



**Calcium** (*Calcium as citrate, aspartate, ascorbate, lactate, phosphate, carbonate, glycinate, malate, amino acid chelates, and microcrystalline hydroxyapatite compound (MCHC)*)

**Common Indications**

- Bone health, including osteoporosis prevention
- Blood pressure regulation/vascular health
- Metabolic balance, including cancer prevention
- Lead toxicity during pregnancy and lactation
- Premenstrual syndrome

**General Comments:**

Calcium is key to so many daily chemical reactions and functions throughout the human body. It is estimated that we have 2 to 3 pounds of calcium in our bones and teeth primarily as hydroxyapatite, and that only a small 1% of it is free to move through the cells and bloodstream. Calcium from dairy products is not well absorbed as only 30% of the calcium in milk is even bioavailable compared to 50% of the calcium found in vegetables. Supplemental forms of calcium such as calcium carbonate comes from ground up seashells and is not well absorbed. Better forms of calcium for supplementation are hydroxyapatite and citrate forms.

Calcium is tightly regulated by our bodies endocrine system. Parathyroid hormone and calcitonin balance each other's impact to regulate calcium flux. Our bodies are capable of adjusting to needs by managing gut absorption or kidney excretion as needed.

**Benefits & Mechanism of Action**

Bone health, including osteoporosis prevention

Calcium's most important function is in the development and maintenance of healthy bones and teeth. Osteoporosis can be categorized into primary and secondary cause osteoporosis. Need for calcium and primary osteoporosis prevention is greatest during periods of rapid growth including childhood, pregnancy, and lactation.<sup>1,2,3,4,5,6,7,8,9</sup> The leading cause of secondary osteoporosis is glucocorticoid induced osteoporosis.<sup>10,11</sup>

Blood pressure regulation/vascular health

Calcium helps to initiate muscle contractions. As such, it plays a vital role in the

contraction-relaxation cycle that regulates a normal heartbeat.<sup>12</sup> Several clinical trials have demonstrated a relationship between increased calcium intakes and both lower blood pressure and risk of hypertension, although the results are inconsistent. A 2009 review of the literature reported that among trials in hypertensive adults, calcium supplementation lowered systolic, but not diastolic, blood pressure by 2-4 mm Hg.<sup>13</sup> It is also involved in several steps of the blood clotting mechanism. Additionally, calcium regulates the passage of fluids across cellular membranes by affecting cell wall permeability and plays a role in the regulation and transmission of nerve impulses.

A meta-analysis in 2012 and multiple other studies have shown an inverse relationship between calcium levels and gestational hypertension. Calcium supplementation significantly reduced the risk of gestational hypertension, reduced the risk of pre-term birth, and was associated with higher birth weight.<sup>14,15,16</sup>

#### Metabolic balance, including cancer prevention

Calcium activates various enzyme systems responsible for muscle contraction, fat digestion, and protein metabolism. Low extracellular calcium signals the release of parathyroid hormone, which increases calcium absorption. Increasing dietary calcium without energy restriction may also facilitate a repartitioning of dietary energy from adipose tissue to lean body mass, resulting in a net reduction in fat mass and adiposity. Increasing dietary calcium intake during energy restriction accelerates augmentation of body weight loss and fat loss in both mice and humans, as supported by epidemiological observations from NHANES III, the Quebec Family Study, the CARDIA Study and the HERITAGE Family Study.<sup>17,18,19,20</sup> However, there have been studies reporting no benefit of calcium intake with weight loss.<sup>21</sup>

There is some evidence that increased calcium intake may decrease the postmenopausal risk for breast cancer, although conflicting studies exist.<sup>22,23,24,25</sup> Several clinical studies using calcium supplementation in men report a slight increase in the incidence of prostate cancer, although a 2013 meta-analysis of calcium and vitamin D intake revealed a decrease risk of prostate cancer when using calcium supplementation.<sup>26,27,28</sup>

#### Lead toxicity during pregnancy and lactation

Ninety-five percent of lead in the body is stored in the bone. During pregnancy, lead levels may rise because of bone resorption, stimulated by the calcium needs of the growing fetus.<sup>29</sup> Multiple studies report up to 79% of free lead crossing the placental barrier.<sup>30,31</sup> Lead also passes into the breastmilk.<sup>32</sup> Supplementation with calcium starting in the first trimester led to reductions in maternal blood lead levels.<sup>33,34,35</sup>

#### Premenstrual syndrome

Calcium has been studied in the treatment and prevention of premenstrual syndrome.

The proposed mechanism is calcium regulation during the luteal phase of the menstrual cycle.<sup>36</sup> Calcium showed significant reductions in premenstrual symptoms when taken consistently.<sup>37,38,39,40</sup>

**Dose:**

DRI\* 1,000 – 1,300 mg elemental calcium daily

ODA 1,000 – 1,500 mg elemental calcium daily

Note – adequate vitamin D (as vitamin D3, generally 400-800IU daily) is recommended in conjunction with calcium supplementation.

\* The Dietary Reference Intakes (DRI) are the most recent set of dietary recommendations established by the Food and Nutrition Board of the Institute of Medicine, 1997-2001. They replace previous RDAs, and may be the basis for eventually updating the RDIs.

\*\*The Optimum Daily Allowance (ODA) represents a reference level beyond the RDI, and is often many times higher than the RDI to prevent diseases such as aging or cancer. These numbers are based on clinical use.

**Standardization:**

Calcium Supplement Equivalents

1000 mg elemental calcium

- 3,950 mg calcium acetate
- 2,500 mg calcium carbonate
- 3,700 mg calcium chloride
- 4,740 mg calcium citrate
- 11,110 mg calcium gluconate
- 7,690 mg calcium lactate
- 4,000 mg microcrystalline hydroxyapatite compound (MCHC)
- 3,450 mg calcium phosphate, dibasic anhydrous
- 4,350 mg calcium phosphate, dibasic dihydrate
- 2,500 mg calcium phosphate, tribasic

**Symptoms of Deficiency:**

There are three skeletal diseases associated with calcium deficiency.

- Rickets is the classical calcium deficiency disease. It occurs in children and causes a variety of bone deformities.
  - When this condition develops in adults, it is called osteomalacia.
- Osteoporosis and osteomalacia are the two main adult conditions caused by calcium deficiency. Bone deformities and fractures are the result.

The symptoms of calcium deficiency include muscle cramps, heart palpitations, high blood pressure, brittle or soft bones, tooth decay, back and leg pains, insomnia, and nervous disorders.

Conditions that leave a patient with an increased need for calcium include:

- Intestinal inflammatory conditions
- Lack of regular exercise
- Menopausal and post menopausal women
- Men susceptible to bone loss
- Elevated blood pressure
- Elevated cholesterol
- Kidney stones
- Women with PMS<sup>41</sup>
- Pregnant women<sup>42</sup>
- Malnutrition
- Magnesium deficiency
- Increased Phosphorus
- Vegetarians/Vegans

Food and supplements that may decrease calcium include:

- Foods high in phosphorus, like soft drinks and animal protein
- Excessive and chronic caffeine intake
- Excess dietary fat and fiber

#### **Cautions & Side Effects:**

Large doses of calcium are efficiently excreted by the body and do not usually produce toxic effects unless the individual has a history of kidney stones. Increased serum calcium, when accompanied by high phosphate levels, can precipitate and cause ectopic calcification in blood vessels, joints, gastric mucosa, renal tissue, cornea, and other connective tissues.<sup>43</sup>

Symptoms that may indicate acute toxicity include:

- Gastrointestinal discomfort
- Nausea
- Constipation
- Flatulence

Medication interactions

Medications that can decrease the amount of calcium include:

- Amino-glycosides
- Amphotericin B
- Anticonvulsants
- Salicylates
- Cholestyramine
- Colchicine

- Digoxin
- Corticosteroids
- Cimetidine
- Isoniazid
- Loop Diuretics
- Aluminum and Magnesium Antacids
- Potassium Sparing Diuretics
- EDTA
- Tetracyclines
- Fluoroquinolones
- Levothyroxine
- Antacids
- Bisphosphonates

Medications with increased effects while taking calcium include:

- Calcium channel blockers
- Cardiac glycosides

Patients with the following disease states or conditions should not use calcium:

- Hyperparathyroidism
- Chronic renal impairment or kidney disease
- Sarcoidosis, or other granulomatous disease

#### **Nutrient Interactions:**

##### Iron

Regularly taking large doses of calcium may interfere with the absorption of iron. Also, supplementation of iron may cause a depletion of calcium.

##### Zinc

Regularly taking large doses of calcium may interfere with the absorption of zinc. Also, supplementation of zinc may cause a depletion of calcium.

##### Magnesium

Magnesium deficiency causes various abnormalities in calcium metabolism. It is important to take supplemental magnesium when taking calcium supplements.

##### Vitamin D

Calcium absorption is increased with vitamin D.<sup>44</sup> There have been reports that calcium without vitamin D may increase the risk of developing heart disease, specifically myocardial infarction.<sup>10</sup> According to the Prostate Cancer Research Institute, prostate cancer patients should supplement their diet with 1,200–1,500 mg calcium (preferably with calcium citrate) and 2,000 IU Vitamin D.

**Food Sources:** Good sources of calcium are dark green leafy vegetables, broccoli, legumes,

nuts, and whole grains. Milk and dairy products are also a source of dietary calcium.

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