

# Low Magnesium Linked to Increased DNA Damage in Healthy Adults

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*Low magnesium levels, especially when combined with high homocysteine, significantly increase DNA damage in healthy adults, accelerating cellular aging and increasing the risk of chronic degenerative diseases*

*Magnesium plays a crucial role in DNA replication, repair and stability. It acts as a cofactor for enzymes involved in these processes and helps maintain the double helix structure*

*Magnesium is essential for brain health, regulating NMDA receptors, modulating immune responses and acting as an antioxidant. It also supports synaptic plasticity, learning and memory functions*

*Adequate magnesium levels are vital for blood sugar control, insulin sensitivity and cellular energy production. Magnesium deficiency leads to insulin resistance and metabolic disorders like Type 2 diabetes*

*To optimize magnesium levels, consider supplements like magnesium threonate, consume magnesium-rich foods and try alternative methods such as Epsom salt baths or topical application for better absorption*

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There's a critical link between magnesium levels and the integrity of your DNA, according to research published in the European Journal of Nutrition.<sup>1</sup> The study, conducted on healthy middle-aged Australians, revealed that low magnesium levels, especially when combined with high homocysteine, significantly increase DNA damage.

This finding underscores the vital role magnesium plays in maintaining your genetic health and staving off age-related diseases. As the fourth most abundant mineral in your body, magnesium is involved in over 600 enzymatic reactions, including those crucial for DNA replication and repair.

Ensuring adequate magnesium intake could be a key factor in protecting your genetic material and promoting healthy aging. In fact, by examining various biomarkers of DNA damage, researchers have shed light on how magnesium deficiency might accelerate cellular aging and increase your risk of developing chronic degenerative diseases.

## **The Hidden Dangers of Magnesium Deficiency**

While magnesium's importance for bone health and nerve function is well-known, its role in safeguarding your DNA is less recognized. The study found that participants with lower magnesium levels exhibited higher frequencies of micronuclei (MN) and nucleoplasmic bridges (NPBs) in their cells.<sup>2</sup> These are telltale signs of DNA damage and chromosomal instability.

Essentially, when your body lacks sufficient magnesium, it struggles to efficiently replicate and repair DNA, leaving your genetic material vulnerable to damage. This vulnerability manifests as increased oxidative stress and a higher likelihood of DNA strand breaks. Over time, these effects accumulate, leading to premature aging of your tissues and organs.

The research suggests that chronic magnesium deficiency might create a state of persistent oxidative stress in your body, similar to the effects seen with deficiencies in other crucial micronutrients like zinc.<sup>3</sup>

## **The Homocysteine Connection: A Double-Edged Sword**

The study didn't just focus on magnesium; it also examined the interplay between magnesium levels and homocysteine, an amino acid linked to various health issues when present in high concentrations. Researchers discovered a significant negative correlation between magnesium and homocysteine levels. In other words, as magnesium levels decreased, homocysteine levels tended to increase.<sup>4</sup>

This relationship is noteworthy because elevated homocysteine is associated with an increased risk of neurodegenerative diseases, cardiovascular problems and pregnancy complications. Participants with both low magnesium and high homocysteine levels showed the highest frequency of DNA damage markers.

This synergistic effect suggests that the combination of magnesium deficiency and elevated homocysteine could be particularly detrimental to your genetic health, accelerating the aging process and increasing your susceptibility to age-related diseases.<sup>5</sup>

## **Unraveling the Mechanisms of Magnesium's Protective Effects**

To understand why magnesium is so crucial for your DNA's integrity, it's important to look at its role in various cellular processes. Magnesium acts as a cofactor for enzymes involved in DNA replication and repair, such as DNA polymerase and DNA ligases. When magnesium levels are low, these enzymes can't function optimally, leading to errors in DNA replication and inefficient repair of damaged DNA.<sup>6</sup>

Additionally, magnesium plays a role in maintaining the stability of DNA and RNA structures. It helps neutralize the negative charges on DNA phosphate groups, contributing to the overall stability of the double helix structure.

The study also hints at magnesium's involvement in epigenetic regulation and protein modification processes that are crucial for maintaining genomic integrity.<sup>7</sup> By ensuring adequate magnesium levels, you're providing your cells with the tools they need to protect

and maintain your genetic material effectively.

## **Magnesium's Role in Protecting Your Brain's Delicate Balance**

Your brain's health depends on a delicate balance of various processes, and magnesium plays a key role in maintaining this equilibrium. Recent research reveals how magnesium acts as a gatekeeper for N-methyl-D-aspartate (NMDA) receptors, which are vital for learning and memory.<sup>8</sup> By regulating these receptors, magnesium helps prevent excessive glutamate activity, which leads to inflammation and neuronal damage.

Additionally, magnesium has been found to influence the production of substance P, a neuropeptide involved in pain perception and inflammatory responses. Low magnesium levels increase substance P, exacerbating neuroinflammation.<sup>9</sup> Furthermore, magnesium's interplay with calcium in your neurons is critical. By limiting calcium influx, magnesium helps prevent a cascade of events that could otherwise result in intensified inflammation and neuronal injury.

This balancing act extends to magnesium's role in modulating immune responses, particularly through its interaction with nuclear factor kappa-light-chain-enhancer of activated B cells (NF-κB), a key player in inflammatory processes. By inhibiting NF-κB activation, magnesium helps dampen the expression of proinflammatory genes, reducing overall brain inflammation.<sup>10</sup>

## **The Hidden Power of Magnesium as an Antioxidant**

While not typically classified as an antioxidant, emerging research suggests that magnesium plays a role in your body's defense against oxidative stress.<sup>11</sup> This is particularly important for your brain health, as oxidative stress is a significant contributor to cognitive decline and neurodegenerative diseases.

Studies have shown that magnesium deficiency is associated with increased markers of oxidative stress, including modified lipids, proteins and DNA. Importantly, magnesium appears to support your body's antioxidant defense mechanisms. One key way it does this is by stabilizing superoxide dismutase (SOD), a critical enzyme that converts harmful superoxide radicals into less reactive molecules.<sup>12</sup>

This stabilization of SOD provides a unique link between magnesium and your antioxidant defense system. Magnesium's involvement in various cellular processes, including mitochondrial function and fatty acid metabolism, further contributes to its role in managing oxidative stress.

By supporting these fundamental processes, magnesium helps maintain cellular health and resilience against oxidative damage. This antioxidant-like activity of magnesium adds another layer to its neuroprotective properties, helping to slow the progression of age-related cognitive decline and neurodegenerative disorders.<sup>13</sup>

## **Magnesium's Impact on Your Brain's Plasticity and Memory**

Recent discoveries have also unveiled magnesium's role in synaptic plasticity, your brain's

ability to form and reorganize connections between neurons.<sup>14</sup> This process is fundamental to learning, memory and cognitive flexibility.

Research has shown that presynaptic intracellular magnesium is instrumental in mediating the transition between two crucial synaptic configurations: one involved in encoding new information and learning, and another responsible for storing and recalling memories.<sup>15</sup> This insight highlights magnesium's importance not just in maintaining neural health but in actively shaping your cognitive processes.

Studies on animal models of Alzheimer's disease have demonstrated that magnesium supplementation enhances cognitive function and synaptic plasticity. Moreover, in a rat model of Alzheimer's, magnesium sulfate supplementation improved cognitive function, synaptic plasticity and even the morphology of dendritic spines — the tiny protrusions on neurons that receive input from other neurons.<sup>16</sup>

These findings suggest that maintaining optimal magnesium levels could be crucial for preserving cognitive function as you age.<sup>17</sup>

## **Magnesium for Blood Sugar Control and Cellular Energy Production**

Your body's intricate blood sugar control system also relies on magnesium. This essential nutrient is involved in the function of your pancreatic beta cells, which produce insulin to regulate blood glucose levels.<sup>18</sup> When you eat, these cells respond by releasing insulin to help your body store glucose as glycogen, primarily in your liver and muscle cells.

Magnesium is vital for this process, acting as a cofactor for enzymes involved in glucose metabolism and insulin signaling. If your magnesium levels are low, your beta cells may struggle to produce and release insulin effectively, leading to blood sugar imbalances. Furthermore, magnesium deficiency impairs the activity of glucokinase, an enzyme that acts as a glucose sensor in beta cells and controls the rate of glucose entry into these cells.<sup>19</sup>

Without adequate magnesium, your body's ability to sense and respond to changes in blood glucose levels may be compromised, setting the stage for metabolic disorders like Type 2 diabetes. Low magnesium levels also contribute to insulin resistance by altering the activity of the insulin receptor and its downstream signaling pathways. Conversely, insulin resistance leads to increased urinary magnesium loss, further depleting your body's magnesium stores.<sup>20</sup>

This creates a self-perpetuating cycle that's difficult to break. Studies have shown that individuals with Type 2 diabetes often have lower intracellular magnesium concentrations compared to those without diabetes.<sup>21</sup>

Beyond its effects on insulin and glucose metabolism, magnesium is essential for your cells' energy production processes. It acts as a cofactor for numerous enzymes involved in glycolysis and the Krebs cycle, two key pathways in [cellular energy generation](#). In the absence of sufficient magnesium, these enzymes may not function optimally, leading to reduced energy production and metabolic inefficiencies.<sup>22</sup>

It's important to remember that magnesium's benefits are far-reaching. Adequate magnesium intake helps maintain healthy blood pressure, support proper muscle and nerve function and promote strong bones.

There are also positive correlations between magnesium levels and other important nutrients like folate and vitamin B12, suggesting that magnesium status is an indicator of overall nutritional health.<sup>23</sup> By prioritizing your magnesium intake, you're not just protecting your DNA, brain or blood sugar; you're supporting your body's overall function and resilience.

## How to Optimize Your Magnesium Levels

More than half of Americans don't get enough magnesium daily,<sup>24</sup> and this deficiency is even more widespread in certain groups. Various health conditions and lifestyle choices increase magnesium loss from your body. For example, if you have diabetes or drink alcohol regularly, you're at higher risk of magnesium deficiency.

Your [magnesium levels](#) are also affected by lack of sleep and stress. Even short periods of stress might lower your magnesium. When it comes to supplements, I prefer magnesium threonate because it's particularly good at entering cells, including those in your brain and mitochondria.

However, if you're new to magnesium supplements, it's best to start slowly with magnesium citrate to find the right dose for you. This method, called "bowel tolerance," helps you determine how much magnesium your body needs. Like vitamin C, excessive oral magnesium results in loose stools, indicating that you've surpassed your optimal intake. This natural safeguard makes magnesium toxicity highly unlikely.

Start with 200 milligrams (mg) of magnesium citrate per day and gradually increase until you notice your stools becoming slightly loose. This indicates you've found your ideal dose. From there, try other types of magnesium if you want.

Take magnesium threonate with or without food. If you're also taking calcium supplements, it's good to take them together. Fitness enthusiasts might benefit from a pre-workout regimen that includes calcium and magnesium in a 1:2 ratio. While a 1:1 ratio of magnesium to calcium is often recommended, most diets are already high in calcium. So, you might need two to three times more magnesium than calcium in your supplements to balance things out.

Remember, blood tests aren't always reliable for checking your magnesium levels, especially in muscles and bones. Instead, tracking what you eat is a more practical way to make sure you're getting enough magnesium. Foods that are high in magnesium include:

- Raw milk and homemade yogurt
- White rice
- Potato
- Dried seaweed or agar
- Broccoli
- Bok choy
- Turnip greens
- Brussels sprouts

Aside from food and oral supplements, alternative methods to increase your magnesium levels include:

- **Epsom salt baths** — Soaking in magnesium sulfate-rich water enables transdermal (skin) absorption, circumventing your digestive system.
- **Topical application** — Create a concentrated Epsom salt solution using the following steps:
  - Heat 6 ounces of water and dissolve 7 tablespoons of Epsom salt
  - Once cooled, transfer to a dropper bottle
  - Apply directly to your skin
  - For enhanced absorption, follow with fresh aloe vera gel

As we continue to uncover the intricate ways in which nutrients interact with our genes and cellular processes, the importance of maintaining optimal magnesium levels becomes increasingly clear. To ensure healthy aging and disease prevention, prioritize getting an adequate intake of magnesium.

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#### **Notes**

1, 2, 3, 4, 5, 6, 7, 23 [European Journal of Nutrition June 12, 2024](#)

8, 9, 10, 11, 12, 13, 14, 15, 16, 17 [Front. Endocrinol., 25 September 2024 Sec. Cellular Endocrinology, Volume 15 – 2024](#)

18, 19, 20, 21, 22 [Front. Nutr., 25 September 2024 Sec. Nutritional Epidemiology, Volume 11 – 2024](#)

24 [Oregon State University, “Micronutrient Inadequacies in the US Population: An Overview” Micronutrient Deficiencies and Inadequacies](#)

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