Osteoporosis

With more and more people living longer, specific health concerns important to the aged have surfaced. One of these health concerns is osteoporosis, a systemic disease of the skeleton, characterized by low bone mass and bone loss, which can lead to skeletal vulnerability. Travel to the National Osteoporosis Foundation to view important disease facts (R). The National Osteoporosis Foundation reported in 1997 that osteoporosis is too often misunderstood. Apparently, many wait for the appearance of symptoms seen in arthritis—swollen joints and pain—before worrying about the disease. Unfortunately, osteoporosis arrives without warning signals and may subsequently remain undetected until an affected individual suffers a fracture, usually in the hip, spine or wrist. Such fractures can impair an individual's posture and mobility, as well as cause significant pain and deformity. The National Institute of Arthritis and Musculoskeletal and Skin Diseases provides information on differentiating among osteoporosis, osteoarthritis and rheumatoid arthritis (O).

Bone is a very metabolically active tissue. That is, new cells form and old cells degenerate continuously. When the rate of old bone breakdown ("resorption") exceeds the rate of new bone formation, osteoporosis may result. Susan Ott, Associate Professor within the Department of Medicine at the University of Washington, maintains a website about bone physiology. The site includes information, photos and animations about bone, including a page explaining and demonstrating the growth and breakdown process (O). Travel to the National Osteoporosis Foundation to see images of normal and osteoporotic bone (R) and to read a more thorough description of bone health (O). In the mid 1990's the World Health Organization categorized bone density across several stages: normal, low bone mass (also known as osteopenia), osteoporosis (low bone density without occurring fractures), and established osteoporosis (low bone density resulting in fractures). For the statistician, "normal" bone mass is considered to be within one standard deviation of average, "osteopenia" to be between 1-2.5 standard deviations below average, "osteoporosis" to be 2.5 or greater standard deviations below average. The Surgeon General's Report on Bone Health and Osteoporosis references a bone mineral density assessment associated with the National Health and Nutrition Examination Survey. Based on data obtained in the assessment, future estimates of low bone mass and osteoporosis were derived (O).

The human skeleton is made of two types of bone, cortical and trabecular bone. Cortical bone is found predominantly in the peripheral skeleton, which includes bones in the pelvis, shoulders, and limbs. Trabecular bone, conversely, is predominantly found in the axial skeleton, including bones within the skull, ribs, sternum and spine. Trabecular bone has a higher "turnover" rate than does cortical bone, meaning more new trabecular is formed per year than cortical bone. Consequently, trabecular bone--particularly in the spinal region—is more prone to osteoporosis than cortical bone. The hip joint contains varying amounts of cortical and trabecular bone. While the femoral neck is typically higher in cortical bone, the "Ward's Triangle" area of the hip is mostly trabecular. To see an illustration of varying trabecular and cortical bone across a few skeletal sites, visit Merckmedicus.com (O). Susan Ott's Osteoporosis and Bone Physiology course website shows illustrations of cortical and trabecular bone differences (R-scroll to the bottom of the page). University of Utah's Webpath has a photo of fractured vertebral bone (R).
**Risk Factors**

There are many risk factors associated with an increased risk for osteoporosis. Some of these risks include:

**Sex**

Women are more at risk for osteoporosis than are men. The reasons for this are multifactorial and relate to other risk factors, particularly a woman's loss of the hormone estrogen during menopause. In advanced age, however, men begin to experience osteoporosis-related incidents more frequently, which means men are at risk as well. According to the National Osteoporosis Foundation, two million men currently have osteoporosis while an additional 12 million are at risk for the disease (O). Since the National Osteoporosis Foundation estimates 10 million Americans have the disease, that means eight million women have osteoporosis.

**Estrogen Deficiency**

Estrogen deficiency has been shown to have an impact on osteoporosis risk. Estrogen deficiency can occur naturally in women as a result of menopause; it can also occur earlier in life if a female's ovaries are removed or if a female experiences prolonged amenorrhea (the stopping of menstruation). Amenorrhea is frequently seen in women with eating disorders, particularly anorexia nervosa, and in athletes who have a very low body fat percentage, such as cross country runners, gymnasts, and dancers.

**Diet**

Currently, Americans do not consume enough calcium, a mineral important in bone formation. Individuals who do not consume adequate levels of calcium, then are at risk for developing poor bone health. Like calcium, Vitamin D is also important in maintaining bone mineral content. Consuming megadosage of Vitamin D, however, can be toxic to the body. Excessive protein intake may also be a factor in osteoporosis risk, due to an increased risk of mineral loss (through urine) with protein overconsumption. Alcohol consumption can also play a role in bone health. Travel to the National Institute of Arthritis and Musculoskeletal and Skin Diseases to read about the alcohol-osteoporosis link (R--scroll down the page to read "Alcohol-Osteoporosis Link"). Overconsumption of Vitamin A may interfere with Vitamin D in bone preservation, or even increase the rate of bone loss. The NIAMS provides information on Vitamin A and bone health (O).

**Ethnicity/Race**

Caucasians and Asians have greater risk for osteoporosis than do African Americans. Asian women, for example, tend to be slender, which seems to increase the risk for the disease (see "Body Size," below). African American individuals have a higher bone density than do Caucasian and Asian individuals, although this group also needs to be aware of other osteoporosis risk factors. As the Latino population in America continues to grow, osteoporosis also becomes a more important concern for this group. Travel to National Institutes' of Health
Body Size

Individuals with smaller frames tend to be at increased risk for osteoporosis. That is, individuals who have smaller bones are more at risk for osteoporosis, as they tend to have less bone mass to lose with age. A small-framed person who does not weigh very much is at further risk for osteoporosis due to a lessened amount of weight bearing on the bones, when compared to a larger person.

Age

Humans continue to accumulate bone mass until approximately the age of 35, when bone loss begins to slowly outpace bone growth. This is currently an inevitable process associated with aging. Although osteoporosis among children and adolescents is rare, it does happen. Juvenile osteoporosis (O, from the NIH Osteoporosis and Related Bone Diseases--National Resource Center) can result from an underlying medical or genetic disorder.

Other risk factors associated with the disease include smoking, family history, certain medications, smoking, excessive alcohol consumption, and medical history.

Osteoporosis Prevention and Treatment

Although some of the risk factors associated with osteoporosis are unalterable, there are lifestyle choices and medical treatments which can minimize the severity of the disease. These include exercise, diet, and pharmacotherapy.

Exercise

Physical activity appears to minimize osteoporotic bone loss. More specifically, activities involving impact seem to have more effect on preventing bone loss than do non-impact activities. Examples of impact activities include walking and running. Impact occurring through a sport such as tennis, where a hand-held racquet strikes a ball, also appear to increase bone mass. Research in the late 1970's and early 1980's compared tennis players' hitting arms with non-hitting arms and found a greater amount of bone in the hitting arms. Furthermore, in comparing the tennis players' hitting arms with dominant arms among non-athletes, researchers found greater bone mineral content among the athletes. Weight training, due to the resistance placed against the bones when performing the activity, can also be used to optimize bone mineral content.

The effect of gravity can also be related to bone mineral maintenance. Many animal studies show that when limbs are lifted in the air for long periods of time ("unweighting"), that bone loss occurs. This idea can be illustrated by the great care taken during and after an astronaut's flight.
The earth's gravitational pull is lost during the trip, and the astronaut subsequently loses bone mass. An astronaut will typically incorporate an hour or two of exercise into the daily regimen to combat the bone loss. PBS has a photo of astronaut Rick Sturckow on his cycle ergometer (O). Travel to the NASA Space Life Sciences Outreach for more information related to "the role of exercise in space" (O).

Diet

A diet with appropriate amounts of calcium and Vitamin D is important in minimizing one's risk for osteoporosis, although neither supplement can replace estrogen when considering disease risk. Regarding calcium supplementation and subsequent absorption, researchers seem to favor calcium citrate over calcium carbonate. Anyone considering calcium supplementation should consult his/her physician before purchasing a product. The National Osteoporosis Foundation describes the importance of and lists food and beverage sources for calcium and Vitamin D (O). Overconsumption of alcohol can also increase risk for osteoporosis. Alcohol affects hormonal levels and calcium balance, and can of course increase risk for falling.

Pharmacotherapy

Estrogen replacement therapy (ERT) has been used in postmenopausal women to prevent the early onset of osteoporosis. There are, however, serious side effects associated with ERT, so women should discuss this therapy with their physicians before deciding to pursue this treatment. Interestingly, when ERT first emerged as a treatment for osteoporosis, many researchers and clinicians urged its use because of the reported cardiovascular benefits associated with it. A 1998 article published in Doctor's Guide, for example, cites the protective benefits of ERT (O). Currently, however, many professionals feel ERT may not only fail to provide protective cardiovascular benefits but actually worsen a person's cardiovascular risk. ERT has also been shown to increase cancer risk among many, particularly those with a family history of the disease. At least one component of the famous Women's Health Initiative research project was halted because of a significantly increased breast cancer risk among those who participated in the project.

The National Osteoporosis Foundation recognizes there is no cure for the disease, but does provide information on medications used to prevent and treat the condition (O). Fosamax (generic name alendronate), Boniva (generic name ibandronate, can be taken as pill or injection), Evista (generic name raloxifene) are among the drugs approved by the FDA for osteoporosis prevention (O). Other therapeutic drugs which have been approved or are currently under investigation include calcitonin, parathyroid hormone, other bisphosphonates, and sodium fluoride.

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