

Keeping bones strong

with calcium, vitamin D, and physical activity

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Healthy eating and physical activity help keep your bones strong. If you don't get adequate amounts of bone-building nutrients such as calcium and vitamin D, your bones become weaker. Over time, consuming too little calcium and vitamin D and being inactive can result in osteoporosis (porous bones), osteopenia (low bone mass), and osteomalacia (soft bones). Fortunately, you can keep your bones strong throughout your lifetime by following three steps: (1) eat foods rich in calcium and vitamin D, (2) be physically active, and (3) meet and talk regularly with your healthcare provider.

This publication explains osteoporosis, osteopenia, and osteomalacia and helps you determine your risk factors for developing these conditions. You will also find information on healthy eating and physical activity and tips for developing or maintaining strong bones.

Osteoporosis and related conditions

What are osteoporosis, osteopenia, and osteomalacia?

Osteoporosis is defined as porous bones that are weak and brittle. Osteopenia is low bone mineral density; it can result in osteoporosis. Osteomalacia is the softening of bones due to the loss of minerals and is a sign of vitamin D deficiency in adults. By the year 2020, it is estimated that 41 million American women and 17 million American men will have osteoporosis or osteopenia.

What are the symptoms of osteoporosis, osteopenia, and osteomalacia?

There are no symptoms of osteoporosis or osteopenia until a bone breaks. Each year approximately 2 million

Americans suffer bone fractures, mainly in the hip, spine, or wrist. About 20 percent of these individuals die from complications. The symptom of osteomalacia is bone pain that may be described as "throbbing" or "aching."

What are the risk factors for developing osteoporosis, osteopenia, and osteomalacia?

A number of factors can increase the likelihood of your developing osteoporosis, osteopenia, or osteomalacia. Some risk factors you can control, while others you cannot.

Which risk factors are out of my control?

Age. While osteoporosis and osteopenia can affect people of all ages, the older you are, the greater your risk of developing osteoporosis and osteopenia. As you age, you will lose bone mass, but some people lose more bone or lose it faster.

Gender. Fractures from osteoporosis are twice as common in women as in men. One in two women over the age of 50 will break a bone due to osteoporosis, and one in four men will do the same.

Menopause. In women, the hormone estrogen protects bones. Bone loss increases after menopause because estrogen levels drop sharply. Early menopause increases your risk of developing osteoporosis. Your risk is also higher if your ovaries have been removed because ovaries produce most of the body's estrogen.

Family history. If you have a parent or sibling with osteoporosis or osteopenia, you are at greater risk of developing it, especially if you have a family history of fractures, height loss, or curvature of the spine.

Frame size. Those with small body frames tend to have a higher risk of developing osteoporosis and osteopenia because they may have less bone mass to draw from as they age.

Which risk factors can I control?

Low calcium intake. Since calcium is a building block of bone, low calcium intake contributes to low bone density, early bone loss, and increased risk of fractures.

Low vitamin D levels. Vitamin D is necessary for calcium absorption. Low vitamin D levels not only limit calcium absorption but also limit how much gets deposited in your bones.

Inactive lifestyle. Inactive people have a greater risk of developing osteoporosis and osteopenia than those who are more active. Weight-bearing activities maintain or increase bone mass, especially walking, running, jumping, dancing, and strength-training.

Tobacco use. While the exact role that tobacco use plays in the development of osteoporosis and osteopenia is unclear, there is a direct relationship between tobacco use and decreased bone density.

Excessive alcohol consumption. Regularly consuming more than two alcoholic drinks per day increases your risk of developing osteoporosis and osteopenia, perhaps because alcohol interferes with the body's ability to absorb calcium.

How can I prevent or treat osteoporosis, osteopenia, and osteomalacia?

You can help keep your bones strong by following these recommendations:

- Eat foods rich in calcium and vitamin D
- Exercise regularly
- Take doctor-prescribed medications for strengthening bone
- Do not smoke or drink too much alcohol

I've stopped growing. Why do I still need to consume bone-building nutrients?

Even though your bone density peaks in adolescence and your bones stop growing when you are around the age of 30, the cells in your bone tissue are worn down and replaced throughout your lifetime. Every year 5–10% of the cells in your bones are replaced by new bone cells. When old bone cells break down, calcium and other nutrients are removed from your bones. When new bone cells are made, calcium and other nutrients are added.

Calcium

Why do I need calcium?

Most of the calcium in your body is found in your bones and teeth and functions to strengthen them. You need a steady supply of calcium from the foods you eat to build new bone cells. Calcium is also involved in muscle contraction and clot formation, and your body will pull calcium from your bones if you do not consume enough to perform these functions.

How much calcium do I need?

The Institute of Medicine (IOM) released updated calcium and vitamin D Recommended Dietary Allowances (RDAs) in 2010. Most adults ages 19–50, and men until the age of 70, should consume 1,000 milligrams (mg) of calcium per day. Women ages 51 and older, and men ages 71 and older, should consume 1,200 mg of calcium per day. Consuming more than 2,000 mg of calcium per day can be harmful, resulting in tissue damage or kidney stones. Excessive calcium intake usually occurs from consuming too many supplements or too many calcium-fortified foods.

Your body absorbs calcium best if you consume no more than 500–600 mg at a time. Therefore, spread out your calcium-rich foods throughout the day, for example, one at each meal.

Where do I get calcium?

Calcium-rich foods include dairy products, some vegetables, canned fish with bones, and calcium-fortified foods (table 1). Low-fat dairy products have slightly more calcium than full-fat versions and are a healthier choice.



Kale and milk are both calcium-rich foods.

Ways to get more calcium in your diet

Breakfast

- Oatmeal made with milk instead of water
- Yogurt with granola or another cereal
- Calcium-fortified orange juice

Lunch

- Sandwich topped with a slice of cheese
- Soup made with milk
- Canned salmon salad with raw kale, tomatoes, and cucumbers
- Salad sprinkled with cheese

Dinner

- Scalloped potatoes made with milk and cheese
- Vegetable and tofu stir fry (recipes available at <http://allrecipes.com>)
- Casserole or meat loaf with added cheese
- Vegetables topped with melted cheese

Snacks

- Nonfat latte or mocha
- Toasted soy nuts
- Cheese broiled on a tortilla
- Hot chocolate made with milk
- Hot popcorn sprinkled with Parmesan cheese
- Fresh fruit with yogurt dip

Dessert

- Pudding made with skim milk
- Apple pie topped with a slice of cheese

Calcium-rich substitutions

- Use yogurt on a baked potato rather than sour cream
- Use yogurt instead of mayonnaise in dips, salad dressings, and salads
- Use evaporated skim milk for cream
- Use yogurt or ricotta cheese in pasta sauce

Table 1. Calcium-rich foods.

Food	Serving size	Calcium per serving (mg)
Milk, low fat (1%)	1 cup	290
Milk, skim (fat free)	1 cup	305
Yogurt, plain, low fat	1 cup	450
Yogurt, fruit, low fat	1 cup	340
Cheddar cheese	1 ounce	205
Soy milk, calcium-fortified	1 cup	370
Orange juice, calcium-fortified	1 cup	350
Sardines, canned, with bones	3 ounces	325
Salmon, canned, with bones	3 ounces	190
Turnip greens, cooked	½ cup	124
Kale, cooked	½ cup	90
Okra, cooked	½ cup	88
Beet greens, cooked	½ cup	82
Tofu	½ cup	250

Vitamin D

Why do I need vitamin D?

You need vitamin D to help your body absorb calcium from both foods and supplements. Your body then deposits calcium into your bone.

How much vitamin D do I need?

The Recommended Dietary Allowance (RDA) for vitamin D is 600 international units (IU) per day for people ages 1–70 years. For those over 70, the RDA is 800 IU per day.

Vitamin D toxicity, which usually occurs from excessive intake of vitamin D supplements, can lead to excessive calcium absorption and calcium deposits in the kidneys and other organs. The maximum suggested intake is no more than 4,000 IU per day.

Where do I get vitamin D?

Vitamin D is unique among vitamins in that the skin makes it after exposure to the sun. The amount the skin makes depends on the length of time you have been in the sun without sunscreen, your skin color, your age, and your geographic location. For instance, your body cannot make vitamin D from November to February if you live north of the 37th parallel, approximately the upper half of the United States.



People living north of the 37th parallel can't make their own vitamin D from November to February.

In the United States, naturally occurring food sources of vitamin D are limited, so Americans get most of their vitamin D from fortified foods (table 2). Some dairy foods mistakenly thought of as good sources are not fortified, for example cheese and sour cream. Eight ounces of fortified 1% low-fat cow's milk has 100 IU per serving and is a good source of vitamin D, but 1 ounce of cheddar cheese has only 3 IU per serving and is not a good source.



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Ways to get more vitamin D in your diet

Breakfast

- Fortified cereal with fortified cow's milk or fortified soy beverage
- Fortified orange juice
- Toast with fortified margarine

Lunch

- Tuna fish sandwich
- Quick Sardine Curry (recipe available at <http://allrecipes.com/>)

Dinner

- Tuna fish casserole
- Salmon patties (recipes available at <http://allrecipes.com/>)

Snacks

- Fruit smoothie made with cow's milk or a fortified non-dairy beverage

Table 2. Foods containing vitamin D.

Food	Serving size	Vitamin D per serving (IU)
<i>Naturally occurring vitamin D</i>		
Cod liver oil	1 tablespoon	1,400
Herring, raw	3 ounces	1,384
Salmon, canned, with bone	3 ounces	530
Steelhead trout, canned, with bone	3 ounces	513
Tuna, canned in oil	3 ounces	201
Sardines, canned in oil	2 fish	65
<i>Fortified with vitamin D</i>		
Cereal	1/3–1 1/3 cups	13–100
Cow's milk	8 ounces	100
Orange juice	8 ounces	60
Soy milk	8 ounces	119

Note: IU = international unit.

How can I select foods from the supermarket that are good or excellent sources of calcium and vitamin D?

A product that is an "excellent" source of a nutrient contains 20% or more of the Daily Value (DV) for that nutrient, while a "good" source contains 10–19% of the DV. Table 3 shows the amount of calcium or vitamin D per serving for a food to be considered an "excellent" or a "good" source.

Table 3. Amounts of calcium or vitamin D in excellent or good food.

Food	Calcium	Vitamin D
Excellent source (at least 20% DV per serving)	at least 200 mg per serving	80 IU per serving
Good source (10–19% DV per serving)	100–190 mg per serving	40–76 IU per serving

Supplements

What about taking supplements to get enough calcium and vitamin D?

If you are not meeting your calcium and vitamin D requirements from the foods you eat, consider taking supplements.

What guidelines should I follow for taking calcium supplements?

There are numerous calcium supplements on the market, usually in pill form. The reason for this is that calcium



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must be combined with other substances into compounds; it cannot exist by itself. Examples of calcium compounds used in supplements include calcium carbonate, calcium citrate, calcium lactate, calcium phosphate, and calcium gluconate. Calcium citrate and calcium carbonate are better absorbed by the body than other forms of calcium.

Each of these calcium compounds contains different amounts of available or “elemental” calcium. The product label lists the amount of elemental calcium and how many pills to take (in other words, the serving size). Do not take more than 500–600 milligrams of calcium at one time and allow 4 to 6 hours between doses.

Most calcium supplements should be taken with a meal. Eating stimulates the secretion of stomach acid and initiates digestion, which helps the body absorb calcium. The exception is calcium citrate, which can be absorbed at any time.

What guidelines should I follow for taking vitamin D supplements?

Most calcium supplements also contain vitamin D, so you may not need to take additional vitamin D if you are taking a calcium supplement. There are two types of vitamin D supplements. Vitamin D2 (ergocalciferol) is made from plants, and vitamin D3 (cholecalciferol) is the form the body makes after being exposed to sunlight. They are both equally good for bone health.

Physical activity

What are the three types of physical activity I need for strong bones?

Weight-bearing exercise, strength-training exercise, and balance exercise will help you build and maintain strong bones.

Weight-bearing exercises force you to work against gravity, which strengthens your bones and muscles. Examples are walking, dancing, tennis, jogging, golf, stair climbing, volleyball, and gardening. In strength-training exercises you use weights or stretch bands. Balance exercises such as yoga and tai chi help decrease your likelihood of falling.

How much physical activity do I need?

You should do **weight-bearing exercises** for a total of 30 minutes on most days of the week, **strength-training exercises** for each muscle group 2 or 3 days per week, and **exercises that improve your balance** every day (table 4).

Table 4. How often to do different kinds of physical activity.

Physical activity	How often	Options
Weight-bearing exercise (walking, dancing, tennis, jogging, golf, stair climbing, volleyball, gardening, etc.)	Most days of the week for 30 minutes	30 minutes at one time OR 3 sessions of 10 minutes each
Strength training (exercising with weights or stretch bands)	Each muscle group 2 or 3 days per week	Exercise all your muscle groups on one day and rest the next OR exercise a different muscle group on each of three days, then repeat. For example, day 1 for arms, day 2 for legs, and day 3 for trunk.
Balance exercise	Daily	Do the exercises all at once or spread them throughout the day.



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Strength training exercises usually involve weights or stretch bands. Sitting on a ball while exercising improves balance.



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Yoga is one form of coordination-balance exercise.



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Weight-bearing exercises force you to work against gravity and include walking and jogging.

Further reading

National Osteoporosis Foundation,
<http://www.nof.org>

International Osteoporosis Foundation,
<http://www.iofbonehealth.org/>

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