

# Magnesium — An Important Nutrient for Heart Health

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## STORY AT-A-GLANCE

- › Magnesium is the fourth most abundant mineral in your body and is involved in more than 600 different biochemical reactions. Research suggests even subclinical deficiency can jeopardize your heart health
- › A lack of magnesium will impede your cellular metabolic function and deteriorate mitochondrial function, and magnesium deficiency has been identified as the greatest predictor of heart disease
- › Magnesium is also important for chromosome folding, which allows cells to divide, multiply and regenerate to make up for lost or damaged cells
- › Check your RBC magnesium level and track signs and symptoms of magnesium insufficiency to determine how much magnesium you need. Low potassium and calcium are also common laboratory signs indicating magnesium deficiency
- › To optimize your magnesium level, eat magnesium-rich foods and/or take a magnesium supplement. Taking Epsom salt baths is another effective way to boost your magnesium level

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Magnesium deficiency is extremely common, and recent research shows even subclinical deficiency can jeopardize your heart health. Magnesium is also important for brain health, detoxification, cellular health and function, and the optimization of your mitochondria. In short, magnesium has enormous potential to influence your health and

general well-being, especially the prevention of heart disease and cancer, but also for general energy and athletic performance.

## Why You Need Magnesium

Magnesium is the fourth most abundant mineral in your body and is involved in more than 600 different biochemical reactions. For example, magnesium plays an important role in:

Creation of adenosine triphosphate (ATP), the energy currency of your body<sup>1,2</sup>

Metabolism of calcium, potassium, zinc, phosphorous, iron, sodium, hydrochloric acid, acetylcholine and nitric oxide, as well as 300 enzymes and the activation of thiamine.<sup>3</sup>

Magnesium is also required for DNA, RNA and protein synthesis and integrity,<sup>4</sup> and plays a role in the creation of chromosomes<sup>5</sup>

Mitochondrial function and health. Magnesium is required both for increasing the number of mitochondria in your cells and for increasing mitochondrial efficiency

Regulation of blood sugar and insulin sensitivity, which is important for the prevention of Type 2 diabetes<sup>6,7,8,9</sup> (In one study,<sup>10</sup> prediabetics with the highest magnesium intake reduced their risk for blood sugar and metabolic problems by 71%)

Relaxation of blood vessels and normalizing blood pressure

Detoxification, including the synthesis of glutathione, considered by many to be your body's most powerful antioxidant

Muscle and nerve function, including the action of your heart muscle	Antioxidant defense via a number of different mechanisms, including anti-inflammatory activity and support of endothelial and mitochondrial function <sup>11</sup>
Maintenance of ionic gradients — keeping intracellular sodium and calcium low and potassium high — and maintaining cellular and tissue integrity <sup>12</sup>	Catalyzing mood-regulating neurotransmitters like serotonin, which helps prevent anxiety and depression. It also provides mental and physical relaxation and is considered an important stress antidote <sup>13</sup>
Lowering the damage from electromagnetic fields (EMF) by blocking voltage gated calcium channels	<p>Supporting healthy brain function. Magnesium acts as a buffer between neuron synapses, particularly those involved with cognitive functions (learning and memory).</p> <p>Magnesium "sits" on the receptor without activating it, protecting the receptor from overactivation by other neurochemicals, especially glutamate, an excitotoxin that can harm your brain if it accumulates.</p> <p>Magnesium also helps prevent migraine headaches<sup>14</sup> by relaxing blood vessels in your brain and acting as a calcium channel blocker<sup>15</sup></p>

## Even Subclinical Magnesium Deficiency Can Hurt Your Heart

Since it's required for the healthy function of most cells in your body, a lack of magnesium can lead to significant health problems. Magnesium is particularly important for your heart health, helping you maintain normal blood pressure and protect against stroke.

According to a 2013 scientific review,<sup>16</sup> which included studies dating as far back as 1937, low magnesium may in fact be the greatest predictor of heart disease — not cholesterol or **saturated fat** intake. At the time, lead author Andrea Rosanoff, Ph.D., told journalists:<sup>17</sup>

*"These numerous studies have found low magnesium to be associated with all known cardiovascular risk factors, such as cholesterol and high blood pressure, arterial plaque buildup (atherogenesis), hardening of the arteries and the calcification of soft tissues. This means we have been chasing our tails all of these years going after cholesterol and the high saturated-fat diet, when the true culprit was and still is low magnesium."*

As explained by British cardiologist Dr. Sanjay Gupta,<sup>18</sup> magnesium supports heart health via a number of different mechanisms. For starters, it combats inflammation, thereby helping prevent hardening of your arteries and high blood pressure. It also improves blood flow by relaxing your arteries, and helps prevent your blood from thickening, allowing it to flow more smoothly. All of these basic effects are important for optimal heart function.

A recent paper in the Open Heart journal warns that even subclinical deficiency can lead to cardiovascular problems. According to the authors:<sup>19</sup>

*"... 'Various studies have shown that at least 300 mg of magnesium must be supplemented to establish a significantly increased serum magnesium concentrations ...' In other words, most people need an additional 300 mg of magnesium per day in order to lower their risk of developing numerous chronic diseases."*

*So while the recommended ... recommended dietary allowance [RDA] for magnesium (between 300 and 420 mg /day for most people) may prevent frank magnesium deficiency, it is unlikely to provide optimal health and longevity, which should be the ultimate goal."*

## **Higher Magnesium Level = Lower Disease and Mortality Risk**

A 2016 meta-analysis<sup>20</sup> of 40 studies involving more than 1 million participants in nine countries also found that, compared to those with the lowest intakes, those with the highest magnesium intakes had:

- A 10% lower risk of coronary heart disease
- 12% lower risk of stroke
- 26% lower risk of Type 2 diabetes

Increasing magnesium intake by 100 mg per day lowered participants' risk for:

- Heart failure by 22%
- Stroke by 7%
- Diabetes by 19%
- All-cause mortality by 10%

## **Magnesium Is Necessary for Mitochondrial Health**

Mitochondria, tiny bacteria-derived organelles residing inside your cells, are the main energy producers in your body, as they're responsible for creating adenosine triphosphate (ATP). Mounting evidence suggests that most health problems can be traced back to mitochondrial dysfunction, so making sure you get the right nutrients and precursors your mitochondria need for optimal performance is extremely important for health, disease prevention and physical performance.

As explained by Rhonda Patrick, Ph.D., in the video above, magnesium plays an important role. Without it, other strategies aimed at improving mitochondrial health simply won't work properly.

As just one example, athletic performance is in part dependent on your oxidative capacity (the ability of your muscle cells to consume oxygen), and your oxidative capacity relies on your mitochondria's ability to produce ATP by consuming oxygen inside the cell. You can increase your oxidative capacity in two ways, and both require magnesium:

1. Increasing the total number of mitochondria in your cells by engaging in exercise. However, in order for new mitochondria to be created, you must have sufficient amounts of magnesium.
2. Increasing the efficiency of your mitochondria to repair damage and produce ATP. This process also requires magnesium as a co-factor.

## **Magnesium Is Also Essential for Cell Division**

Recent research<sup>21</sup> also shows that magnesium is critical for chromosome folding, which allows cells to divide, multiply and regenerate to make up for lost or damaged cells. According to the authors, "The findings provide a new mechanism for chromosome organization."

Using a newly developed type of ion detector called magnesium ratiometric indicator for optical imaging (MARIO), Japanese researchers were able to demonstrate how changes in the concentration of free magnesium ions inside cells affects the folding of chromosomes. In summary, the researchers found that:

- Chromosomes, which have a negative charge, are neutralized by free magnesium, which is what allows the chromosomes to condense during cell division.
- Free magnesium ions dramatically increase during cell division, peaking "during the transition from metaphase to anaphase, which marks the period in cell division that the cell membrane begins showing signs of breaking into two cells."

- There's a "clear relationship" between the ATP level in the cell and the number of free magnesium ions. The less ATP present, the greater the free magnesium level and the more chromosome condensation occurs, allowing for more efficient cell division. The authors' hypothesis is that "ATP-bound magnesium is released by the hydrolysis of ATP." (Hydrolysis refers to the chemical reaction during which energy stored in ATP is released).

## Most People Are Magnesium-Deficient

Magnesium resides at the center of the chlorophyll molecule, so if you rarely eat fresh leafy greens, you're probably not getting much magnesium from your diet. Furthermore, while eating organic whole foods will help optimize your magnesium intake, it's still not a surefire way to ward off magnesium deficiency, as most soils have become severely depleted of nutrients, including magnesium.

Magnesium absorption is also dependent on having sufficient amounts of selenium, parathyroid hormone, and vitamins B6 and D, and is hindered by excess ethanol, salt, coffee and phosphoric acid in soda. Sweating, stress, lack of sleep, excessive menstruation, certain drugs (especially diuretics and proton-pump inhibitors) also deplete your body of magnesium.<sup>22</sup>

For these reasons, many experts recommend taking supplemental magnesium. Taking a magnesium supplement is particularly advisable if you:<sup>23</sup>

Experience symptoms of insufficiency or deficiency <sup>24</sup>	Have hypertension
Engage in strenuous exercise on a regular basis.  Research shows just six to 12 weeks of strenuous physical activity can result in magnesium deficiency, <sup>25</sup> likely due to	Are taking diuretics or medication for hypertension, especially thiazides, which have been shown to induce undetectable magnesium deficiency <sup>26</sup> (while patients may have normal or even high serum

increased magnesium demand in your skeletal muscle	magnesium, their bodies are actually depleted of magnesium)
Have had or are planning heart transplant or open heart surgery	Are at risk for or have had a heart attack, or if you experience ventricular arrhythmia
Are insulin resistant or diabetic (as this increases magnesium depletion)	Have congestive heart failure

## How to Boost Your Magnesium Level

The RDA for magnesium is around 310 to 420 mg per day depending on your age and sex,<sup>27</sup> but many experts believe you may need 600 to 900 mg per day, which is more in line with the magnesium uptake during the Paleolithic period.<sup>28</sup>

Personally, I believe many may benefit from amounts as high as 1 to 2 grams (1,000 to 2,000 mg) of elemental magnesium per day, as most of us have EMF exposures that simply cannot be mitigated, and the extra magnesium should help lower the damage from that exposure.

Elemental refers to how much pure magnesium is in each mg or what percent is actual magnesium which changes the actual dose as they are all different. You need far more of some than others as they have lower percentage of magnesium. Generally most supplements provide about **10 to 15% of the total dose as elemental magnesium** after you factor in absorption.

One of the best forms is magnesium threonate, as it appears to be the most efficient at penetrating cell membranes, including your mitochondria and blood-brain barrier.

Another effective way to boost your magnesium level is to take Epsom salt (magnesium sulfate) baths, as the magnesium will effectively absorb through your skin. I seek to use about two ounces a week. I am also fond of magnesium malate as malic acid is a Krebs cycle intermediate useful for ATP production.



I prepare a supersaturated solution of Epsom salts by dissolving 7 tablespoons of the salt into 6 ounces of water and heating it until all the salt has dissolved. I pour it into a dropper bottle and then apply it to my skin and rub fresh aloe leaves over it to dissolve it. This is an easy and inexpensive way to increase your magnesium and will allow you to get higher dosages into your body without having to deal with its laxative effects.

If you agree with the higher doses of magnesium, it is best to take it in evenly divided doses throughout the day to prevent loose stools. It can be taken with or without food. If you're also taking calcium, take them together. If you exercise regularly, consider taking your calcium and magnesium in a ratio of one part calcium to two parts magnesium with your pre-workout meal.<sup>29</sup>

While the ideal ratio of magnesium to calcium is thought to be 1-to-1, most people get far more calcium than magnesium from their diet; hence, your need for supplemental magnesium may be two to three times greater than calcium.

## Signs and Symptoms of Magnesium Deficiency

To measure your magnesium level and gauge how much magnesium you might need, get an RBC magnesium test (which measures the amount of magnesium in your red blood cells) and track your signs and symptoms of magnesium deficiency (see below). Also keep an eye on your potassium and calcium levels, as low potassium and calcium are common laboratory signs of magnesium deficiency.<sup>30</sup>

Common signs and symptoms of magnesium insufficiency include the following.<sup>31,32</sup> For a more exhaustive list of signs and symptoms, see Dr. Carolyn Dean's post, "Gauging Magnesium Deficiency Symptoms."<sup>33</sup> If you regularly experience any of these, chances are you need more magnesium.

Seizures; muscle spasms, especially "charley horses" or spasms in your calf muscle that happen when you stretch your leg and/or eye twitches

The Trousseau sign.<sup>34</sup> To check for this sign, a blood pressure cuff is inflated around your arm. The pressure should be

greater than your systolic blood pressure and maintained for three minutes.

By occluding the brachial artery in your arm, spasms in your hand and forearm muscles are induced.

If you are magnesium-deficient, the lack of blood flow will cause your wrist and metacarpophalangeal joint to flex and your fingers to adduct.

For a picture of this hand/wrist position, see [registerednurses.com](http://registerednurses.com)<sup>35</sup>

Numbness or tingling in your extremities	Low potassium and calcium levels
Insulin resistance	Increased number of headaches and/or migraines
High blood pressure, heart arrhythmias and/or coronary spasms	Low energy, fatigue and/or loss of appetite

## Protect Your Health by Optimizing Your Magnesium Intake

While you may still need magnesium supplementation, it would certainly be wise to try to get as much magnesium from your diet as possible. Organic unprocessed foods would be your best bet, but if they're grown in magnesium-depleted soil, even organics could be low in this vital mineral. Dark green leafy vegetables lead the pack when it comes to magnesium content, and juicing your greens is an excellent way to boost your intake.

Other foods that are particularly rich in magnesium include the following.<sup>36</sup> Including more magnesium-rich foods in your diet along with magnesium supplementation, if needed, can go a long way toward optimizing your health and preventing chronic disease, and is an extremely cost-effective way to lower your risk of heart disease.

- **Raw cacao nibs and/or unsweetened cocoa powder** — One ounce (28.35 grams) or raw cacao nibs contains about 65 mg of magnesium.
- **Avocados** — One cup of avocado on average (values differ depending on whether they come from California or Florida) contains about 44 mg of magnesium. Avocados are 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 191 mg, 129 mg and 41 mg of magnesium respectively. Cashews, almonds and Brazil nuts are also good sources; one-fourth cup of cashews contains 89 mg of magnesium.
- **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.
- **Organic, raw grass fed yogurt and natto** — Yogurt made from raw organic grass fed milk with no added sugars; 1 cup of natto yields 201 mg of magnesium.

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