

Magnesium's Role in the 12 Hallmarks of Aging

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STORY AT-A-GLANCE

- › Magnesium deficiency is common, affecting over 50% of the population. It plays crucial roles in over 300 enzymatic reactions and is linked to an increased risk of chronic diseases
- › A 2024 study explored magnesium's effects on the 12 hallmarks of aging, including genomic instability, telomere attrition and mitochondrial dysfunction. Magnesium deficiency negatively impacts these aging processes
- › Magnesium deficiency, which is often caused by chronic diseases or malabsorption conditions, can lead to various symptoms like muscle cramps, lethargy, depression and heart arrhythmia
- › Adequate magnesium intake may help improve sleep quality, which is crucial for overall health and reducing cortisol levels. Poor sleep accelerates aging and increases health risks
- › To increase your magnesium intake, consume magnesium-rich foods like leafy greens. Supplements and Epsom salt baths are also recommended methods to boost magnesium levels

Magnesium may be one of the most undervalued minerals when it comes to optimizing your health. According to the Linus Pauling Institute in Oregon State University, surveys indicate that 52.2% of the population do not get enough magnesium.¹ This information is concerning since magnesium is the fourth most abundant mineral in the body, playing a role in more than 300 enzymatic reactions.²

According to Harvard T.H. Chan School of Public Health, magnesium is essential to numerous body processes, such as building proteins and strong bones. It also plays a role in regulating your blood sugar and blood pressure levels, as well as muscle and nerve functions.³

Being deficient in magnesium has also been linked to an increased risk of chronic degenerative diseases, including diabetes and cancer.⁴ Now, research suggests that magnesium deficiency influences at least a dozen aging processes as well.

Are You Getting Enough Magnesium?

In a 2024 study published in *Nutrients*,⁵ researchers dove deep into the effects of magnesium on the aging process, as well as its impact on age-related diseases. This is an important undertaking, as they noted that magnesium deficiency becomes more common as you age. According to the study, here are the most common signs of magnesium deficiency:⁶

Muscle cramps/spasms	Lethargy	Vertigo
Depression	Convulsions	Hypertension
Osteoporosis	Migraine	Asthma
Chronic fatigue	Heart arrhythmia	

Magnesium deficiency can occur due to a variety of factors. Prominent examples include chronic diseases such as diabetes, hypertension and chronic diarrhea. Malabsorption diseases like celiac disease, cystic fibrosis and pancreatitis can also contribute to deficiency.⁷

The Effects of Magnesium on the 12 Hallmarks of Aging

The featured Nutrients study builds upon the nine hallmarks of aging proposed back in 2013 by Lopez-Otin et al.⁸ Since its publication, new research has come out, and this study adds three new aging hallmarks linked to magnesium. The list below presents a summary of the current research:⁹

- 1. Genomic instability** – This refers to an increased risk of genetic problems, such as mutations and DNA damage. As your genes become unstable, the aging process accelerates, and essential functions, such as cell-to-cell communication, fall by the wayside.

In the context of magnesium, your DNA has both minor and major binding sites for it. Magnesium also contributes to chromatin (mixture of DNA and proteins¹⁰) stability and is involved in the secondary and tertiary structure of DNA.

"Thus, maintaining intracellular magnesium at a physiological level is an important determinant of DNA stability," the researchers say.

- 2. Telomere attrition** – Telomeres are protein structures located at both ends of a chromosome, which provide structural integrity to a cell during replication.¹¹ As cells continue to replicate, they become shorter and will shut down after reaching a limit, helping prevent cancer.

Magnesium plays a role in telomerase regulation, as well as telomeric chromatin structure and integrity. In fact, over 50% of telomere are reliant on magnesium, according to the researchers.

- 3. Epigenetic alterations** – Epigenetics is the process of modifying genome expression without changing your DNA sequence that modulates cellular and tissue functions. As you age, inhibitory molecules from injured and stressed cells can cause epigenetic alterations, leading to possible changes in cellular function.

According to the researchers, magnesium can avert this by helping regulate genes related to inflammatory pathways. Furthermore, magnesium deficiency can upregulate the p53 gene and sphingomyelinase in your cardiomyocytes, which is

linked to "genomic changes during aging and is associated with the genesis of cardiovascular disease."

- 4. Mitochondrial dysfunction** — As noted in my article "[What You Need to Know About Your Mitochondria](#)," your mitochondria are responsible for producing the energy your body needs. However, as the featured study points out, they also produce waste in the form of free radicals.

When the free radicals exceed your body's cellular antioxidant capacity, aging accelerates. Excess free radicals damage your mitochondria, causing DNA to mutate, thereby reducing your body's ability to produce energy.

According to the researchers, over a third of all cellular magnesium is found in mitochondria, and various cellular processes rely on this mineral to function. When magnesium mitochondrial homeostasis is disrupted, ATP (adenosine triphosphate) production becomes compromised and oxidative stress is intensified.

- 5. Loss of proteostasis** — Proteostasis, a combination of the words "protein" and "homeostasis," refers to your body's delicate balancing act of managing proteins¹² through proper production, folding, transportation and degradation in cells.¹³

According to the researchers, proteostasis dysregulation has been linked to several age-related chronic diseases, such as Alzheimer's and Parkinson's disease, as well as cardiovascular disease.

Considering this, the researchers noted that low magnesium levels in the brain have been linked to Alzheimer's, Parkinson's and epilepsy. Furthermore, they noted that magnesium downregulates the primary mechanisms of these conditions.

- 6. Deregulated nutrient sensing** — The researchers noted that patients diagnosed with insulin sensitivity, Type 2 diabetes and glucose tolerance impairment were also deficient in magnesium. Conversely, higher magnesium intake was associated with better insulin sensitivity and a lower risk of Type 2 diabetes.

In addition, the researchers pointed out that low intracellular magnesium levels disrupt insulin signaling, which can lead to insulin resistance that can ultimately result in metabolic syndrome and/or Type 2 diabetes.

- 7. Cellular senescence** – Senescence, or the process of deterioration while aging, causes cellular alterations, especially in the context of magnesium deficiency. The researchers noted that it can lead to reduced protection against oxidative stress, culture growth and cell cycle progression.

The researchers also noted that cell replication capacity was reduced. On the other hand, higher magnesium intake was correlated to better mitochondrial function and enhanced lifespan.

- 8. Stem cell exhaustion** – Stem cells are special cells that develop into different types, such as muscle or brain cells.¹⁴ However, their function is reduced when certain factors exacerbate the aging process, possibly reducing immune system function.

However, magnesium may be able to turn things around. The researchers noted that magnesium is a cofactor for immunoglobulins synthesis and immune cell adherence, as well as reducing the expression of proinflammatory molecules.

- 9. Altered intercellular communication** – Proper intercellular communication is important for optimal cell functioning throughout the whole body. In this case, magnesium is a key modulator of various intracellular signaling pathways, such as the NMDA (N-methyl-D-aspartate) receptor, which is linked to memory, neuroplasticity and circadian clock rhythm.

When the NMDA becomes excitable, neurodegeneration occurs.¹⁵ However, increasing magnesium blocks its excessive activation.

- 10. Compromised autophagy** – Autophagy is your body's way of eliminating damaged cells by consuming them. When activated properly, it can even promote neuronal survival by removing unnecessary proteins, as noted by a 2021 study.¹⁶

According to the Nutrients researchers, magnesium is crucial for important cellular processes, which includes apoptosis. For context, apoptosis, which is programmed cell death, is regulated by the autophagy signaling pathway.¹⁷

11. Gut dysbiosis – According to the researchers, the gut microbiome tends to change around mid- to late adulthood. Notably, they observed that healthy participants over the age of 80 had a unique, diverse gut probiotic profile, which was associated with better survival compared to participants with low gut microbiome uniqueness.

Where does magnesium fit in this picture? Based on their findings, they surmise that the gut acts as an intermediary for the mineral.

In one cited animal study,¹⁸ increased levels of the Bacteroides strain and other probiotics were linked to increased production of short-chain fatty acids. Other research cited in the featured study noted that magnesium deficiency had a negative impact on gut microbiota, which resulted in poorer mental function.^{19,20,21}

12. Inflammation – Aging is typically correlated with higher inflammatory markers, such as C-reactive protein (CRP). In the featured study, low magnesium levels caused altered calcium homeostasis and increased reactive oxygen species production, which raised inflammatory markers.

They also cited a meta-analysis²² that reviewed 17 studies, noting that "magnesium supplementation significantly reduced different human inflammatory markers, specifically nitric oxide and CRP concentrations."

How Magnesium Can Boost Sleep Quality to Fight Aging

Are you feeling tired most of the time? If that's the case, you may want to review your sleeping habits and check if you're getting enough sleep. According to the National Council on Aging, around 35.5% of Americans adults get fewer than seven hours of sleep, which is below the recommended amount by the American Academy of Sleep Medicine and the Sleep Research Society.²³

Poor sleep habits can have numerous health ramifications that impact aging in one way or another. For example, a study²⁴ noted that sleep deprivation raises cortisol, a known stress hormone. Having elevated cortisol levels can accelerate aging, as noted in my previous article "[Key Strategies to Reduce Your Cortisol Levels](#)." Conversely, getting sufficient, high-quality sleep can help inhibit cortisol secretion to normal levels.²⁵

It's clear that getting enough high-quality sleep is paramount to keeping cortisol levels down. Moreover, it's just a good practice to adopt, as sleep plays a role in promoting overall health. As noted in a 2021 study published in the *Journal of Clinical Sleep Medicine*:²⁶

"Sleep is vital for health and well-being in children, adolescents, and adults. Healthy sleep is important for cognitive functioning, mood, mental health, and cardiovascular, cerebrovascular, and metabolic health. Adequate quantity and quality of sleep also play a role in reducing the risk of accidents and injuries caused by sleepiness and fatigue, including workplace accidents and motor vehicle crashes."

Here's where magnesium comes in. According to the Sleep Foundation, magnesium may help improve sleep quality by increasing sleep times while simultaneously lessening waketime tiredness.²⁷ While experts haven't pinpointed the exact reason how magnesium influences sleep, a study published in *BMC Complementary Medicine and Therapies* supports this hypothesis, noting that magnesium supplementation may help increase total sleep time.²⁸

Dietary Recommendations for Increasing Your Magnesium Intake

Now that you're aware of the importance of magnesium for overall health, how do you boost your intake? The most logical answer is modifying your diet. According to the researchers, you can boost your magnesium levels by getting enough green leafy veggies. This is a sensible approach, as these veggies also provide other important nutrients that can contribute to better health.

The RDA (recommended dietary allowances) for magnesium is around 320 to 420 milligrams (mg) per day for women and men, respectively.²⁹ According to James DiNicolantonio, Pharm.D., you may need 600 mg per day, which is more in line with the intake of our ancient ancestors during the Paleolithic period.³⁰

However, even that amount may still be insufficient. I believe most people may benefit from amounts as high as 1,000 to 2,000 mg of elemental magnesium per day, as most of us are exposed to electromagnetic fields (EMFs), and the extra magnesium may help lower the damage from this invisible toxin.

In [my interview with Martin Pall, Ph.D.](#), he explains that EMFs activate the voltage-gated calcium channels (VGCCs) located inside your cells. When these gates open, calcium ions flow inward to the cell, causing the hallmark damages related to EMFs.

To protect yourself, one natural solution is to increase your magnesium intake. "It is clear that when we're deficient in magnesium, you get excessive activity of the VGCCs. It's important to allay that deficiency," he says. That said, here are some magnesium-rich foods you can add more of to your diet:

Spinach	Collard greens	Swiss chard
Turnip greens	Beet greens	Broccoli
Brussels sprouts	Kale	Bok choy
Romaine lettuce	Raw cacao	Organic, raw grass fed yogurt
Squash	Fruits and berries	Natto

Herbs and spices also contain high amounts of magnesium and other nutrients. Some of the best options include chives, coriander, cumin, parsley, fennel, basil and cloves.

Other Strategies to Boost Your Magnesium Intake

In addition to a healthy diet, consider taking a magnesium supplement to meet my recommended intake. I recommend magnesium threonate, as I believe it's the most efficient at penetrating your cell membranes, including your mitochondria and blood-brain barrier.

I am also fond of magnesium malate, as malic acid is a Krebs cycle intermediate useful for ATP production. The interesting thing about magnesium is that it can also be absorbed through your skin, so taking an Epsom salt (magnesium sulfate) bath is another effective method.

You can also make a supersaturated solution of Epsom salts by dissolving 7 tablespoons of Epsom salt into 6 ounces of water. Heat it until all the salt dissolves. This is the strategy I use. I pour the solution onto my skin using a dropper bottle, then apply fresh aloe leaves to melt it. This is an easy way to increase your magnesium in higher doses without having to deal with its laxative effects, since it doesn't pass through your digestive system.

When taking magnesium as a supplement, space out the doses throughout the day, with or without food. Taking it in one big dose can cause loose stools. If you're taking a calcium supplement, take them together, too. According to published research,³¹ magnesium ions are a physiological antagonist of calcium ions, and even small changes in your magnesium levels can disturb calcium ion signaling.

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.

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