



Calcium

Why is Calcium Important?

Calcium, like all electrolytes in your body, has very important functions. Electrolytes help regulate your acid-base balance, the pH of your blood, osmotic gradients, and muscles contractions, both cardiac and skeletal. Calcium is the most abundant mineral in the human body and is very important in a lot of bodily functions. It is primarily found inside of your cells, but some can be found outside of the cells and is used to help your blood clot. Calcium plays an important role in your nervous, skeletomuscular, and cardiac systems. Most people know that calcium is in your bones and that is true. You have calcium in both your blood and in your bones. About 99% of the calcium in your body is found in your bones and teeth. The calcium in your blood is responsible for enabling your nerves to fire correctly, muscles to move the right way, and for your heart to beat efficiently.

Osmotic Gradients: These are gradients in your blood, especially your kidney's, that govern the amounts of certain minerals and nutrients that your body either reabsorbs or secretes by urination.

What Body Functions is Calcium Important for?

Blood Clotting: Calcium activates certain clotting factors in your blood when blood clot formation is triggered.

Digestive System: When you consume calcium it moves through your digestive tract triggering the secretion of gastric acid, which is important for proper digestion.

Maintaining Bone Density: When your blood calcium levels drop it triggers your bones to release calcium into your blood to raise your levels. When your blood calcium levels get too high it triggers your bones to absorb calcium to lower your levels.

Skeletal Muscle Contraction: Calcium is stored in your muscle cells and when a signal from your brain tells your muscle to move, calcium is released and it binds on to your muscle filaments allowing them to bind to each other, enabling the contraction of a muscle. For your

skeletal muscles to relax calcium needs to be cleared from the extracellular space. If not, your muscle will keep contracting.

Cardiac Muscle Contraction: Calcium is stored in your cardiac muscle cells and when your cardiac conduction system initiates a heartbeat it causes small amounts of calcium to be released into the cells, then a large amount of calcium that binds to your muscle filaments allowing them to bind to each other, enabling the contraction of your heart. For your heart to relax calcium needs to be cleared from the extracellular space.

Different Types of Calcium:

Calcium Carbonate: This form of calcium is **best absorbed when taken with a meal**. It can be used as a supplement if there is low dietary intake of calcium. It is also commonly found in antacid medications and can be used in the treatment of peptic ulcer disease.

Calcium Gluconate: This form of calcium is a salt, and it is very important in regulating low blood calcium levels, resuscitation after cardiac arrest, and cardiotoxicity from hyperkalemia (high potassium) and hypermagnesemia (high magnesium). Hyperkalemia can cause cardiac arrhythmias. Calcium gluconate can regulate your heart rate.

*Cell membrane potential: The electrical charge that your cells contain and is crucial for nerve signal transmission.

Calcium Lactate: This form of calcium has two uses. 1: it can be used to supplement for low calcium levels. 2: it is added to food as a flavoring agent or thickener in food. When used in food it can help the calcium get absorbed better by your body.

Calcium Citrate: This form of calcium is a calcium salt and is important in regulating low blood calcium levels if dietary intake of calcium is too low. Calcium citrate is **best absorbed when taken on an empty stomach**, so it should be taken before your first meal of the day. Calcium citrate has better intestinal absorption than calcium carbonate.

Food Sources Calcium is Found in:

Animal Products	mg/Serving
Sardines (3 ounces)	325
Full-Fat Greek Yogurt	240-250
Plain Yogurt (8 ounces)	205
Salmon (3 ounces)	181
Mozzarella Cheese (1 ounce)	143
Cottage Cheese (½ cup)	80
Plant Sources	mg/Serving
Tofu	434
Soybeans (½ cup)	131
Boiled Spinach (½ cup)	123
Boiled Turnip Greens (½ cup)	99
Kale (1 cup)	94
Chia Seeds (1 Tbsp)	76
Bok Choy (1 cup)	74
Pinto Beans (½ cup)	54
Broccoli (½ cup)	21

Signs and Causes of Calcium Deficiency:

Causes of *hypocalcemia includes *parathyroid issues, or lack of vitamin D. Low vitamin D leads to insufficient calcium absorption.

Muscle Cramping: Calcium plays a very important role in muscle contractions and having an insufficient amount of Calcium can lead to muscle cramps, especially in your legs. Additionally, can lead to muscle weakness and tingling in arms and legs.

Dry Skin and Brittle Nails: If you notice your skin being abnormally dry or your nails breaking more easily this may indicate low calcium levels.

Increase in PMS Symptoms: Increases in cramping or changes to your menstrual cycle can indicate low calcium.

Bone Fractures: If your blood calcium levels are too low, they are taking calcium from your bones which causes your bones to become more brittle making them more susceptible to fractures.

*Hypertension: Those who do not consume enough calcium have a greater risk of developing chronic hypertension. This can also coincide with seasonal changes of sun exposure lowering the amount of vitamin D you have, therefore lowering the absorption of calcium.

*hypocalcemia = low blood calcium levels

*hypertension = high blood pressure

*Parathyroid: located on the back of your thyroid gland and works together with your thyroid to produce hormones.

Signs of and Causes of Calcium Toxicity:

Causes of *hypercalcemia includes *hyperthyroidism and in rare cases vitamin D toxicity. Hyperthyroidism can be caused by tumors on the thyroid or parathyroid glands. High levels of calcium can lead to poor absorption of other minerals, for example, magnesium.

*hyperthyroidism = overactive thyroid

Digestive System: Nausea, vomiting, low appetite, or constipation can be signs. This is due to slowing of digestion and increase in stomach acid production which can cause an upset stomach.

Urinary System: Increased thirst and increased urination are signs of *hypercalcemia. This is due to the kidneys trying to flush the calcium out of your system because they have to work harder to filter it if there is too much present.

Muscles: You might have muscle weakness or muscle twitching due to changes in the muscles ability to contract correctly.

Brain: Too much calcium in your brain can cause fatigue, drowsiness, confusion, trouble focusing, and even depression. This is due to your neurons in your brain not firing efficiently.

*hypercalcemia = high blood calcium

Supplementation of Calcium:

Supplementation of calcium is important in those who are pregnant, breast feeding, or post-menopausal. When you are pregnant or breastfeeding, your body needs more calcium than usual to function properly due to increased demand on the body. Those who are post-menopausal are at greater risk of osteoporosis due to the decrease in estrogen levels, so supplementing calcium is important to maintain good bone health and decrease risk of osteoporosis. It is important when supplementing calcium to **only take up to 500mg at a time for max absorption. If you are taking 1000mg of calcium supplements a day, it is important you split the dose and take 500mg twice a day.** The two main forms are calcium that is supplemented is calcium carbonate and calcium citrate. Calcium carbonate absorbs better when taken with a meal and calcium citrate absorbs best on an empty stomach and is best for people who have lower amounts of stomach acid. Supplementation is important in those who are pregnant to reduce the risk of preeclampsia.

***It is important to know that dietary intake of calcium should be your main source of calcium, and any calcium supplements should supplement the calcium you are already ingesting.**

Daily Recommended Dose of Calcium:

Age	Amount
Birth to 6 months	200 mg
7 to 12 months	260 mg
1-3 years	700 mg
4-8 years	1,000 mg
9-13 years	1,300 mg
14-18 years	1,300 mg
19-50 years	1,000 mg
Women 51-70 years	1,200 mg
Men 51-70 years	1,000 mg
71+ years	1,200 mg
Pregnant and Breastfeeding Teens	1,300 mg
Pregnant and Breastfeeding Women	1,000 mg

References:

- Al Omari, M. M. H., Rashid, I. S., Qinna, N. A., Jaber, A. M., & Badwan, A. A. (2016). Calcium carbonate. *Profiles of drug substances, excipients and related methodology*, 41, 31-132.
- Caputo, C. (1968). The role of calcium in the processes of excitation and contraction in skeletal muscle. *The Journal of general physiology*, 51(5), 180.
- Chakraborty, A., & Can, A. S. (2020). *Calcium gluconate*.
- Ivanovich, P., Fellows, H., & Rich, C. (1967). The absorption of calcium carbonate. *Annals of Internal Medicine*, 66(5), 917-923.
- Mayo Foundation for Medical Education and Research. (2024, March 8). *Hypercalcemia*. Mayo Clinic. <https://www.mayoclinic.org/diseases-conditions/hypercalcemia/symptoms-causes/syc-20355523#:~:text=Excess%20calcium%20makes%20the%20kidneys,pain%2C%20vomiting%2C%20and%20constipation.>
- Palermo, A., Naciu, A. M., Tabacco, G., Manfrini, S., Trimboli, P., Vescini, F., & Falchetti, A. (2019). Calcium citrate: from biochemistry and physiology to clinical applications. *Reviews in Endocrine and Metabolic Disorders*, 20, 353-364.
- Peacock, M. (2010). Calcium metabolism in health and disease. *Clinical Journal of the American society of nephrology*, 5(Supplement_1), S23-S30.
- Power, M. L., Heaney, R. P., Kalkwarf, H. J., Pitkin, R. M., Repke, J. T., Tsang, R. C., & Schulkin, J. (1999). The role of calcium in health and disease. *American journal of obstetrics and gynecology*, 181(6), 1560-1569.

Pravina, P., Sayaji, D., & Avinash, M. (2013). Calcium and its role in human body. *International Journal of Research in Pharmaceutical and Biomedical Sciences*, 4(2), 659-668.

Saunders, D., Sillery, J., & Chapman, R. (1988). Effect of calcium carbonate and aluminum hydroxide on human intestinal function. *Digestive diseases and sciences*, 33, 409-413.

Theobald, H. E. (2005). Dietary calcium and health. *Nutrition Bulletin*, 30(3), 237-277.

U.S. Department of Health and Human Services. (n.d.-a). *Office of dietary supplements - calcium*. NIH Office of Dietary Supplements.
<https://ods.od.nih.gov/factsheets/Calcium-Consumer/>

U.S. National Library of Medicine. (n.d.-a). *Calcium carbonate: Medlineplus drug information*. MedlinePlus.
<https://medlineplus.gov/druginfo/meds/a601032.html#:~:text=Calcium%20carbonate%20is%20a%20dietary,acid%20indigestion%2C%20and%20upset%20stomach.>

U.S. National Library of Medicine. (n.d.-b). *Hypercalcemia: Medlineplus medical encyclopedia*. MedlinePlus. <https://medlineplus.gov/ency/article/000365.htm>