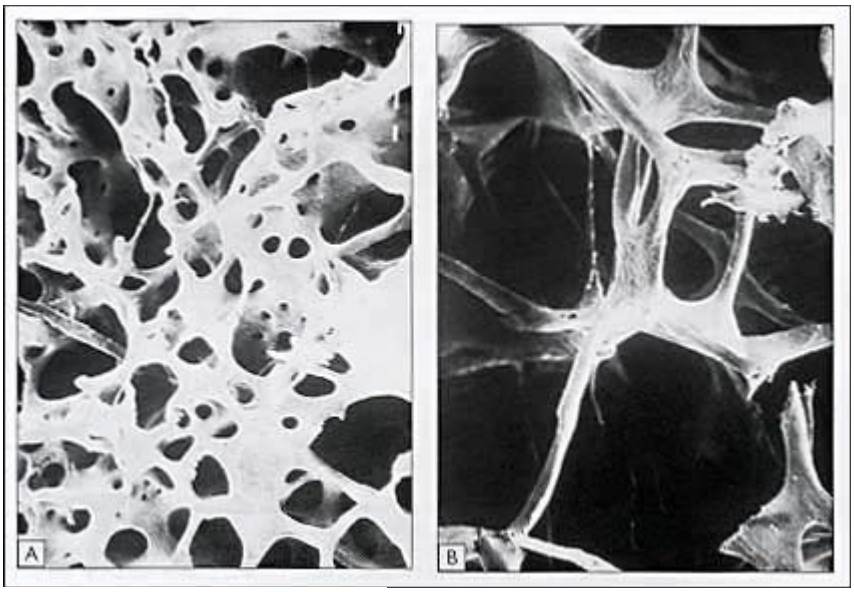
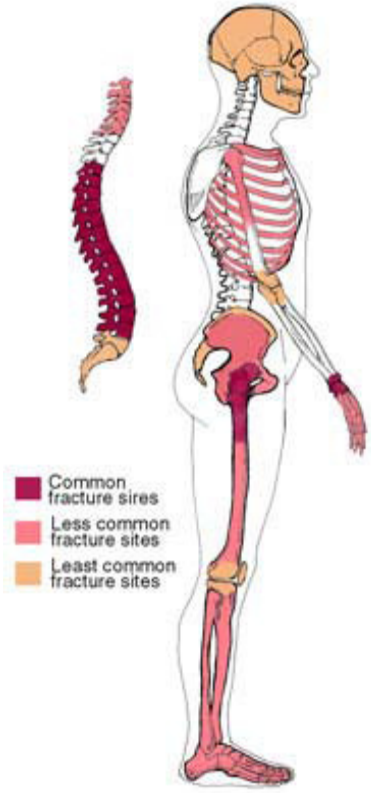
Osteoporosis

Basics:
Osteoporosis is the loss of bone density and strength. A normal skeleton is made up of two major types of bone. One type, called cortical bone, is the dense, stiff bone that is the major component of the long bones of the legs and arms and other sites. Another type of bone, called trabecular bone (or "spongy" bone), occurs in areas such as the spine, hips, heels, and wrists, where flexibility and shock absorption are required. Trabecular bone contains many small holes (pores) through which blood circulates. Within these small pores, special cells called osteoclasts break down bone, and other special cells called osteoblasts build bone back up.

The constant process of breakdown and re-formation is called remodeling. One cycle of remodeling takes up to six months. In fact, your entire skeleton is slowly replaced by remodeling every four to five years. Osteoporosis happens when osteoclasts break down bone more quickly than the osteoblasts form new bone. When this happens, your bones will lose strength and density. Trabecular bone loses density more readily than cortical bone.

Early bone loss is just thinning of the bone around the already porous areas (osteopenia). At this early stage, bone loss may be fully reversible. If the process of bone loss is not reversed, however, it may eventually lead to severe osteoporosis. Osteoporotic bone contains much larger holes connected only by thin strips of weakened bone. This weakened bone is less dense, and is much more prone to fractures. Sites containing more spongy (trabecular) bone tend to fracture first, which is why hip, spine, and wrist fractures are more common than fractures at other sites. People with more severe osteoporosis have a greater risk of fracturing the ribs and the long bones of the arms and legs.





Causes

As you age, your bones break down faster than they can build back up. The primary cause of osteoporosis is increasing age. Most women reach their maximum bone density by the age of 35—most men reach their maximum bone density by age 40. After you reach your peak bone density, your bone mass is maintained by a process whereby cells break down and re-form bone (remodeling). As you get older, however, your bones break

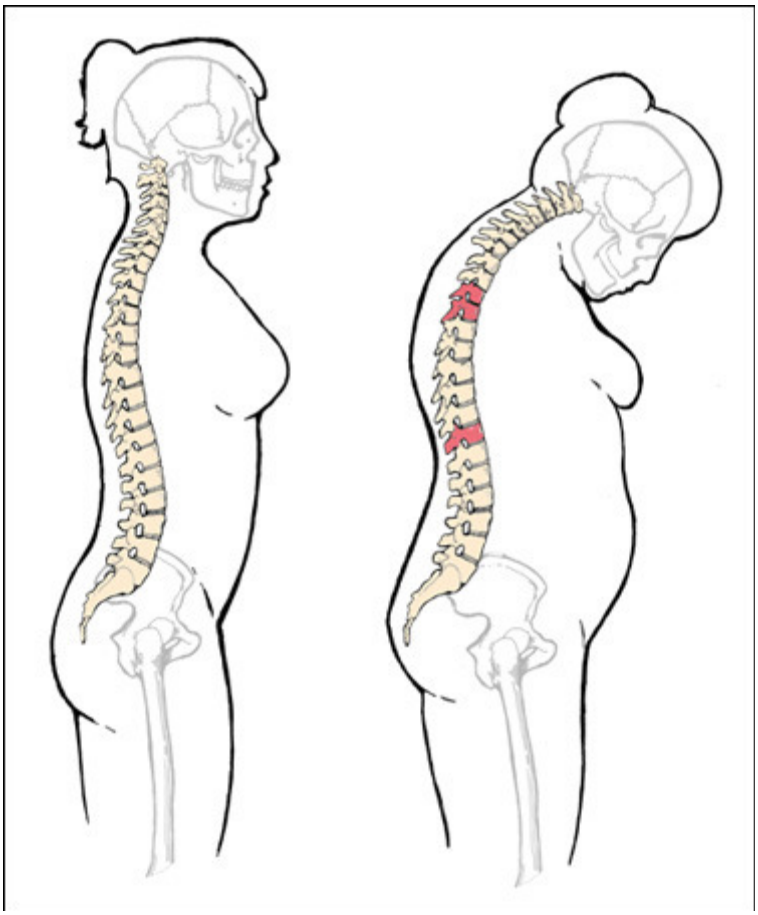
down more quickly than they re-form. Therefore, your bones become thinner and more likely to break. Age-related losses of balance and muscle strength also increase your risk of falling and breaking a bone.

Poor nutrition and lack of physical activity contribute to decreased bone density. It is important to consume calcium and vitamin D during adolescence and young adulthood. During this time your bones are still building mass, and calcium and vitamin D help to make them as strong as possible. It is also important to get regular physical exercise during this time; especially weight-bearing exercise.
A poor diet and a sedentary lifestyle can hinder bone-building and contribute to brittle bones in later age. Drinking caffeine and soda on a regular basis, in particular, is thought to increase the rate of calcium loss from bones. This is particularly disturbing since many young people now drink soda and coffee instead of milk.

It remains important to get exercise and consume calcium and vitamin D as you age to slow bone loss.

Symptoms:
Osteoporosis can occur without any symptoms. You may not realize that your bones are becoming brittle until you get a fracture. Even regular x-rays cannot detect osteoporosis until you have lost more than 20% of your bone density.

There are, however, some late signs of osteoporosis. A collapsed bone in your back (vertebra), for example, may cause severe back pain, loss of height, or a stooped posture (kyphosis). If you have lost more than 1 ½ inches of height since the age of 35, you are at increased risk for osteoporosis.



A collapsed bone in your back may cause severe back pain, loss of height, or a stooped posture (kyphosis)

Risk Factors:
Women are at a greater risk for osteoporosis than men [Table 1]. One out of two women and one out of eight men will break a bone because of osteoporosis after the age of 50. Women have a greater risk of osteoporosis because they have bones that are smaller and less dense than those of men. In addition, women tend to participate in fewer weight-bearing activities, and also tend to lose more bone mass than men. Women who have irregular menstrual cycles or no menstrual periods (amenorrhea) and women who have gone through menopause have a greater risk of osteoporosis. During the years just before and after menopause, women can lose about 20% of their bone mass.

Low estrogen levels contribute to brittle bones. Estrogen helps prevent bone breakdown, but doesn't build bone. Therefore, if you have low estrogen levels, you may experience bone loss that is not replaced, even if your estrogen levels return to normal. Estrogen-related bone loss usually tends to occur earliest in the spine, with the hip and wrist losing bone somewhat later on.

Some female athletes stop having their periods (amenorrhea) because the physical exertion changes their levels of reproductive hormones. These women are at risk for osteoporosis because their lack of estrogen causes them to lose bone mass. They may experience stress fractures that are very difficult to treat. This risk does not decrease if they exercise less or take calcium supplements.

Osteoporosis isn't just a disease of the very old. Some women may lose half their bone mass by age 65 because of prematurely low estrogen levels.

Young women with eating disorders (such as anorexia nervosa) are at risk for dramatic bone loss and stress fractures.

If you are close to or have reached menopause, you are at an increased risk for having osteoporosis. During the time around menopause, some women lose bone as they begin to skip periods and have other menopausal symptoms. Some may have as much as 50% bone loss during the five to seven years before their periods stop and true menopause begins. Women who have reached menopause are at a particular risk for osteoporosis as their estrogen levels further decline.

If you are a woman who has had her uterus removed (hysterectomy), you have a greater risk of osteoporosis.

A total hysterectomy at any age results in rapid bone loss. Even when both ovaries remain following a partial hysterectomy, there is usually a significant decline in estrogen production following removal of the uterus that results in menopause and increased bone loss in about five to eight years.

Osteoporosis from hormone loss also happens to men. Men who have low testosterone levels have a much higher risk for osteoporosis than other men. Osteoporosis related to low testosterone levels has a similar pattern to osteoporosis in women, and can cause significant bone loss in the spine and hip. Low testosterone levels can occur in men at any age; a decrease in sexual function and hair loss are the most common symptoms. All men over the age of 60 experience a decline in testosterone levels. Men who are treated for prostate cancer have a particularly high risk of osteoporosis.

Of the men who have osteoporosis, 20% have a type known as "idiopathic", a type that has no cause. Idiopathic osteoporosis can occur at any age. As a result, men who have major fractures or fractures with very little trauma, or who have curvature of the upper spine (kyphosis) or unexplained height loss should be screened for osteoporosis.

Insufficient vitamin D intake increases your risk of osteoporosis and decreases response to any osteoporosis treatment plan. Adequate levels of vitamin D are required in order to absorb calcium and to build bone. It is estimated that more than 70% of the population in the northern half of the US are Vitamin D--deficient. This significant bone loss is directly related to inadequate levels of vitamin D and sun exposure. This is true for all age groups, but is even more severe in the elderly. In addition, after age 50, there is a progressive

decline in the absorption, metabolism, and effectiveness of vitamin D in both men and women. After about age 50 it is essentially impossible to get enough vitamin D from sun exposure alone. Vitamin D is not readily available in the diet, so supplements are usually required.

Insufficient calcium intake increases your risk of osteoporosis and decreases your response to any osteoporosis treatment plan. Calcium is required to build and maintain bone density at all ages. After the age of about 50, your ability to absorb calcium decreases, which is often made worse if you don't get enough vitamin D. As a result, you should increase your intake of calcium after age 50. However, you should take your calcium in several smaller doses to optimize absorption.

Having a small-boned frame or being tall increases your risk for osteoporosis. There is a direct relationship between increased height combined with low body weight and osteoporosis in both men and women. In women, body weight of less than 128 lbs has been shown to significantly increase risk of osteoporosis. Low body mass index (BMI) in men or women dramatically increases osteoporosis and fracture risk, as well as increasing risk of falls. In addition, small—boned women have an increased risk of fracture irrespective of bone density due to the decrease in bone mass.

Having either a parent or sibling who has had osteoporosis, a spine or hip fracture, or another fragility fracture increases your risk of getting osteoporosis.

Smoking, drinking alcohol to excess, or leading an inactive lifestyle puts you at risk for osteoporosis. These modifiable risk factors are often major contributors to early osteoporosis in both men and women. In women, tobacco use causes menopause three years earlier than it would occur in a nonsmoking woman. In both men and women, tobacco inhibits normal bone metabolism. Alcohol abuse is a major contributor to osteoporosis (especially in men) because it results in abnormal bone metabolism and is associated with malnutrition. In addition, alcohol abuse carries with it an increased risk of injury and falls, which is dangerous for a person with weakened bones.

Some ethnic groups are more at risk than others. Although risk is higher among Caucasian and Asian women, African-Americans as well as Hispanic-Americans are also at risk for osteoporosis. Among African-American women, for example, 10% over the age of 50 have osteoporosis, and another 30% have low bone density.

Table 1. Risk Factors for Osteoporosis

THINGS YOU CAN'T CHANGE	THINGS YOU CAN CHANGE
Age (women: over 50; men: over 60)	Stop smoking
Female gender	Drink no more than 2 alcoholic drinks per day, and no more than 6 drinks per week
Being tall, having a small frame, or a slender build (weight under 128 lbs or BMI below average)	Get enough exercise, but not so much as to induce amenorrhea (women)
Family history (mother, father, or sibling)	Get adequate calcium and vitamin D

Race (Caucasian or Asian ancestry at greater risk than others)	Avoid certain medications (see Table 2)
Menopause	
Certain diseases (see Table 3)	
History of previous fracture, especially after age 50	
Confusion or dementia and/or unsteady gait and frequent falls that cannot be reversed with treatment	

Certain drugs increase your risk for osteoporosis by decreasing calcium absorption and vitamin D metabolism, and/or by directly affecting bone formation and breakdown [Table 2].

Table 2. Drugs that Increase Your Risk for Osteoporosis
Major culprits
Corticosteroids at all ages, and also inhaled corticosteroids in the elderly *(Prednisone*, *Medrol*, etc.)
Phenytoin (*Dilantin*), Phenobarbitol (possibly other, newer anticonvulsants as well)
Aluminum—containing antiacids (not the more common magnesium containing ones)
Warfarin (*Coumadin*), Heparin
Excessive thyroid hormone replacement (often taken to shrink a thyroid mass)
Benzodiazipines (*Valium*, etc)
Any treatment for prostate cancer.
Most (possibly all) chemotherapy agents (including interferon, etc.)
Methotrexate (possibly other, newer rheumatoid arthritis drugs as well)
Other drugs/medications also associated with decreased bone density
Insulin
More than five years of continuous tetracycline use or excess vitamin A or use of oral vitamin A derivatives for acne treatment.
Gonadatropin—releasing hormone treatment for endometriosis
Caffeine (also contained in many headache medications)
Certain diuretic medications (“loop diuretics” such as *Lasix*, *Demidex*, *Bumex*)
Cholestyramine use for more than five years (used to lower cholesterol)

Some diseases increase your risk of osteoporosis by affecting bone metabolism [Table 3].

Table 3. Diseases Associated with Decreased Bone Density
Overactive parathyroid glands
Overactive thyroid gland
Inflammatory bowel disease (Crohn's or other colitis; not irritable bowel)
Severe chronic lung disease (emphysema, pulmonary fibrosis, etc.)
Intestinal sprue, surgery to remove part of the stomach or small intestine, or other causes of malabsorption in the upper intestinal tract
Cystic fibrosis

Renal tubular acidosis or chronic renal dialysis
Chronic immunosupression for any type of organ transplantation
Osteogenesis imperfecta
Insulin—dependent (type 1) diabetes
Cushing's disease
Grand mal seizure disorder
Rheumatoid arthritis (not osteoarthritis)
Dementia of any type
Any disease resulting in muscle weakness or paralysis
History of any previous fracture, especially after age 50
Dramatic increase in fracture risk with history fracture of either the spine or hip
Scoliosis

There are some factors that have been shown to result in increased bone mass [Table 4].

Table 4. Factors that Increase Bone Mass
Morbid obesity (weight over 250 lbs or significantly elevated BMI) without increased risk of falls
Delayed menopause and/or continuous hormone replacement therapy
More than three pregnancies combined with adequate calcium and vitamin D intake
Lifetime high intake of milk products (average three or more servings per day)
Use of Thiazide diuretics for more than five years (decreases calcium excretion)
Use of “statin” lipid—lowering medications (*Zocor* or *Pravachol* or *Mevacor*) for more than three years
Lifetime history of extremely heavy weight—bearing activity (involving regular, continuous lifting of more than 40 lbs)

Diagnosis:
Your doctor will perform a complete physical exam, and will review your medical history when diagnosing osteoporosis. Diagnosis can be elusive among people with brittle bone disease, mainly because its symptoms are silent. Your doctor should go over your medical history, including your family history, and give you a full physical exam that includes your height, weight, x-rays, and blood and urine samples.

Your doctor may run tests to determine bone density and fracture risk. Anyone who has significant risk factors for osteoporosis, especially older women, should undergo bone density tests. These tests measure bone density in different areas of the body; specifically the hips, wrists, and vertebrae, where osteoporosisrelated fractures may appear. Such tests can detect osteoporosis before a fracture occurs, and can assess your odds of sustaining a fracture. Also, frequent testing may help to determine your rate of bone loss through the years.

There are different types of tests to measure bone density.

Dual energy x-ray absorptiometry of the hip and spine (DEXA) testing measures bone density of the spine, hip, or total body (when necessary, this method may also be used to measure bone density in the wrist). At present, DEXA of the hip and spine is the preferred test for diagnosis and monitoring of osteoporosis because it is the most precise and reproducible. It is also the only test readily available that can accurately measure bone density in the hip, which is one of the most important diagnostic sites. DEXA tests usually take no more than 10 minutes, and give off much less x-ray irradiation than a mammogram. This test is recommended by most experts as the only dependable diagnostic method for women under age 50, or for men of any age.

CT bone density testing of the spine is used less commonly due to the high x-ray exposure and the inability to measure bone density in any other site than the spine. This test may be used if there are no other options available to you.

Peripheral dual x-ray absorptiometry (DXA) measures bone density of the wrist, heel, or finger. However, this test may miss osteoporosis that has started in the spine and is not yet evident in the extremities (osteoporosis often begins in the spine in women, sometimes years before it is evident in other sites). Peripheral bone density tests have been shown to miss osteoporosis in up to 30% of cases in women younger than 65 years of age.

Ultrasound bone density testing is the most recent diagnostic method approved by the U.S. Food and Drug Administration. This method assesses the risk of osteoporosis in one minute, and uses no x-rays. Bone density is determined by measuring the absorption of high-frequency sound waves by the bone in the heel of your foot. By placing your foot into the device, which is shaped like a box, a picture of the heel bone is taken. The sonometer is less costly than other tests, and may serve as a preliminary screening tool for some high-risk populations, or for those who cannot have a DEXA scan. In women over 65 years old this test is fairly specific for osteoporosis, but still may miss up to 20% of cases that would be found on DEXA. In men or younger women, however, there can be a very high false negative rate.

Prevention and Screening:

To prevent osteoporosis, it is critical to take steps to maximize bone growth in childhood and young adulthood. After your bones reach their peak density, it is equally important to take further preventive measures to avoid the gradual loss of bone that can result in low bone density and osteoporosis later in life.

Maintain healthy eating habits and levels of activity throughout life. Because peak bone mass continues to develop from childhood on through adolescence, parents should pay close attention to the eating and lifestyle habits of their children. Parents should continue to set examples and encourage good eating and lifestyle habits as their children grow to become teenagers and young adults. It is most important to eat a balanced diet with plenty of calcium and vitamin D each day. You should not smoke, and you should limit

your intake of soda and caffeine. Other key lifestyle routines that help build stronger bones include doing weight—bearing activities such as lifting weights and walking. Young women in competitive sports (especially swimming or track) should be monitored closely for normal menstrual cycles, and a physician should evaluate any significant changes. Young women should also be monitored closely for signs of eating disorders, as these have become more and more frequent and can result in significant bone loss.

A bone density test helps to determine your chances of a future fracture. Anyone with significant risk factors for osteoporosis or fracture should consider bone density testing, as treatment can result in major decreases in future fracture risk.

Urgent Care:
Call your doctor immediately if you have sudden back pain or a broken bone.

It is especially important to get immediate treatment for a hip fracture. Patients with significant osteoporosis may have major fractures with little or no trauma. Hip fractures are especially critical; 20% of patients over the age of 50 die during the year of their fracture; men have a 26% higher death rate than women within a year of fracturing a hip. These fractures are often debilitating, and can require long-term care. A woman's risk of developing a hip fracture is equal to her risks of developing breast, uterine, and ovarian cancer combined.

Self Care:
Eat a calcium-rich diet to build strong bones. If you find it hard to get the daily-recommended amount of calcium, you should take calcium supplements [Table 5]. Eat a balanced diet with plenty of calcium. Foods rich in calcium include: dairy products such as milk, yogurt, and cheese; calcium-fortified foods such as orange juice, bread, and cereals; canned fish with edible bones such as sardines and salmon; leafy dark green vegetables such as kale, collard greens, spinach, and broccoli. Before the age of 40, you should get about 1,000 mg of calcium a day. If you are a woman past menopause, you should consider increasing your daily intake to 1,500 mg of calcium a day (one cup of low—fat milk contains 300 mg of calcium). After about age 40 or 50, you should take calcium supplements in divided doses of not more than 500 to 600 mg per dose. Milk and milk products remain the safest and most effective source of calcium.

Calcium supplements can be found in different forms; calcium carbonate and calcium citrate are both acceptable. Calcium carbonate should always be taken with food to improve absorption. Calcium citrate can be taken at any time, with or without food. Some patients find calcium citrate to be less constipating.

Although there has been a lot of concern over lead contamination in calcium supplements in the past, several recent studies have shown that there is little to no significant lead contamination in the major calcium supplements.

In addition, there is no increased risk for kidney stones from increasing calcium intake as long as it is combined with an adequate intake of vitamin D. Anyone with a history of kidney stones should maximize fluid intake to at least three to four quarts of water a day.

Make sure you get enough vitamin D, as your body needs it to absorb calcium. Your body can't readily absorb calcium without sufficient amounts of vitamin D. Vitamin D is also required for proper bone metabolism. Spending time outdoors, even for ten minutes each day, will help you get the vitamin D you need, but may still be insufficient. If you live in the northern half of the US (or further north), you are unlikely to be able to get enough vitamin D to help you maximize your peak bone density, or adequately suppress bone loss with age. Dairy products can be a good source for vitamin D if you consume three or more servings each day. You may wish to consider supplementation with 400 U (units) of vitamin D per day from childhood through age 40 (particularly in the winter); especially if your dairy intake is limited. After about age 40 or 50 you should consider increasing your vitamin D intake to 600 to 800 U per day as the production and effectiveness of vitamin D declines with age. If you are being treated for low bone density, you should consider taking 800 U per day of vitamin D supplementation unless other major sources of vitamin D are available. Many calcium supplements come with vitamin D, usually at a dose of 125 to 200 U per pill. Some fortified foods, such as cereals and breads, contain limited amounts of vitamin D.

To ensure your safety, you should always discuss vitamin intake with your clinician--especially if you have a history of chronic diseases or organ problems (liver or kidney, etc), or if you are on any prescription medications.

Fluoride may be useful for maintaining bone. Fluoride is known to fight cavities, and has been postulated to help build bone. However, studies show that the new bone stimulated by large amounts of fluoride intake is weak and abnormal, and is prone to increased fracture risk. The relatively tiny amounts of fluoride typically found in water, toothpaste, or other sources do not seem to have any significant positive or negative effect on bone.

Table 5. Supplements Used to Prevent Osteoporosis

DRUG NAME	DOSING	SPECIAL CONSIDERATIONS
Calcium supplements		
Calcium carbonate, calcium citrate	Premenopausal women and men who have normal bone density: 1,000 mg a day	Calcium carbonate: Always take with food. May cause constipation
	Men over age 60 who have normal bone density: 1,200 mg a day	Calcium citrate: May take with or without food. May cause dyspepsia if taken alone (rare). May help constipation
	Postmenopausal women and anyone with a low bone density: 1,500 mg a day	Always divide doses greater than 500 to 600 mg. Best taken after noon; avoid taking with caffeine or soda

	Elderly: 1.2 g per day	
Vitamin D supplements		
Vitamin D	400-800 U per day	Side effects are rare

Both calcium and vitamin D supplementation can result in kidney stones or symptoms related to high calcium levels (for example, constipation, loss of appetite, or nausea) in elderly patients with underlying or undiagnosed metabolic disease, or in patients with severe osteoporosis if not taken with appropriate medications to suppress bone reabsorption.

Weight-bearing exercises build stronger bones. When your legs, arms, and other parts of the body meet resistance, you build bone. Weight-bearing exercises include weight lifting, gentle running, walking, stair-climbing, and gardening. Swimming and bicycling are not, even though they have benefits for aerobic and cardiac fitness. If done regularly, weight-bearing exercises help to prevent osteoporosis. These types of exercises also help to improve balance, decreasing the chance of a fall. If you have bone loss, you will need to choose exercises that not only help build bone, but are also safe and unlikely to result in falls.

Standing from a chair without pushing off is a simple exercise that can be repeated in sets of five. This exercise has been shown to help decrease bone loss and also improve balance in the elderly.

Exercises that strengthen the back will help to prevent or treat osteoporosis. Exercises that strengthen the back help you maintain or improve posture. A strong back and good posture will help you avoid fractures. Weight—lifting programs using relatively light weights (2-10 lbs) can result in less upper back pain, and, when carefully supervised, can greatly facilitate response to any osteoporosis treatment plan. Weight lifting beyond 10 lbs should be considered only with careful supervision to avoid the increased risk of injury associated with heavier weights. Rowing machines may also be useful in a back-strengthening program, although their direct effect on bone density has not been studied. If you smoke, quit. Smoking lowers estrogen levels; smokers have been found to reach menopause more than three years earlier than non-smokers. Smoking significantly decreases response to hormone-replacement therapy, while also increasing the risks of serious side effects such as blood clots or heart attacks. In addition, smoking may impede calcium absorption, and also impedes the formation of collagen that forms the protein structure of bone and skin.

Consuming excessive alcohol has multiple negative effects on bone density and fracture risk. People who drink excessively (more than 2 drinks in 24 hours and/or more than 6 drinks per week) often suffer from poor nutrition, resulting in bone loss as well as an increased risk of falls and injuries when intoxicated. Studies have shown a major correlation between alcoholism and osteoporosis in men.

Drug Therapy:
Your doctor is the best source of information on the drug treatment choices available to you.

Other Therapies:
Practice the Chinese martial art of tai chi to improve balance and prevent a fall. If you have osteoporosis, avoiding a fall is important. About 33% of people over the age of 65 experience a fall. Broken bones at this age can mean long-term rehabilitation or even death. Although there are no scientific studies to prove it, practicing the ancient Chinese martial art of tai chi may be beneficial. The exercise uses slow, flowing movements that increase flexibility and strength, and improve balance. Studies have shown that 30 minutes of daily of practice significantly improves balance.

If you do suffer a broken bone, you may need physical therapy. To recover from a broken bone such as the hip, wrist, or spine, you may need to see a physical therapist. He or she can help devise a therapy plan to fit your degree of bone loss. Talk to your clinician for referrals.

Wearing hip protectors may prevent a fracture if you fall. Hip protectors are hand-sized cups that fit into a special pair of underwear. The hip protector sits over the hip bone, and is held in place by pockets in the underwear. If worn consistently, hip protectors can prevent a hip fracture due to a fall. Hip protectors are available over the internet, or through medical supply stores.

Surgery:
Although still not widely available, a specialized therapy called kyphoplasty may immediately relieve pain and prevent debilitating deformities caused by collapsed vertebrae. Kyphoplasty is an invasive procedure that involves expanding the collapsed vertebrae using “balloons” and injecting “bone-like” material into the crushed vertebrae. The material hardens, and the entire process brings the vertebrae back up to near its original shape. Most patients who have undergone kyphoplasty have immediate relief from most of the fracture-related pain.

Alternative Medicine:
Some people use soy and other plants to increase their bone density. However, no studies have confirmed that these substances have a significant effect on bone density. Although soy and other plants contain significant amounts of estrogen-like plant substances (phytoestrogens), there have been no studies to confirm that any substances have a significant effect on increasing bone density. The activity of phytoestrogens is thought to be 20 to 50 times less than the most common human estrogen, estradiol. However, soy and other plants that contain phytoestrogens often do contain calcium and protein, and are generally a good source of nutrition for patients with osteoporois. It remains to be proven if a high daily intake can help prevent osteoporosis.

Talk to your clinician about matters that affect your gait and balance. Bad vision, poor balance, chronic diseases that impair your mental or physical performance and certain medications (such as sedatives) can all lead to a fall. If you are on any of the following medications, you should talk to your clinician about the use of these medications and other concerns that may affect your balance and the way you walk:

Amitriptyline or Nortriptyline

Benzodiazipines such as Valium, Xanax, or Ativan

Over-the-counter medications containing Benadryl

Sleep medications such as Ambien

Avoid a fall by practicing safe living habits [Table 6]. Take precautions while outdoors to prevent a fall: try using a four—pronged cane for stability; use rubber soled shoes or strap-on treads for traction, avoid slippery sidewalks or carry salt in your pocket to spread onto walkways, and avoid wet polished floors. While indoors, use carpet runners, keep your floors clutter-free, remove loose wires, and do not walk in socks, slippers, or hose. Be sure lighting is adequate and light switches are accessible. Area rugs should be tacked to the floor or have slip-proof backing; make sure stairs have handrails; make sure bathrooms have handrails in the shower, tub, and near the toilet; use a rubber bath mat; only use wide step stools with handrails; keep a cordless phone with you to avoid rushing to answer it; keep a flashlight and batteries at your bedside and consider automatic dial emergency services.

Table 6. Safe Living Habits to Prevent a Fall

WHILE OUTDOORS	WHILE INDOORS
Use a four-pronged cane for stability	Use carpet runner
Wear rubber-soled shoes or strap on treads for traction	Keep floors clutter-free
	Remove loose wire
Avoid slippery sidewalks or carry salt in your pocket to spread on walkways	Do not walk in socks, slippers, or hose
	Tack area rugs to the floor or use slip-proof backing
Avoid wet polished floors	Make sure the stairs have handrails
	Make sure bathrooms have handrails in the shower, tub, and near the toilet
	Use a rubber bath mat
	Only use wide step stools with handrail
	Keep a cordless phone with you to avoid rushing to answer it
	Keep a flashlight and batteries at your bedside
	Make sure your house is well-lit and that light switches are easy to access

Prognosis:
Osteoporosis can be life-threatening. Women who fracture a hip have a 20% risk of death in the first year after the fracture. Men have a 33% chance of death in the first year after hip fracture. If you survive a hip fracture, you will still need to make major lifestyle changes. For example, you may not be as independent as you had previously been, or you may even need long—term care.

While there is no cure for osteoporosis, it can be treated. To manage your osteoporosis, it's important to take preventive measures such as consuming plenty of calcium and vitamin D, doing weight-bearing exercises, and avoiding excessive alcohol and smoking. These same measures can also increase your response to any medication treatment plan by more than 20%. Osteoporosis can also be treated, and may even be avoided or delayed by adequate drug therapy. Extensive studies of the quality of bone formed with osteoporosis have suggested that this bone is identical to younger bone in structure and response to stress.

Follow-Up:
Return to your doctor for regular bone density tests. Your doctor can monitor your rate of bone loss, and thus head off low bone density with drug therapy and supplements. It's never too late; a bone density test is also recommended for older woman who can benefit from different therapies. The tests measure bone density in various parts of the body, and can detect osteoporosis before a fracture occurs. If done regularly once a year, the DEXA bone density test can monitor the results of your treatment. There are also several urine and serum tests that can detect your rate of bone turnover. These tests may also be used to evaluate early treatment response (4 months).

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Osteoporosis

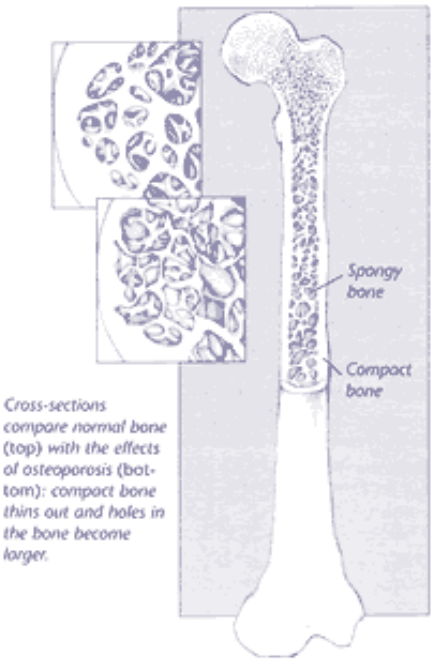
Bones go through a constant state of loss and regrowth. As a person ages, more bone loss than bone growth occurs. This can lead to a condition called osteoporosis. The bones then become thin and fragile and can fracture or break easily. This pamphlet explains:

- Risk factors of osteoporosis
- How it can be detected
- How you can help prevent it

What Is Osteoporosis?

Bone is made up of ***calcium*** and protein. There are two types of bone—compact bone and spongy bone. Each bone in the body contains some of each type. Compact bone looks solid and hard and is found on the outer part of bones. Spongy bone is filled with holes, just like a sponge, and is found on the inside of bones. The first signs of osteoporosis are seen in bones that have a lot of spongy bone, such as the spine, hip, and wrist.

Once made, bone is always changing. Old bone is removed in a process called resorption, and new bone is formed in a process called formation. From childhood until age 30 years, bone is formed faster than it is broken down. The bones become large and more dense. After age 30 years, the process begins to reverse: bone is broken down faster than it is made. This process continues for the rest of your life. A small amount of bone loss after age 35 years is normal in all women and men. Most of the time, it does not cause any problems. However, too much bone loss can result in osteoporosis.



Cross-sections compare normal bone (top) with the effects of osteoporosis (bottom): compact bone thins out and holes in the bone become larger.

With osteoporosis, bones become thin and brittle because more bone is lost than formed. The bones are still the same size, but the outside walls of compact bone become thinner, and the holes in spongy bone become larger. These changes greatly weaken the bone.

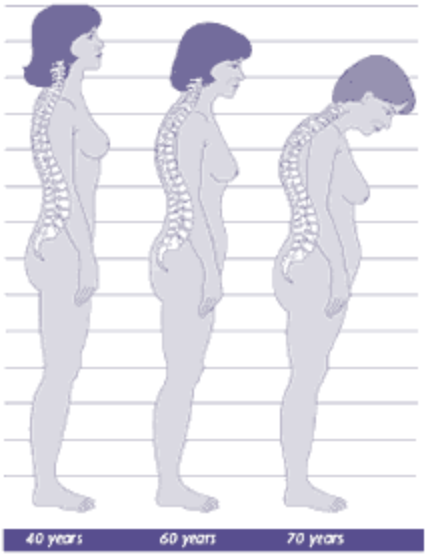
Osteoporosis can pose a special threat to women. Estrogen—a female ***hormone***—protects against bone loss. As a woman nears ***menopause,*** her body produces less ***estrogen.*** Hormone therapy slows bone loss after menopause. Estrogen has been shown to decrease the risk of hip fractures and

spinal deformities. In women who have a uterus, estrogen is given along with another hormone—***progestin.*** This decreases the risk of endometrial cancer, which occurs when estrogen is given alone.

However, bone loss begins to happen long before menopause. Often, by the time symptoms of osteoporosis show, a great deal of bone loss has already occurred.

Some symptoms of osteoporosis are back pain or tenderness. Signs include a loss of height more than what is normal for your age group, and a slight curving of the upper back. As the spinal bones weaken, they slowly collapse under the weight of the upper body. This causes a curving of the spine—often called a "dowager's hump."

Osteoporosis affects at least 10 million Americans—most of whom are women. Each year, more than 1.5 million fractures related to osteoporosis occur in the United States. One in two women older than 50 years will have a fracture related to osteoporosis in their lifetime. Fractures can be crippling and painful and cause lifelong disability.



As spinal bones weaken, they collapse under the weight of the upper body

Risk Factors

Compared with men, women are more at risk of osteoporosis because of menopause and because their bones are smaller and lighter than men's bones. Women who take certain medications (see box) or have certain medical conditions also are at increased risk of osteoporosis. The following factors can increase the risk of fractures caused by osteoporosis:

- Personal history of fracture
- Family history of osteoporosis
- Caucasian race
- Dementia
- Poor nutrition
- Low body weight
- Early menopause (younger than 45 years)—Bone loss increases after menopause because the ***ovaries*** stop making estrogen, which protects against bone loss.
- Removal of ovaries—If a woman has her ovaries removed before menopause, the sudden decrease in estrogen can result in rapid bone loss unless she takes a preventive treatment, such as estrogen.
- Prolonged ***amenorrhea*** before menopause (more than 1 year)
- Diet low in calcium (lifelong)
- History of falls
- Lack of exercise
- Alcoholism
- Vision problems
- Certain medications

Medications and Osteoporosis

Women who take certain medications may be at increased risk for osteoporosis. These medications may include:

- Anticonvulsants
- Aluminum
- Drugs that suppress the immune system
- Excessive thyroid hormone
- Drugs that affect the adrenal gland and the ***pituitary gland***
- ***Gonadotropin-releasing hormone*** (GnRH) ***agonists***
- Blood thinner
- Lithium
- Anti-cancer drugs

Prevention

It is hard to grow new bone after it is lost, so prevention is important. Slowing bone loss helps build strong bones. To prevent osteoporosis, focus on building and keeping as much bone as you can. This can be done by doing weight-bearing exercises and choosing foods with enough calcium and Vitamin D. After menopause, your doctor may suggest medication to protect against bone loss if your bones show signs of early osteoporosis.

Exercise

Exercise increases bone mass before menopause and slows bone loss after menopause. Just as muscles become stronger with regular exercise, so do bones. Bones are strengthened by having the muscles pull on them. Bone loss will occur any time the bones are not used. For example, it becomes worse in people who are bedridden for a long time. Active women have higher bone density than women who do not exercise.

Most aerobic exercise is good for the heart and bones. To help prevent bone loss, the exercise should be weight-bearing, such as low-impact or step aerobics, brisk walking, and tennis. Even walking several blocks each day will slow bone loss. A little bit of exercise is better than none at all. If you have questions about the best exercise program for you, talk with your doctor or a professional who knows about health and exercise. Let him or her know if you have a physical problem that may limit your exercise.

Diet

Bone loss can increase if your diet is low in calcium. Calcium slows the rate of bone loss. If the amount of calcium in the bloodstream is too low, it will be taken from the bones to supply the rest of the body.

Good sources of calcium are dairy products, such as milk and yogurt. Other sources are leafy green vegetables, nuts, seafood, and juices and cereals that are fortified with calcium (see Table 1). A well-balanced diet is very healthy for bones.

Table 1. Foods Containing Calcium

Food	Amount	Calcium (mg)	Fat (g)
Milk and dairy products			
American cheese	1 oz	195	8.4
Cheddar cheese	1 oz	211	9.1
Swiss cheese	1 oz	219	7.1
Ice cream—hard	1 cup	176	14.1
Low-fat milk	1 cup	298	4.7
Skim milk	1 cup	303	0.4
Low-fat plain yogurt	1 cup	415	3.4
Seafood			
Scallops, steamed	3½ oz	115	1.4
Shrimp, raw	3½ oz	63	0.8
Green leafy vegetables			
Broccoli, cooked	⅔ cup	88	0.3
Kale, cooked, without stem	¾ cup	187	0.7
Spinach, cooked	½ cup	83	0.3
Turnip greens, cooked	⅔ cup	184	0.2
Other foods			
Chili con carne with beans	5 oz	61	9.9
Cream of celery soup made with milk	1 serving	135	33.0
Figs, dried	5 medium	126	1.3
Slice from 12-inch cheese pizza	1 piece	144	4.4
Pudding, chocolate	½ cup	147	6.6
Raisins, dried, seedless	⅝ cup	62	0.2

Most women do not consume enough calcium in their diets. In fact, many women get only one half of the daily amount of calcium they need. You may need to take calcium supplements. Ask your pharmacist to suggest one that is right for you. Women aged 51 years and older need 1,200 mg of calcium per day. The National Institutes of Health recommends 1,500 mg of calcium per day for postmenopausal women who do not take ***hormone therapy*** and all women older than 65 years. Be aware, however, that your body can only absorb about 500 mg of calcium at one time. If you take more, try to divide it into two doses.

Calcium cannot be absorbed without vitamin D. Milk that is fortified with vitamin D, including lactose-free milk, is one of the best sources. Another is sunlight. Being in the sun for just 15 minutes a day helps your skin produce vitamin D and activates vitamin D in your body. You also can use vitamin D supplements. A woman should take the recommended daily amount of vitamin D, which is 10 micrograms for women aged 51–70 years and 15 micrograms for women older than age 70 years.

Avoiding Falls

Women with osteoporosis should try to reduce their risks of injuries from falls. They should:

- Learn good posture.
- Avoid twisting, bending, and lifting.
- Make their homes safe by removing throw rugs or using nonskid backing, making sure rooms are well lit, and using handrails by stairs and in the bathroom.
- Check and correct (if needed) vision and balance problems
- Review medications for side effects that may affect balance and stability

Detection

You should have a physical exam once a year during which your height is measured. All women aged 65 years and older or younger women who have had a bone fracture should be tested for bone mineral density no more than every 2 years. More frequent testing may be needed if new risk factors occur. Testing also may be suggested for postmenopausal women younger than 65 years who have one or more risk factors for osteoporosis.

Bone mineral density tests measure bone mass in the heel, spine, hip, hand, or wrist. Measuring one area can give your doctor a sense of your bone density in other parts of your skeleton. The devices used for the tests vary, but all involve X-rays or beams from other energy sources. You may be asked to lie on your side or back for the X-ray, or you may sit and place your hand or foot into a cylinder. The tests can take as little as 1 minute or as much as 40 minutes. A bone density test can help detect problems before a fracture occurs. A test also can help determine:

- Whether you have osteoporosis
- Your rate of bone loss
- Your risk of a future fracture

There are several ways to measure bone density. They are all painless and safe.

Dual-Energy X-ray Absorptiometry

Dual-energy X-ray absorptiometry (DXA) is used most often to measure the bone density of your spine or hip. It is currently the most accurate test available.

During the test, you lie down for 3–10 minutes while an arm-like device (an imager) scans your body. With this test you are exposed to a very small amount of radiation—less than the amount in a normal chest X-ray.

After the test, you will be given a T-score. This is a number that is calculated when your DXA test results are compared to the average bone density of a healthy 30-year-old. A

negative score means you have thinner bones than an average 30-year-old. A positive score means your bones are stronger and thicker than an average 30-year-old.

If your T-score is -1 to -2.5, you have low bone mass and are at increased risk for osteoporosis. A score of -2.5 or lower means you have osteoporosis. A low T-score may mean that you also are at increased risk of a bone fracture. In rare cases, low T-scores are caused by other medical conditions.

Other Methods

There are several other methods that can be used to measure bone density. However, none are as accurate as DXA, the preferred method.

Quantitative Computed Tomography (QCT). This method uses both ***computed tomography*** scanning and computer software to test the bone density of the spine. This test provides three-dimensional images and requires only a little more radiation than a DXA test.

Quantitative Ultrasonography. This test uses sound waves instead of radiation to measure bone density. During this test, you place your bare foot on the machine and sound waves are transmitted through your heel. Although this test may help predict the risk of fracture in your spine or hip, it often is not as accurate as other tests. This is because bone mass is not the same in all areas of the body.

Treatment

There are many treatment options available to help reduce the risk of fracture. Some need to be taken every day, some are weekly, and some are monthly. There is also an option of getting a yearly injection. No matter what dosing method you choose, the earlier treatment is started, the better it works.

Bisphosphonates

Bisphosphonates are medications used to prevent and treat osteoporosis. In cases of prevention, they are used to slow bone breakdown. To treat osteoporosis, they are used to help increase bone density and reduce the risk of fractures. These medications must be taken on an empty stomach. Although rare, side effects may include nausea, stomach pain, and digestive problems.

Selective Estrogen Receptor Modulators

Women also can take a type of drug known as selective estrogen receptor modulators (SERMs) to help prevent or treat some of the bone problems that can occur during menopause. Raloxifene is a type of SERM that helps strengthen the tissues of the bones.

SERMs may be a good choice for women who need protection from osteoporosis, but cannot or do not want to take hormone therapy. This may include:

- Women at risk of breast cancer
- Women who cannot tolerate the side effects of hormone therapy
- Women who do not need relief from symptoms of menopause

Hormone Therapy

Starting estrogen at any time after menopause can help prevent bone loss. It can be a good choice for women who also have symptoms of menopause. However, it only protects bones for as long as you use it. When you stop taking hormone therapy, bone loss resumes. You and your doctor should decide whether this treatment is right for you.

Other Options

Another medication used to slow the breaking down of bone is called calcitonin. It can be given by injection or nasal spray. Parathyroid hormone also may be used to increase bone density and reduce the risk of fractures.

Finally...

To increase your chances of staying healthy, you have an important goal—to prevent bone loss. Exercise every day, even if you walk only a few blocks, and get enough calcium. Talk with your doctor about methods to prevent, diagnose, and treat osteoporosis.

Glossary

Amenorrhea: The absence of menstrual periods.

Calcium: A mineral stored in bone that gives it hardness.

Computed Tomography: A type of X-ray that shows internal organs and structures.

Estrogen: A female hormone produced in the ovaries that stimulates the growth of the lining of the uterus.

Gonadotropin-releasing Hormone (GnRH) Agonists: Medical therapy used to block the effects of certain hormones.

Hormone: Substance produced by the body to control the functions of various organs.

Hormone Therapy: Treatment in which estrogen, and often progestin, is taken to relieve the symptoms and changes caused by the low levels of hormones produced by the body.

Menopause: The time in a woman's life when ovaries stop functioning and menstruation stops.

Ovaries: Two glands, located on either side of the uterus, that contain the eggs released at ovulation and produce hormones.

Pituitary Gland: A gland located near the brain that controls growth and other changes in the body.

Progestin: A synthetic form of progesterone that is similar to the hormone made naturally by the body.