



MAGNESIUM

HOW TO
SUPPLEMENT
WITH AND WHY
YOU SHOULD
DO IT



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Eat right. Exercise regularly. Recover well. Get sunlight. *Take your vitamins and minerals.*

There is no doubt that these are all incredibly important steps to a healthy life. But, ensuring you have adequate minerals in their ideal ratios, is arguably the foundation to health and longevity. These minerals are what drive all of the cellular processes in our bodies - from creating energy to move to sending nerve impulses between our limbs and our brains. Our bodies are electric beings. Our cells all have a voltage, and it is the quantity, location and interplay of these minerals that keeps our cells 'charged' in order to function optimally. A low voltage means a low functioning cell.

One of the minerals that is vitally important to us is magnesium. It is the fourth most abundant mineral in our bodies and the second most common deficiency we see in the world today - the first being vitamin D (read my guide on Vitamin D [here](#)). If you've been contemplating supplementing with magnesium but just don't know where to start, then this guide is for you.

Facts about magnesium

We tend to think of mineral deficiencies as having little impact on our health, but when we're talking about magnesium and the fact that it is essential for the function of over 354 enzymes in our body and there are over 3751 binding sites for magnesium proteins in our cells, we should re-evaluate its importance! In fact, some even argue that magnesium deficiency may be responsible for more diseases than any other mineral deficiency.

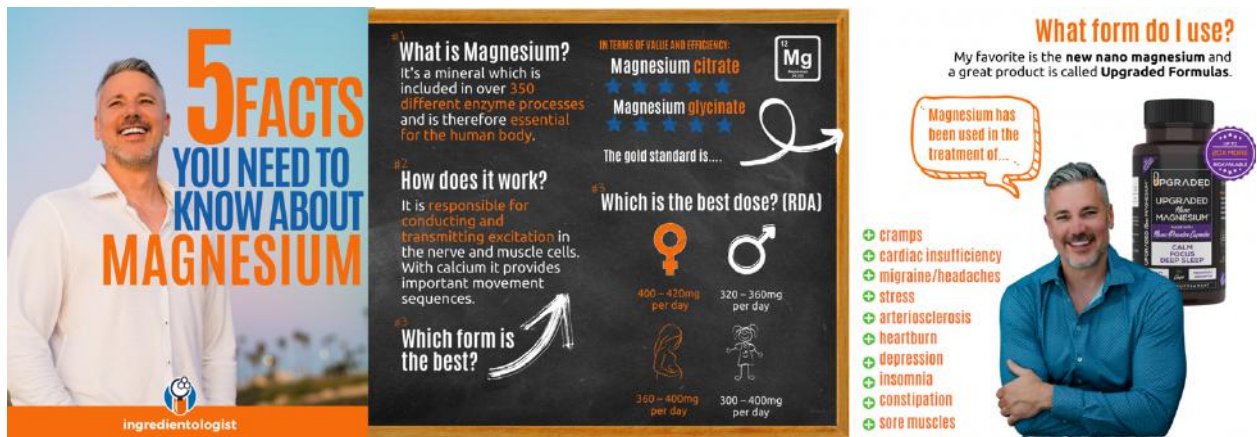
There are seven macrominerals - minerals that we do not make ourselves and need to obtain more than 100mg of them from our diet. We have about 20 to 28 grams of magnesium in our body. One percent of that is in our blood, 60% in our bones and teeth and the rest is in our muscles, heart, brain and other tissues.

Magnesium is found naturally in plants and some animal foods which they absorb from the soil. We absorb this mineral throughout our small intestine in a well-regulated and sensitive way, and our kidneys control how much is secreted and reabsorbed depending on our magnesium status.

But, magnesium is also the most depleted mineral in our soils. Factors that cause this depletion include:

- The use of pesticides and herbicides
- Potash fertilizer - potassium chloride/carbonate that replaces magnesium in soil
- Soil erosion and acid rain

All of these strip magnesium from the soil and result in plants that are weak and pale as magnesium is needed for chlorophyll and plant photosynthesis.



5 FACTS YOU NEED TO KNOW ABOUT MAGNESIUM

1. What is Magnesium?
It's a mineral which is included in over 350 different enzyme processes and is therefore essential for the human body.

2. How does it work?
It is responsible for conducting and transmitting excitation in the nerve and muscle cells. With calcium it provides important movement sequences.

3. Which form is the best?

IN TERMS OF VALUE AND EFFICIENCY:
Magnesium citrate (5 stars)
Magnesium glycinate (4 stars)
 The gold standard is... **Magnesium citrate**

4. Which is the best dose? (RDA)

♀	♂
400 – 420mg per day	320 – 360mg per day
♀	♂
360 – 400mg per day	300 – 400mg per day

5. What form do I use?
My favorite is the new nano magnesium and a great product is called **Upgraded Formulas**.

Magnesium has been used in the treatment of...

- tramps
- cardiac insufficiency
- migraine/headaches
- stress
- arteriosclerosis
- heartburn
- depression
- insomnia
- constipation
- sore muscles

What depletes magnesium in humans?

- **Food processing:** Modern processing methods like refining grains, heating and treating natural foods, and even boiling vegetables strips them of magnesium.
- **Fluoride & Chlorine:** Found in water and toothpaste, fluoride displaces magnesium in our cells, and stays there.
- **Stress:** High amounts of stress influences how we absorb magnesium by lowering our stomach acid.
- **Gut Sensitivities:** IBS or leaky gut cause poor absorption.
- **Anti-nutrients:** Some plants contain tannins (in tea), phytates and oxalates. These compounds all decrease the absorption of magnesium.
- **Highly processed, sugary foods:** These foods provide zero magnesium, but use it to be metabolized. They deplete vitamin B6 levels which is responsible for magnesium absorption.
- **Alcohol, some drugs & caffeine:** These can impact absorption and distribution of magnesium in our bodies.

- **Hypokalemia:** Low potassium levels influence the balance of magnesium.
- **High estrogen levels:** Estrogen has been shown to lower levels of magnesium.
- **Insulin resistance:** Being insulin sensitive is vital for our intestinal cells ability to absorb magnesium. High levels of insulin in the blood cause magnesium to be lost in the urine.
- **Coffee:** Although coffee provides a source of magnesium, it causes less magnesium to be absorbed, and more to be excreted by the body.
- **Low salt intake:** Low sodium in the blood causes both sodium and magnesium to be pulled from bone and placed into the blood. It also increases magnesium lost in sweat.
- **Low stomach acid:** This reduces the absorption of magnesium in the gut.

Looking at all of these factors that impact a healthy level of magnesium are because of the modern world we live in today. Many people are overly stressed, have a poor diet that is low in magnesium-rich foods and are either severely or moderately insulin resistant.

In fact, if we look at the calcium:magnesium ratio, back in the early 1900's it was 1:1 - the optimal ratio of magnesium to calcium. Today, we have a ratio of anywhere between 5:1 and 15:1, simply because of the modern environment we live in. This ratio is extremely important, with too little magnesium causing constipation, for example.

Magnesium Supplements

Why take magnesium?

Well, apart from what's already been mentioned about how critical magnesium is in many processes in our bodies and how likely it is that we're deficient, let's take a look at some of the mechanisms by which magnesium acts:

1. Energy Production

Magnesium exists in every cell and for good reason. The enzymes involved in the breakdown of carbohydrates, proteins and fats to produce energy in the form of adenosine triphosphate or ATP - the 'energy molecule' - all require magnesium ions to work. In fact, ATP exists in our cells as MgATP.

Low magnesium status = low ATP production = low energy = ***fatigue***. Many people attribute their fatigue to external life stressors, but a low magnesium status may be the underlying cause.

2. Neurotransmission

The firing of nerves in the nervous system is tightly controlled as minerals and neurotransmitters (chemicals that control nerve signals) flow in and out of neurons. Magnesium controls the flow of calcium ions which controls the excitability of nerve impulses. Without this regulation, nerves fire at random and too frequently, causing ADHD and poor sleep.

Magnesium also binds to NMDA receptors in the brain which regulates glutamate production. Overall, synaptic density, function and plasticity is influenced by magnesium. This is the underpinning of a healthy functioning brain.

3. Muscle Contraction & Heart Function

Over 35% of magnesium is within our muscles because it is essential for muscular contractions - the very process that moves our bodies!

Magnesium plays a similar role in muscle contraction as it does in nerve transmission; tightly regulating the flow of positively and negatively charged ions into and out of cells. The build up and consequent flow of these charged ions is what creates an electrical gradient that drives the 'pumping' of our hearts.

Calcium, another important player here, flows into muscle cells and causes a contraction. Magnesium is a calcium channel blocker which means it controls how much calcium gets into muscle cells so that our muscles aren't always in a state of contraction. With low magnesium, our muscles cramp regularly, we get muscle pain, fibromyalgia and even heart arrhythmias.

Our blood pressure is also influenced by magnesium as it plays a role in producing nitric oxide - a compound that dilates our blood vessels. For this reason, hypertension is commonly seen in those with magnesium deficiency .

4. Protein Synthesis

From amino acids into functional proteins; the process of making new proteins and repairing existing ones is dependent on magnesium. RNA, DNA and glutathione are a few examples.

5. Psychological Health & Sleep Quality

Depression and anxiety are major clinical symptoms of a magnesium deficiency. Magnesium is a cofactor needed in the formation of important mood-related hormones: serotonin, melatonin, dopamine and noradrenaline. Each step in the production of these hormones needs a magnesium ion to work. For example, the biochemical process: *tryptophan* → *5 HTP* → *serotonin* → *melatonin*, needs magnesium at each step. Imbalances in these hormones is the underlying cause of many mental disorders like anxiety and depression and of course, poor sleep.

Others include:

- Blood sugar control
- Activation of B Vitamins, Vitamin D and glutathione
- Cell division (growth of new cells)
- Electrolyte homeostasis (Na, K, Ca, P, Mg etc.)

We can see how diverse magnesium's role is in the body and why being in a deficit can cause so many health problems. The diversity of the systems in the body that are impacted make the symptoms of magnesium deficiency rather broad:

Mild deficiency:

- Loss of appetite, nausea
- Headache, brain fog
- Fatigue
- Eye twitching
- Chocolate cravings

Severe deficiency:

- Arrhythmias (irregular heart beats)
- Muscle cramps
- Fibromyalgia
- Numbness & tingling

It is estimated that a whopping 75% of Americans aren't getting enough magnesium. That's 3 out of every 4 people. On average, people's intake of magnesium is below the recommended daily allowance, with an average of 250mg. This is likely because of our nutrient depleted soils, a low intake of magnesium-rich foods and a high intake of refined, processed, sugar-laden foods. The standard American diet is a sure route to becoming deficient in this essential mineral.

Magnesium and the athlete

Magnesium is essential for optimal performance and post-exercise recovery! The mineral is needed for the energy producing pathways glycolysis, the TCA cycle and creatine phosphate production, which in simple terms just means the breakdown of glucose or other food into energy to fuel exercise. On top of that, exercise is known to deplete magnesium stores, especially through sweat which is why athletes may have a higher requirement for magnesium compared to a sedentary person.

Magnesium and the immune system

Magnesium is not often thought to influence the immune system. You'll be surprised to find out that magnesium is essential for our immune cells, specifically natural killer cells and T cells to express receptors that bind to virally infected cells and cancerous cells to target them for destruction. Without magnesium inside our cells, we can't attack viruses.

Additionally, we know how important vitamin D is for a healthy immune system. But, vitamin D needs to be converted from calcidiol into its active form called calcitriol by various enzymes in the liver and kidneys. This cannot happen without magnesium. No magnesium means no active vitamin D.

Why people supplement with magnesium

Based on magnesium's many functions in the human body, it plays a role in the prevention and treatment of many diseases such as Alzheimer's, insulin resistance and type 2 diabetes, cardiovascular disease and ADHD to name a few. We can see from the many roles described above that having adequate magnesium levels is important. Because of its universal role in the body, some companies can make far reaching claims. Most commonly, magnesium is taken to:

- Improve sleep
- Enhance exercise performance
- Reduce muscle cramps and pain
- Prevent migraine headaches
- Treat constipation
- Improve heart health
- Improve insulin sensitivity

Nutrition is key!

Magnesium is found in many plant foods and animal foods but due to food processing techniques and our mineral-depleted soils, some foods are devoid of magnesium by the time they reach our plates. One study showed that "the daily dietary intake of magnesium in Western society has been declining from about 500mg per day in the 1900's to a value closer to 175mg per day."

Being careful about what you eat is important - focus on eating foods in their natural state and buying organic where possible. Following a paleo diet or a well-formulated ketogenic diet that is whole-foods based is a great way to start. The following ten foods have high amounts of magnesium in them. Try to include them in your diet every day!

1. Dark leafy greens

2. Avocados
3. Grass-fed dairy
4. Pumpkin seeds
5. Sea vegetables (dulse, nori, kelp, chlorella, chlorophyll & spirulina)
6. Pink Himalayan salt
7. Nuts (brazil, pistachio, almond)
8. Wild salmon
9. Sprouts (sprouted seeds also have fewer phytates & oxalates)
10. Dark chocolate

It is hard to overdose with magnesium from food sources, as any excess will simply be excreted in urine by your kidneys. In contrast, overdosing with supplemental magnesium can cause negative side effects like diarrhea.

Interestingly, magnesium and sodium (salt) balance play a role in maintaining normal magnesium levels. If you don't include enough salt in your diet, you have low sodium in your bloodstream which causes your body to pull magnesium from your bones and place it into the blood to counteract this. Also, when we sweat, we excrete mostly sodium. If you're low in sodium, magnesium replaces this in sweat and you end up losing more magnesium. The bottom line is: if you eat a mostly whole-foods diet, you should regularly salt your food, but in the modern world, many people consume too many processed foods that contain way too much sodium!

If you're got your nutrition dialed in but still experiencing the symptoms mentioned above, or have had your magnesium levels tested and you're still deficient, then adding a magnesium supplement that suits you is a good idea.

Measuring magnesium status

There are 3 tests that you can take to determine whether you're magnesium deficient. You can measure the amount of magnesium in:

1. Serum/blood
2. Urine
3. Cells (red blood cells)

A simple blood test is the easiest but is not reflective of your overall levels because, as mentioned previously, only 1% of magnesium exists in the blood. It is a good indicator for acute changes in magnesium like straight after taking a supplement. If you have too much magnesium in your urine, you may be excreting too much, but its presence is not necessarily a bad thing as our kidneys are continuously controlling our levels by retaining and excreting certain amounts. The level in your cells - measured by the amount in your red blood cells - is a more sensitive method but again, if it is low, this may mean you have a poor ability to absorb magnesium into your cells.

In summary, the most optimal situation would be to test all three so that you can have a well-rounded understanding of your overall magnesium status.

Choosing Supplements

With the wide range of magnesium supplements on the market today, choosing the right supplement can be challenging! What's the difference between the different forms? Which one does my body need? When should I take it?

These are all very valid questions! And I have asked them a couple of times myself. There are a few things to consider when choosing a supplement, the most important being *bioavailability*. The last thing you want is to be spending money on supplements that your body isn't using.



SUPPLEMENTING MAGNESIUM

← WHAT YOU NEED TO KNOW →

✗

- PHYTATES, OXALATES AND TANNINS **LOWERS BIOAVAILABILITY** -
- HAVING **POOR INSULIN SENSITIVITY**, HAS BEEN LINKED TO **POOR ABSORPTION** -
- MAGNESIUM **OXIDE, CHLORIDE AND SULFATE** ARE **BETTER TO USE FOR SKIN** -
- INORGANIC FORMS** HAVE **INFERIOR ABSORPTION: OXIDE AND CARBONATE** -
- 3 OUT OF 4 OF AMERICANS** **AREN'T GETTING ENOUGH** MAGNESIUM. -

✓

- ESSENTIAL FOR OPTIMAL PERFORMANCE** AND **POST-EXERCISE RECOVERY** +
- ATHLETES** MAY HAVE A **HIGHER REQUIREMENT** +
- ORGANIC FORMS** HAVE **SUPERIOR ABSORPTION:** CITRATE AND GLYCINATE +
- IF YOU ARE A **KETO DIETER**, YOU **NEED MORE** +
- MAGNESIUM AND **SODIUM (SALT)** **BALANCE** PLAY A **ROLE** IN **MAINTAINING NORMAL MAGNESIUM LEVELS** +

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Bioavailability

The truth of the matter is that there are many factors that influence the bioavailability of a magnesium supplement. This means the amount of elemental magnesium that gets absorbed and used by the body and can range from 35% to 70%. This is the very reason researchers and scientists have come up with so many different forms of magnesium, searching for the form with the best bioavailability.

What matters is whether a supplement increases the amount of magnesium within our cells. Magnesium is an 'intracellular' mineral, which means that it does most of its 'jobs' inside our cells. An oral magnesium supplement needs to get from the acidic environment of the stomach, get absorbed into the bloodstream from the intestine and circulate throughout the body where it can enter the cells. If a supplement can do this, it is very bioavailable.

The three main factors influencing bioavailability:

1. **Solubility** - the more soluble, the easier the magnesium ion separates from the compound it's attached to so that it can be absorbed.
2. **Elemental Magnesium Load** - the amount of magnesium that the supplement provides compared to the salt/chemical it is bound to.
3. **Magnesium Status** - the person's level of magnesium will influence how much is absorbed, with greater absorption seen in those who are deficient.

The different forms

Magnesium supplements come in different forms that vary in the factors described above. Typically, magnesium supplements are sold as magnesium salts, which is essentially a magnesium ion bound to either an organic or *inorganic* salt.

Organic salts are created by combining magnesium with an acid or an amino acid (protein) - called an 'amino acid chelate'. For example, magnesium citrate is made by combining magnesium with citric acid while magnesium glycinate is made by combining magnesium to the amino acid glycine.

Inorganic salts are generally harvested from the earth.

Organic magnesium salts bound to an acid include:

- Mg Citrate
- Mg Gluconate
- Mg Malate
- Mg Orotate
- Mg Ascorbate
- Mg Lactate
- Mg Fumarate

Organic magnesium salts bound to an amino acid include:

- Mg Glycinate
- Mg Threonate
- Mg Pidolate
- Mg Taurate
- Mg Glutamate
- Mg Aspartate

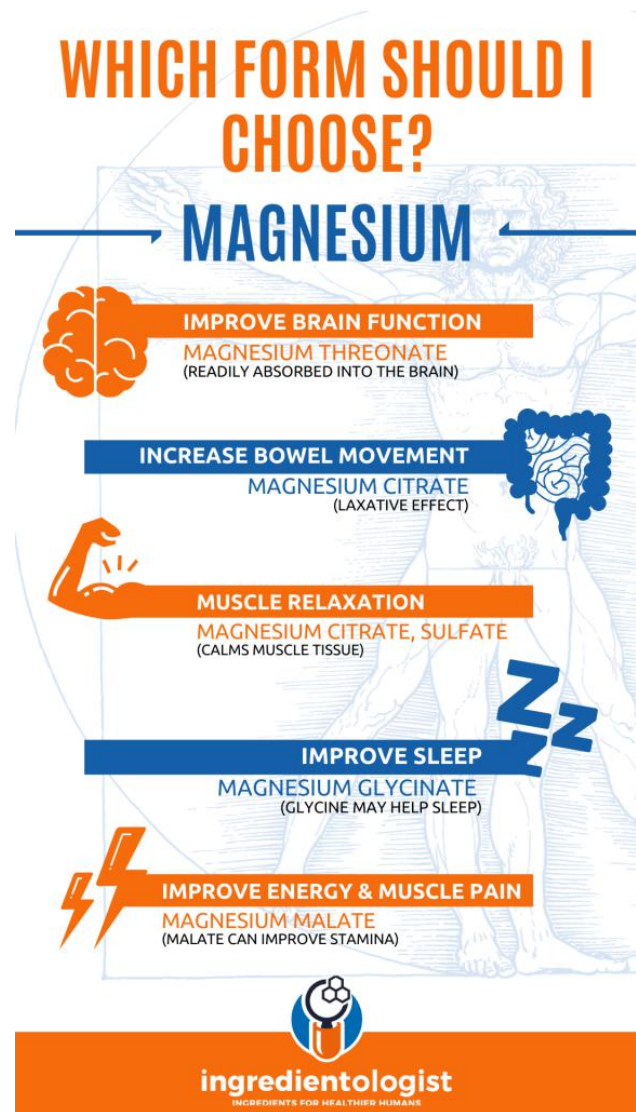
Inorganic magnesium salts include:

- Mg Oxide
- Mg Chloride
- Mg Sulfate
- Mg Carbonate

Which form is the best?

From the scientific research that we do have, the results tend to differ quite a lot, but generally, organic salts have a greater bioavailability than inorganic salts.

Multiple studies have shown magnesium citrate to be more absorbable than magnesium oxide because it can withstand the acidity of stomach acids and it is very



WHICH FORM SHOULD I CHOOSE?

MAGNESIUM

- IMPROVE BRAIN FUNCTION**
MAGNESIUM THREONATE
(READILY ABSORBED INTO THE BRAIN)
- INCREASE BOWEL MOVEMENT**
MAGNESIUM CITRATE
(LAXATIVE EFFECT)
- MUSCLE RELAXATION**
MAGNESIUM CITRATE, SULFATE
(CALMS MUSCLE TISSUE)
- IMPROVE SLEEP**
MAGNESIUM GLYCINATE
(GLYCINE MAY HELP SLEEP)
- IMPROVE ENERGY & MUSCLE PAIN**
MAGNESIUM MALATE
(MALATE CAN IMPROVE STAMINA)

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soluble. There is a tradeoff between the two however, where citrate has a higher solubility than oxide, it comes with a slightly lower amount of elemental magnesium.

There has been no evidence to show amino acid chelates to have better bioavailability than other magnesium salts. Their benefits may come from the value of the amino acid itself. For example, magnesium glycinate provides a glycine amino acid with it which has unique gut health and brain benefits. Another, magnesium threonate can potentially allow the magnesium ion to cross the blood brain barrier getting more magnesium into the brain, however more research is needed to confirm these benefits.

Many people are aware of the laxative effect of magnesium. In this case, it isn't ideal to continue supplementing with it because you don't absorb all of the magnesium. Instead, it is flushed through your body far too quickly to have any impact. Magnesium citrate and hydroxide are two forms commonly used for their laxative effect. The reason you experience this is because magnesium draws water into the intestines and colons, increasing gut motility. Rather experiment with a different form, or check with your doctor before carrying on.

In summary, highly absorbable forms of magnesium salts are magnesium citrate and magnesium glycinate. More research needs to be done comparing all of the different forms to one another, but if you opt for organic salts over inorganic salts, you're taking one step in the right direction.

Other forms:

Nano Minerals

Interestingly, a new form of magnesium called a 'nano mineral' appears to be a highly bioavailable supplement. In the form of 'nano magnesium chloride', it is essentially a smaller magnesium ion that, because of its size, can pass into the bloodstream from the intestine easily, without the need of a transporter. More research is needed on this.

Topical Magnesium

Many forms of magnesium can be used topically - applied to the skin - such as magnesium chloride and magnesium sulfate. While the skin is the largest organ in our body, some argue that it has the best rates of absorption. It is also a good alternative to getting enough

magnesium if you experience adverse effects from oral supplements. Taking an epsom salt bath is a very common relaxation practice.

Each person responds differently, however, commonly used forms for specific health problems are:

- Improve brain function → magnesium threonate (readily absorbed into the brain)
- Increase bowel movement → magnesium oxide, hydroxide & citrate (laxative effect)
- Muscle relaxation → magnesium citrate, sulfate (calms muscle tissue)
- Improve sleep → magnesium glycinate (glycine may help sleep)
- Improve energy & muscle pain → magnesium malate (malate can improve stamina)

What form do I use?

My preference, especially on the keto diet, is magnesium glycinate but I also like to have a powdered magnesium, by BioTrust, before bed as it helps me to relax.

What lowers magnesium's bioavailability?

- *Phytates, oxalates and tannins*
These chemicals found in plants inhibit the absorption of magnesium and other minerals in our gut (calcium, iron, zinc, selenium, chromium and manganese). They are dietary ligands (proteins) that bind to minerals in the intestine, decreasing their ability to get absorbed in the gut.
- *Insulin resistance*
Having poor insulin sensitivity, which means your cells don't respond to insulin very well, has been linked to poor magnesium absorption. People who are insulin resistant tend to have higher blood sugar levels which can increase magnesium loss in urine.
- *Calcium intake*
Some medical professionals believe that when calcium and magnesium are taken together that the bioavailability of magnesium is decreased. This may be because they are both ions with a positive charge of 2 and therefore compete for uptake in the gut. Perhaps, if the magnesium and calcium salts were of different forms, this problem could be avoided.
- *Magnesium status*
The more deficient you are in magnesium, the more magnesium your body will absorb in the gut.

Dose

The recommended daily allowances:

Men (aged 19+): 400 – 420mg per day

Women (aged 19+): 320 – 360mg per day

Children (aged 1 – 18 years): 85 – 300mg per day

Pregnant/breastfeeding women: 350 – 400mg per day

Dosage recommendations can vary depending on your needs. The bioavailability of the supplement will influence what dose you're ultimately getting too. Studies have found positive effects with daily doses between 125 - 2500mg, however it is best to get tested first and to consult with your doctor before taking a supplement, especially at higher dosages.

Can you overdose with magnesium?

Your kidneys should do the work to get rid of any excess magnesium and so overdosing is not very common. Although, in individuals with poor kidney function, taking too much magnesium could lead to hypermagnesemia.

In general, the risk is low for healthy people, but if you are experiencing adverse symptoms like loose stools regularly, you may be taking too much magnesium.

By now I hope you realize just how important magnesium is for a healthy functioning body. If you're not already making a conscious effort to incorporate magnesium-rich foods into your diet, then you may want to get your levels tested. Be aware of all of the magical marketing claims out there - they can be misleading, especially when the science behind the different magnesium forms is lacking.

Let me know if you take a magnesium supplement, and what forms you have found to work best! We are all on a continuous journey to find ways to optimize our health. Follow mine on Instagram, and share yours with me too!

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