

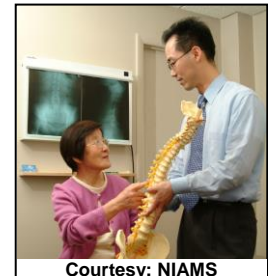
An Integrative Approach to Healthy Bones: Osteoporosis, Osteopenia, and Fracture Prevention

Introduction

Prevention is an important focus for every body system, and the health of the skeleton is no exception. The vertebral bodies, the femur, and other bones must handle a tremendous amount of force throughout a person's lifetime. Healthy bone requires a precise balance between bone formation (by osteoblasts) and bone absorption (by osteoclasts).

Around age 30, bone density peaks. After that, for most people, it steadily decreases with age. It is vital to pay attention to bone health throughout the life cycle, especially *before* diagnoses such as osteopenia or osteoporosis are made. Future bone density is influenced by whether or not a person's mother had healthy calcium and vitamin D levels, and whether or not the person was breast fed.¹ It is vital that children and adolescents maintain healthy calcium and vitamin D levels to optimize their peak bone density. The first few years of menopause are a period of especially significant bone loss as estrogen levels drop and there is less osteoclast inhibition.

Why does bone health matter? The main concern is fracture risk, which increases when bone density and overall bone quality are low. There are 1.5 million osteoporosis-related fractures in the U.S. yearly, and 300,000 of them are hip fractures due to a fall. These are not only costly financially but also detrimental to quality of life. Five to 20% of people with hip fractures die within one year, and 60% who have fractures will need assistance with their daily activities for the rest of their lives.²⁻³ For more information, see the Washington University School of Medicine handout at [Bone and Mineral Diseases: Facts About Osteoporosis](http://wuphysicians.wustl.edu/dept.aspx?pageID=4&ID=43) (or enter this URL into your browser <http://wuphysicians.wustl.edu/dept.aspx?pageID=4&ID=43>).



Courtesy: NIAMS

Bone density, because it can be easily measured and because it responds well to drug treatments, understandably receives a great deal of attention when bone health is discussed. However, it is not the only determinant of a healthy skeleton. Even at ½ bone density, the human spine should be able to maintain five times the amount of weight it normally has to carry. Why then, do so many people get spine fractures? Fracture risk seems to be related not only to bone *quantity* but also to bone *quality*.

This handout is designed to provide an evidence-based approach to maintaining bone health throughout the life cycle, with attention given to bone density as well as to other factors that are tied to bone health.

Diagnosing Bone Problems

Patients often question how bone density issues are diagnosed.

- **Dual-energy x-ray absorptiometry (Dexa) scan.** The main test that is used by conventional medicine is the dual-energy x-ray absorptiometry (usually called “dexa”) scan. This test



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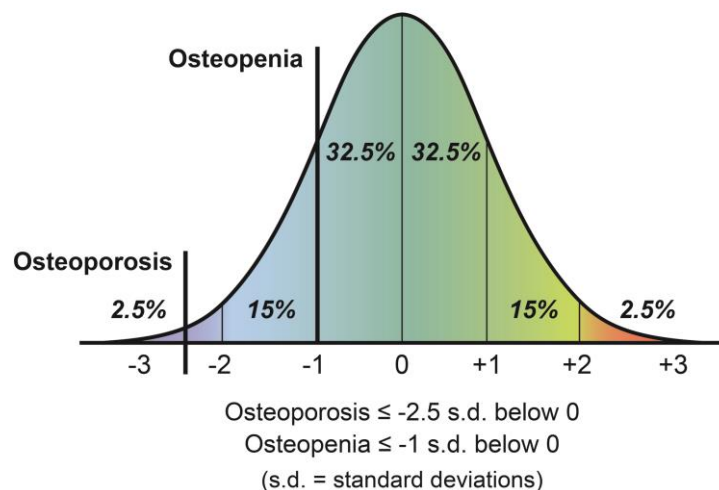
involves little radiation (much less than a CT scan). During the test, certain bones are exposed to two different X-ray beams with different energy levels at the same time. The differences in penetration generate information on bone density. For more about this test written at a level for patients, see [Bone Density Scan at RadiologyInfo.org](http://www.radiologyinfo.org/en/info.cfm?pg=dexa). (http://www.radiologyinfo.org/en/info.cfm?pg=dexa) Readings for the spine and the hip are most often used to diagnose low bone density.

Results of dexa scans are given in terms of T scores and Z scores. These are based on standard deviations under a mean distribution curve (see Figure 1). Those who fall farthest to the left on the bell curve (the 2.5% of people in a given group with the lowest bone density) are considered to have osteopenia or osteoporosis.

- **T scores** compare a patient's bone density to that of a healthy 30-year-old of the same gender. The more negative the number, the less dense the bones.
 - **Osteopenia** is diagnosed if the T score is between -1 and -2.5.
 - **Osteoporosis** is diagnosed if the score is less than -2.5.
 - **Severe established osteoporosis (SEO)** is diagnosed if the T score is less than -2.5 and someone has had a fracture.

Test results vary according to what brand of dexa machine is used, so it is best for patients to have follow-up tests done at the same place on the same machine. It is usually recommended that people wait *at least* a year between tests when they are being treated for low bone density to ensure sufficient time has passed for measurable changes to have occurred. For those who are not being treated, checking every 2-5 years is recommended.⁴

Figure 1: Bone Density Scores and Standard Deviation



A bone density bell curve demonstrating how T and Z scores are obtained.

T scores and Z scores represent the number of standard deviations from median bone density. For 100 percent of patients, the 2.5% with the lowest bone density will be classed as having osteoporosis. Another 15% will be classed with osteopenia. Note that this is always in comparison to a young healthy person of the same gender.



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- **Z scores** compare a person's bone density to that of others of the same age, sex, and weight. This number is usually less negative than the T score, but it is not used to diagnose osteoporosis or osteopenia. Rather, it lends a more individualized perspective to a person's density. Most 80-year-old women have osteoporosis, so their T scores will always be low. A Z score can be used to compare an 80-year-old woman to her peers for a better sense of the relative severity of her bone loss.

Clinical Pearl

T scores measure the patient relative to a healthy 30-year-old of the same gender. Z scores measure the patient relative to peers of the same age, gender, and weight. The T score will always be low for an 80-year-old woman but a Z score may not.

The North American Menopause Society recommends that all women over age 65 have a dexameter scan, as well as younger women who have risk factors such as history of fracture, low weight, family history of hip fracture, or rheumatoid arthritis.⁵ It has been suggested that men at risk be tested over age 70, or younger if they have various risk factors.⁴ Most providers determine whether or not the test is needed based on overall risk as well as age. Medicare covers initial dexameter screenings, and it pays for follow-ups a year or more later for people with osteoporosis to evaluate treatment success. An important piece in the treatment of bone loss is following the rate that bone density changes over time.

Based on dexameter measurements, 18 million Americans have osteopenia, and 10 million have osteoporosis. Fifty percent of women and 20% of men have it, and by age 75, 70% of men and women will have it. At least 1 in 5 women over age 50 have osteoporosis by age 65. Half of all women over 50 will have a hip, vertebral, or wrist fracture at some point in their lives. For men, lifetime risk is 13-25%, but mortality from fracture is higher.⁶

Patients may ask about other available testing:

- **Quantitative ultrasound (QUS).** Some facilities offer quantitative ultrasound (QUS) to screen for low bone density, usually looking at the bones of the foot. This test can pick up low bone density so that additional evaluation by a dexameter scan can be recommended, but a normal test is not always a guarantee that bone density is normal.
- **Quantitative CT's.** Quantitative CT scans can also show loss of density, but these are rarely used. X-rays are not accurate for diagnosing bone density changes.
- **Lab testing.** Some resources also suggest lab testing to follow bone breakdown. Urine deoxypyridinoline and n-telopeptide (NTX) levels are used to measure rates of bone turnover. However, these may or may not be covered by insurers; some patients choose to pay for these tests out of pocket. The importance of these tests in management of low bone density is controversial.^{4,5} For instance, the n-telopeptide test is a sensitive measure of bone breakdown, but it is not specific (i.e., if it is present, it can reliably tell you that there is breakdown, but if it is not present, that does not guarantee that bone breakdown is not occurring).



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There are no symptoms in the early stages of osteoporosis. Patients can be encouraged to pay attention to changes in their height and to be aware of bone pain (especially in the low back or neck). Kyphosis is also a finding in the later stages of the disease.

What Are Risk Factors for Poor Bone Health?

A number of risk factors influence bone density and bone health in general. Some of these can be modified; others cannot. The use of risk factors to predict fractures has low sensitivity and specificity; however, it does appear that at least 50% of hip fractures can be explained on the basis of risk factors that are potentially reversible. The list of links on page 13 of this handout includes a risk calculator for people to gauge their likelihood of developing osteoporosis.

CAUSES OF LOW BONE DENSITY	
<ul style="list-style-type: none"> • Older age 	<ul style="list-style-type: none"> • Weight under 125 pounds (body mass index under 20)
<ul style="list-style-type: none"> • Being female 	
<ul style="list-style-type: none"> • White or Asian ethnicity 	<ul style="list-style-type: none"> • Weight loss of 12 pounds or more (The good things about this always outweigh the fracture risks.)
<ul style="list-style-type: none"> • First degree relative (such as a mother) with osteoporosis 	
<ul style="list-style-type: none"> • Late start of menstruation (after 15 years old) 	<ul style="list-style-type: none"> • History of previous fracture
<ul style="list-style-type: none"> • Early menopause (Estrogen inhibits the osteoclasts, and when its levels drop, so does bone density.) 	<ul style="list-style-type: none"> • Increased inflammation in the body
	<ul style="list-style-type: none"> • Limited sun exposure (leads to low Vitamin D)
<ul style="list-style-type: none"> • Prolonged time without having periods (amenorrhea) 	<ul style="list-style-type: none"> • Health conditions including: anorexia nervosa, depression, type 1 diabetes, elevated parathyroid, low testosterone, elevated thyroid, Cushing's disease, liver disease, poor absorption of nutrients in the gut, rheumatoid arthritis, history of a transplant, Turner's syndrome, autoimmune diseases, celiac disease
<ul style="list-style-type: none"> • Smoking 	
<ul style="list-style-type: none"> • Alcohol use 	
<ul style="list-style-type: none"> • Dietary Issues <ul style="list-style-type: none"> ○ Low Vitamin D Intake ○ Low calcium intake ○ Low Vitamin K intake ○ High animal protein intake (over 75 grams a day) ○ Excess Sodium intake ○ Low magnesium intake ○ Excess phosphorus intake (including from soft drinks) ○ More than 300 mg of caffeine (four cups of coffee) daily. Tea is protective even with caffeine. ○ Poor-quality vegetarian diets 	
	<ul style="list-style-type: none"> • Taking drugs that can lower bone density, including: Warfarin, seizure medications, chemotherapy, corticosteroids, thyroid drugs, Cyclosporine, Medroxyprogesterone (such as Depot Provera), Heparin, Lithium, antidepressants, drugs that decrease acid in the stomach, such as proton pump inhibitors

It has been speculated that genes account for 25-45% of the variation in bone mineral density,⁷ but a prospective 25-year study of twins did not find osteoporotic fractures to be influenced by genetic factors.⁸



Preventive and Therapeutic Approaches

Ideally, prevention is the most important step in maintaining bone health. Integrative care of the bones can be organized into 6 main categories: 1) nutrition, 2) dietary supplements, 3) lifestyle (e.g., physical activity and stopping smoking), 4) fall prevention and safety, 5) medications for bone density, and 6) other therapies (e.g., sun exposure, mind-body approaches, kyphoplasty).

Approaches to treatment of low bone density once it has occurred may also include pain management and surgery.

1. Nutrition

Healthy bone formation requires absorption of sufficient levels of Vitamins D, C, B, and K. Boron, chromium, copper, fluoride, iodine, iron, magnesium, manganese, selenium, silicon, and zinc are also important.⁷ Here are general suggestions for optimal nutrition based on the current body of osteoporosis research.

- **Do NOT rely on dairy intake alone, but consider other foods that help.** A 37-study, meta-analysis revealed a minimal link between dairy intake and bone health, unless Vitamin-D fortified foods were consumed.⁹

FOODS THAT ENHANCE BONE HEALTH ¹¹		
Alliums (onion family)	Fennel	Parsley
Arugula	French beans	Pomegranate
Broccoli	Garlic	Prunes
Celeriac	Leeks	Red cabbage
Chinese cabbage	Lettuce	Turmeric
Cucumbers	Mushrooms (not shitake)	Wild garlic
Dill	Oranges (and other citrus fruit)	

- **Eat a few servings of soy.** One small study found that those who ate soy protein had better bone density than those who did not, but studies using soy supplements for osteoporosis have had mixed results. Bottom line – soy in foods may reduce fracture risk, so a few servings a day are reasonable, but supplements may not be worth it.¹⁰
- **Calcium matters, but there is more to it than just taking calcium.** A high calcium diet may not be the full solution either. Absorption is an important part of obtaining adequate amounts of calcium. Many of the suggestions noted in this section of the handout work, in part, because they enhance calcium absorption. Vitamin D plays an especially important role. People who absorb adequately can obtain 600-800 mg of calcium in their diets.
- **Maintain adequate Vitamin D.** This is not always easy to do with diet alone. Vitamin D in dairy is not well-absorbed. Sun exposure can help, but research indicates that even with sun exposure and dietary intake of the recommended daily allowance, many people still have low Vitamin D levels. These levels should be kept above 34 ng/dL to minimize fracture risk and maximize calcium absorption. Some recommend keeping the level above 50. (See page 8 for information on supplementing this vitamin).



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- **Keep Vitamin A intake reasonable.** Many supplements have high levels of vitamin A, but amounts over 3000 IU daily can increase fracture risk.
- **Keep alcohol down.** Drinking fewer than 7 alcoholic beverages a week is tied to a lower risk of fractures than drinking more than that.
- **Watch caffeine, but it is okay to drink tea.** Keeping caffeine under 300 mg daily (less than 4 cups of coffee), is better for the bones.¹⁰ Tea, even with caffeine, has NOT been found to have a negative effect on bone density. In fact, green, black, and oolong teas seem to have a protective effect against osteoporosis development.^{8,11}
- **Avoid cola.** Five to six servings of soft drinks per week (particularly colas) constitute an osteoporosis risk factor, according to one population-based study.¹²
- **Eat to decrease inflammation in the body.** Increasing numbers of studies are showing that low bone density is linked in part to chronic, low-grade inflammation.^{8,10} For more information, see our handout on the [Anti-Inflammatory Diet](#).
- **Consume omega-3's.** Omega-3 fats, such as those found in fish oil, can suppress osteoclast activation, and too much omega-6 relative to omega-3 fats in the body is tied to lower bone density.¹³ While a recent systematic review held that more study is needed, increasing omega-3 consumption is safe, not to mention effective, for numerous other health issues as well. See our handout on [Omega 3 Fats](#) for more information.
- **Eat 8-10 servings of fruits and vegetables daily.** A serving is the amount that can fit in the palm of a person's hand. A high vegetable to animal diet ratio seems to be protective against bone loss.¹⁴
- **Minimize animal proteins.** Various studies have shown that women who eat over 75 grams of protein daily probably generate more acids in the bloodstream. One of the body's main ways of coping with acidity is to take calcium out of the bones to neutralize it. However, the medical research literature is not clear on how much an "alkaline diet" helps to promote health. Typically these diets encourage a low-grain, low dairy, vegetarian diet, which certainly can have benefits for many different reasons. Aiming for 0.4 grams of protein per pound of body weight might be a good overall approach. The type of protein seems to matter as well. People have lower bone density in places where most of the protein comes from animal, not plant, sources.^{7,10,14} For more information, see our handout [Protein Alternatives to Meat](#).
- **Consider pH.** Diets that tend to be acidic (to lower blood pH) may lead to decreased bone density, as the body mobilizes bone mineral stores to keep pH stable. However, research on alkaline diets and the use of alkali supplements does not indicate an influence of these therapies on overall bone health.¹⁵ The best way to obtain an alkaline diet is to eat 8-10 servings of fruits and vegetables daily.





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- **Some specific diets seem to help.** The DASH and Mediterranean diets seem to have bone sparing effects, but caloric restriction and weight loss diets may have a negative effect.⁷ The DASH (Dietary Approaches to Stop Hypertension) diet has been found to decrease bone turnover. It may be effective because it leads to decreased sodium intake. For more information, see the following links:
 - [DASH Diet](http://www.nhlbi.nih.gov/health/public/heart/hbp/dash/new_dash.pdf) (http://www.nhlbi.nih.gov/health/public/heart/hbp/dash/new_dash.pdf)
 - [Mediterranean Diet](http://www.med.umich.edu/umim/food-pyramid/about.htm) (http://www.med.umich.edu/umim/food-pyramid/about.htm)

2. Supplements

Supplement use becomes an important aspect of maintaining bone health. Many vitamins and minerals are involved in bone formation. Not only must they be taken in appropriate amounts, but they also must be properly absorbed. Ideally, a healthy diet can be the mainstay of healthy nutrient levels, but for many people, dietary intakes are not sufficient.

- **Calcium.** Calcium consumption is often thought of as synonymous with bone health. Calcium supplementation does increase bone density, but it does not decrease fracture risk and may even increase it.¹⁶ Use of calcium supplementation becomes even more confusing in light of recent trials that suggest calcium levels may be tied to risk of myocardial infarction (hazard ratio of 1.312, 95% confidence interval 1.02-1.67, p=0.035).¹⁷ This review showed no mortality changes from supplementation, however, raising the question of how significant the effect of calcium on cardiac risk will prove to be.

Absorption of calcium supplements is an important consideration. Patients must be taught how to calculate overall calcium intake. Recommendations from the Institute of Medicine for calcium are 1300 mg daily for females ages 9-18, 1000 mg a day from ages 19-50, and 1200 a day for ages 50 and up. The first 3-6 years after menopause are especially crucial, as this is when many women have very high bone loss rates.

Remember that these recommendations are for elemental calcium, not the total amount of a calcium salt. Labels may or may not give doses in terms of elemental calcium versus total amounts of the salt.

500 mg of elemental calcium is equivalent to ¹⁸
○ 1250 mg of calcium carbonate
○ 2350 mg of calcium citrate
○ 1282 mg calcium phosphate
○ 3846 mg of calcium lactate
○ 5556 mg of calcium gluconate

There is a lot of hype regarding which calcium products are best to take, but in truth, no one calcium salt is clearly superior to all the others. Here are a few important facts about some of the more popular calcium supplements that are available:

- **Calcium carbonate.** This is better absorbed when taken with food. Some sources say that elderly people can only absorb about 5% of the calcium carbonate they take. Calcium carbonate decreases the acidity in the stomach, which may alter digestion.



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- **Calcium citrate** is absorbed well even with low stomach acidity.
- **Bone meal (microcrystalline hydroxyapatite)** seems to be beneficial and contains a number of other minerals as well.
- **Calcium lactate and gluconate** are other forms that are available.

The effects of taking calcium supplements for two years on bone mineral density are largely lost within two years after the supplements are discontinued.¹⁸ Many authorities suggest that calcium will be much better absorbed if taken in 3-4 divided doses that are less than 500 mg each.¹⁸ One approach is to encourage patients to aim for their daily recommended intake through a combination of diet and supplements, as we wait for additional research to guide calcium use. Because Vitamin D may mitigate the cardiac risk somewhat, it should be taken whenever calcium supplements are taken.¹⁹

- **Vitamin D.** Vitamin D controls the absorption of calcium in the gut and how it is deposited into bone. Dietary sources can include fatty fish and cod-liver oil, liver, and sun-exposed mushrooms.

Vitamin D has received a lot of attention recently because it is showing promise in treating and preventing a number of health problems. Vitamin D deficiency is perhaps one of the main contributors to osteoporosis and fractures. Vitamin D has been found to decrease fracture risk in the elderly, and it can reduce fall risk by about 22% in older adults who take it.²⁰ A meta-analysis of 29 trials found that D3 and calcium supplementation decreased bone fracture absolute risk by 24%.²¹

While diet and sun exposure provide some Vitamin D, it has been found that 50% of women receiving treatment for osteoporosis have levels that are too low.¹⁸ It is often stated that people should take Vitamin D3 (cholecalciferol) because it is 3 times more potent than D2 (ergocalciferol). However, recent literature has indicated that supplementing with either form at appropriate levels can lead to normalization of serum Vitamin D levels. It has been recommended that levels be kept in the upper half of the lab reference range, if possible, in the 40-80 ng/dL range. Both D2 and D3 are activated by the kidneys when they are converted to 1,25 Vitamin D; renal function plays an important role in bone health.

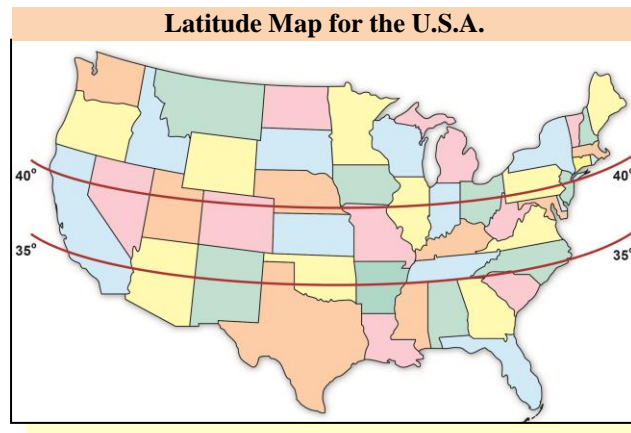
Vitamin D supplements should be taken with meals. The issue of toxicity of Vitamin D sometimes comes up, but it is actually quite difficult to overdose on this, and case reports of it happening are few. People usually need to take 40,000 units a day over several months to become toxic.²² It is helpful to measure 25-hydroxy Vitamin D levels to assess how much a person needs. 1,25 hydroxy Vitamin D levels do NOT accurately show vitamin D levels. Calcium absorption is 65% higher for people with a Vitamin D level of 35 compared to those with a level below 20. Twenty minutes of full body sun exposure will give a young Caucasian person 20,000 IU of Vitamin D, but it is not possible to develop Vitamin D toxicity through sun exposure.⁷

Dosing recommendations vary. Studies have found that 700-800 IU of D3 daily make a difference with fracture risk and decrease sarcopenia (muscle-wasting). Many experts recommend 1000 IU daily for people over 65, since the skin is only 25% as efficient at



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making Vitamin D with sun exposure in older people. Some integrative providers are now recommending 2000 IU of D3 daily for all adults. The distance from the equator that the individual lives is also important. People living north of 35-40 degrees latitude in the northern hemisphere may require more Vitamin D. Subcutaneous fat can also reduce the absorption of Vitamin D through the skin, thus obese individuals are also at high risk for deficiency but less risk for osteoporosis.



- **Vitamin K.** Vitamin K comes in 2 main forms. Vitamin K1 (phylloquinone) is found in green leafy vegetables. Vitamin K2 (menaquinone) is found in meats, cheeses, and fermented foods, such as fermented soy.

Vitamin K is required for the activation of osteocalcin. It works in synergy with Vitamin D3. Many patients with low BMD and fracture are known to have Vitamin K deficiency, and a 2006 meta-analysis indicated that supplementing with Vitamin K reduced fracture incidence (up to 80% for hip fractures) and bone loss.^{23,24}

Vitamin K should be used with caution in those taking warfarin for anticoagulation, as it will reverse the drug's effects. Dosing used in studies tends to be 1 (or in some studies, 10) mg of K1 and 45 mg of K2 daily.²⁵ Vitamin K3 (menadione) is linked to hepatotoxicity and is no longer used.

- **Magnesium.** Magnesium is an important component of bone as well. It helps keep bone flexible and has been found to increase BMD in post-menopausal women.²⁶ It has become increasingly popular for use within dietary supplements for osteoporosis,¹⁸ but further research is needed to determine its clinical usefulness. Supplementation to complement dietary intake may be reasonable, given that an estimated 80% of Americans are magnesium deficient. Higher doses can lead to diarrhea. A standard dose is 400-800 mg daily.

For more information on magnesium supplementation including magnesium content of various foods, recommended daily intakes, and important drug interactions, see the [NIH Office of Dietary Supplements' handout on magnesium](http://ods.od.nih.gov/factsheets/magnesium).
(<http://ods.od.nih.gov/factsheets/magnesium>)



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- **Strontium Ranelate (Protelos).** Strontium is an element in the body, but it is not considered an essential element. It is found only in bone. Strontium ranelate (also known as Protelos) seems to work similarly to the drug alendronate to prevent fractures in the vertebrae of postmenopausal women who have had fractures in the past (a 40% risk reduction). However, questions have been raised about it. It is much heavier than calcium and can replace calcium in bone. Its effects on x-rays can make bones seem more dense.

Strontium ranelate is available by prescription in 70 countries, but not in the U.S. Most of the strontium supplements sold in the U.S. contain strontium citrate, which has not been studied as carefully. Some rare side effects have been reported, including blood clots and memory loss.²⁷ It seems to accumulate in the body, which leads many clinicians to want more research data before they routinely suggest it for bone health.

- **Other Vitamins.** Vitamin A, B Vitamins, and Vitamin C
Vitamin A above the recommended daily intake of 2000-2800 IU daily significantly reduces bone mass in the elderly.²⁸ B vitamins have been found to significantly reduce fracture risk in elderly stroke patients but not affect bone density.¹⁸ Vitamin C seems to be associated with a lower degree of loss in elderly men.
- **Other Minerals.** Higher potassium intake is associated with less bone loss, but more trials are needed. Phosphorus deficiency is quite rare, and because phosphorus can lead to a decrease in calcium absorption, supplementation is not likely to be needed.⁷ Animal studies indicate that manganese and copper may improve BMD, but perhaps only in people who are deficient. Studies of the role of fluoride have been mixed. Zinc should be supplemented to assure recommended daily intakes of 30-50 mg daily are obtained.
- **Herbal Remedies.**
 - **Soy and Other Phytoestrogens.** Phytoestrogens are compounds contained in plants that are able to bind to estrogen receptors. Their effects depend on how much estrogen is in the body. In premenopausal women, they compete with estrogen, and since they have a relatively weaker effect when they bind receptors, they tend to be anti-estrogenic. In postmenopausal women, where estrogen concentration is low, they produce a greater estrogenic effect than would circulating estrogens alone.¹⁸

Reviews of the effects of dietary soy on bone density have shown benefit, but findings related to soy supplements are mixed. Soy contains the isoflavones daidzein and genistein, which are often taken in isolation from other soy constituents. Some studies indicate some benefit for bone density (For example, one randomized controlled trial found that 54 mg of genistein was as effective as hormone replacement for preventing bone loss in postmenopausal women.²⁹), but most studies did not find these supplements to have significant benefit.¹⁰

Ipriflavone, a synthetic derivative of the soy isoflavone daidzein, enhances osteoblast activity and inhibits osteoclast recruitment. When taken with 1000 mg



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of calcium, it does help to improve bone density. Notably, it also decreases back pain caused by compression fractures. The challenge is that it was found to decrease lymphocyte levels by nearly 30% after six or more months of use in about 13% of study participants. Lymphocyte counts tend to normalize after 12 months of taking ipriflavone, but patients are best served taking this only with routine surveillance of blood counts by their providers.¹⁸ The dose is 200 mg three times daily, and this supplement is widely available over the counter.

Other common estrogenic herbs include red clover, flaxseed, dong quai, panax ginseng, alfalfa, and licorice. Studies have not found these to be beneficial in osteoporosis prevention and treatment.¹⁸

- **Asian Combination Herbal Remedies.**¹⁰ Two Chinese combination herbal products, Shu Di Shan Zha and Shen Gu, have shown promise in randomized trials for improving bone density and various laboratory measures of bone breakdown. A number of other remedies have also shown promise in testing. Reosto, a combination of 2 forms of organic calcium and five herbs, has long been used in Indian Ayurvedic medicine. It was found to improve bone density in a controlled trial involving 128 subjects. Similarly, Chujo-to, a Japanese remedy, has shown promise in rat studies.

3. Lifestyle

- **Exercise.** Exercise is beneficial for improving bone density. Walking, weight-bearing exercise, and resistance training are helpful, and the benefits are seen for all age groups. Exercise is an important contributor to decreasing fall risk, and activity can stimulate increases in bone diameter throughout the lifespan.³⁰ Vigorous, speedy walking, not just gentle ambulation, makes a difference in maintaining BMD. Rates should be at 3.8 miles/hour or more for greater benefit.³¹
- **Tai chi.** Tai chi has been found to significantly reduce the risk of falls in elderly patients by improving balance.³² The effects of tai chi specifically on BMD remain to be studied.³³
- **Smoking.** Smoking increases lifetime vertebral fracture risk by 13% in women and 32% in men; hip fractures are increased 31% and 40%. The effect of smoking is dose dependent.³⁴



Courtesy: NIAMS

4. Fall Prevention

Because decreasing fractures and their related complications is the ultimate goal of prevention and treatment of low bone density, prevention of falls is an important aspect of bone health. The following web links provide patients with detailed guidelines regarding fall prevention in the home.

- [Check for Safety: A Home Fall Prevention Checklist for Older Adults](http://www.cdc.gov/ncipc/pub-res/toolkit/checklistforsafety.htm) from the National Center for Injury Prevention and Control at the Centers for Disease Control (CDC). (<http://www.cdc.gov/ncipc/pub-res/toolkit/checklistforsafety.htm>)



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- [Patient Handout—Falls: General Information](http://www.healthinaging.org/public_education/tools/06_falls_general_information.pdf) from the American Geriatrics Society (AGS) Foundation for Health in Aging. (http://www.healthinaging.org/public_education/tools/06_falls_general_information.pdf)

5. Medications

The table below lists the drugs used for the treatment of low bone density, their dosing and mechanisms of action, and their benefits and potential harms.

Drug Class	Drug Name	Dose	Effects	Harms
Bisphosphonates (Interfere with osteoclast precursors to stop reabsorption)	Alendronate (Fosamax)	5 mg daily or 35 mg weekly	47% fewer vertebral fractures, 56% fewer femur fractures	20% do not respond to bisphosphonates. Can cause muscle and joint pain, bone damage (especially given IV), abdominal pain, esophagitis, arrhythmias and dyspnea Zoledronic acid increases atrial fibrillation risk
	Risedronate (Actonel)	5 mg daily or 35 mg weekly	36% fewer vertebral fractures, 39% fewer nonvertebral fractures	
	Ibendronate (Boniva)	150 mg orally monthly or IV every 3 months	52% decrease in vertebral fractures, no overall decrease in others	
	Zoledronic acid (Reclast, Zometa)	5 mg IV yearly	Spine fracture risk down 70%, hip 41%, nonvertebral 25%	
Selective Estrogen Receptor Modulators (SERMS) (Bind estrogen receptors without other estrogenic effects)	Raloxifene (Evista)	60 mg daily	Decrease breast cancer 60%; 30% decrease vertebral fractures	Increased risk of clots, e.g., deep vein thrombosis, pulmonary emboli
Biological (Decreases osteoclast activity)	Calcitonin (Miacalcin)	200 IU intranasally daily	Half as effective as others, but quite safe. Decreases fracture pain	Facial flush, nasal irritation
Anabolic (Analog of parathyroid hormone)	Teriperatide (Forteo)	20 mcg/day subcutaneously	Stimulates new bone growth	Under study, risk seems to be minimal for <2 years of use



6. Other Approaches

- **Mind-Body Approaches.** There are reports that depression may be associated with lower bone mineral density, but reviews conclude that the role of depression remains inconclusive.³⁵ Nevertheless, stress reduction approaches are worth considering, given that they can be beneficial for people for an array of medical concerns, and because they tend to have few adverse effects.



Courtesy: U.S. Nat'l. Park Service

- **Sun Exposure.** One study of 250 patients who were institutionalized following strokes found that regular sun exposure for a year increased Vitamin D levels by four times and increased BMD an average of 3% compared to controls.³⁶

- **Essential Oils.** One review noted that essentials oils from thyme, rosemary, sage, and other plants, when added to food, seem to inhibit osteoclast activity, increasing bone density in animals, but more study is needed in humans.¹⁰

Links

ORGANIZATION	DESCRIPTION	URL
U.S. National Library of Medicine, National Institutes of Health (NIH)	<ol style="list-style-type: none"> 1. Patient handout on osteoporosis. 2. Medline Plus information on osteoporosis. Has links to an interactive tutorial and to information In Spanish. 	<ol style="list-style-type: none"> 1. http://www.ncbi.nlm.nih.gov/pubmedhealth/PMH0001400/ 2. http://www.nlm.nih.gov/medlineplus/osteoporosis.html
National Osteoporosis Foundation	The "About Osteoporosis" section has detailed information for patients.	http://www.nof.org/
Siteman Cancer Center Barnes-Jewish Hospital Washington University School of Medicine	Risk Calculator. Allows patients to calculate risk of osteoporosis, as well as other common health problems.	http://www.yourdiseaserisk.siteman.wustl.edu/
World Health Organization Collaborating Centre for Metabolic Bone Diseases, University of Sheffield, UK	FRAX® Fracture risk assessment tool. Allows clinicians and patients to calculate fracture risk.	http://www.shef.ac.uk/FRAX/tool.jsp?locationValue=9



We have also developed a corresponding [handout for patients](#) on this topic.

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