activities that force the body to work against gravity. Research has shown that this is an excellent way to activate osteoblasts to build more new bone. Conversely, physical inactivity lowers peak bone mass, decreases BMD at all ages, and is linked to an increase in fracture risk, especially in the elderly. Even in the elderly, weight bearing exercise can increase bone mass.

**Figure 9.7.2:** Dancing is a form of weight-bearing activity that forces the body to move against gravity and therefore stimulates new bone growth. San Francisco Sunday Streets: Valencia. (CC-BY-2.0; David McSpadden)

**Being Underweight**

Being underweight significantly increases the risk for developing osteoporosis. This is because people who are underweight often also have a smaller frame size and therefore have a lower peak bone mass. Maintaining a normal, healthy weight is important and acts as a form of weight-bearing exercise for the skeletal system as a person moves about. Additionally, inadequate nutrition negatively impacts peak bone mass and BMD. The most striking relationship between being underweight and bone health is seen in people with the psychiatric illness anorexia nervosa. Anorexia nervosa is strongly correlated with low peak bone mass and a low BMD. In fact, more than 50 percent of men and women who have this illness develop osteoporosis and sometimes it occurs very early in life. Mehler, P. S. and K. Weiner. “The Risk of Osteoporosis in Anorexia Nervosa.” Reprinted from Eating Disorders Recovery Today 1, no. 5 (Summer 2003). © 2003 Gurze Books. www.eatingdisordersreview.com/nl/nl_edt_1_5_2.html Women with anorexia nervosa are especially at risk because they not only have inadequate nutrition and low body weight, but also the illness is also associated with estrogen deficiency.

**Smoking, Alcohol, and Caffeine**

Cigarette smoking has long been connected to a decrease in BMD and an increased risk of osteoporosis and fractures. However, because people who smoke are more likely to be physically inactive and have poor diets, it is difficult to determine whether smoking itself causes osteoporosis. What is more, smoking is linked to earlier menopause and therefore the increased risk for developing osteoporosis among female smokers may also be attributed, at least in part, to having stopped estrogen production at an earlier age. A review of several studies, published in the British Medical Journal in 1997, reports that in postmenopausal women who smoked, BMD was decreased an additional 2 percent for every ten-year increase in age and that these women had a substantial increase in the incidence of hip fractures. Law,

Alcohol intake’s effect on bone health is less clear. In some studies, excessive alcohol consumption was found to be a risk factor for developing osteoporosis, but the results of other studies suggest consuming two drinks per day is actually associated with an increase in BMD and a decreased risk for developing osteoporosis. The International Osteoporosis Foundation states that consuming more than two alcoholic drinks per day is a risk factor for developing osteoporosis and sustaining a hip fracture in both men and women. [International Osteoporosis Foundation. “New IOF Report Shows Smoking, Alcohol, Being Underweight, and Poor Nutrition Harm our Bones.” Accessed October 2011. http://www.iofbonehealth.org/news/news-detail.html?newsID=193](http://www.iofbonehealth.org/news/news-detail.html?newsID=193). Moreover, excessive alcohol intake during adolescence and young adulthood have a more profound effect on BMD and osteoporosis risk than drinking too much alcohol later in life.

Some studies have found that similar to alcohol intake, excessive caffeine consumption has been correlated to decreased BMD, but in other studies, moderate caffeine consumption actually improves BMD. Overall, the evidence that caffeine consumption poses a risk for developing osteoporosis is scant, especially when calcium intake is sufficient. Some evidence suggests that carbonated soft drinks negatively affect BMD and increase fracture risk. Their effects, if any, on bone health are not attributed to caffeine content or carbonation. It is probable that any effects of the excessive consumption of soft drinks, caffeinated or not, on bone health can be attributed to the displacement of milk as a dietary source of calcium.

### Nutrition

Ensuring adequate nutrition is a key component in maintaining bone health. Having low dietary intakes of calcium and vitamin D are strong risk factors for developing osteoporosis. Another key nutrient for bone health is protein. Remember that the protein collagen comprises almost one-third of bone tissue. A diet inadequate in protein is a risk factor for osteoporosis. Multiple large observational studies have shown that diets high in protein increase BMD and reduce fracture risk and that diets low in protein correlate to decreased BMD and increased fracture risk. There has been some debate over whether diets super high in animal protein decrease bone quality by stimulating bone resorption and increasing calcium excretion in the urine. A review in the May 2008 issue of the *American Journal of Clinical Nutrition* concludes that there is more evidence that diets adequate in protein play a role in maximizing bone health and there is little consistent evidence that suggests high protein diets negatively affect bone health when calcium intake is adequate. [Heaney, R. P. and D.K. Layman. “Amount and Type of Protein Influences Bone Health.” *Am J Clin Nutr* 87, no. 5 (2008): 1567S–70S. http://www.ajcn.org/content/87/5/1567S.long](http://www.ajcn.org/content/87/5/1567S.long)

### Key Takeaways

Non-modifiable risk factors for osteoporosis include: being female, being over age fifty, having a small frame, having an endocrine disorder, having a family member with the disease, and being Caucasian or Asian. The risk factors for osteoporosis that can be changed are smoking, alcohol intake, physical inactivity, and poor nutrition. Dietary inadequacy, certain medications, and diseases increase the risk for developing osteoporosis.
1. Discuss why it is important for a person with more than one biological risk factor for osteoporosis to begin to manage their lifestyle early on to prevent the development of the disease.