

Compliments of:

Julie A. Bauer, MD

Kimberley A. Bourne, MD, FACE

Board Certified Endocrinology, Diabetes and Metabolism

Patient information: Calcium supplementation in osteoporosis

Hillel N Rosen, MD
Harvard Medical School

UpToDate performs a continuous review of over 330 journals and other resources. Updates are added as important new information is published. The literature review for version 13.2 is current through April 2005; this topic was last changed on May 10, 2004.

These materials are for your general information and are not a substitute for medical advice. You should contact your physician or other healthcare provider with any questions about your health, treatment, or care. Do not contact UpToDate or the physician authors of these materials.

Osteoporosis is a common bone disorder characterized by a progressive decrease in bone density and mass. As a result, bones become thin, weakened, and easily fractured. It is estimated that more than 1.3 million osteoporosis-associated (or "osteoporotic") fractures occur every year in the United States, primarily of bone within the vertebral column, the hip, and the forearm near the wrist.

Osteoporosis is the result of accelerated bone loss due to an imbalance between the normal breakdown (resorption) and replacement (formation) of bone. In most patients, such bone loss is largely menopause- and/or age-related. Bone mass naturally declines as people age (ie, beginning at about age 35 years); in addition, women are particularly at risk for osteoporosis following menopause due to declining production of the female hormone estrogen, which helps to maintain bone mass.

Multiple therapies are available that may **prevent** bone loss in postmenopausal women and the elderly and **treat** an already existing reduction in bone mass by increasing new bone formation and/or inhibiting the breakdown and removal of bone. (For further information, please see "Patient information: Prevention and treatment of osteoporosis"). However, the first step in preventing or treating osteoporosis is ensuring **adequate nutrition**, particularly maintaining a sufficient daily intake of calcium, a mineral essential for bone strength, and vitamin D, which aids in calcium metabolism and absorption.

WHAT ARE THE BENEFITS OF ADEQUATE CALCIUM INTAKE? – Evidence suggests the importance of adequate nutrition at all ages, from children to the elderly, for optimal skeletal health. In some, but not all studies in postmenopausal women, the administration of calcium reduced the rate of bone loss and decreased the risk of recurrent vertebral fractures. In addition, increased intake of calcium in the diet during childhood (eg, in milk) is associated with higher bone mass in adulthood. The increase in bone mineral density is important in modifying future fracture risk. The risk for most osteoporotic fractures is inversely proportional to bone density: ie, that the lower the bone mass, the greater the tendency to fracture.

"Calcium balance" in the body refers to the balance between calcium intake and its output through bodily excretions (eg, urine). Not surprisingly, the less calcium an individual takes in, the more negative the calcium balance. By increasing one's calcium intake, calcium balance can become more positive.

Multiple investigations have supported the importance of calcium intake, demonstrating that adequate calcium reduces bone loss in adults. As examples:

- Two studies demonstrated that postmenopausal women whose calcium intake was less than 400 or 750 mg/day had significant reductions in bone loss when supplemented with calcium as opposed to placebo (an inactive substance).
- In women over age 60 years with a low calcium intake who had preexisting spinal (vertebral) fractures, calcium supplementation reduced the incidence of additional vertebral fractures compared to placebo and stopped detectable bone loss within the forearm (over four years of follow-up).
- One study demonstrated that calcium supplementation in postmenopausal women was associated with a small but significant increase in bone density.

Calcium and vitamin D supplements have been shown to help prevent tooth loss in the elderly.

WHAT ARE THE CURRENT RECOMMENDATIONS REGARDING CALCIUM INTAKE? – As mentioned above, adequate calcium intake can result in positive calcium balance and a reduction in the rate of bone loss; the effect on potentially decreasing associated fracture risk is less clear. However, due to such reductions in bone loss and other factors, most physicians recommend calcium supplementation for patients with a low calcium intake.

Although the optimal level has not been clearly established, daily calcium intake should be at least 1000 mg in premenopausal women and in men, and 1500 mg in postmenopausal women who do not take estrogen (although we no longer recommend estrogen as a first-line drug for osteoporosis). However, for most patients, the total daily calcium intake should not routinely exceed 2000 mg due to the possibility of adverse effects.

Underlying gastrointestinal diseases – It is important to note that the recommendations here apply to individuals without underlying gastrointestinal diseases. Patients with impaired absorption of nutrients from the gastrointestinal tract (malabsorption) may have higher than normal calcium requirements due to reduced calcium absorption. In such cases, your doctor will help you to determine the appropriate level of calcium supplementation.

Medications – Administration of certain medications may also influence calcium balance, such as drugs that promote the excretion of urine (diuretics). As an example, so-called "loop diuretics" increase the excretion of calcium; however, "thiazide diuretics" may lead to reduced levels of calcium in the urine, potentially helping to protect against possible bone loss and kidney stones (see below). Therefore, it is important for patients to tell their physicians and pharmacists about all medications they are taking so that any possible interactions with calcium can be identified.

HOW CAN I DETERMINE MY CURRENT DAILY CALCIUM INTAKE? – The primary sources of calcium within the diet include milk and other dairy products, such as hard cheese, cottage cheese, or yogurt, as well as green vegetables, such as spinach. A simple way to estimate one's daily intake of dietary calcium is to

multiply the number of dairy servings consumed each day by 300 mg. One serving equals 8 oz of milk or yogurt, 1 oz of hard cheese, 16 oz of cottage cheese, or 2 cups of broccoli.

Many experts recommend calcium supplementation rather than dietary changes for individuals with inadequate calcium intake. Evidence suggests that calcium is as well absorbed from supplements as from whole milk. In addition, calcium supplements were used in the studies cited above that demonstrated benefits from increased calcium intake. Therefore, it is likely that calcium supplements are just as effective as calcium in dairy products. However, calcium absorption from vegetables (eg, spinach) is less than that from dairy products.

ARE THERE OTHER SPECIFIC RECOMMENDATIONS CONCERNING CALCIUM SUPPLEMENTATION? – Those with inadequate calcium intake should speak with their physicians concerning the specific type of supplement, dose levels, and timing of administration that may be most appropriate for their particular case (show figure 1). For most patients, experts typically recommend:

- Taking appropriate preparations of calcium carbonate, since it is an effective yet inexpensive form of calcium.
- Taking calcium carbonate with meals to help ensure optimal absorption. On the other hand, some evidence indicates that such supplementation with meals reduces iron absorption from food by about 50 percent. Thus, patients should consider taking calcium carbonate with a low-iron meal such as breakfast to avoid possible iron deficiency.
- For elderly people who may absorb calcium carbonate less readily (because of less acid in the stomach), physicians recommend preparations of calcium citrate (eg, Citracal™).
- Taking chewable preparations of calcium carbonate (eg, Tums™) or calcium citrate since many natural calcium carbonate preparations (eg, bone meal, oyster shells) are poorly soluble. In addition, there is evidence that most of the natural calcium carbonate preparations have lead contamination. Therefore, we currently recommend either Tums or Citracal (a calcium citrate preparation).

In addition, patients should be aware of the following:

- The daily intake recommendations described above apply to "elemental calcium." More specifically, calcium carbonate is 40 percent elemental calcium. Therefore, 500 mg of calcium carbonate contains 200 mg of elemental calcium.
- Calcium supplementation in excess of 500 mg/day should be taken in divided doses. Single doses above this level may cause a "plateau" in calcium absorption, thus preventing attainment of a positive calcium balance.
- Calcium supplementation **must not** be viewed as an alternative to other osteoporosis treatments. The effect of calcium alone in slowing bone loss in postmenopausal women, though significant, is less than that of estrogen or the combination of calcium and estrogen. However, we no longer recommend hormone therapy as our first choice for osteoporosis management (For further information, please see "Patient information: Prevention and treatment of

osteoporosis").

ARE THERE ANY SIDE EFFECTS ASSOCIATED WITH A HIGH CALCIUM INTAKE? – The only known side effects related to a high intake of calcium are constipation and indigestion (dyspepsia). However, there may be **benefits** unrelated to bone, such as a reduction in blood pressure and lower cholesterol levels.

Previous concerns that high dietary calcium may increase the risk of developing kidney stones (nephrolithiasis) appear to be unfounded. In fact, according to a study of over 90,000 women who were followed for 12 years, high dietary calcium intake was associated with a **lower** risk of symptomatic kidney stone disease. However, this might not be true for those who take calcium supplements. Most experts agree that those with a personal or family history of kidney stones should take their calcium supplements with meals to avoid this risk.

WHERE TO GET MORE INFORMATION – Your doctor is the best resource for finding out important information related to your particular case. Not all patients with osteoporosis are alike, and it is important that your situation is evaluated by someone who knows you as a whole person.

This discussion will be updated as needed every four months on our web site (www.uptodate.com). Additional topics as well as selected discussions written for health care professionals are also available for those who would like more detailed information.

A number of other sites on the internet have information about prevention and treatment of osteoporosis. Information provided by the National Institutes of Health, national medical societies, and some other well-established organizations are often reliable sources of information, although the frequency with which their information is updated is variable.

- National Library of Medicine
(<http://www.nlm.nih.gov/medlineplus>)
- Osteoporosis and Related Bone Diseases National Resource Center (ORBD-NRC)
1232 22nd Street, NW
Washington, DC 20037-1292
Phone: (202) 223-0344
Toll-free: (800) 624-BONE (2663)
TTY: (202) 466-4315
E-mail: orbdnrc@nof.org
(<http://www.osteoo.org/>)
- National Osteoporosis Foundation
1232 22nd Street NW
Washington, DC 20037-1292
Phone: (202) 223-2226
E-mail: patientinfo@nof.org
(<http://www.nof.org/>)
- Osteoporosis Society of Canada

33 Laird Drive
Toronto, Ontario M4G 3S9
Phone: (800) 463-6842
(<http://www.osteoporosis.ca/>)

- The Hormone Foundation
(<http://www.hormone.org>)

[1-7]

References

1. NIH Consensus Development Panel on Optimal Calcium Intake. Optimal calcium intake. *JAMA* 1994; 272:1942.
2. Aloia, JF, Vaswani, A, Yeh, JK, et al. Calcium supplementation with and without hormone replacement therapy to prevent postmenopausal bone loss. *Ann Intern Med* 1994; 120:97.
3. Cook, JD, Dassenko, SA, Whittaker, P. Calcium supplementation: Effect on iron absorption. *Am J Clin Nutr* 1991; 53:106.
4. Curhan, GC, Willett, WC, Speizer, FE, et al. Comparison of dietary calcium with supplemental calcium and other nutrients as factors affecting the risk for kidney stones in women. *Ann Intern Med* 1997; 126:497.
5. Dawson-Hughes, B, Harris, SS, Krall, EA, Dallal, GE. Effect of calcium and vitamin D supplementation on bone density in men and women 65 years of age or older. *N Engl J Med* 1997; 337:670.
6. Ross, EA, Szabo, NJ, Tebbett, IR. Lead content of calcium supplements. *JAMA* 2000; 284:1425.
7. Heaney, RP. Lead in calcium supplements: cause for alarm or celebration?. *JAMA* 2000; 284:1432.