Magnesium — An Essential Mineral for Heart Health

STORY AT-A-GLANCE -

- Magnesium is the fourth most abundant mineral in your body. There are more than 3,750 magnesium-binding sites on human proteins, and more than 300 enzymes rely on magnesium for proper function
- Your heart has the highest magnesium requirement of any organ, specifically your left ventricle. With insufficient amounts of magnesium, your heart cannot function properly
- Circulating and dietary magnesium intake is inversely associated with cardiovascular disease risk. Serum magnesium is also inversely associated with coronary artery calcification, while higher magnesium intake is inversely associated with a potent inflammatory marker

By Dr. Mercola

Magnesium is the fourth most abundant mineral in your body. Researchers have detected more than 3,750 magnesium-binding sites on human proteins[1] giving an indication of its wide-ranging health effects. More than 300 different enzymes also rely on magnesium for proper function.

A common estimate is that 50 to 80 percent of Americans are deficient in magnesium, and the health consequences are significant. Magnesium plays an important role in your body's biochemical processes, many of which are crucial for proper metabolic function. This includes but is not limited to:

- Creation of adenosine triphosphate (ATP), the energy currency of your body[2,3]
- Relaxation of blood vessels
- Muscle and nerve function, including the action of your heart muscle
- Proper formation of bones and teeth
- Regulation of blood sugar and insulin sensitivity, which is important for the prevention of type 2 diabetes.[4,5,6,7,8] For example, magnesium is essential for insulin release by pancreatic β-cells, and acts as a messenger for insulin action[9]

Magnesium and Heart Health

If you're lacking in cellular magnesium, it can lead to the deterioration of your cellular metabolic function and mitochondrial function, which in turn can lead to more serious health problems. The scientific evidence suggests magnesium is particularly important for your heart health.

Moreover, it's very important to have a proper balance between magnesium and calcium, but few people get enough magnesium in their diet these days, while calcium tends to be overused and taken in high quantities.

Insufficient magnesium tends to trigger muscle spasms, and this has consequences for your heart in particular. This is especially true if you also have excessive calcium, as calcium causes muscle contractions.

Magnesium also functions as an electrolyte, which is crucial for all electrical activity in your body.[10] Without electrolytes such as magnesium, potassium and sodium, electrical signals cannot be sent or received, and without these signals, your heart cannot pump blood and your brain cannot function properly.

As explained by Dr. Carolyn Dean, author of the seminal paper "Death by Medicine" in 2003 (identifying modern medicine as a leading cause of death in the U.S.) and the book, "The Magnesium Miracle," your heart has the highest magnesium requirement of any organ, specifically your left ventricle.

With insufficient amounts of magnesium, your heart simply cannot function properly. Hypertension (high blood pressure), cardiac arrhythmia,[11] cardiovascular disease (CVD) and sudden cardiac death are all potential effects of magnesium deficiency and/or a lopsided magnesium to calcium ratio.

Magnesium Associated With Lower Cardiovascular Disease Risk

According to a systematic review and meta-analysis[12] published in 2013, "circulating and dietary magnesium are inversely associated with CVD risk." This means the lower your magnesium intake (and the lower the circulating magnesium in your body), the higher your risk for CVD.

- Each 0.2 millimole per liter (mmol/L) of circulating magnesium was associated with a 30 percent lower risk of CVD
- A 200 milligram per day (mg/d) increase in dietary magnesium was associated with a 22 percent lower risk of fatal ischemic heart disease (IHD), but had no significant impact on CVD risk.

  The inverse association between dietary magnesium intake and IHD also leveled out above 250 mg/d

The authors noted their finding "supports the need for clinical trials to evaluate the potential role of magnesium in the prevention of CVD and IHD." The Weston A. Price Foundation has also noted that:[13]

> *"[M]agnesium shines brightest in cardiovascular health. It alone can fulfill the role of many common cardiac medications: magnesium inhibits blood clots (like aspirin), thins the blood (like Coumadin), blocks calcium uptake (like calcium channel-blocking drugs such as Procardia) and relaxes blood vessels (like ACE inhibitors such as Vasotec)"*

Magnesium May Be Key for Blood Pressure Control

Recent research[14,15] also suggests magnesium may be a key component of blood pressure management. Addressing your high blood pressure is important, as it is a risk factor for both heart disease and stroke. As mentioned, magnesium helps relax and dilate your blood vessels, thereby reducing your blood pressure.

In this review, data from 34 clinical trials involving more than 2,000 participants was evaluated. The studies used dosages of magnesium supplements ranging from 240 mg/d to 960 mg/d.

Although the association was mild, they did find that higher magnesium intake was associated with "healthy reductions" in blood pressure. Key findings include:

- A daily dose of 368 mg of magnesium, taken for three months, lowered systolic blood pressure (the upper number in the blood pressure reading) by 2 millimeters of mercury (mm/Hg) and diastolic blood pressure (the lower number) by 1.78 mm/Hg
- Those who took 300 mg of magnesium per day were able to elevate their circulating magnesium levels and lower their blood pressure in as little as four weeks
- Higher magnesium intake was associated with improved blood flow

- Benefits of magnesium appeared to be restricted to those who had insufficiency or deficiency in magnesium to begin with, meaning those whose blood pressure might have been caused by lack of magnesium.

  According to lead author Dr. Yiqing Song, "Such suggestive evidence indicates that maintenance of optimal magnesium status in the human body may help prevent or treat hypertension."[16]

To Optimize Your Magnesium, Eat Magnesium-Rich Foods

According to the authors, 368 mg of magnesium can be obtained from a healthy diet, so you do not necessarily need to take a supplement. Dr. Suzanne Steinbaum, a New York City cardiologist, told Medicinenet.com:[17]

> "*As clinicians, we need to stress the importance of a well-balanced meal, not only for all the cholesterol lowering and sugar-modulating benefits, but for ensuring an adequate amount of magnesium in the blood,*" adding that "*checking magnesium levels as part of a screening for heart health may become an essential part of prevention and for treatment of blood pressure.*"

Indeed, a useful way to maintain healthy magnesium levels is to make sure you eat plenty of dark-green leafy vegetables. Juicing your greens is an excellent way to increase your magnesium, along with many other important plant-based nutrients.

That said, if the mineral is lacking in the soil, it's also going to be low in the food, and mineral depleted soils are commonplace these days unless the farmer is using regenerative methods. If you eat organic whole foods and show no signs of deficiency, you're probably getting sufficient amounts from your food.

If you eat well but still exhibit deficiency signs (discussed below), you may want to consider taking a supplement as well. When it comes to leafy greens, those highest in magnesium include:

Spinach
Swiss chard
Turnip greens
Beet greens
Collard greens
Broccoli
Brussels sprouts
Kale
Bok Choy
Romaine lettuce

Other foods that are particularly rich in magnesium include:[18,19,20,21]

Raw cacao nibs and/or unsweetened cocoa powder

One ounce or 28 grams (g) or raw cacao nibs contain about 64 mg of magnesium, plus many other valuable antioxidants, iron and prebiotic fiber that help feed healthy bacteria in your gut.

Avocados

One medium avocado contains about 58 mg of magnesium, plus healthy fats and fiber and other vitamins. They're also a good source of potassium, which helps offset the hypertensive effects of sodium.

Seeds and nuts

Pumpkin seeds, sesame seeds and sunflower seeds score among the highest, with one-quarter cup providing an estimated 48 percent, 32 percent and 28 percent of the recommended dietary allowance (RDA) of magnesium respectively. Cashews, almonds and Brazil nuts are also good sources; 1 ounce (28 g) of cashews contains 82 mg of magnesium, which equates to about 20 percent of the RDA.

Fatty fish

Interestingly, fatty fish such as wild caught Alaskan salmon and mackerel are also high in magnesium. A half fillet or 178 g (about 6.3 ounces) of salmon can provide about 53 mg of magnesium, equal to about 13 percent of the RDA.

Squash

One cup of winter squash provides close to 27 g of magnesium; about 7 percent of your RDA.

Herbs and spices

Herbs and spices pack lots of nutrients in small packages, and this includes magnesium. Some of the most magnesium-rich varieties are coriander, chives, cumin seed, parsley, mustard seeds, fennel, basil and cloves.

Fruits and berries

Ranking high for magnesium are papaya, raspberries, tomato, cantaloupe, strawberries and watermelon. For example, one medium sized papaya can provide nearly 58 g of magnesium.

Magnesium Level Inversely Associated With Arterial Calcification

In related news, your blood level of magnesium has also been shown to be inversely associated with coronary artery calcification (CAC).[22] Previous studies have noted this association among patients with chronic kidney disease, but this study found the same correlation exists among general, otherwise healthy populations.

Among people who did not have any signs of symptomatic cardiovascular disease, and compared to those with the lowest serum levels, those who had the highest serum level of magnesium had a:

- 48 percent lower risk of high blood pressure
- 69 percent lower risk of type 2 diabetes
- 42 percent lower risk of an elevated CAC score

A 0.17 milligram per deciliter (mg/dL) increase in serum magnesium was associated with a 16 percent reduction in CAC score. The authors concluded that:

> "*[L]ow serum magnesium was independently associated to higher prevalence not only of hypertension and DM2 [diabetes mellitus 2], but also to coronary artery calcification, which is a marker of*

atherosclerosis and a predictor of cardiovascular morbidity and mortality."

Magnesium Intake Is Also Inversely Associated With Inflammation Marker

Research published in 2014 also found that higher magnesium intake is inversely associated with serum C-reactive protein (CRP) levels.[23] CRP is a marker for inflammation and rises when you have inflammation brewing in your body. Here, data collected from seven cross-sectional studies of more than 32,900 people showed that people who had higher magnesium intake had lower CRP levels. According to the authors:

"*This meta-analysis and systematic review indicates that dietary Mg [magnesium] intake is significantly and inversely associated with serum CRP levels. The potential beneficial effect of Mg intake on chronic diseases may be, at least in part, explained by inhibiting inflammation*."

Risk Factors, Signs and Symptoms of Magnesium Deficiency

A primary risk factor for magnesium deficiency is eating a processed food diet, and the reason for this is because magnesium resides at the center of the chlorophyll molecule. If you rarely eat leafy greens and other magnesium-rich whole foods (listed above), you may not get enough magnesium from your diet alone.

Magnesium is also lost through stress, sweating from heavy exertion, lack of sleep, alcohol consumption and use of certain prescription drugs (especially

diuretics, statins, fluoride and fluoride-containing drugs such as fluoroquinolone antibiotics), and tend to decline in the presence of elevated insulin levels.[24] These are all factors that affect a large majority of people in the Western world.

Unfortunately, unlike sodium or potassium, there is no easily available commercial lab test that will give you a truly accurate reading of your magnesium status. The reason for this is because the vast majority of the magnesium in your body is found in bones and soft tissues.

Only 1 percent of it shows up in your blood. That said, some specialty labs do provide an RBC magnesium test that can give you a reasonable estimate. Perhaps the best way to ascertain your status is to carefully evaluate and track your symptoms.

Early signs of magnesium deficiency include "Charlie horses" (the muscle spasm that occurs when you stretch your legs), headaches/migraines, loss of appetite, nausea and vomiting, fatigue or weakness. These are all warning signs indicating you probably need to boost your magnesium intake.

More chronic magnesium deficiency can lead to far more serious symptoms such as abnormal heart rhythms and coronary spasms, seizures, numbness and tingling, as well as changes in personality and behavior.

Dean's book, "The Magnesium Miracle," contains an extensive list of signs and symptoms, which can be helpful for evaluating your magnesium status. You can also follow the instructions in her blog post, "Gauging Magnesium Deficiency Symptoms,"[25] which will give you a check list to go through every few weeks. This will also help you gauge how much magnesium you need to resolve your deficiency symptoms.

Tips and Suggestions on Dosage

The RDA for magnesium[26] ranges from 310 to 420 mg per day, depending on your age and sex. However, as noted by Dean, some researchers believe as much as 600 to 900 mg/d may be required for optimal health. Fortunately, there's room for error. Magnesium is quite safe, so you don't have to worry about taking too much. That said, if you have renal failure, you'll want to avoid taking too much, as it could have adverse effects.

Dean suggests using your intestinal reaction as a marker for your ideal dose. Start out at 200 mg of oral magnesium citrate per day, and gradually increase your dose until you develop slightly loose stools. This is your personal cutoff point. When your body has too much magnesium it simply flushes it out the other end. Magnesium citrate is known for having a laxative effect, which is why it's recommended in this case.

When Supplementing, Balance Magnesium with Calcium, Vitamin K2 and D

One of the major benefits of getting your nutrients from a varied whole food diet is that you're less likely to end up with lopsided nutrient ratios. Foods in general contain all the cofactors and needed co-nutrients in the proper ratios for optimal health. Essentially, the wisdom of Mother Nature eliminates the guesswork. When you rely on supplements, you need to become savvier about how nutrients influence and interact with each other in order to avoid getting yourself into trouble.

For example, it's important to maintain the proper balance between magnesium, calcium, vitamin K2 and vitamin D. Unfortunately, we don't yet know the precise

ideal ratios between all of these nutrients, but some general guidelines and considerations include the following:

- Magnesium will help keep calcium in your cells so they can do their job better. The ideal ratio between magnesium and calcium is currently thought to be 1:1. Keep in mind that since you're likely getting far more calcium from your diet than you are magnesium, your need for supplemental magnesium may be two to three times greater than calcium.

  Vitamin K2 has two crucial functions, one is in cardiovascular health and the other is in bone restoration. By removing calcium from the lining of the blood vessels and shuttling it into your bone matrix, vitamin K2 helps prevent occlusions from atherosclerosis. Meanwhile, vitamin D helps optimize calcium absorption.

  Vitamins D and K2 also work together to produce and activate Matrix GLA Protein (MGP), which congregates around the elastic fibers of your arterial lining, thereby guarding your arteries against calcium crystal formation. Magnesium and vitamin K2 also complement each other, as magnesium helps lower blood pressure, which is an important component of heart disease.

- While the ideal or optimal ratios between vitamin D and vitamin K2 have yet to be determined, Dr. Kate Rheaume-Bleue (whom I've interviewed on this topic) suggests taking 100 micrograms (mcg) of K2 for every 1-2,000 international units (IUs) of vitamin D you take.

- As for how much vitamin D you need, I strongly recommend getting your vitamin D level tested twice a year (summer and winter) to help determine your personal dosage. Sensible sun exposure is the ideal way to optimize your levels, but if you opt for a supplement, your "ideal dosage" is one that

will put you into the therapeutic range of 40 to 60 nanograms per milliliter (ng/ml).