

Calcium, Nutrition, and Bone Health

The health and strength of our bones rely on a balanced diet and a steady stream of nutrients, most importantly, calcium and Vitamin D.

Calcium is a mineral that people need to build and maintain strong bones and teeth. It is also very important for other physical functions, such as muscle control and blood circulation.

Calcium is not made in the body – it must be absorbed from the foods we eat. To effectively absorb calcium from food, our bodies need Vitamin D.

If we do not have enough calcium in our diets to keep our bodies functioning, calcium is removed from where it is stored in our bones. Over time, this causes our bones to grow weaker and may lead to osteoporosis – a disorder in which bones become very fragile.

Postmenopausal women are most vulnerable to osteoporosis. Although loss of estrogen is the primary reason for this, poor lifelong calcium and Vitamin D intake, as well as lack of exercise, play a role in the development of osteoporosis.

Note that men also are at risk for osteoporosis – typically later in life than women – and it is important for them to keep track of calcium intakes, as well.

Calcium

Calcium needs vary with age. The Food and Nutrition Board (FNB) of the Institute of Medicine of the National Academies provides guidelines on the amount of calcium needed each day.

Recommended Daily Allowance in Milligrams (mg)

Life Stage Group	Recommended Daily Calcium Intake
Women and men 9 to 18 years	1,300 mg
Women and men 19 to 50 years	1,000 mg
Women 51 to 70 years	1,200 mg
Men 51 to 70 years	1,000 mg
Women and men > 70 years	1,200 mg

Pregnant or nursing women 14 to 18 years 1,300 mg

Pregnant or nursing women 19 to 50 years 1,000 mg

Reprinted and adapted with permission from Tables S-1 and S-2, Dietary Reference Intakes for Calcium and Vitamin D, 2011 by the National Academy of Sciences, Courtesy of the National Academies Press, Washington, D.C.

Dietary Sources of Calcium

People can get the recommended daily amount of calcium by eating a healthy diet that includes a variety of calcium-rich foods. Milk, yogurt, cheese, and other dairy products are the biggest food sources of calcium.

Other high-calcium foods include:

- Kale, broccoli, Chinese cabbage (bok choy) and other green leafy vegetables
- Sardines, salmon, and other soft-bone fish
- Tofu
- Breads, pastas and grains
- Calcium-fortified cereals, juices, and other beverages.

A more complete listing of calcium-rich foods is included at the end of this article.

Some foods make it harder for the body to absorb calcium. In particular, sodas and carbonated beverages should be avoided, not just for bone health but for many nutritional reasons, including preventing obesity. Sodas decrease calcium absorption in the intestines and contain empty calories. Milk, calcium-fortified juices, and water are better beverage alternatives for all age groups.

Calcium Supplements

Although adequate calcium can be obtained through your diet, it is difficult for many people, particularly for those who avoid dairy products. People who are lactose-intolerant or vegetarians who do not eat dairy products have a harder time getting enough calcium from foods.

It is also hard to get enough calcium from the diet during certain times of our lives, such as in adolescence when our bodies require more calcium to build strong bones for life. Postmenopausal women and men older than age 70 also require more calcium to slow down bone loss.



Good sources of calcium include milk, cheeses, leafy green vegetables, and almonds.

Doctors recommend calcium supplements to those who do not get enough calcium from the foods they eat. Although calcium is sometimes found in multivitamins, it is typically not in significant amounts. Many people need to take separate calcium supplements to ensure they reach the Recommended Dietary Allowance for their life stage.

Not all the calcium consumed – whether through food or supplement – is actually absorbed in the intestines. Research shows that calcium is absorbed most efficiently when it is taken in doses less than 500 mg. Because many calcium supplements come in 500 mg doses, people who require 1,000 mg of supplementation each day should take their doses at separate times. Newer daily slow release formulations of calcium citrate that supply 1200 mg have recently become available.

Most calcium supplements also contain Vitamin D, which helps the body absorb calcium.

Vitamin D

Without Vitamin D, our bodies cannot effectively absorb calcium, which is essential to good bone health.

Children who lack Vitamin D develop the condition called rickets, which causes bone weakness, bowed legs, and other skeletal deformities, such as stooped posture. Adults with very low Vitamin D can develop a condition called osteomalacia (soft bone). Like rickets, osteomalacia can also cause bone pain and deformities of long bones.

Vitamin D Recommended Dietary Allowance

The FNB recommends 400 International Units (IU) of Vitamin D for infants during the first year of life. The RDA for everyone from age 1 through 70 years is 600 IU. Recent research, however, supports that the body needs at least 1000 IU per day for good bone health, starting at age 5 years.

Many foods contain some Vitamin D, however, few contain enough to meet the daily recommended levels for optimal bone health.

In the 19th and early 20th centuries, children were routinely given cod liver oil for a range of medicinal purposes. When cod liver oil was tied to the prevention and treatment of rickets, Vitamin D was discovered. Soon after, Vitamin D was added to milk – one glass of milk contains about 100 IU of Vitamin D. As a result, parents stopped using cod liver oil. Because today's children do not drink as much milk as in the past, it is difficult for them to get enough Vitamin D from milk. In addition, other dairy products are not typically supplemented with Vitamin D. Getting enough Vitamin D from what we eat is very difficult.

Although our bodies can make Vitamin D in our skin when it is exposed to good sunlight, it is very important to protect our skin by using sunscreen when we are outdoors. This blocks the excessive UV radiation that can cause skin cancer. Sunscreen does, however, also block our skin's ability to make Vitamin D. This is why doctors often recommend Vitamin D supplements for both adults and children. The American Academy of Pediatrics recommends that all children – from infancy through adolescence – take Vitamin D supplements.



The American Academy of Pediatrics recommends that all children take Vitamin D supplements.

Safe Levels of Calcium and Vitamin D

Too much calcium and/or Vitamin D can be harmful and cause serious side effects. In addition to establishing RDA guidelines, the FNB has established Tolerable Upper Intake Levels (ULs). These represent the highest levels of calcium and Vitamin D that can be consumed by the average individual and still be safe.

These ULs are important guidelines for people who may require different dosages of these supplements. For example, people who live in areas with little sun, those with darker skin, and people who are obese may need more Vitamin D than the recommended daily amount.

Note that ULs are not levels that people should try to reach – they are the safe limits based on current research. When intake goes beyond the ULs listed below, the risk for serious side effects increases.

Upper Safe Limit for Calcium Intake

Life Stage	Upper Safe Limit
Birth to 6 months	1,000 mg
Infants 7-12 months	1,500 mg
Children 1-8 years	2,500 mg
Children 9-18 years	3,000 mg
Adults 19-50 years	2,500 mg
Adults 51 years and older	2,000 mg
Pregnant and breastfeeding teens	3,000 mg
Pregnant and breastfeeding adults	2,500 mg

Upper Safe Limit for Vitamin D Intake

Age	Male	Female	Pregnancy	Lactation
0-6 months	1,000 IU	1,000 IU		
7-12 months	1,500 IU	1,500 IU		

1-3 years	2,500 IU	2,500 IU		
4-8 years	3,000 IU	3,000 IU		
≥9 years	4,000 IU	4,000 IU	4,000 IU	4,000 IU

Reprinted and adapted with permission from Tables S-1 and S-2, Dietary Reference Intakes for Calcium and Vitamin D, 2011 by the National Academy of Sciences, Courtesy of the National Academies Press, Washington, D.C.

More foods in the U.S. are being fortified with calcium and Vitamin D, and awareness of the importance of these nutrients for bone health is growing. In recent years, the media has reported on the potential health benefits of taking high levels of Vitamin D, such as in the areas of cancer prevention, diabetes management, and heart health. As a result, it is becoming more likely that people may consume unsafe quantities of these nutrients.

The FNB conducted an extensive review of the medical literature and found enough evidence of bone health benefits to support raising the UL levels on Vitamin D in adults from 2000 IU to 4000 IU. What was also determined, however, is that very high levels of Vitamin D (above 10,000 IUs per day) can cause kidney damage and dangerously high serum calcium levels. Too much calcium from dietary supplements can also cause adverse health effects, including kidney stones, higher risks for heart problems, and possibly increased risk for prostate cancer.

Calcium and Vitamin D are essential for good bone health, but must be consumed safely. If you are not sure what intake levels are right for you and your health needs, be sure to talk to your doctor.

Other Key Nutrients in Bone Health

Many other nutrients – most found naturally and at sufficient levels in a typical diet – contribute to bone health and growth. They include:

- **Phosphorus.** A major mineral in the body's bone crystal, phosphorus is found in dairy products and meat. Vitamin D improves phosphorus absorption in the intestine and kidney.
- **Magnesium.** Primarily found in bone crystals, magnesium improves bone strength. Older adults are more likely to be deficient in magnesium. Calcium supplements that contain magnesium can help.
- **Vitamin K.** Necessary for bone formation and mineralization, Vitamin K also is important for blood clotting, and may assist in channeling calcium directly to the bone rather than the blood vessels.
- **Vitamin C.** Collagen is the main protein in bone, and Vitamin C is necessary for collagen synthesis. Vitamin C is present in citrus fruits and tomatoes and in many vegetables.
- **Vitamin A.** Vitamin A is necessary for cells to differentiate normally and for normal skeletal growth, and also is extremely important for eye health. Vitamin A is available in liver, eggs, butter, green leafy vegetables and carrots. Too little vitamin A is a major cause of blindness worldwide. In contrast, too

much vitamin A can cause bone loss and increase the risk of hip fracture. The animal source supplements (retinols) may cause toxicity but plant sources (B carotene) do not. Daily intake of retinols should be less than 10,000 IU.

Dietary Sources of Calcium

Selecting foods high in calcium is one way to help you achieve your targeted daily calcium intake. Here are some major food sources of calcium to assist your meal planning.

Selected Food Sources of Calcium

Food	Milligrams (mg) per serving	Percent DV*
Yogurt, plain, low fat, 8 ounces	415	42
Orange juice, calcium-fortified, 6 ounces	375	38
Yogurt, fruit, low fat, 8 ounces	338-384	34-38
Mozzarella, part skim, 1.5 ounces	333	33
Sardines, canned in oil, with bones, 3 ounces	325	33
Cheddar cheese, 1.5 ounces	307	31
Milk, nonfat, 8 ounces**	299	30
Milk, reduced-fat (2% milk fat), 8 ounces	293	29
Milk, buttermilk, 8 ounces	282-350	28-35
Milk, whole (3.25% milk fat), 8 ounces	276	28
Tofu, firm, made with calcium sulfate, 1/2 cup***	253	25
Salmon, pink, canned, solids with bone, 3 ounces	181	18
Cottage cheese, 1% milk fat, 1 cup	138	14
Tofu, soft, made with calcium sulfate, 1/2 cup***	138	14
Instant breakfast drink, various flavors and brands, powder prepared with water, 8 ounces	105-250	10-25
Frozen yogurt, vanilla, soft serve, 1/2 cup	103	10
Ready-to-eat cereal, calcium-fortified, 1 cup	100-1,000	10-100
Turnip greens, fresh, boiled, 1/2 cup	99	10
Kale, fresh, cooked, 1 cup	94	9
Kale, raw, chopped, 1 cup	90	9
Ice cream, vanilla, 1/2 cup	84	8
Soy beverage, calcium-fortified, 8 ounces	80-500	8-50
Chinese cabbage (bok choy) raw, shredded, 1 cup	74	7
Bread, white, 1 slice	73	7
Pudding, chocolate, ready to eat, refrigerated, 4 ounces	55	6
Tortilla, corn, ready-to-bake/fry, one 6" diameter	46	5
Tortilla, flour, ready-to-bake/fry, one 6" diameter	32	3

Sour cream, reduced fat, cultured, 2 tablespoons	31	3
Bread, whole-wheat, 1 slice	30	3
Broccoli, raw, 1/2 cup	21	2
Cheese, cream, regular, 1 tablespoon	14	1

* DV = Daily Value. DVs were developed by the U.S. Food and Drug Administration to help consumers compare the nutrient contents among products within the context of a total daily diet. The DV for calcium is 1,000 mg for adults and children aged 4 years and older. Foods providing 20% or more of the DV are considered to be high sources of a nutrient, but foods providing lower percentages of the DV also contribute to a healthful diet. The U.S. Department of Agriculture's Nutrient Database Web site lists the nutrient content of many foods. It also provides a comprehensive list of foods containing calcium.

** Calcium content varies slightly by fat content; the more fat, the less calcium the food contains.

*** Calcium content is for tofu that is processed with a calcium salt. Tofu processed with other salts does not provide significant amounts of calcium.

Source: National Institutes of Health (NIH) (); U.S. Department of Agriculture, Agricultural Research Service. 2011. USDA National Nutrient Database for Standard Reference, Release 24. ; Institute of Medicine of the National Academies .

Last Reviewed

July 2012

Contributed and/or Updated by

[Barbara J. Campbell, MD](#)

Peer-Reviewed by

[Stuart J. Fischer, MD](#)

AAOS does not endorse any treatments, procedures, products, or physicians referenced herein. This information is provided as an educational service and is not intended to serve as medical advice. Anyone seeking specific orthopaedic advice or assistance should consult his or her orthopaedic surgeon, or locate one in your area through the AAOS [Find an Orthopaedist](#) program on this website.