

H A N D O U T O N H E A L T H

Recognizing
The National
Bone and Joint Decade
2002–2011

Osteoporosis

**U.S. Department of Health and
Human Services
National Institutes of Health
National Institute of Arthritis and
Musculoskeletal and Skin Diseases**

For Your Information

This publication contains information about medications used to treat the health condition discussed here. When this booklet was printed, we included the most up-to-date (accurate) information available. Occasionally, new information on medication is released.

For updates and for any questions about any medications you are taking, please contact the U.S. Food and Drug Administration at 1-888-INFO-FDA (1-888-463-6332, a toll-free call) or visit its Web site at www.fda.gov.

For updates and questions about statistics, please contact the Centers for Disease Control and Prevention's National Center for Health Statistics toll free at 1-800-232-4636 or visit its Web site at www.cdc.gov/nchs.

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**U.S. Department of Health and
Human Services**

Public Health Service

National Institutes of Health

**National Institute of Arthritis and
Musculoskeletal and Skin Diseases**

**NIH Publication No. 07-5158
April 2007**

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Osteoporosis

This booklet is for people who have osteoporosis, their families, and others interested in learning more about the disease. It describes osteoporosis and its impact and contains information about the causes, diagnosis, and treatment of this disease. This booklet also describes current research efforts supported by the National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS) and other components of the U.S. Department of Health and Human Services' National Institutes of Health (NIH). Also covered are risk factors for osteoporotic fractures, ways to prevent the disease and its progression, and how people with the disease can reduce their risk of future fractures. If you have further questions, you may wish to discuss them with your doctor or seek additional information from the sources listed at the end of this booklet.

Defining Osteoporosis

Osteoporosis is a disease marked by reduced bone strength leading to an increased risk of fractures, or broken bones. Bone strength has two main features: bone mass (amount of bone) and bone quality. Osteoporosis is the major underlying cause of fractures in postmenopausal women and the elderly. Fractures occur most often in bones of the hip, spine, and wrist, but any bone can be affected. Some fractures can be permanently disabling, especially when they occur in the hip.

Osteoporosis is often called a “silent disease” because it usually progresses without any symptoms until a fracture occurs or one or more vertebrae (bones in the spine) collapse. Collapsed vertebrae may first be felt or seen when a person develops severe back pain, loss of height, or spine malformations such as a stooped or hunched posture. Bones affected by osteoporosis may become so fragile that fractures occur spontaneously or as the result of minor bumps, falls, or normal stresses and strains such as bending, lifting, or even coughing.

Many people think that osteoporosis is a natural and unavoidable part of aging. However, medical experts now believe that osteoporosis is largely preventable. Furthermore, people who already have osteoporosis can take steps to prevent or slow further progress of the disease and reduce their risk of future fractures. Although osteoporosis was once viewed primarily as a disease of old age, it is now recognized as a disease that can stem from less than optimal bone growth during childhood and adolescence, as well as from bone loss later in life.

The Occurrence and Impact of Osteoporosis

In the United States today, an estimated 10 million people over age 50 have osteoporosis and nearly 34 million have low bone mass that puts them at increased risk for developing the disease. Four out of five people who have osteoporosis are women, but about 2 million men in the United States also have the disease and 14 million more have low bone mass that puts them at risk for it. One in two women and as many as one in four men over age 50 will have an osteoporosis-related fracture in their lifetime.

Osteoporosis can strike at any age, although the risk for developing the disease increases as you get older. In the future, more people will be at risk for developing osteoporosis because people are living longer and the number of elderly people in the population is increasing.

Osteoporosis affects women and men of all races and ethnic groups. It is most common in non-Hispanic white women and Asian women. African American women have a lower risk of developing osteoporosis, but they are still at significant risk. For Hispanic and Native American women the data aren't clear. Among men, osteoporosis is more common in non-Hispanic whites and Asians than in men of other ethnic or racial groups.

The cost of osteoporosis to society is high. In 2002 dollars, between \$12.2 billion and \$17.9 billion was spent in the United States on hospitals and nursing homes for people with osteoporosis-related and associated fractures, and the costs are rising. The indirect costs of the disease, such as those resulting from reduced productivity and lost wages, are unknown. In addition to the financial costs, osteoporosis takes a toll in terms of reduced quality of life for many people who suffer fractures. It can also affect the lives of family members and friends who serve as caregivers.

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Of all fractures, hip fractures have the most serious impact. Most hip fractures require hospitalization and surgery; some hip fracture patients require nursing home placement. Fifty percent of people who fracture a hip will be unable to walk without assistance. About one in five hip fracture patients over age 50 die in the year following their fracture as a result of associated medical complications. Vertebral fractures also can have serious consequences, including chronic back pain and disability. They have also been linked to increased mortality in older people.

Bone Basics

Bone is a living tissue that supports our muscles, protects vital internal organs, and stores most of the body's calcium. It consists mainly of a framework of tough, elastic fibers of a protein called collagen and crystals of calcium phosphate mineral that harden and strengthen the framework. The combination of collagen and calcium phosphate makes bones strong yet flexible to hold up under stress.

Bone also contains living cells, including some that nourish the tissue and others that control the process known as bone remodeling. Throughout life, our bones are constantly being renewed by means of this remodeling process, in which old bone is removed (bone resorption) and replaced by new bone (bone formation). Bone remodeling is carried out through the coordinated actions of bone-removing cells called osteoclasts and bone-forming cells called osteoblasts.

During childhood and the teenage years, new bone is added to the skeleton faster than old bone is removed, or resorbed. As a result, bones grow in both size and strength. After you stop growing taller, bone formation continues at a faster pace than resorption until around the early twenties, when women and men reach their peak bone mass, or maximum amount of bone. Peak bone mass is influenced by various genetic and external, or environmental, factors, including whether you are male or female (your sex), hormones, nutrition, and physical activity. Genetic factors may determine as much as 50 to 90 percent of bone mass; environmental factors account for the remaining 10 to 50 percent. This means you have some control over your peak bone mass.

After your early twenties, your bone mass may remain stable or decrease very gradually for a period of years, depending on a variety of lifestyle factors such as diet and physical activity. Starting in midlife, both men and women experience an age-related decline in bone mass. Women lose bone rapidly in the first 4 to 8 years after menopause (the completion of a full year without a menstrual period), which usually occurs between ages 45 and 55. By age 65, men and women tend to be losing bone tissue at the same rate, and this more gradual bone loss continues throughout life.

Starting in midlife, both men and women experience an age-related decline in bone mass.

Causes of Osteoporosis

A major cause of osteoporosis is less than optimal bone growth during childhood and adolescence, resulting in failure to reach optimal peak bone mass. Thus, peak bone mass attained early in life is one of the most important factors affecting your risk of osteoporosis in later years. People who start out with greater reserves of bone (higher peak bone mass) are less likely to develop osteoporosis when bone loss occurs as a result of aging, menopause, or other factors. Other causes of osteoporosis are bone loss due to a greater than expected rate of bone resorption, a decreased rate of bone formation, or both.

Deterioration of bone quality, which reflects the internal structure, or architecture, of bone as well as other factors, is also thought to contribute to decreased bone strength and increased fracture risk. Scientists do not yet clearly understand all the factors that affect bone quality and the relationship between these factors and the risk of osteoporosis and fractures. However, this is an active area of research.

A major contributor to bone loss in women during later life is the reduction in estrogen production that occurs with menopause. Estrogen is a sex hormone that plays a critical role in building and maintaining bone. Decreased estrogen, whether due to natural menopause, surgical removal of the ovaries, or chemotherapy or radiation treatments for cancer, can lead to bone loss and eventually osteoporosis. After menopause, the rate of bone loss speeds up as the amount of estrogen produced by a woman's ovaries drops dramatically. Bone loss is most rapid in the first few years after menopause but continues into the postmenopausal years.

In men, sex hormone levels also decline after middle age, but the decline is more gradual. These declines probably also contribute to bone loss in men after around age 50.

Osteoporosis can also result from bone loss that may accompany a wide range of disease conditions, eating disorders, and certain medications and medical treatments. For instance, osteoporosis may be caused by long-term use of some antiseizure medications (anticonvulsants) and glucocorticoid medications such as prednisone and cortisone. Glucocorticoids are anti-inflammatory drugs used to treat many diseases, including rheumatoid arthritis, lupus, asthma, and Crohn's disease. Other causes of osteoporosis include alcoholism, anorexia nervosa, abnormally low levels of sex hormones, hyperthyroidism, kidney disease, and certain gastrointestinal disorders. Sometimes osteoporosis results from a combination of causes.

Medications Associated With Osteoporosis

- Anticoagulants (heparin)
- Anticonvulsants
- Cyclosporine A and tacrolimus
- Cancer chemotherapy drugs
- Glucocorticoids (and adrenocorticotropic hormone [ACTH])
- Gonadotropin-releasing hormone agonists
- Lithium
- Methotrexate
- Parenteral nutrition
- Thyroxine

Risk Factors for Osteoporosis

Factors that are linked to the development of osteoporosis or contribute to an individual's likelihood of developing the disease are called risk factors. Many people with osteoporosis have several risk factors for the disease, but others who develop osteoporosis have no identified risk factors. There are some risk factors that you cannot change, and others that you can or may be able to change.

Risk factors you cannot change:

- **Sex:** Your chances of developing osteoporosis are greater if you are a woman. Women have lower peak bone mass and smaller bones than men. They also lose bone more rapidly than men in middle age because of the dramatic reduction in estrogen levels that occurs with menopause.
- **Age:** The older you are, the greater your risk of osteoporosis. Bone loss builds up over time, and your bones become weaker as you age.
- **Body size:** Slender, thin-boned women are at greater risk, as are, surprisingly, taller women.
- **Race:** Caucasian (white) and Asian women are at highest risk. African American and Hispanic women have a lower but significant risk. Among men, Caucasians are at higher risk than others. These differences in risk can be explained in part – although not entirely – by differences in peak bone mass among these groups.
- **Family history:** Susceptibility to osteoporosis and fractures appears to be, in part, hereditary. People whose parents have a history of fractures also tend to have reduced bone mass and an increased risk for fractures.

Risk factors you can or may be able to change:

- ***Sex hormone deficiencies:*** The most common manifestation of estrogen deficiency in premenopausal women is amenorrhea, the abnormal absence of menstrual periods. Missed or irregular periods can be caused by various factors, including hormonal disorders as well as extreme levels of physical activity combined with restricted calorie intake – for example, in female marathon runners, ballet dancers, and women who spend a great deal of time and energy working out at the gym. Low estrogen levels in women after menopause and low testosterone levels in men also increase the risk of osteoporosis. Lower than normal estrogen levels in men may also play a role. Low testosterone and estrogen levels are often a cause of osteoporosis in men being treated with certain medications for prostate cancer.
- ***Diet:*** From childhood into old age, a diet low in calcium and vitamin D can increase your risk of osteoporosis and fractures. Excessive dieting or inadequate caloric intake can also be bad for bone health. People who are very thin and do not have much body fat to cushion falls have an increased risk of fracture.

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- ***Certain medical conditions:*** In addition to sex hormone problems and eating disorders, other medical conditions – including a variety of genetic, endocrine, gastrointestinal, blood, and rheumatic disorders – are associated with an increased risk for osteoporosis. Anorexia nervosa, for example, is an eating disorder that leads to abnormally low body weight, malnutrition, amenorrhea, and other effects on the body that adversely affect bone health. Late onset of puberty and early menopause reduce lifetime estrogen exposure in women and also increase the risk of osteoporosis.
- ***Medications:*** Long-term use of certain medications, including glucocorticoids and some anticonvulsants, leads to bone loss and increased risk of osteoporosis. Other drugs that may lead to bone loss include anticlotting drugs, such as heparin; drugs that suppress the immune system, such as cyclosporine; and drugs used to treat prostate cancer.
- ***An inactive lifestyle or extended bed rest:*** Low levels of physical activity and prolonged periods of inactivity can contribute to an increased rate of bone loss. They also leave you in poor physical condition, which can increase your risk of falling and breaking a bone.
- ***Excessive use of alcohol:*** Chronic heavy drinking is a significant risk factor for osteoporosis.
- ***Smoking:*** Most studies indicate that smoking is a risk factor for osteoporosis and fracture, although the exact reasons for the harmful effects of tobacco use on bone health are still unclear.

Risk Factors for Osteoporosis-Related Fractures

Although low bone mass (or low bone density) plays an important role in determining a person's risk of osteoporosis, it is only one of many risk factors for fractures. Fracture risk results from a combination of bone-dependent and bone-independent factors. Various aspects of "bone geometry," such as tallness, hip structure, and thighbone (femur) length, can also affect your chances of breaking a bone if you fall. Increasing age, excessive weight loss, a history of fractures since age 45, having an existing spine fracture, and having a mother who fractured her hip all increase the risk of hip fracture independent of a person's bone density, and individuals with more risk factors have a higher chance of suffering a hip fracture.

Factors that increase the likelihood of falling and the severity of falls also contribute to fracture risk. These include decreased muscle strength, poor balance, impaired eyesight, and impaired mental abilities. The angle at which you fall also affects your risk of fracture. Use of certain medications, such as tranquilizers and muscle relaxants, and hazardous elements in your living environment, such as slippery throw rugs and icy sidewalks, can also increase your risk of falls. Information on falls and fall prevention is provided in "Treating Osteoporosis" (page 17).

Risk Factors for Fractures

- Older age (age 65 and older)
- Fracture after age 45
- First-degree female relative with a fracture in adulthood
- Self-report health as “fair” or “poor”
- Current tobacco use
- Weight less than 127 pounds
- Menopause prior to age 45
- Amenorrhea
- Lifelong low calcium intake
- Excess alcohol consumption
- Poor vision despite correction
- Falls
- Minimal weight-bearing exercise
- Medical conditions – hyperthyroidism, chronic lung disease, endometriosis, malignancy, chronic hepatic or renal disease, hyperparathyroidism, vitamin D deficiency, Cushing’s disease
- Medications – oral glucocorticoids, excess thyroxine replacement, antiepileptic medications, gonadal hormone suppression, immunosuppressive agents

Diagnosing Osteoporosis

Diagnosing osteoporosis involves several steps, starting with a physical exam and a careful medical history, blood and urine tests, and possibly a bone mineral density assessment. When recording information about your medical history, your doctor will ask questions to find out whether you have risk factors for osteoporosis and fractures. The doctor may ask about any fractures you have had, your lifestyle (including diet, exercise habits, and whether you smoke), current or past health problems and medications that could contribute to low bone mass and increased fracture risk, your family history of osteoporosis and other diseases, and, for women, your menstrual history. The doctor will also do a physical exam that should include checking for loss of height and changes in posture and may include checking your balance and gait (the way you walk).

If you have back pain or have experienced a loss in height or a change in posture, the doctor may request an x ray of your spine to look for spinal fractures or malformations due to osteoporosis. However, x rays cannot necessarily detect osteoporosis. The results of laboratory tests of blood and urine samples can help your doctor identify conditions that may be contributing to bone loss, such as hormonal problems or vitamin D deficiency. If the results of your physical exam, medical history, x rays, or laboratory tests indicate that you may have osteoporosis or that you have significant risk factors for the disease, your doctor may recommend a bone density test.

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determinant of bone strength. Bone mineral density (BMD) testing can be used to definitively diagnose osteoporosis, detect low bone mass before osteoporosis develops, and help predict your risk of future fractures. In general, the lower your bone density, the higher your risk for fracture. The results of a bone density test will help guide decisions about starting therapy to prevent or treat osteoporosis. BMD testing may also be used to monitor the effectiveness of ongoing therapy.

The most widely recognized test for measuring bone mineral density is a quick, painless, noninvasive technology known as dual-energy x-ray absorptiometry (DXA). This technique, which uses low levels of x rays, involves passing a scanner over your body while you are lying on a cushioned table. DXA can be used to determine BMD of the entire skeleton and at various sites that are prone to fracture, such as the hip, spine, or wrist. Bone density measurement by DXA at the hip and spine is generally considered the most reliable way to diagnose osteoporosis and predict fracture risk.

The doctor will compare your BMD test results to the average bone density of young, healthy people and to the average bone density of other people of your age, sex, and race. For both women and men, the diagnosis of osteoporosis using DXA measurements of BMD is currently based on a number called a T-score. Your

T-score represents the extent to which your bone density differs from the average bone density of young, healthy people. If you are diagnosed with osteoporosis or very low bone density, or if your bone density is below a certain level and you have other risk factors for fractures, the doctor will talk with you about options for treatment or prevention of osteoporosis.

The U.S. Preventive Services Task Force, an independent panel of experts in primary care and prevention, recommends that all women age 65 and older be screened for osteoporosis. The task force also recommends that routine screening begin at age 60 for women at increased risk for fractures due to osteoporosis (for instance, those who have additional risk factors). If you have not been checked for osteoporosis and you are a woman over age 65, or if you suspect that you have significant risk factors for the disease, you may want to talk to your doctor about being evaluated. For example, if you are over 50 and have broken a bone, you may have osteoporosis or be at increased risk for the disease. You should also ask your doctor about osteoporosis if you notice that you have lost height or your posture has become stooped or hunched, or if you experience sudden back pain. You may also want to be evaluated for osteoporosis and fracture risk if you have a chronic disease or eating disorder known to increase the risk of osteoporosis, are taking one or more medications known to cause bone loss, or have multiple risk factors for osteoporosis and osteoporosis-related fractures.

When to Talk to Your Doctor About Osteoporosis

Consider talking to your doctor about being evaluated for osteoporosis if:

- You are a man or woman over age 45 or a postmenopausal woman and you break a bone.
- You are a woman age 65 or older.
- You have lost height, developed a stooped or hunched posture, or experienced sudden back pain with no apparent cause.
- You have been taking glucocorticoid medications such as prednisone, cortisone, or dexamethasone for 2 months or longer or are taking other medications known to cause bone loss.
- You have a chronic illness or are taking a medication that is known to cause bone loss.
- You have anorexia nervosa or a history of this eating disorder.
- You are a premenopausal woman, not pregnant, and your menstrual periods have stopped, are irregular, or never started when you reached puberty.

Treating Osteoporosis

The primary goal in treating people with osteoporosis is preventing fractures. A comprehensive treatment program includes a focus on proper nutrition, exercise, and prevention of falls that may result in fractures. Your doctor may also prescribe one of several medications that have been shown to slow or stop bone loss or build new bone, increase bone density, and reduce fracture risk. If you take medication to prevent or treat osteoporosis, it is still essential that you obtain the recommended amounts of calcium and vitamin D. Exercising and maintaining other aspects of a healthy lifestyle are also important.

For people with osteoporosis resulting from another condition, the best approach is to identify and treat the underlying cause. If you are taking a medication that causes bone loss, your doctor may be able to reduce the dose of that medication or switch you to another medication that is effective but not harmful to your bones. If you have a disease that requires long-term glucocorticoid therapy, such as rheumatoid arthritis or lupus, you can also take certain medications approved for the prevention or treatment of osteoporosis associated with aging or menopause (see page 27). Staying as active as possible, eating a healthy diet that includes adequate calcium and vitamins, and avoiding smoking and excess alcohol use are also important for people with osteoporosis resulting from other conditions. Children and adolescents with such conditions as juvenile rheumatic diseases and asthma can also be diagnosed with this kind of osteoporosis.

Idiopathic Juvenile Osteoporosis

Some children and adolescents develop osteoporosis that has no known cause, known as idiopathic juvenile osteoporosis (IJO). Young people who have this rare form of osteoporosis usually recover completely within 2 to 4 years. The basic treatment strategy is to protect the spine and other bones from fracture until recovery occurs. Doctors may also recommend treatment of IJO with calcium and vitamin D supplements or with certain medications used to treat adults with osteoporosis, especially in severe cases.

Medical specialists who treat osteoporosis include family physicians, internists, endocrinologists, geriatricians, gynecologists, orthopaedic surgeons, rheumatologists, and physiatrists (doctors specializing in physical medicine and rehabilitation). Physical and occupational therapists and nurses may also participate in the care of people with osteoporosis.

Nutrition

A healthy, balanced diet that includes plenty of fruits and vegetables; enough calories; and adequate calcium, vitamin D, and vitamin K is essential for minimizing bone loss and maintaining overall health. Calcium and vitamin D are especially important for bone health. Calcium is the most important nutrient for preventing osteoporosis and for reaching peak bone mass. For healthy postmenopausal women who are not consuming enough calcium (1,200 mg per day) in their diet, calcium and vitamin D supplements help to preserve bone mass and prevent hip fracture.

Calcium is also needed for the heart, muscles, and nerves to work properly and for blood to clot normally. We take in calcium from our diet and lose it from the body mainly through urine, feces, and sweat. The body depends on dietary calcium to build healthy new bone and avoid excessive loss of calcium from bone to meet other needs. The Institute of Medicine of the National Academy of Sciences recommends specific amounts of dietary calcium and vitamin D for various stages of life. (See “Recommended Calcium and Vitamin D Intakes” on page 34.) Adults need 1,000 milligrams of calcium per day, and the recommendation increases to 1,200 milligrams after age 50.

Many people in the United States consume much less than the recommended amount of calcium in their diets. Good sources of calcium include low-fat dairy products; dark green leafy vegetables, including broccoli, bok choy, collards, and turnip greens; sardines and salmon with bones; soy beans, tofu, and other soy products; and calcium-fortified foods such as orange juice, cereals, and breads. If you have trouble getting enough calcium in your diet, you may need to take a calcium supplement such as calcium carbonate, calcium phosphate, or calcium citrate. Your daily calcium intake should not exceed 2,500 milligrams because too much calcium can cause problems such as kidney stones. Calcium coming from food sources provides better protection from kidney stones. Anyone who has had a kidney stone should increase their dietary calcium and decrease the amount from supplements as well as increase fluid intake.

Vitamin D is required for proper absorption of calcium from the intestine. It is made in the skin after exposure to sunlight. Fifteen minutes in the sun every day without sunscreen and with some of your skin exposed is enough to meet the body's needs for vitamin D. Only a few foods naturally contain significant amounts of vitamin D, including fatty fish and fish oils. Foods fortified with vitamin D, such as milk and cereals, are a major dietary source of vitamin D. Although many people obtain enough vitamin D naturally, studies show that vitamin D production decreases in older adults, in people who are housebound, and during the winter – especially in northern latitudes. If you are at risk for vitamin D deficiency, you can take multivitamins or calcium supplements that contain vitamin D to meet the recommended daily intake of 400 International Units (IU) for men and women age 51 to 70 and 600 IU for people over 70. Doses of more than 2,000 IU per day are not advised unless under the supervision of a doctor. Larger doses can be given initially to people who are deficient as a way to replenish stores of vitamin D.

Lifestyle

In addition to a healthy diet, a healthy lifestyle is important for optimizing bone health. You should avoid smoking and, if you drink alcohol, do so in moderation (no more than one drink per day is a good general guideline). It is also important to recognize that some prescription medications can cause bone loss or increase your risk of falling and breaking a bone. Talk to your doctor if you have concerns about any medications you are taking.

Exercise

Exercise is an important part of an osteoporosis treatment program. Physical activity is needed to build and maintain bone throughout adulthood, and complete bed rest leads to serious bone loss. The evidence suggests that the most beneficial physical activities for bone health include strength training or resistance training. Exercise can help maintain or even modestly increase bone density in adulthood and, together with adequate calcium and vitamin D intake, can help minimize age-related bone loss in older people. Exercise of various sorts has other important benefits for people with osteoporosis. It can reduce your risk of falling by increasing muscle mass and strength and improving coordination and balance. In older people, exercise also improves function and delays loss of independence.

Although exercise is beneficial for people with osteoporosis, it should not put any sudden or excessive strain on your bones. If you have osteoporosis, you should avoid high-impact exercise. To help ensure against fractures, a physical therapist or rehabilitation medicine specialist can recommend specific exercises to strengthen and support your back, teach you safe ways of moving and carrying out daily activities, and recommend an exercise program that is tailored to your circumstances. Other trained exercise specialists, such as exercise physiologists, may also be able to help you develop a safe and effective exercise program.

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Fall Prevention

Fall prevention is a critical concern for men and women with osteoporosis. Falls increase your likelihood of fracturing a bone in the hip, wrist, spine, or other part of the skeleton. Fractures can affect your quality of life and lead to loss of independence and even premature death. A host of factors can contribute to your risk of falling.

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Falls can be caused by impaired vision or balance, loss of muscle mass, and chronic or short-term illnesses that impair your mental or physical functioning. They can also be caused by the effects of certain medications, including sedatives or tranquilizers, sleeping pills, antidepressants, anticonvulsants, muscle relaxants, some heart medicines, blood pressure pills, and diuretics. Use of four or more prescription medications has also been shown to increase the risk for falling.

Drinking alcoholic beverages is another risk factor. If you have osteoporosis, it is important to be aware of any physical changes you may be experiencing that affect your balance or gait and to discuss these changes with your doctor or other health care provider. It is also important to have regular checkups and tell your doctor if you have had problems with falling.

The force or impact of a fall (how hard you land) plays a major role in determining whether you will break a bone. Catching yourself so that you land on your hands or grabbing onto an object as you fall can prevent a hip fracture. You may break your wrist or arm instead, but the consequences are not as serious as if you break your hip. Studies have shown that wearing a specially designed garment that contains hip padding may reduce hip fractures resulting from falls in frail, elderly people living in nursing homes or residential care facilities, but use of the garments by residents is often low.

Falls can also be caused by factors in your environment that create unsafe conditions. Some tips to help eliminate the environmental factors that lead to falls include:

Outdoors and away from home:

- Use a cane or walker for added stability.
- Wear shoes that give good support and have thin nonslip soles. Avoid wearing slippers and athletic shoes with deep treads.
- Walk on grass when sidewalks are slippery; in winter, sprinkle salt or kitty litter on slippery sidewalks.
- Be careful on highly polished floors that are slick and dangerous, especially when wet, and walk on plastic or carpet runners when possible.
- Stop at curbs and check their height before stepping up or down.

Indoors:

- Keep rooms free of clutter, especially on floors.
- Keep floor surfaces smooth but not slippery.
- Wear shoes that give good support and have thin nonslip soles. Avoid wearing slippers and athletic shoes with deep treads.
- Be sure carpets and area rugs have skid-proof backing or are tacked to the floor. Use double-stick tape to keep rugs from slipping.
- Be sure stairwells are well lit and that stairs have handrails.
- Install grab bars on bathroom walls near tub, shower, and toilet.
- Use a rubber bathmat or slip-proof seat in the shower or tub.
- Improve the lighting in your home. Use a nightlight or flashlight if you get up at night.
- Use stepladders that are stable and have a handrail.
- Install ceiling fixtures or lamps that can be turned on by a switch near the room's entrance.
- If you live alone (or spend large amounts of time alone), consider purchasing a cordless phone; you won't have to rush to answer the phone when it rings and you can call for help if you do fall.
- Consider having a personal emergency-response system; you can use it to call for help if you fall.

Preventing Falls Among Seniors¹

Falls are not just the result of getting older. Many falls can be prevented. Falls are usually caused by a number of things. By changing some of these things, you can lower your chances of falling.

You can reduce your chances of falling by doing these things:

Begin a regular exercise program: Exercise is one of the most important ways to reduce your chances of falling. It makes you stronger and helps you feel better. Exercises that improve balance and coordination (like tai chi) are the most helpful. Lack of exercise leads to weakness and increases your chances of falling. Ask your doctor or health care worker about the best type of exercise program for you.

Make your home safer: About half of all falls happen at home. To make your home safer:

- Remove things you can trip over (such as papers, books, clothes, and shoes) from stairs and places where you walk.
- Remove small throw rugs or use double-sided tape to keep the rugs from slipping.

¹ U.S. Department of Health and Human Services. *Bone Health and Osteoporosis: A Report of the Surgeon General*. Rockville, MD: U.S. Department of Health and Human Services, Office of the Surgeon General, 2004.

- Keep items you use often in cabinets you can reach easily without using a stepstool.
- Have grab bars put in next to your toilet and in the tub or shower.
- Use nonslip mats in the bathtub and on shower floors.
- Improve the lighting in your home. As you get older, you need brighter lights to see well. Lamp shades or frosted bulbs can reduce glare.
- Have handrails and lights put in on all staircases.
- Wear shoes that give good support and have thin nonslip soles. Avoid wearing slippers and athletic shoes with deep treads.

Have your health care provider review your medicines: Have your doctor or pharmacist look at all the medicines you take (including the ones that don't need prescriptions, such as cold medicines). As you get older, the way some medicines work in your body can change. Some medicines, or combinations of medicines, can make you drowsy or lightheaded, which can lead to a fall.

Have your vision checked: Have your eyes checked by an eye doctor. You may be wearing the wrong glasses or have a condition such as glaucoma or cataracts that limits your vision. Poor vision can increase your chances of falling.

Medications

The U.S. Food and Drug Administration (FDA) has approved several medications for prevention or treatment of osteoporosis, based on their ability to reduce fractures. Alendronate (Fosamax)², raloxifene (Evista), risedronate (Actonel), and ibandronate (Boniva) are approved for the prevention and treatment of postmenopausal osteoporosis. Teriparatide (Forteo) is approved for treatment of the disease in postmenopausal women and men who are at high risk for fracture. Calcitonin (Miacalcin, Fortical) is also approved for treatment. Estrogen (hormone therapy) is approved for the prevention of postmenopausal osteoporosis, but has associated health risks that may outweigh its benefits. In addition, alendronate and risedronate are approved for treating osteoporosis in men and for use by men and women with glucocorticoid-induced osteoporosis.

Alendronate, risedronate, and ibandronate belong to a group of drugs known as bisphosphonates, which reduce the activity of cells that cause bone loss. In postmenopausal women with osteoporosis, the bisphosphonate drugs reduce bone loss, increase bone density in both the spine and hip, and reduce the risk of fracture. Side effects may include digestive system problems.

² Brand names included in this booklet are provided as examples only, and their inclusion does not mean that these products are endorsed by the National Institutes of Health or any other Government agency. Also, if a particular brand name is not mentioned, this does not mean or imply that the product is unsatisfactory.

Raloxifene is also approved for the treatment and prevention of osteoporosis. It is one of a relatively new group of drugs known as selective estrogen receptor modulators (SERMs). These drugs are not estrogens, but they have estrogen-like effects on some tissues and estrogen-blocking effects on other tissues. Raloxifene mimics the effects of estrogen on bones, but does not have estrogen's potentially harmful effects on breast tissue or the uterus. Raloxifene has been shown to prevent bone loss, have beneficial effects on bone mass, and reduce the risk of spine fractures. It is taken as a tablet once a day. Side effects may include hot flashes, sweating, clot formation in some blood vessels, muscle soreness, weight gain, or a rash.

Teriparatide is an injectable form of human parathyroid hormone (PTH) that is approved for postmenopausal women and men with osteoporosis who are at high risk for having a fracture. It is the first approved agent for the treatment of osteoporosis that stimulates new bone formation. Teriparatide is taken by once-daily injection into the thigh or abdomen. This treatment stimulates new bone formation in both the spine and hip and reduces the risk of fractures in postmenopausal women and men. Side effects include nausea, dizziness, and leg cramps. Use of teriparatide for more than 2 years is not recommended because the effects of long-term treatment are not yet known. Following PTH treatment with a bisphosphonate drug will preserve the bone mass gains.

Calcitonin is approved for the treatment of osteoporosis in women who are at least 5 years beyond menopause. Calcitonin is a hormone involved in calcium regulation and bone metabolism. It is taken as a single daily nasal spray or as an injection under

the skin. In women who are at least 5 years beyond menopause, calcitonin slows bone loss and increases spinal bone density. Some patients report that calcitonin also relieves pain from bone fractures. The effects of calcitonin on fracture risk are still unclear. Injected calcitonin does not affect other organs or systems in the body besides bone, but it may cause an allergic reaction. Side effects may include flushing of the face and hands, increased frequency of urination, nausea, and skin rash. The only side effects reported with nasal calcitonin are a runny nose and other signs of nasal irritation.

Calcitonin is approved for the treatment of osteoporosis in women who are at least 5 years beyond menopause.

Estrogen and combined estrogen and progestin (hormone therapy) are approved for the prevention of postmenopausal osteoporosis as well as the treatment of moderate to severe hot flashes and vaginal dryness that may accompany menopause. Estrogen without an added progestin is recommended only for women who have had a hysterectomy (surgery to remove the uterus), because estrogen increases the risk of developing cancer of the uterine lining and progestin reduces that risk. Studies have shown that hormone therapy can increase bone density and prevent bone loss, and that estrogen plus progestin prevents osteoporosis-related fractures in the hip and other sites in postmenopausal women. Results of the NIH-sponsored Women's Health Initiative, a large, long-term study of disease prevention strategies in postmenopausal women, show that both

estrogen alone as well as estrogen plus progestin prevent osteoporosis and fractures when used at the commonly administered doses. The drugs used in these trials were conjugated equine estrogens (CEE, 0.625 mg /day) and medroxyprogesterone acetate (MPA, 2.5 mg/day). At these doses, there was no protection from cardiovascular disease and an increase in strokes and blood clots. In the trial of combination therapy, there was also an increase in breast cancer. On the basis of these findings, medical experts concluded that, in most women, the harmful effects of long-term use of hormone therapy are likely to outweigh the disease prevention benefits. The Food and Drug Administration has recommended that women use hormone therapy at the lowest dose and for the shortest time. The risks and benefits of low-dose hormone therapy and estrogen patches are still unclear. Women who use, or are considering, hormone therapy (either estrogen plus progestin or estrogen alone) solely for the prevention of osteoporosis should carefully consider and discuss with their doctor other approved treatments. They should also talk to the doctor about whether the benefits of hormone therapy outweigh the potential harms in view of their personal preferences and individual risk factors for various diseases and consider whether lower doses of hormone therapy may be appropriate.

Alternative Therapies

Many people are interested in the use of natural estrogens, particularly phytoestrogens, as an alternative to hormone therapy for the prevention of osteoporosis. Phytoestrogens are compounds from plants that have weak estrogen-like effects. One form of phytoestrogen is found in flaxseed (linseed), rye, berries, fruits, vegetables, and whole grains. Another

form is present in red clover and beans, especially soybeans and soy products. Some animal studies with phytoestrogens have had promising results, but no effects on bone density or fracture reduction in humans have yet been shown. A study of ipriflavone, a synthetic phytoestrogen derivative used as an osteoporosis therapy outside of the United States, showed that this compound did not reduce bone loss in postmenopausal women. In addition, ipriflavone use was linked to low white blood cell counts. NIH is sponsoring clinical trials designed to provide information on whether dietary phytoestrogens might be a safe and effective alternative to estrogen therapy for preventing bone loss in postmenopausal women.

Preventing Osteoporosis

Preventing osteoporosis is a lifelong endeavor. To reach optimal peak bone mass and minimize loss of bone as you get older, there are several factors you should consider. Addressing all of these factors is the best way to optimize bone health throughout life.

Calcium

An inadequate supply of calcium over a lifetime is thought to play a significant role in the development of osteoporosis. Many published studies show that low calcium intakes are associated with low bone mass, rapid bone loss, and high fracture rates. National surveys suggest that the average calcium intake of individuals is far below the levels recommended for optimal bone health. Individuals who consume adequate amounts of calcium and vitamin D throughout life are more likely to achieve optimal skeletal mass early in life and are less likely to lose bone later in life.

An inadequate supply of calcium over a lifetime is thought to play a significant role in the development of osteoporosis.

Calcium needs change during your lifetime (see “Recommended Calcium and Vitamin D Intakes” on page 34).

The body’s demand for calcium is greater during childhood and adolescence, when the skeleton is growing rapidly, and in women during pregnancy and breastfeeding. Postmenopausal women and older men also need to consume more calcium. Increased calcium requirements in older people may be related to vitamin D

deficiencies that reduce intestinal absorption of calcium. Also, as you age, your body becomes less efficient at absorbing calcium and other nutrients. Older adults are also more likely to have chronic medical problems and to use medications that may impair calcium absorption. Calcium and vitamin D supplements may help slow bone loss and prevent hip fracture. Results from the Women's Health Initiative Calcium with Vitamin D trial showed that for postmenopausal women, particularly those over age 60, a daily dose of 1,000 mg of calcium carbonate combined with 400 IUs of vitamin D₃ led to improvements in hip bone density and a reduction in hip fracture. Information on how to ensure adequate calcium intake is provided in "Treating Osteoporosis" on page 17. Further details are also available from several of the organizations listed at the end of this booklet.

Adolescence is the most critical period for building bone mass that helps protect against osteoporosis later in life. Yet studies show that among children age 9 to 19 in the United States, few meet the recommended levels. Therefore, it is especially important for parents, other caregivers, and pediatricians to talk to children and young teens about developing bone-healthy habits, including eating calcium-rich foods and getting enough exercise. More information on this subject is available in the NIH publication *Kids and Their Bones* (see "For More Information" on page 49 for details).

Vitamin D

Vitamin D plays an important role in calcium absorption and bone health. It is made in the skin after exposure to sunlight and can also be obtained through the diet, as described in the section of this booklet on treating osteoporosis. Although many people are able to obtain

Recommended Calcium and Vitamin D Intakes³

Age	Calcium (milligrams)	Vitamin D (International Units)
Infants		
Birth–6 months	210	200
6 months–1 year	270	200
Children/Young Adults		
1–3 years	500	200
4–8 years	800	200
9–18 years	1,300	200
Adult Women and Men		
19–50 years	1,000	200
51–70 years	1,200	400
Over 70 years	1,200	600

Pregnant or Nursing Women: Note that the recommended levels for women age 19 to 50 years are the same as those for women of the same age who are not pregnant or nursing; there are no different recommendations for pregnancy or breastfeeding. Women under 18 should follow the age guidelines.

18 years or younger	1,300	200
19–50 years	1,000	200

³ Food and Nutrition Board, Institute of Medicine, National Academy of Sciences, 1997

enough vitamin D naturally, vitamin D production decreases in the elderly, in people who are housebound or do not get enough sun, and in some people with chronic neurological or gastrointestinal diseases. These individuals and others at risk for vitamin D deficiency may require vitamin D supplementation. The recommended daily intake of vitamin D is 200 International Units (IU) for infants, children, and adults up to age 50; 400 IU for men and women age 51 to 70; and 600 IU for people over 70. Consuming more than 2,000 IU of vitamin D per day (or 1,000 IU for infants) can cause serious health problems.

Overall Nutrition

A healthy, balanced diet that includes lots of fruits and vegetables and enough calories is also important for lifelong bone health.

Exercise

Like muscle, bone is living tissue that responds to exercise by becoming stronger. There is good evidence that physical activity early in life contributes to higher peak bone mass. (However, remember that excessive exercise can be bad for bone health.) The best exercise for building and maintaining bone mass is weight-bearing exercise: exercise that you do on your feet and that forces you to work against gravity. Weight-bearing exercises include jogging, aerobics, hiking, walking, stair climbing, gardening, weight training, tennis, and dancing. High-impact exercises may provide the most benefit. Bicycling and swimming are not weight-bearing exercises, but they have other health benefits. Exercise machines that provide some degree of weight-bearing exercise include treadmills, stair-climbing machines, ski machines, and exercise bicycles.

Strength training to build and maintain muscle mass and exercises that help with coordination and balance are also important. Later in life, the benefits of exercise for building and maintaining bone mass are not nearly as great, but staying active and doing weight-bearing exercise is still important. A properly designed exercise program that builds muscles and improves balance and coordination provides other benefits for older people, including helping to prevent falls and maintaining overall health and independence. Experts recommend 30 minutes or more of moderate physical activity on most (preferably all) days of the week, including a mix of weight-bearing exercises, strength training (two or three times a week), and balance training.

Smoking

Smoking is bad for your bones and for your heart and lungs. Women who smoke have lower levels of estrogen compared to nonsmokers and frequently go through menopause earlier.

Alcohol

People who drink heavily are more prone to bone loss and fractures because of poor nutrition and harmful effects on calcium balance and hormonal factors. Drinking too much also increases the risk of falling, which is likely to increase fracture risk.

Medications That Cause Bone Loss

The long-term use of glucocorticoids can lead to a loss of bone density and fractures. Other forms of drug therapy that can cause bone loss include long-term treatment with certain antiseizure drugs, such as phenytoin (Dilantin) and barbiturates; some drugs used to treat endometriosis; excessive use of aluminum-containing antacids; certain cancer treatments; and excessive thyroid hormone. It is important to discuss the use of these drugs with your doctor, and not to stop or alter your medication dose on your own. (See “Causes of Osteoporosis” on page 6 for more information.)

The long-term use of glucocorticoids can lead to a loss of bone density and fractures.

Prevention Medications

Various medications are available for the prevention, as well as treatment, of osteoporosis (see “Treating Osteoporosis” on page 17).

Osteoporosis and Quality of Life

Aside from its effects on your bones, osteoporosis can change your life in many other ways.

Osteoporosis affects each person differently and to different degrees. For example, people with a single fracture and those who have had multiple fractures do not face the same challenges. The particular site of a fracture (hip, spine, etc.) may also influence a person's life in different ways. The effects of osteoporosis on quality of life can include:

- anxiety and depression
- reduced self-image
- limitations in the ability to work and enjoy leisure activities
- acute or chronic pain
- difficulties in performing the activities of daily life
- loss of independence
- changes in relationships with family and friends.

Because osteoporosis has such wide-ranging effects, experts say that doctors and other health care providers should treat the whole person, not only the disease. Various measures are available to address the impact of osteoporosis on an individual's quality of life, including the emotional, physical, and functional effects of the disease as well as its social aspects. Some of these issues and how to address them are outlined below.

Emotional Impacts of Osteoporosis

- If you are nervous about the risk of breaking a bone when you go out to crowded places such as malls, movie theaters, or museums, try going at less crowded times. Take breaks and sit down when you feel tired.
- If you have been feeling symptoms of depression – such as loss of appetite, hopelessness, feeling useless and helpless, or having thoughts of suicide – for more than 2 weeks, consult a doctor, social worker, or therapist. Medications and counseling are available to fight depression.
- If you are feeling self-conscious about changes in your appearance, such as the curvature (kyphosis) that occurs in the upper spine after multiple vertebral fractures, look for styles of clothing that minimize figure changes.

Functional and Physical Aspects of Osteoporosis

- If you have trouble working, doing chores around the house, or other routine activities such as grocery shopping, try breaking them into short segments. Get up from sitting every half hour or so to ease muscle strain and reposition your skeleton. Also be aware of your posture, and avoid bending and twisting at the same time.
- Look for ways to modify sports and leisure activities that you enjoy to protect your bones, or cultivate new forms of physical activity that put less stress on your skeleton.

- If you experience pain after a fracture, try such pain-relief strategies as hot and cold compresses, biofeedback, and other relaxation strategies. Avoid long periods of inactivity or bed rest, which will worsen osteoporosis. Consult your health care professional about the use of analgesics such as acetaminophen (Tylenol or other brands).
- For chronic (long-term) back pain or tiredness caused by fractures in the spine, consult a physical therapist or rehabilitation specialist for exercises to strengthen the back muscles, which may minimize or relieve pain. You will need to continue these exercises faithfully to maintain their benefits.

Social Aspects of Osteoporosis

- Support groups, friends, and family members can help you manage the social challenges and limitations resulting from osteoporosis.
- Don't be afraid to ask others for help in dealing with the effects of osteoporosis on your life. For example, you may need to ask a family member, friend, or neighbor to help you bring groceries into your house or apartment. Find ways to give to others who help you so that you do not feel forced to choose between feeling that you are taking too much help and not taking any help at all.

- Remember that it is normal to want and need help from others as well as to help other people. You can work to keep relationships balanced so that no one does most of the taking over a long period of time, and keep in mind that we all help others throughout life. Friends and family are probably happy to help you, just as you feel good when you help others.
- Concern about experiencing or causing fractures can affect intimate relations between a husband and wife when one or both of you have osteoporosis. Although these topics can be difficult to discuss, couples can look for ways to achieve intimacy without increasing fracture risk. Most physical therapists have been trained to address this issue and can offer advice.
- If tension builds up between you and your spouse as you try to cope with limitations that result from living with osteoporosis, talk with your spouse about these feelings and discuss ways that you might handle the situation. Simply acknowledging and sharing your mutual concerns can often be helpful.

**Don't be afraid
to ask others for
help in dealing
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your life.**

Current Research

The National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS) leads the Federal research effort on osteoporosis. Scientists at universities, medical centers, and other research institutions across the United States who are funded by NIAMS and other NIH components are pursuing a wide range of basic and clinical studies on the disease.

Significant advances in preventing and treating osteoporosis continue to be made. Such advances are the direct result of research focused on:

- determining the causes and consequences of bone loss at the cellular and tissue levels
- assessing risk factors
- developing new strategies to maintain and even enhance bone density and reduce fracture risk
- exploring the roles of such factors as genetics, hormones, calcium, vitamin D, drugs, and exercise on bone mass.

Some key areas of osteoporosis research supported by NIAMS and its partners at NIH are described below.

Genetic Studies

Researchers are studying genes involved in bone formation as well as genes that affect bone mass and the risk of osteoporosis-related fractures. For instance, in an effort that drew together the work of many scientists, a gene that was previously unsuspected of playing any role in bone has emerged as a possible key to restoring bone in cases of osteoporosis. Studying families with unusually dense, strong bones has revealed that

an abnormality in a particular gene called LRP5 is responsible for the extra bone growth. Future work will focus on understanding how LRP5 functions, with the goal of using its actions to stimulate bone growth.

**Scientists also
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bone mass.**

Scientists also continue to identify many genes that may affect bone mass. Experiments with genetically modified mice have been particularly useful in pinpointing areas of interest for human studies. Such efforts seem likely to identify targets for the development of new osteoporosis therapies. Results may also lead to the development of simple genetic tests that can detect early in life those individuals who are at greatest risk of developing the disease, which could in turn lead to effective targeting of prevention-based treatment strategies.

Bone Cell Biology

Study of the cells that control bone remodeling also continues to yield insights on the underlying causes of osteoporosis and points to possible new therapeutic targets. For example, bone-forming osteoblasts arise from precursor cells that give rise to different tissues. Some osteoblasts develop into osteocytes, the cells that are thought to be important for the response of bone to mechanical loading such as occurs with weight-bearing exercise. The complex balance between the generation of precursor cells, their development into osteoblasts and osteocytes, and ultimately their death, determines the rate of new bone formation. NIAMS is encouraging research that addresses the control of osteoblast differentiation and the generation of genetic resources to advance this research.

Study of Osteoporotic Fractures

The Study of Osteoporotic Fractures (SOF), which is supported by NIAMS and the National Institute on Aging (NIA), is a multicenter study that has been following more than 9,000 postmenopausal Caucasian women since 1986 and has yielded comprehensive data about multiple risk factors for osteoporosis-related fractures. This study has provided the foundation for developing ways to identify people at greatest risk for osteoporosis and fractures decades in advance, and thus has greatly aided disease prevention efforts. SOF investigators have added African American women to the group of patients they are following, and they hope to provide unique information on risk factors for osteoporosis and fractures in older African American women.

Osteoporosis in Men

Osteoporosis in men is undergoing major scrutiny in a seven-center study funded by NIAMS in partnership with NIA and the National Cancer Institute. The study is following some 5,700 men age 65 years and older at the start of the study, and will determine the extent to which the risk of fracture in men is related to bone mass and structure, biochemistry, lifestyle, tendency to fall, and other factors. The study will also try to find out whether high bone mass is associated with an increased risk of prostate cancer. Such a relationship already exists between high bone mass and breast cancer, another condition that is affected by sex hormones.

Evaluating and Assessing Bone Quality

Researchers supported through a recent NIAMS initiative are exploring factors that influence bone quality, in hopes of gaining a better understanding of how properties of bone other than its mass or density affect bone strength. They are also developing new methods to assess bone quality and bone strength and predict fracture risk using technologies such as ultrasound and magnetic resonance imaging. Key goals of this initiative include improving the ability to identify individuals at risk for osteoporosis-related fractures and providing useful markers of the effect of drug interventions to improve and facilitate the drug development process. NIAMS partnered with the American Society for Bone and Mineral Research, the French Institute of Health and Medical Research (INSERM), and NIH's National Institute of Biomedical Imaging and Bioengineering in sponsoring a scientific meeting to bring together leading scientists from around the world in order to move this critical research field forward.

Treatments for Osteoporosis

NIAMS is funding clinical studies of several combination therapies for osteoporosis, including low-dose hormone therapy plus alendronate and parathyroid hormone plus alendronate. Lower doses and combinations of drugs known to be effective may

reduce the side effects and risks associated with current individual drug treatments and improve overall responsiveness to therapy. NIAMS is also supporting research examining the molecular and cellular mechanisms by which currently used osteoporosis drugs work, in the hope of advancing knowledge about their application to bone. In other studies, scientists are investigating novel approaches for preventing and treating osteoporosis. These include cholesterol-lowering statin drugs, the hormone leptin (best known for its role in controlling obesity), and nitric oxide (a medication given to heart patients in the form of nitroglycerin), all of which were recently found to have unexpected effects on bone mass, dietary phytoestrogens (plant estrogens), and mechanical (vibrational) stimulation of bone.

NIH-supported investigators are also conducting clinical studies of various treatments and preventive measures for osteoporosis from other conditions in children and adults – including osteoporosis resulting from cancer chemotherapy,

NIAMS is funding clinical studies of several combination therapies for osteoporosis, including low-dose hormone therapy plus alendronate and parathyroid hormone plus alendronate.

depression, and glucocorticoid use – and testing therapies for osteoporosis in men.

Nutritional Studies

Researchers are also continuing to explore the role of factors such as hormones, drugs, and exercise on bone mass in children and adults and to examine the influence of diet, hormones, and disease on the calcium in our bones. Recent studies have shown that although some substances – such as high levels of dietary protein, caffeine, phosphorus (which is present in soft drinks), and sodium – can adversely affect calcium balance, their effects appear not to be important in individuals who have an adequate calcium intake.

Hope for the Future

With ongoing research, experts hope that osteoporosis will come to be considered a curable disease. Research has enhanced our knowledge about how to maintain a healthy skeleton throughout life and has led to progress in understanding the causes, prevention, diagnosis, and treatment of osteoporosis. Every research advance brings us closer to eliminating the pain and suffering caused by this disease.

For More Information

NIH Osteoporosis and Related Bone Diseases ~ National Resource Center (NIH ORBD~NRC)

2 AMS Circle

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www.niams.nih.gov/bone

The NIH Osteoporosis and Related Bone Diseases ~ National Resource Center provides patients, health professionals, and the public with an important link to resources and information on osteoporosis and other metabolic bone diseases. The mission of NIH ORBD~NRC is to expand awareness and enhance knowledge and understanding of the prevention, early detection, and treatment of these diseases as well as strategies for coping with them. The center has a wide range of publications on osteoporosis, including *Bone Health and Osteoporosis: A Report of the Surgeon General* and an accompanying booklet written for the general public. Fact sheets on osteoporosis include more detailed information on topics such as prevention of falls and fractures, calcium supplements, exercise, quality-of-life issues, and osteoporosis in men and various ethnic groups. Fact sheets on bone health and osteoporosis are also available in Spanish and Chinese. These and other fact sheets are available by mail and on the center's Web site, which also provides links to other sources of information on osteoporosis.

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NIAMS leads the Federal research effort on osteoporosis and related bone diseases. The Institute distributes patient and professional educational materials about osteoporosis and can refer people to other sources of information. Through its Web site, NIAMS also provides information about current research related to osteoporosis, as well as health information about the disease. *Kids and Their Bones*, a publication produced jointly by NIAMS and the NIH Osteoporosis and Related Bone Diseases ~ National Resource Center, is available on the NIAMS Web site and by mail.

National Institute on Aging (NIA) Information Center

P.O. Box 8057

Gaithersburg, MD 20898-8057

Phone: 800-222-2225 (free of charge)

TTY: 800-222-4225

www.nia.nih.gov

The National Institute on Aging, a part of the National Institutes of Health, has a book and video about exercise for older people. For more information and a free publications list, write or call the NIA Information Center. In consultation with NIAMS, NIA has also provided information about the prevention and treatment of osteoporosis on the NIHSeniorHealth Web site (www.nihseniorhealth.gov), a joint effort of NIA and the National Library of Medicine.

American Academy of Orthopaedic Surgeons (AAOS)

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The academy provides education and practice management services for orthopaedic surgeons and allied health professionals. It also serves as an advocate for improved patient care and informs the public about the science of orthopaedics. The orthopaedist's scope of practice includes disorders of the body's bones, joints, ligaments, muscles, and tendons. For a single copy of an AAOS brochure, send a self-addressed stamped envelope to the address above or visit the AAOS Web site.

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The American Geriatrics Society is a not-for-profit organization of health professionals devoted to improving the health, independence, and quality of life of all older people. The society provides leadership to health care professionals, policy makers, and the public by implementing and advocating for programs in patient care, research, professional and public education, and public policy. The AGS Web site provides educational materials on fall prevention, osteoporosis, and bone health for patients and health professionals.

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The American Society for Bone and Mineral Research is a professional scientific and medical society established to bring together clinical and experimental scientists involved in the study of bone and mineral metabolism. ASBMR encourages and promotes the study of this expanding field through annual scientific meetings; an official journal, the *Primer on the Metabolic Bone Diseases and Disorders of Mineral Metabolism*; and advocacy and interaction with Government agencies and related societies.

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The National Osteoporosis Foundation is a nonprofit, voluntary health organization dedicated to promoting lifelong bone health in order to reduce the widespread prevalence of osteoporosis and associated fractures, while working to find a cure for the disease through programs of research, education, and advocacy. NOF provides information and resources on osteoporosis for patients and the public. It also provides resources and professional relations and education programs on the disease for health professionals.

Acknowledgments

NIAMS gratefully acknowledges the assistance of Joan McGowan, Ph.D., and William Sharrock, Ph.D., NIAMS, NIH; Sundeep Khosla, M.D., Mayo Clinic College of Medicine, Rochester, MN; Barbara Lukert, M.D., University of Kansas, Kansas City, KS; and Eric Orwoll, M.D., Oregon Health and Science University, Portland, OR; in the preparation and review of this publication. Elia Ben-Ari, Ph.D., was the primary author of this booklet.

The mission of the National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS), a part of the U.S. Department of Health and Human Services' National Institutes of Health (NIH), is to support research into the causes, treatment, and prevention of arthritis and musculoskeletal and skin diseases; the training of basic and clinical scientists to carry out this research; and the dissemination of information on research progress in these diseases. The NIAMS Information Clearinghouse is a public service sponsored by the Institute that provides health information and information sources. Additional information can be found on the NIAMS Web site at www.niams.nih.gov. Information on bone and its disorders can be obtained from the NIH Osteoporosis and Related Bone Diseases ~ National Resource Center by calling (toll free) 800-624-BONE (2663) or by visiting its Web site at www.niams.nih.gov/bone.



**U.S. Department of Health and
Human Services**

Public Health Service

National Institutes of Health

**National Institute of Arthritis and
Musculoskeletal and Skin Diseases**

NIH Publication No. 07-5158

April 2007