Magnesium Deficiency Symptoms, Causes, & Treatments

Magnesium deficiency was first documented by Hirschfelder and Haury (1934) in a report entitled *Clinical Manifestations of High and Low Plasma Magnesium*. Since the publishing of this report in the 1930s, our understanding of magnesium deficiencies has advanced significantly. We now know that hypomagnesemia (serum magnesium below 1.7 mg/dL) is not always indicative of an underlying biological magnesium deficiency, nevertheless, it seems as though a majority of the U.S. population is deficient in magnesium.

Data compiled by the USDA (United States Department of Agriculture) research service indicates that just 43% of individuals living in the United States attain the recommended daily allowance (RDA) for magnesium, whereas ~57% of persons are deficient. The recommended daily allowance of magnesium for adults is 400 to 420 mg/day for men and 310 to 360 mg/day for women. Unless you carefully track your magnesium intake on a daily basis to ensure that the RDA quota is met, odds are that you're deficient.

What's problematic is the fact that many individuals with a magnesium deficiency are not only unaware of the deficiency, but they fail to understand the potentially serious biological toll this deficiency may incur. Magnesium is implicated in over 300 biological functions and reactions including: blood pressure normalization, energy production, heart rhythm, glucose regulation, and protein synthesis – to name a few. When magnesium levels are abnormally low, your body isn't functioning at its best, whereby a host of deficiency-related symptoms may emerge.

Magnesium Deficiency Symptoms (List of Possibilities)

Individuals with magnesium deficiencies may experience a myriad of symptoms. Understand that the specific symptoms occurring as a result of an underlying magnesium deficiency will be subject to significant individual variation, largely based upon the severity of the deficiency. Individuals with mild magnesium deficiencies may not experience any noticeable symptoms and/or may intuitively sense that they aren't functioning at their best.

Nonetheless, anyone with a mild magnesium deficiency might experience symptoms such as: anxiety, bouts of insomnia, and/or irritability. In more extreme cases, persons with moderate-to-severe magnesium deficiencies might report symptoms such as: cognitive dysfunction, confusion, hypotension, muscle spasms, and seizures. What's most problematic is that magnesium deficiencies may mimic and/or overlap with symptoms of other medical conditions, making it difficult for an individual to pinpoint low magnesium as a cause of his/her symptoms. Included below is a comprehensive list of magnesium deficiency symptoms with a brief explanation for each.

Agitation: A deficiency in magnesium, especially over a long-term, could cause an individual to feel more agitated than usual. Agitation is characterized as a state of internal stirring or nervous-excitement, and is usually associated with onset of other symptoms such as anxiety, irritability, and restlessness. The most likely cause of agitation stemming from magnesium deficiency is dysregulation of the HPA (hypothalamic pituitary adrenal) axis.

HPA axis dysregulation leads to increased concentrations of stress hormones such as CRH (corticotropin-releasing hormone) in the paraventricular hypothalamic nucleus (PVN) and serum ACTH (adrenocorticotropic hormone). As a result of this stress response, an individual becomes increasingly agitated. It could be theorized that the more significant a person's magnesium deficiency, the greater his/her HPA axis dysregulation and corresponding agitation are likely to be.

Another problem is that, because the HPA axis is dysregulated and stress response is overactive, magnesium is depleted at a faster rate than usual. Even if a person who's highly agitated as a result of a magnesium deficiency were to meet the RDA for magnesium (based on age/sex), meeting the RDA may be insufficient to fully reverse the deficiency and agitated feelings. That said, increasing dietary magnesium intake and/or using supplemental magnesium may attenuate the significance of HPA axis dysregulation to counteract stress-induced agitation.

Anxiety: If you're experiencing a magnesium deficiency, one of the most uncomfortable symptoms that you may end up dealing with is anxiety. You may suddenly feel anxious "out of nowhere" or start to believe you have an anxiety disorder – even if you never struggled with much anxiety in the past. If the magnesium deficiency is severe, your anxiety is likely to be extreme and/or difficult to bear, possibly accompanied by insomnia, irritability, and shakiness.

In fact, since over half the population doesn't meet the RDA for magnesium, it is reasonable to suspect that a subset of individuals diagnosed with anxiety disorders could correct them simply by increasing their magnesium intake. What's insidious about experiencing anxiety as a symptom of magnesium deficiency is that, over time, anxiety accelerates the depletion of magnesium and worsens the deficiency. As a result of the anxiety-induced accelerated magnesium depletion, anxiety is exacerbated and it becomes a vicious circle.

There are many studies to support the idea that insufficient magnesium causes anxiety in humans and animal models. It is believed that magnesium regulates HPA (hypothalamic pituitary adrenal) axis function, and if magnesium levels are low, the HPA axis is subject to dysregulation. HPA axis dysregulation as a result of a magnesium deficiency leads to increases in CRH (corticotropin-releasing hormone) in the paraventricular hypothalamic nucleus (PVN) and elevated ACTH (adrenocorticotropic hormone), whereby an individual exhibits severe anxiety and mood changes.

Appetite loss: Among the earliest symptoms of a magnesium deficiency experienced by a subset of individuals is impairment or loss of appetite. Those experiencing a decreased appetite as a result of a magnesium deficiency may report feeling less hungry than usual and/or might find themselves consuming fewer total calories per day. Additionally, loss of appetite may affect motivation to consume food and could lead to unhealthy weight loss.

Appetite loss as a symptom of magnesium deficiency may be more severe for some individuals than others, and is likely caused in part by magnesium deficiency-related dysregulation of the HPA axis. HPA axis dysregulation is known to downregulate activity in brain regions implicated in food motivation, especially among women. The problem with appetite loss as a symptom of magnesium deficiency is that, because appetite loss typically leads to lower total caloric intake, an individual who's already deficient in magnesium may further reduce his/her consumption of magnesium-rich foods (due to poor appetite).

This becomes a vicious circle in that, lower intake of magnesium-rich foods exacerbates the severity of magnesium deficiency and may potentiate the loss of appetite. Furthermore, if appetite loss leads to fasting, food deprivation, or intentional starvation – intracellular magnesium stores will be subject to depletion, and even during a food reefed (eating again), it becomes difficult for the body to retain magnesium. Although loss of appetite loss as a symptom of magnesium deficiency may be mild for some, others will report an extreme decrease in motivation to consume food.

Asthma: Another symptom that may emerge from magnesium deficiency is asthma. Asthma is a respiratory condition characterized by spasms within the bronchi of the lungs, whereby it becomes difficult to breathe. Lack of magnesium is understood to impair lung function and induce bronchial hyper-reactivity (BHR), each of which are associated with asthma.

Magnesium is known to elicit a variety of biological effects that might protect against the onset of asthma, as well as asthma attacks, including: inhibit vascular and bronchial smooth muscle contract, inhibit release of acetylcholine, facilitate production of nitric oxide, and stabilize smooth muscle. When a person isn't getting enough magnesium from his/her diet, he/she may be at higher risk of developing asthma and/or experiencing more frequent or severe asthma

attacks (if already diagnosed). Reports suggest that hypomagnesemia (low serum magnesium) is exhibited by patients with asthma more than among persons without asthma.

Some believe that increasing dietary magnesium intake may reverse risk for asthma and/or may reduce the frequency of future attacks. What's more, there's evidence suggesting that asthma can be managed with administration of inhaled or intravenous magnesium. For this reason, if you're experiencing asthma or having difficulties with breathing, it's possible that asthmatic symptoms are related to an underlying magnesium deficiency.

Bone loss / fragility: Bone loss, bone fragility, and osteoporosis can all emerge as symptoms of a magnesium deficiency. Research suggests that tightly regulated homeostasis of magnesium is critical for maintaining bone health. Severe magnesium deficits in animal models impairs bone growth, causes osteopenia (a condition in which new bone isn't formed as quickly as old bone is reabsorbed), and induces skeletal fragility.

Research by Rude, Singer, and Gruber (2009) discovered that suboptimal magnesium levels (e.g. 50% of the RDA) can substantially downregulate serum parathyroid hormone (PTH) and vitamin D levels, both of which are necessary for bone formation. Magnesium deficiencies are also understood to increase skeletal secretion of substance P, which in turn sends signals for increased production of proinflammatory cytokines such as TNF-alpha and interleukin-1 beta – each of which enhances osteoclast-mediated bone resorption. Furthermore, there's evidence suggesting that low magnesium leads to increased RANKL (Receptor activator of nuclear factor kappa-B ligand) and decreased OPG (osteoprotegerin), causing excessive bone resorption.

Without proper levels of magnesium, osteoclast-mediated bone degradation (breakdown) outpaces osteoblast-mediated bone deposition (rebuilding) for a net effect of bone loss. The severity of your bone loss and/or fragility will be contingent upon the degree to which you are deficient in magnesium, as well as the total duration of the deficiency. Anyone dealing with severe bone loss and/or a skeletal issue is recommended to assess their magnesium intake.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/19828898

Brain fog: If you're deficient in magnesium, another symptom that might emerge as a result is "brain fog" or inability to think clearly. Anyone experiencing brain fog may feel as though their consciousness is somehow clouded, foggy, or eternally locked in a dream-like state. The problem with brain fog for many is that it impairs one's ability to engage in conversation, organize thoughts, stay productive, and perform cognitively-demanding tasks.

Brain fog is often interrelated with other symptoms of magnesium deficiency such as anxiety and depression. For example, foggy thinking might cause a person to feel anxious in social situations due to feeling as though his/her head is in the clouds, making it difficult to respond appropriately in conversation. Clouded thinking may also lead to feelings of depression due to a perceived inability to "fit in" with the rest of society who don't appear to have the same problem.

Realize that not everyone with a magnesium deficiency will be severely afflicted with brain fog, however, certain individuals will report this as a symptom. Assuming brain fog was caused in part by a magnesium deficiency, increasing dietary magnesium intake and/or supplementing with magnesium regularly should help restore clarity of thought. Keep in mind that the brain fog is unlikely to reverse itself overnight – consistent magnesium intake will be necessary over an extended duration.

Cognitive impairment: A symptom of magnesium deficiency that is closely associated with brain fog is cognitive impairment, in fact, many consider them to be synonymous. In any regard, magnesium deficiency is known to significantly impair many aspects of cognitive function including: attention, critical thinking, learning, memorization and recall, organization of thoughts, and problem solving. The severity of cognitive impairment that a person experiences as a result of deficient magnesium may be contingent upon the significance of the deficiency, as well as the duration over which he/she was deficient.

Impaired cognitive function stemming from a magnesium deficiency is problematic in that it may take a significant toll on a person's work performance. A person may notice that he/she is unable to efficiently complete cognitively-demanding tasks and may feel as though they've somehow developed late-onset ADHD or early-onset Alzheimer's. Studies show that magnesium acts as a neuroprotective agent in that it inhibits synaptic death and enhances synaptic connectivity, but when magnesium levels are low, individuals may lose more synapses, exhibit increased neuronal death, and/or imbalanced neurotransmission.

A study by Slutsky, Abumaria, Wu, et al. (2010) suggests that increasing concentrations of magnesium in the brain with the compound Magnesium-L-threonate (MgT) enhances learning, working memory, and long-term memory in animal models. For this reason, it's very believable that individuals with severe magnesium deficits may exhibit cognitive impairment. By consistently getting enough magnesium from one's diet and/or supplementation, cognitive function should improve.

Confusion: Some individuals may experience confusion as a symptom of magnesium deficiency whereby they constantly feel delirious and/or disorientated. Generally, any confusion resulting from a magnesium deficiency is closely related to symptoms such as brain fog and cognitive impairment. Chronically deficient magnesium is thought to disturb brain connectivity, alter neurotransmission, and accelerate brain aging – each of which could cause confusion.

Experiencing confusion is typically accompanied by arousal changes (hyperactivity or hypoactivity), circadian rhythm abnormalities, perceptual oddities, and sometimes even psychotic features. In severe cases of confusion from a magnesium deficiency, it may appear as though a person is struggling with a severe neurodegenerative disorder – especially if he/she is middle-aged or elderly. By ramping up dietary magnesium intake and/or supplementing with magnesium over a period of months, the confusion resulting from the deficiency should diminish.

Constipation: It is possible that a subset of individuals exhibiting a magnesium deficiency may experience constipation as a symptom. A study by Murakami, Sasaki, Okubo, et al. (2007) discovered that low intake of magnesium was independently associated with constipation among individuals consuming low-fiber diets. Although correlation of low magnesium intake and constipation among those consuming low fiber diets does not indicate causation, there's reason to believe that it could.

Supplementation with magnesium is understood to induce a laxative effect, which is often useful for alleviation of constipation. Magnesium supplements treat constipation by drawing water into stools (making them softer and easier to pass), and simultaneously decreasing tension on the intestinal wall, thereby increasing likelihood of passing a bowel movement. It is possible that sufficient dietary magnesium augments digestive processes, making a person less susceptible to constipation – especially if consuming a low-fiber diet.

Though constipation may occur in a subset of persons regardless of their magnesium status, it might also be one of many potential magnesium deficiency symptoms. If mild constipation occurs along with many other symptoms on this list, you may want to thoroughly assess your daily magnesium intake. By gradually increasing intake of dietary magnesium, you may be surprised to discover that your constipation ceases.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/17151587

Depression: Individuals deficient in magnesium may exhibit depression as a symptom, possibly so severe that they are diagnosed by a psychiatrist with major depressive disorder (MDD). The severity of a person's depression resulting from a magnesium deficiency may be contingent upon the chronicity (how long) a person has been deficient in magnesium, as well as the extent to which he/she is deficient. Someone with an extreme magnesium deficiency over an extended duration is likely to experience some mood abnormalities and/or depression.

Understand that not everyone with major depression necessarily has a problem with his/her magnesium level.

Nonetheless, it appears as though lack of magnesium intake causes NMDA (N-methyl-d-aspartate)-coupled calcium channels to open more frequently, ultimately injuring neurons and inducing neurological dysfunction – both of which are implicated in cases of depression. Furthermore, we know that a magnesium deficiency increases production of pro-inflammatory cytokines and stress hormones (via HPA dysregulation), each of which contribute to the pathogenesis of depression.

Some research suggests that concentrations of magnesium in the CSF (cerebral spinal fluid) is abnormally low among persons with treatment-resistant depression (TRD) and/or suicidal ideation compared to non-depressed persons. Additionally, data from neuroimaging studies suggests that brain magnesium levels are low among persons with treatment-resistant depression. It appears as though administration of magnesium supplements is capable of attenuating depressive symptoms for a subset, possibly due to reversal of the magnesium deficiency.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/19944540

Fatigue: Among the earliest, most noticeable symptoms of a magnesium deficiency is fatigue. If you're deficient in magnesium, you may notice that you're suddenly prone to bouts of tiredness and/or lethargy that you never previously endured. For some individuals, the fatigue associated with low magnesium will be modest and temporarily managed by drinking more caffeine and/or getting more sleep than usual, whereas others may find the fatigue to be unbearable.

Low magnesium concentrations may induce chronic fatigue as a result of upregulated concentrations of stress hormones and cytokines. Damaged neurons and neurological dysfunction stemming from opening of NMDA-coupled calcium channels (as occurs in magnesium deficiency) may lead to onset of fatigue. Moreover, some theorize that insufficient magnesium intake decreases ATP (adenosine triphosphate) production and increases oxidative stress – each of which could sap energy and promote fatigue.

Research by Cox, Campbell, and Dowson (1991) documented that a subset of individuals with chronic fatigue syndrome (CFS) exhibit magnesium deficiencies, and that when treated with supplemental magnesium, energy levels, emotional status, and mental state significantly improve. Additionally, work by Bitarafan, Harirchian, and Nafissi (2014) discovered that lower dietary magnesium intake was associated with higher scores of fatigue in patients with multiple sclerosis, supporting the idea that low magnesium is linked to fatigue. Overall, there's reason to believe that fatigue can emerge as a symptom of magnesium deficiency.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/1672392
- Source: http://www.ncbi.nlm.nih.gov/pubmed/24800044

Fingernail appearance: A symptom of magnesium deficiency that is rare, but can occur, is fingernail abnormalities. Some individuals may experience poor nail growth due to insufficient magnesium intake, whereas others might report that their fingernails or toenails have become soft and/or more brittle than usual. Due to the fact that magnesium is one of many minerals (others include: calcium, iron, zinc, sodium, and copper) that is necessary for the growth of nail plates, a severe deficiency may affect nail appearance and strength.

Another link between low magnesium and nail abnormalities has to do with hypoparathyroidism, or diminished secretion of parathyroid hormone. It is known that magnesium modulates function of the parathyroid gland, and that extremely low magnesium can induce a paradoxical inhibitory effect whereby the parathyroid gland fails to produce parathyroid hormone (PTH). Lack of parathyroid hormone can lead to brittle nails, nail breaks, and/or abnormal nail appearance.

This is primarily due to the fact that blockade of the parathyroid gland that occurs from low magnesium also affects calcium. Calcium is more important than magnesium for nail strength and health, but if calcium levels plummet due to insufficient parathyroid, nails are affected. Although nail abnormalities can be caused by medical conditions, a chronic and/or severe magnesium deficiency may lead to horizontal ridges, white lines, and/or splinters.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/20620759

Glucose abnormalities: It is well-established that magnesium is a cofactor for many enzymes involved in glucose metabolism. For this reason, in the event that someone experiences a magnesium deficiency, his/her enzymes necessary for glucose metabolism may remain underactive. The underactivity of glucose-metabolizing enzymes could lead to elevated blood glucose levels (hyperglycemia), as a byproduct of magnesium deficiency.

Research shows that increasing magnesium concentrations is capable of improving homeostatic glucose and insulin levels. This is likely due to the fact that when magnesium intake increases (either through diet or supplementation), enzymes metabolize glucose more efficiently and less insulin secretion is necessary to shuttle glucose out of the bloodstream. If your blood glucose levels spike unpredictably to high levels, it's possible that a lack of magnesium in your diet could be a partial cause.

In fact, a study by Lal, Vasudev, Kela, and Jain (2003) discovered a greater occurrence of hypomagnesemia among persons with Type 2 diabetes than non-diabetic patients, indicative of the fact that chronically low magnesium may induce glucose abnormalities. In the event that glucose abnormalities (e.g. hyperglycemia) result from an underlying magnesium deficiency, supplementation with magnesium could decrease severity or hyperglycemia via augmentation of enzymatic glucose metabolism, islet Beta-cell response, and reversal of insulin resistance. Moreover, a vicious circle may occur in which hyperglycemia (resulting from low magnesium) exacerbates magnesium depletion (through frequent urination or insulin resistance), and the depletion of magnesium promotes increased likelihood of future hyperglycemia.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/2253826
- Source: http://www.ncbi.nlm.nih.gov/pubmed/8091358
- Source: http://www.ncbi.nlm.nih.gov/pubmed/12693452

Hallucinations: An extremely uncommon/rare symptom of magnesium deficiency that has been briefly mentioned in the literature is hallucinations. Hallucinations are considered perceptions of sound (e.g. hearing voices), sight (e.g. seeing visuals), touch, smell, and/or taste – that have no basis in reality. Individuals prone to hallucinations usually exhibit neuropsychiatric disorders such as: brain damage, major depression, neurodegeneration, psychosis, and/or schizophrenia.

It is possible that a long-term magnesium deficiency could lead to onset of hallucinations in a small percentage of the population. That said, magnesium deficiency-related hallucinations are not likely to occur among persons without a preexisting neurological disorder. For a magnesium deficiency to induce hallucinations, a person likely needs a preexisting neurological condition that makes him/her susceptible to hallucinations.

Theoretically, if an individual isn't getting enough magnesium via his/her diet, the lack of magnesium might: induce HPA axis dysfunction, upregulate stress hormones, increase inflammatory cytokines, and modulate NMDA-coupled calcium channels – each of which could provoke hallucinations in vulnerable populations. Many theorize that, since hallucinations are often triggered by stress, magnesium's anxiolytic effects may be protective against hallucinations. It is reasonable to suspect that increasing magnesium concentrations through supplementation and/or diet could reduce the frequency and/or severity of hallucinations in a subset of individuals.

Headaches & Migraines: Among the most common symptom of magnesium deficiency is headache and/or migraine. This is because without sufficient intracellular and extracellular magnesium in the brain, neural activity becomes dysregulated, neurons don't function properly, and neurotransmission is abnormal. As a result of irregular neural activity stemming from a magnesium deficiency, intracranial blood vessels contract or expand excessively, causing tension-type headaches and migraines, respectively.

Whether a person experiences headache or migraine from lack of magnesium may be contingent upon genetics and individual neurobiology. For example, extreme headaches from a magnesium deficiency may be due to a corresponding dysregulated HPA axis whereby stress hormones are released for the freeze-fight-flight response, and vasoconstriction reduces intracranial blood flow. On the other hand, migraines may occur as a result of cortical spreading depression, platelet hyperaggregation, and altered serotonergic transmission.

Furthermore, since increases in proinflammatory cytokines and oxidative stress are also implicated in the pathogenesis of headache and migraine, and magnesium deficiency increases each, it is likely that these contribute to headache and migraine from low magnesium. Research by Mauskop, Altura, Cracco, and Altura (1996) indicates that intravenous administration of magnesium sulfate (1 gram) rapidly attenuates various types of headache and migraine among persons with low serum magnesium levels. There's strong reason to believe that taking supplemental magnesium for migraines and/or other headaches is an effective treatment for those with an underlying deficiency.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/8984087

High blood pressure: Magnesium is involved in regulation of blood pressure, and when an individual is deficient in magnesium, he/she is at greater risk for developing prehypertension or hypertension. Research by Rosanoff (2005) suggests that magnesium status directly influences relaxation capacity of vascular smooth muscle cells and simultaneously modulates the placement of cations (sodium, potassium, and calcium) for maintenance of normative blood pressure. In particular, suboptimal magnesium intake is associated with inactivation of Na-K-ATPase, as well as impaired activation of Mg-ATP sodium-potassium pumps and calcium pumps.

The net result of deficient magnesium is high intracellular calcium (iCa(2+)) and high cellular sodium to potassium ratio (Na:K), ultimately leading to vasoconstriction and hypertension. For this reason, anyone deficient in magnesium over an extended duration is at high risk for developing prehypertension (blood pressure exceeding 120/80) and hypertension (blood pressure exceeding 140/80). Although high blood pressure does not always indicate that a person is deficient in magnesium, it is sometimes an obvious sign of a deficiency.

If you've been diagnosed with hypertension and don't eat many magnesium-rich foods and/or experience a host of other symptoms on this list – an underlying magnesium deficiency may be (at least partially) to blame. What's more, research suggests that magnesium supplementation is effective as a treatment for prehypertension and hypertension. This finding supports the idea that onset of hypertension may be attributable, in certain cases, to low magnesium intake.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/15692166

Hormonal imbalances: Individuals with magnesium deficits over an extended duration may be prone to hormonal imbalances. Researchers Zofková and Kancheva (1995) mention that sufficient magnesium is necessary for normative function of the parathyroid glands, and note that a magnesium deficiency can cause hypoparathyroidism. A paper by Vetter and Lohse (2002) notes that very low serum concentrations of magnesium induces a paradoxical block of the parathyroid glands, leading to hypocalcemia (low serum calcium) along with low magnesium.

Signs of hypoparathyroidism include: paresthesias (abnormal sensations throughout the body), muscle aches or cramps, twitching of muscles, fatigue, depression, memory problems, hair loss, and dry skin. Evidence from Cinar (2007) suggests that magnesium supplementation can increase FT3 (free triiodothyronine) and TSH (thyroid-stimulating hormone) and prevents thyroid activity reduction. Based on these findings, it's reasonable to believe that chronically low magnesium levels may be implicated among persons with abnormal levels of thyroid hormones.

We also know that magnesium deficiency can increase stress hormones (CRH, ACTH, etc.) and insulin. Work by Maggio, Ceda, Lauretani, et al. (2011) suggests that magnesium levels are highly correlated with anabolic hormones

such as IGF-1 and testosterone in men. When considering that magnesium deficits increase stress hormones, which can decrease anabolic hormones over time, it's reasonable to believe that the aforestated finding is causative. If you have hormonal imbalances, you might want to investigate whether low magnesium is playing a role.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/7669510
- Source: http://www.ncbi.nlm.nih.gov/pubmed/12105390
- Source: http://www.ncbi.nlm.nih.gov/pubmed/17984925
- Source: http://www.ncbi.nlm.nih.gov/pubmed/21675994

Hyperexcitability: CNS hyperexcitability will emerge as a symptom of magnesium deficiency in many individuals. Magnesium is understood to regulate nerve transmission by inhibiting the release of acetylcholine, but when magnesium levels are low, acetylcholine is released in excess, thereby inducing a hyperexcitable state. The severity of hyperexcitability resulting from magnesium deficiency is inversely associated with magnesium levels; the lower the magnesium, the greater the hyperexcitability (and vice-versa).

In addition to excessive acetylcholine release, it is thought that excitatory neurotransmitters and modulators such as aspartate, dopamine, glutamate, norepinephrine are released in greater concentrations due to lack of magnesium. While excitatory agents are upregulated, lack of magnesium reduces production of inhibitory agents such as: GABA, melatonin, serotonin, and taurine. Since the balance of CNS activity becomes lopsided towards excitability, individuals may report twitching, anxiety, jitters, restlessness, and other related symptoms.

Durlach, Bac, Bara, and Guiet-Bara (2000) suggest that CNS hyperexcitability is a latent symptom of magnesium deficiency in that, a person is usually deficient in magnesium long before hyperexcitability emerges. Some theorize that increased proinflammatory cytokines, free radicals, and sodium conductance also potentiate hyperexcitability among those with magnesium deficiencies. Moreover, Mousain-Bosc, Roche, Rapin, and Bali (2004) discovered normalizing magnesium intake with supplementation can reverse CNS hyperexcitability and corresponding behavioral abnormalities.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/11153899
- Source: http://www.ncbi.nlm.nih.gov/pubmed/15466962

Hyperventilation: If you're prone to bouts of hyperventilation, you may want to consider magnesium deficiency may be partially culpable. Hyperventilation occurs when breathing in oxygen and breathing out carbon dioxide become imbalanced, leading to low levels of carbon dioxide within the bloodstream. During hyperventilation, individuals may experience dizziness, lightheadedness, balance problems, tingling sensations, and/or syncope.

Research by Hafen, Laux-End, Truttmann, et al. (1996) shows that hyperventilation is associated with significant reductions in both free and ionized magnesium concentrations. Though it is unknown as to whether low magnesium levels cause hyperventilation, work by Fehlinger and Seidel (1985) suggests that they might. It was proposed that hyperventilation syndrome and hyperventilation attacks may be manifestations of a magnesium imbalance.

The exact mechanisms by which a magnesium deficiency could induce hyperventilation are somewhat unclear. It is plausible that an upregulation of excitatory neurotransmitters and downregulation of inhibitory transmitters as a result of low magnesium could be to blame. Moreover, since deficient magnesium can induce anxiogenic effects (via HPA dysregulation), and anxiogenic effects increase likelihood of hyperventilation, it's possible that the anxiety from lack of magnesium contributes to hyperventilation.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/8869418
- Source: http://www.ncbi.nlm.nih.gov/pubmed/4046641

Insomnia: If you're chronically deficient in magnesium, you may also end up dealing with the symptom of insomnia. Though there are different types of insomnia, the condition is generally defined as an inability to fall asleep and/or stay asleep throughout the night. A study by Depoortere, Françon, and Llopis (1993) shows that a diet lacking sufficient magnesium yields neuronal excitability, disorganized sleep, increased wakefulness, and reduced slow wave sleep – in animals over a duration of 9 weeks.

Researchers note that insufficient magnesium via one's diet can induce a state of spasmophilia, or excessive muscle contraction resulting from imbalance of ions, ultimately causing insomnia by interfering with the transition of wakefulness to sleep. Insomnia is often caused by heightened release of stress hormones, excitatory neurotransmitters, inflammatory cytokines, and reactive oxygen species (ROS) – all of which tend to increase among those with a magnesium deficiency. It is also possible that CNS hyperexcitability from uninhibited acetylcholine secretion (due to lack of magnesium) promotes insomnia.

Some research goes as far as to suggest that adequate magnesium is necessary to maintain a healthy circadian rhythm. The bottom line is that anyone who's deficient in magnesium is at greater risk of going to bed feeling over-aroused (physically and mentally), ultimately preventing a smooth transition from a state of wakefulness to sleep. Over time, the insomnia may worsen if the magnesium deficiency remains uncorrected by further upregulating the stress response. When considering the following: most of the population is deficient in magnesium; insomnia affects ~1 in 3 adults; and magnesium has been shown to treat insomnia in RCTs – there's reason to believe that a deficiency can cause (or exacerbate) insomnia.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/8232845
- Source: http://www.ncbi.nlm.nih.gov/pubmed/23853635

Insulin abnormalities: There's reason to believe that some individuals might experience insulin abnormalities or develop insulin resistance as a result of a magnesium deficiency. Insulin resistance is a condition in which there's an impaired biological response to insulin; cells don't react to the hormone insulin. Research by Takaya, Higashino, and Kobayashi (2004) suggests an inverse relationship between plasma magnesium concentrations and insulin resistance (impaired biological response to insulin).

Evidence suggests that intracellular magnesium deficits interfere with cellular glucose entry and compromise the action of insulin by detrimentally affecting cellular metabolism. It is theorized that low intracellular magnesium can interfere with normative tyrosine kinase activity, ultimately modifying insulin sensitivity via modulation of receptor binding, signaling, or processing. As a byproduct of insulin resistance, individuals may be prone to excessive insulin secretion (hyperinsulinemia) whereby their tissues are damaged, fat accumulates, and cancer risk increases.

A study by Kandeel, Balon, Scott, and Nadler (1996) discovered that an intracellular magnesium deficiency in rats promotes insulin resistance through modulation of glucose entry into cells and that this resistance can be reversed upon correction of the deficiency. Research by Chutia and Lynrah (2015) discovered an association between serum magnesium levels and insulin resistance, suggesting that magnesium deficiencies may play a causal role in insulin resistance. Should you have insulin resistance, you may want to consider that a magnesium deficiency could be partially culpable.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/15319146
- Source: http://www.ncbi.nlm.nih.gov/pubmed/8692018
- Source: http://www.ncbi.nlm.nih.gov/pubmed/26417155

Irregular heartbeat: A symptom of magnesium deficiency that may be alarming is irregular heartbeat. There are many reasons as to why a person may experience heart rhythm abnormalities as a result of a magnesium deficiency,

including: CNS hyperexcitability, excitatory neurotransmitters, stress response, and vasoconstriction of blood vessels. There's also reason to believe that magnesium deficits could lead to heart palpitations as a result of HPA axis dysregulation, whereby an individual develops chronic stress and remains locked in a "freeze-fight-flight" response.

Research by Nielsen, Milne, Klevay, et al. (2007) discovered that magnesium intake at 33% the RDA induces heart arrhythmias. When magnesium concentrations are replenished to correct the underlying deficiency, heartbeat irregularities abate. A study by Dorman, Sade, Burnette, et al. (2000) discovered that supplementation with magnesium protects against incidence of postoperative arrhythmias among pediatric heart surgery patients.

In this study, it was also reported that incidence of tachycardia (abnormally rapid heart rate) was correlated with magnesium deficiencies. Other evidence suggests that, users of proton-pump inhibitors (PPIs) are more at risk for cardiovascular events and arrhythmias due to the fact that PPIs deplete magnesium levels. If you're experiencing heartbeat irregularities, you should work with a cardiologist to rule out serious medical conditions, and ensure that you aren't deficient in magnesium.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/17536123
- Source: http://www.ncbi.nlm.nih.gov/pubmed/10689268

Irritability: Another symptom that can emerge as a result of magnesium deficiency is irritability. If your magnesium level remains deficient for an extended period of time, NMDA-coupled calcium channels will likely have remained open more than they should, and this can cause neural damage plus dysregulation, leading to onset of irritability. In particular, it seems as though magnesium deficiency takes a major toll on functionality of the HPA axis, whereby stress hormones are secreted in excess, sympathetic tone increases, and a person becomes irritable.

Onset of irritability stemming from deficient magnesium might also be related to CNS hyperexcitability. Hyperexcitability of the CNS is associated with increased release of excitatory neurotransmitters, especially acetylcholine, which leads us to muscle tension, restlessness, jitters – and corresponding irritability. A report by Nuytten, Van Hees, Meulemans, and Carton (1991) suggests that magnesium deficiency is a cause of CNS irritability, which can promote seizure occurrence in epileptics.

Eby and Eby (2006) discussed the fact that magnesium deficiencies can yield neuropsychiatric symptoms of irritability and depression. It appears as though administration of 125-300 mg of magnesium with each meal throughout the day, plus at bedtime, can alleviate many neuropsychiatric symptoms resulting from the deficiency. Though low magnesium may not be the standalone cause of irritability, increasing magnesium intake can help stabilize brain activity and may reverse unwanted irritable emotion.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/1919610
- Source: http://www.ncbi.nlm.nih.gov/pubmed/16542786

Memory deficits: As was already mentioned, magnesium deficiency can accelerate cognitive decline and impair overall cognitive performance. An aspect of cognition that is significantly affected by magnesium deficiency is memory. If you aren't getting enough magnesium in your diet, you may notice that you have a difficult time consolidating new memories, as well as that your ability to retrieve short-term and long-term memories is compromised.

Research suggests that dietary magnesium intake affects how much magnesium crosses the blood brain barrier. Lack of magnesium in the brain leads to over-expression of inflammatory cytokines (e.g. TNF-alpha), dysfunction of NMDA receptors, and abnormal HPA axis function – each of which can interfere with memory processing. Studies in rats suggest that endogenous magnesium concentrations are directly correlated with memory, such that, the greater the magnesium level, the better the recognition and spatial memory performance.

Favorably, it appears as though normalization of magnesium levels (among those with a deficiency) restores memory function. Research by Slutsky, Abumaria, Wu, et al. (2010) found that supplementation with magnesium-l-threonate significantly improves working memory and long-term memory in rats through modulation of activity in hippocampal subregions (DG & CA1). Anyone with poor memory function should consider that lack of magnesium might be an underlying cause.

- Source: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4890594/
- Source: http://www.ncbi.nlm.nih.gov/pubmed/20152124

Muscle aches, cramps, pains: A symptom that's sometimes reported among individuals with a magnesium deficiency is muscle aches and/or cramps. Professionals Bilbey and Prabhakaran (1996) suggest that magnesium deficiency may be more common than suspected, and outline case reports in which low magnesium is directly associated with muscle cramps. The first case report presented involved a 17-year-old military recruit who experienced aches throughout his muscles and thighs accompanied by tenderness.

He admitted to over-exercising with running, weight lifting, sprints, and swimming – which lead to wobbling of his legs, weakness, and acute spasms. Upon medical analysis, the only irregularity appeared to be low magnesium (0.54 mmol/L). The individual was treated with intravenous infusions of magnesium sulfate over a period of several days and completely recovered from his muscle aches within 4 days.

A second case report involved an 81-year-old woman who was admitted to the hospital with severe abdominal cramping, pain in her lower limbs, swollen ankles, and spasms. Medical professionals realized that her muscles felt like "putty" and none of the initial treatments prescribed helped alleviate the problem. Further laboratory analysis suggested her serum magnesium levels were 0.49 mmol/L to 0.51 mmol/L, and thereafter, intravenous magnesium infusions alleviated her pain within 3 days.

There are many reasons as to why someone may be prone to muscle aches, pains, and cramps if deficient in magnesium. Sufficient magnesium within the body promotes muscle relaxation and prevents excessive muscle tension by inhibiting secretion of acetylcholine, reducing inflammation, and attenuating excessive levels of excitatory agents. In the event that you have unexplainable muscle aches and/or cramps that don't respond to traditional interventions, you may want to ensure that a magnesium deficiency isn't the cause.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/8754704

Nausea: In 1990, researchers Hashizume and Mori documented that an early symptom of magnesium deficiency is nausea. It is unknown as to whether nausea is a very common symptom of magnesium deficiency, however, it can emerge in a subset of individuals lacking magnesium. For most who are deficient in magnesium, the intensity of the nausea may be contingent upon the severity of the magnesium deficiency such that a severe deficiency would lead to more intense nausea.

Assuming you're feeling nauseous and have ruled out major medical conditions and/or side effects from substances you take (e.g. medications, supplements, etc.) as potential causes of your nausea, insufficient dietary magnesium intake might be to blame. In extreme cases, the nausea you experience from insufficient magnesium may become so severe that it leads to vomiting. At this point, you may mistake the nausea for some sort of chronic illness of unknown origin, and may fail to realize that it was caused by lack of dietary magnesium.

The induction of nausea from chronically insufficient magnesium intake may be related to biological changes that occur from lack of magnesium including: increases in proinflammatory cytokines, oxidative stress, glutamate binding to NMDA receptors, HPA axis dysregulation, and acetylcholine secretion. For example, HPA dysregulation can provoke severe anxiety, and this anxiety may lead to panic, hyperventilation, and nausea. By increasing dietary intake of magnesium

and/or strategically administering supplemental magnesium, nausea resulting from an underlying magnesium deficiency should diminish.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/2273620/

Paresthesia: A symptom of magnesium deficiency that many report experiencing is paresthesia or an abnormal physical sensation. There are many types of paresthesias that a person deficient in magnesium might experience including: tingling and prickling (i.e. "pins and needles"), burning or coldness, skin crawling, itching, or even numbness. The paresthesia that you experience may be confined to a particular bodily region (e.g. chest) or may be widespread throughout your entire body.

It is also possible that you may experience different types of paresthesias at specific times and/or that the areas of your body affected by paresthesia change over time. There's no one specific reason as to why an individual who's low on magnesium may experience paresthesia. Several plausible explanations for paresthesia resulting from a magnesium deficiency are: excessive acetylcholine secretion throughout the CNS, dysregulated brain activity (e.g. HPA axis), inflammation, vasoconstriction (and increased blood pressure), and anxiety.

If your particular paresthesia was caused by insufficient dietary magnesium intake, you may find that they subside upon normalization of magnesium levels. Enya, Kanoh, Mune, et al. (2004) discussed a case in which, a woman with Gitelman syndrome (a condition associated with imbalanced ions – including magnesium within the body) experienced paresthesia, and that administration of magnesium sulfate attenuated the paresthesia. Other cases of individuals experiencing paresthesias (usually in the extremities) from hypomagnesemia have been reported in medical literature, supporting the idea that lack of magnesium can cause paresthesia.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/15206555

Personality changes: It's possible that some individuals with magnesium deficiencies could exhibit personality changes as a symptom. In most cases, personality changes associated with a magnesium deficit won't be overly significant or noticeable, but for others, friends and/or family may detect significant changes over a period of months (or years). Assuming the magnesium deficiency didn't occur until adulthood, it's possible that any corresponding personality change is reversible by normalizing magnesium levels.

That said, it's unclear as to whether chronically low magnesium among teenagers without fully developed brains would deleteriously alter neural development and have long-term consequences – some of which may be associated with personality. We know that if a person is deficient in magnesium, it can take a toll on their arousal, behavior, cognitive function, and emotional status – each of which influence personality. Chronically low magnesium yields significantly different neurological and physiological activity than adequate magnesium levels, ultimately affecting personality.

In 1986, Henrotte reported that Type A behavior was associated with magnesium deficiency. Persons with a Type A personality were more sensitive to stress and generate greater levels of catecholamines than individuals with a Type B personality. As a result of the stress sensitivity, those with Type A personalities tend to lose more intracellular magnesium, which further exacerbates the Type A traits (such as stress sensitivity).

Essentially what Henrotte realized is that magnesium deficiency can amplify Type A personality traits, perhaps to a greater extent than necessary. Research by Kopitsyna, Grishina, Torshin, et al. (2015) documented that low plasma magnesium levels are associated with statistically significant risk for: borderline personality disorder, schizotypal disorder, and affective disorder. Correction of the underlying magnesium deficiency seems to improve unfavorable personality features for some individuals.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/3523058

- Source: http://www.ncbi.nlm.nih.gov/pubmed/26978056

Restless leg syndrome (RLS): The condition restless leg syndrome (RLS) may emerge for some individuals as a symptom of magnesium deficiency. Restless leg syndrome is characterized as ongoing or intermittent bouts of twitching, tickling, or tingling within the leg muscles while sitting or lying down, which are alleviated through [restless] leg movements. It should be noted that the general feeling of restlessness throughout the entire body might also occur due to low magnesium intake.

As was already discussed, lack of magnesium may induce CNS hyperactivity as a result of failing to keep acetylcholine secretion in check, which could lead to restless leg syndrome and/or general restlessness. It has also been shown that insufficient magnesium causes HPA axis dysregulation, which in turn induces anxiety and hyper-emotionality. Anxiety and hyper-emotionality upregulate production of stress hormones, possibly inducing an uncomfortable state of restlessness in which a person finds it difficult to sit still.

Not only are there plausible mechanisms by which a magnesium deficiency may induce restless leg syndrome, but it appears as though administration of magnesium could alleviate restless leg syndrome among sufferers. Bartel and Zallek (2006) propose that intravenous magnesium sulfate could attenuate pregnancy-related RLS. Hornyak, Voderholzer, and Hohagen (1998) document that oral magnesium therapy ameliorates moderate symptoms of restless leg syndrome.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/17557494
- Source: http://www.ncbi.nlm.nih.gov/pubmed/9703590

Seizures: Some individuals could experience seizures as a result of a severe magnesium deficiency. Without adequate magnesium, voltage-dependent calcium channels aren't sufficiently antagonized, membrane depolarization occurs, and NMDA glutamate receptors are prone to activation (leading to irregular activity within neuronal networks accompanied by bursts of action potentials) – possibly making a subset of the population more prone to seizures. Although seizures are not a common symptom of magnesium deficiency, they have been reported among persons with hypomagnesemia.

Research by Chaistitwanich, Mahoney, and Hendricks (1987) suggests that audiogenic seizures occur in rats fed diets lacking magnesium and calcium. The researchers concluded that serum magnesium concentrations were the most important determinant of seizure susceptibility. Other work by Leaver, Parkinson, and Schneider (1987) documented that low magnesium intake in sheep reduces calcium and affects parathyroid hormone function, all of which increased susceptibility to convulsions.

Case reports presented by Nuytten, Van Hees, Meulemans, and Carton (1991) suggest that magnesium depletion can cause acute, intractable seizures in humans. Yuen and Sander (2012) noted that magnesium may modulate seizure activity through the NMDA receptor, and hypothesized that magnesium supplementation could minimize the occurrence of seizures among patients with epilepsy. Unless your magnesium level is extremely low, seizures are unlikely to occur, however, if you have a condition whereby you're more susceptible to seizures than usual, deficient magnesium might increase seizure frequency.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/3659067
- Source: http://www.ncbi.nlm.nih.gov/pubmed/3677481
- Source: http://www.ncbi.nlm.nih.gov/pubmed/1919610
- Source: http://www.ncbi.nlm.nih.gov/pubmed/22406257

Sleep disturbances: Inadequate magnesium intake can wreak havoc on a person's circadian rhythm, sleep quality, and cause sleep disturbances. When magnesium levels are low, numerous neurological and physiological changes

occur that might disturb sleep including: overstimulation of the NMDA glutamate receptors, HPA axis dysregulation, upregulation of inflammatory markers, acetylcholine secretion, and release of stress hormones (CRH, ACTH, etc.). Research by Depoortere, Françon, and Llopis (1993) shows that magnesium deficiency in rats yields increased wakefulness at the expense of slow wave sleep (SWS).

Within 9 weeks of the magnesium deficiency, researchers discovered that the sleep in rats becomes highly disorganized, in part due to neuronal hyperexcitability. Durlach, Pagès, and Bac (2002) note that magnesium deficiency affects the suprachiasmatic nucleus and pineal gland to adversely modulate our biological clock. Specifically, they propose that a lack of magnesium interferes with sleep by altering generation of serotonin, melatonin, reactive oxygen species (ROS), GABA, taurine, and nitric oxide (NO).

Other research suggests that magnesium deficiency induces sleep disturbances chiefly through downregulated production of melatonin. It has also been reported that magnesium plus zinc enhance melatonin formation through binding to the enzyme AANAT (aralkylamine N-acetyltransferase) which is highly correlated with biorhythms. Decreased melatonin production may lead to onset of CNS hyperexcitability, anxiety, delayed sleep phase syndrome, insomnia, etc.

An investigation by Abbasi, Kimiagar, and Sadeghniiat (2012) discovered that magnesium supplementation in elderly patients significantly increased sleep time, sleep efficiency, and melatonin production – and simultaneously decreased sleep onset latency and serum cortisol levels. In this study, researchers believed that sleep improvements from magnesium supplementation were mediated via NMDA antagonism and GABA agonism. An earlier study by Nielsen, Johnson, and Zeng (2010) reported that magnesium supplementation enhanced sleep quality among adults, while simultaneously reducing inflammation (CRP levels).

In summary, anyone experiencing a magnesium deficiency is likely to exhibit disturbed sleep through numerous (potentially individually-exclusive) mechanisms. Sleep disturbances are likely to be more extreme among persons with a long-term and/or severe magnesium deficiency. Ensuring consistent dietary magnesium intake and/or administering magnesium supplements while deficient should ameliorate sleep abnormalities resulting from a deficit.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/8232845
- Source: http://www.ncbi.nlm.nih.gov/pubmed/12030424/
- Source: http://www.ncbi.nlm.nih.gov/pubmed/23853635
- Source: http://www.ncbi.nlm.nih.gov/pubmed/21199787

Weakness: The symptom asthenia, characterized by abnormal weakness and/or a lack of physical energy, often occurs as a result of magnesium deficiency. Individuals who are deficient in magnesium over an extended duration may feel as if their muscle mass decreased and/or as if their overall strength has declined. While some weakness may be related to sheer laziness, inactivity, and/or old-age, it is known that bone loss can occur when a person remains chronically deficient in magnesium.

Animal models with abnormally low serum magnesium exhibit impairments in bone formation and increases in skeletal fragility, each of which could result in objective and subjective weakness. Weakness stemming from bone abnormalities may be due to several biological changes that occur in a state of magnesium deficiency, including: decreased parathyroid secretion, lower vitamin D levels, increased inflammation, upregulated RANKL, and downregulated OPG. These biological changes impair bone synthesis while bolstering bone resorption via osteoclasts, thereby reducing bone size and density.

A paper by Caddell (2001) hypothesizes that cases of magnesium deficiency can contribute to SIDS (Sudden Infant Death Syndrome) due to weakness from impaired muscle strength, ultimately preventing them from turning their body

during sleep. While most individuals who are deficient in magnesium will not experience severe bone loss to cause weakness, an ongoing deficiency (even if minor) could cause mild-to-moderate weakness. Fortunately, it appears as though correcting a magnesium deficiency by including more magnesium in the diet and/or with supplementation can restore strength fairly quickly.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/11300621

Vomiting: Although a less common symptom of deficient magnesium, some individuals may become so nauseous that they experience intermittent and/or uncontrollable bouts of vomiting. It isn't known as to why magnesium deficiency can trigger vomiting in a subset of the population, however, numerous biological changes that occur among those who are deficient in magnesium may be to blame, including: HPA axis dysregulation, increased inflammatory cytokines and eicosanoids, elevated reactive oxygen species (ROS), and abnormally high levels of excitatory neurotransmitters.

For some individuals, hypomagnesemia (lack of serum magnesium) directly generates a vomiting response. An experimental study by Shils (1969) depleted humans of magnesium for deliberate induction of hypomagnesemia, and reported vomiting (along with nausea, weakness and apathy) as common symptoms. In other persons, it is likely that the biological changes associated with deficient magnesium can indirectly provoke vomiting through primary side effects such as anxiety and nausea, such that when the primary side effects become severe enough, vomiting occurs.

For example, let's say someone's stress response is overactive due HPA axis dysregulation stemming from magnesium deficiency. The high stress response may cause severe anxiety or panic episodes plus hyperventilation, leading to onset of nausea, which in turn triggers the vomiting. Restoration of magnesium levels through meeting the dietary RDA and/or supplementation should end vomiting that occurred as a symptom.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/5763574

Note: Keep in mind that symptoms of magnesium deficiency may be subject to individual variation, as well as degree of severity. Extreme symptoms such as vomiting and personality changes do not usually occur with a modest-to-moderate deficiency, but may occur among those with a severe deficiency. If you suspect that you may have a magnesium deficiency, it's best to get your levels checked by a medical professional and increase your dietary magnesium intake to counteract the symptoms. Should you have another symptom to report that wasn't mentioned on the list above, share it in the comments section below.

Variables that influence magnesium deficiency symptoms

There are 2 primary variables that influence the severity of symptoms that you're likely to experience from a magnesium deficiency, including: significance of the deficiency AND duration of the deficiency. Individuals who are significantly deficient in magnesium should exhibit a greater number of deficiency-related symptoms, plus more severe symptoms, than those who are negligibly deficient. Moreover, someone that's been deficient for a short-term (e.g. 1 week) is unlikely to endure as many severe deficiency-related complications as a person who's been deficient for a longer-term (e.g. 1 year).

1. Significance of deficiency

The significance of your magnesium deficiency will play a substantial role in determining: how many deficiency-related symptoms you experience, the specific symptoms that emerge, as well the respective severities of each symptom. Someone with a severe magnesium deficiency will notice more debilitating symptoms than a person with a moderate deficiency. Similarly, a person with a moderate deficiency will experience a greater number of symptoms than an individual with a mild/negligible deficiency.

How can you determine the severity of an underlying magnesium deficiency? The best way is through a magnesium EXA test. Although most professionals may recommend serum tests to assess for a magnesium deficiency, serum tests are problematic in that less than 1% of the body's total magnesium circulates in the plasma. An EXA test will reveal magnesium deficiencies throughout the body such as in the cells, bones, and muscles – and more accurately depict your magnesium status.

- **Mild**: Individuals with a mild magnesium deficiency may not experience any symptoms, especially if they've only been deficient for a short duration. If you are consuming some magnesium via your diet, but are barely deficient, you probably won't notice much of anything. Other individuals with a mild deficiency may notice subtle symptoms such as: slight fatigue, increased stress, and/or sleep changes. Although mild deficiencies are easiest to reverse, they are usually most difficult to detect among the general population because symptoms are not severe enough for an individual to suspect a magnesium deficiency and/or pursue magnesium testing.
- **Moderate**: For most individuals, a moderate magnesium deficiency should induce more severe symptoms compared to a mild deficiency. Those with moderate magnesium deficiencies will likely sense that something is wrong with their general health. A moderate deficiency may lead a person to visit a doctor to rule out serious medical conditions. At the doctor visit, he/she may report a barrage of vague symptoms such as: anxiety, fatigue, sleep issues, weakness, etc. The problem is that, unless an EXA test is administered, a professional may assume that a patient is solely dealing with a psychiatric issue. Individuals with moderate magnesium deficiencies may use medications and/or supplements in attempt to cope with the myriad of symptoms they experience, yet may never suspect that low magnesium is the culprit.
- **Severe**: Anyone with a severe magnesium deficiency is likely to experience very noticeable and/or debilitating symptoms. When an individual is severely deficient in magnesium, especially over a long-term, he/she may experience symptoms that would've never occurred among those with mild or moderate deficiencies. Examples of symptoms that may emerge in more severe deficiencies include: vomiting, osteopenia, seizures, panic attacks, and ongoing insomnia. Consultation with a doctor about these symptoms may lead to several diagnoses such as: generalized anxiety disorder (GAD), restless leg syndrome (RLS), chronic insomnia, and osteoporosis – each of which may end up treated with pharmaceutical medication because the magnesium deficit remains undetected.

2. Duration of deficiency

Although the significance of a person's magnesium deficiency may have a big impact on determining the severity and/or number of deficiency-related symptoms that are experienced, the cumulative duration of a deficiency also warrants consideration. For example, someone with a moderate magnesium deficiency for one day as a result of vomiting, diarrhea, and/or high-dose calcium supplementation may not notice many symptoms of magnesium deficiency. On the other hand, someone who maintains a magnesium deficiency for several weeks, months, or years will endure more severe symptomatic consequences due to the fact that biological functions will have been impaired for an extended duration.

- **Short-term**: A short-term magnesium deficiency should yield fewer severe side effects than a long-term deficiency. Although an extreme depletion of magnesium over a short-term can cause side effects, many of the unwanted symptoms resulting from magnesium deficiency require time to reach peak severity. As an example, researchers have discovered that dietary magnesium deficiency impairs sleep, but the most extreme changes in sleep architecture (e.g. diminished slow wave sleep) don't occur until 9-weeks post-deficiency. Another example to consider is the magnesium deficiency symptom of osteopenia (bone loss). Osteopenia won't be noticeable within just a day or two of the magnesium deficiency, rather, it'll probably take several months (or longer) for it to become very noticeable. As a general rule of thumb, assume that symptoms will be milder if the deficiency has only occurred for a brief duration.
- **Moderate-term**: A magnesium deficiency that occurs for a moderate-term such as several weeks or months

should generate more severe and/or noticeable symptoms than a shorter-term deficiency. After a few months of a severe deficiency, neural activity may be severely dysregulated, some bone loss and/or muscle weakness may be apparent, and/or you might experience more prominent mood changes (e.g. agitation, anxiety, depression, etc.). The symptoms of a magnesium deficiency will have compounded over a moderate duration, making them more difficult to manage.

- **Long-term**: The most severe symptoms resulting from magnesium deficiency tend to emerge after a long-term. Assuming someone fails to detect that he/she is deficient in magnesium for a duration of years, the consequences may be extreme. Persons who are chronically deficient in magnesium will likely exhibit a profoundly different neurobiological signature than if normative magnesium stores were maintained. Magnesium protects and stabilizes brain activity, and when a person is deficient over an extended duration, CNS function, brain activity/connectivity, and neurotransmission are altered. Over the long-term, these changes accumulate and potentiate neuronal damage, imbalanced neurotransmitters, and dysfunction within various regions of the brain. Symptoms of long-term magnesium deficiency are more difficult to reverse and may be irreversible if the deficiency was extreme and/or occurred for years during a critical developmental period (e.g. adolescence).

Note: Understand that both the severity and duration should be taken into account synergistically when attempting to understand the magnesium deficiency symptoms that you're experiencing, as well as their respective severities. A significant deficiency for a long-term is likely to yield more debilitating symptoms than: a modest deficiency for a long-term OR a severe deficiency for a short-term.

What causes a magnesium deficiency?

There are several possible reasons that you might end up with a magnesium deficiency including: inadequate dietary magnesium intake, poor absorption of consumed magnesium, and/or depletion of preexisting magnesium stores. The most common reason someone might end up with a magnesium deficiency is related to inadequate intake of magnesium from highly bioavailable sources. Nonetheless, there are cases in which magnesium might be subject to accelerated depletion as a result of lifestyle choices, medical conditions, and/or pharmaceutical medications.

Inadequate dietary intake: A major reason that most people are deficient in magnesium is because they aren't consuming magnesium-rich foods. The stereotypical "standard American diet" (SAD), or what the majority of U.S. citizens consume includes: meats, refined carbohydrates, sodas, sugars, and processed foods. – most of which contain a paltry or negligible quantity of magnesium and/or may deplete preexisting magnesium stores. Among the most efficient means of attaining magnesium is by consuming cooked or pureed magnesium-rich foods (e.g. spinach) with other foods that enhance nutrient bioavailability (e.g. medium-chain triglycerides).

Consumption of steamed leafy veggies on a daily basis should help most avert a magnesium deficiency because magnesium contents within the leafy greens is highly bioavailable, meaning it can be easily absorbed by the body. Furthermore, approximately 2 cups of spinach provides ~320 mg magnesium (enough to meet the RDA for adult women) and 3 cups provides ~480 mg magnesium (more than enough for adult men). Why are many people deficient in magnesium? Probably because they aren't eating many leafy greens. Included below is a list of foods richest in magnesium, but keep in mind that, while contents of magnesium may appear high, bioavailability might be low.

- *Buckwheat flour (4 oz) = 250 mg*
- *Oats (4 oz) = 235 mg*
- *Halibut (4 oz) = 107 mg*
- *Brown rice (1/2 cup) = 86 mg*
- *Spinach (1/2 cup) = 80 mg*
- *Almonds (1 cup) = 78 mg*
- *Swiss chard (1/2 cup) = 75 mg*

- *Lima beans (1/2 cup) = 63 mg*
- *Peanut butter (2 tbsp) = 50 mg*
- *Black-eyed peas (1/2 cup) = 45 mg*
- *Low-fat milk (1 cup) = 40 mg*
- *Whole wheat bread (1 slice) = 25 mg*

Poor magnesium absorption: Magnesium is absorbed through the gastrointestinal (GI) tract or a pathway that encompasses the mouth, esophagus (throat), stomach, small intestine, and large intestine. When you chew food, the act of chewing increases bioavailability of magnesium contents, and upon swallowing the food, gastric acids within the stomach are secreted as part of digestion. During digestion, approximately 40% of magnesium is absorbed within the small intestine where it passes through tiny, elongated projections called "villi" into capillaries (blood vessels).

Thereafter, around 5% of ingested magnesium that wasn't absorbed from the small intestine is absorbed by the large intestine. The remaining 55% of magnesium ingested could exit the body as unabsorbed waste product. It is important to emphasize that the bioavailability of ingested magnesium will influence how much is absorbed within the body – certain magnesium-rich foods and/or magnesium supplements exhibit extremely low absorption percentages (e.g. 5%-20%), whereas others may exhibit absorption percentages above 55%.

As was mentioned, approximately 57% of the U.S. population fails to consume the recommended daily allowance (RDA) of magnesium. Even among the 43% of individuals that meet the recommended daily allowance of magnesium, it is unclear as to whether they are fully absorbing the magnesium that they consume. Some theorize that, in most cases, individuals absorb between 20% and 50% of ingested magnesium.

This suggests that a majority of magnesium contents within foods isn't efficiently utilized by the body, and could potentially lead to a deficiency. To put things in perspective, you might consume 16 ounces of halibut and assume that your body absorbed and utilized ~428 mg of magnesium, easily meeting the RDA. However, it may turn out that your body only absorbed ~50% of the magnesium contents within your halibut (around 214 mg).

This inefficient absorption could lead to a mild magnesium deficiency even among those who critically assess their magnesium intake in accordance with nutritional labels. For example, although you might suspect that a few cups of oats (containing ~235 mg per 4 oz) provides sufficient magnesium for one day, the bioavailability of magnesium within oats is poor. Oats are known to contain antioxidant compounds known as "phytates" which are bound to magnesium (and other nutrients) and cannot be digested by humans.

As a result, the amount of absorbed magnesium within oats may be lower than consumer expectations. On the other hand, consumption of pureed/steamed spinach (containing ~80 mg per ½ cup) will exhibit a high bioavailability due to lack of phytates and cooking. Nevertheless, even highly bioavailable magnesium-rich foods won't exhibit 100% absorption rates, meaning you might need to consume more magnesium than expected to minimize odds of a deficiency.

Furthermore, it is necessary to account for the fact that co-ingested foods may influence magnesium absorption. Some foods that may bolster magnesium absorption include: fermentable fibers, fructose, medium-chain triglycerides, and certain proteins. Additionally, it is known that a low pH within the GI tract (indicative of acidity) and adequate vitamin D levels improve magnesium absorption, whereas high pH in the GI tract (alkaline) and low vitamin D interfere with magnesium absorption.

What's more, foods can interfere with magnesium absorption, including: insoluble fibers, oxalate-rich foods, phosphoric acid-containing foods, and phytate-rich foods. Beverages such as alcohol, coffee, and tea can impair magnesium absorption by inflaming the intestines and/or inducing diuretic effects. Other things such as: aging, genetic disorders,

GI dysfunction, kidney dysfunction, and stress can also compromise dietary magnesium absorption.

Consumption of certain minerals such as: calcium, copper, iron, manganese, and phosphorous – also impair absorption of magnesium. Knowing that many foods don't contain highly bioavailable magnesium (due to phytate contents), and considering that absorption of magnesium is often poor as a result of alcohol consumption, certain foods, medical conditions, other minerals, etc. – it makes sense that deficiencies are common in part due to poor absorption.

Accelerated magnesium excretion: In addition to insufficient magnesium intake via diet and poor magnesium absorption as causes of a magnesium deficiency, some individuals might end up with magnesium deficiency as a result of an accelerated magnesium excretion rate. Although it was mentioned earlier that around 45% of magnesium is absorbed by the small intestine and 5% is absorbed by the large intestine, the kidneys act as a barrier to help your body conserve existing magnesium stores prior to complete elimination.

Of the magnesium that undergoes renal filtration, approximately 95% is reabsorbed within the body and just 5% is excreted within the urine. That said, magnesium excretion can be accelerated due to impaired renal filtration and/or reabsorption resulting from lifestyle choices and medical conditions. If your body isn't properly conserving its preexisting magnesium stores through renal filtration and/or reabsorption, a magnesium deficiency is likely to occur even if you're meeting the recommended daily allowance.

Included below is a list of things/conditions that may accelerate the elimination of magnesium and/or interfere with its reabsorption:

- *Alcohol*: Consumption of alcohol doubles the excretion rate of magnesium, regardless of whether alcohol is consumed acutely or chronically. Individuals who drink alcohol regularly are at increased risk of magnesium deficiencies. It is believed that alcohol inflames the intestinal lining, whereby magnesium isn't properly absorbed from the diet, and simultaneously induces a diuretic effect to facilitate accelerated magnesium excretion.
- *Caffeine*: Regular high-dose consumption of caffeine in the form of coffee and/or tea can interfere with your body's ability to retain magnesium. Caffeine is understood to induce bowel movements and frequent urination. As a result, magnesium may be subject to malabsorption, as well as accelerated elimination. Anyone consuming high amounts of caffeine on a daily basis is at higher risk for a magnesium deficiency – especially if the caffeine is ingested along with magnesium-rich foods and/or a supplement.
- *Diabetes*: Individuals diagnosed with diabetes (both Type 1 & 2) exhibit higher-than-average rates of magnesium excretion for multiple reasons. Persons with diabetes are more likely to exhibit varying degrees of renal dysfunction, and as a result, more magnesium is excreted at a quicker rate than usual. Additionally, it is thought that elevations in blood sugar (e.g. hyperglycemia) increases loss of urinary magnesium.
- *Gastrointestinal disorders*: Many gastrointestinal disorders including: Chron's disease, IBS (irritable bowel syndrome), IBD (inflammatory bowel disease), SIBO (small intestinal bacterial overgrowth) and others – often accelerate the fecal excretion of magnesium and impair its absorption. Individuals with gastrointestinal disorders tend to exhibit intestinal inflammation, altered gastric motility, and diarrhea – all of which might lead to rapid magnesium loss. For this reason, it is often necessary for individuals with GI issues to consume magnesium at levels much higher than the RDA.
- *Excessive sweating*: Anything capable of inducing excessive and/or profuse sweating such as: high ambient temperature, hyperhidrosis, physical exercise, or sauna usage – can deplete preexisting magnesium stores quicker than expected. Although sweating won't eliminate as much magnesium as diarrhea or frequent urination, it might deplete magnesium stores (as well as other electrolytes) quicker than expected, ultimately causing a deficiency.
- *Medications*: Many classes of pharmaceutical drugs are understood to either speed up magnesium elimination and/or impair its absorption. Examples of medications that may increase odds of a magnesium deficiency due to accelerated elimination include: ACE inhibitors, acid blockers, antacids, antibiotics, antiviral agents, CNS

stimulants, corticosteroids, diuretics, hormone replacement therapy, immunosuppressant agents, oral contraceptives, proton pump inhibitors, and more. If you're taking any pharmaceutical drug, you may want to talk to inquire a medical professional regarding whether it might impact your magnesium status.

- *Other medical conditions*: Persons with medical conditions associated with frequent diarrhea and/or vomiting will be at risk for moderate-to-severe magnesium deficiencies. Diarrhea and vomiting inhibit absorption of magnesium, expedite the elimination of already-absorbed magnesium, and prevent reabsorption of magnesium from the kidneys prior to excretion. For this reason, someone with severe diarrhea and/or vomiting may require magnesium intake much higher than the RDA to replenish losses and avoid a deficiency.
- *Prolonged fasting*: As was already mentioned, lack of dietary magnesium intake is the most common cause of magnesium deficiency. Individuals with eating disorders such as anorexia nervosa, or those who regularly engage in extended bouts of fasting (for health reasons, medical purposes, etc.) are not only at risk for a magnesium deficiency due to lack of intake, but they may experience a deficiency during a "reefed" when they decide to eat their next meal. Specifically, fasting depletes the body of intracellular magnesium stores, plus during a reefed, insulin secretion promotes cellular uptake of magnesium, phosphate, and water – ultimately depleting serum magnesium levels. For this reason, any individuals exhibiting signs of the condition known as "refeeding syndrome," is likely deficient in magnesium and other nutrients.
- *Stress*: Anxiety and stress are understood to activate the sympathetic branch of the autonomic nervous system, whereby catecholamine and stress hormone production are upregulated. As a result, the freeze-fight-flight response is generated and magnesium is released from blood cells into plasma for rapid urinary elimination. It is the rapid urinary elimination of magnesium that's responsible for magnesium deficiencies among those with long-term anxiety and/or stress. Additionally, stress can disrupt GI function and/or induce frequent urination, thereby impairing absorption and potentiating excretion, respectively. Moreover, anxiety/stress creates a vicious circle in which magnesium is inadequately absorbed and eliminated quicker than usual, plus it becomes more challenging for a person to eat magnesium rich foods (as a result of stress-related appetite changes).
- *Supplements*: Similar to pharmaceutical medications, dietary supplements may interfere with magnesium absorption while fast-tracking magnesium elimination. Any dietary supplements that cause diarrhea, affect GI function, and/or exert diuretic effects may reduce the duration of magnesium retention. There's some evidence to suggest that calcium supplementation, especially over an extended duration, can deplete the body of magnesium and induce a deficiency.
- *Syndromes*: Conditions such as Bartter syndrome and Gitleman syndrome are associated with magnesium deficiencies. Bartter syndrome is characterized by low potassium, high blood pH, and hypotension. It has been noted that some individuals with Bartter syndrome experience magnesium wasting, or renal excretion of magnesium greater than 1 mmol/day, resulting from chronic metabolic acidosis. Gitleman syndrome is a kidney disorder that can increase calcium reabsorption and decrease magnesium absorption, ultimately causing a magnesium deficiency.

Magnesium Deficiency Treatment: How to Increase Magnesium Levels

If you are currently deficient in magnesium, you'll want to assess the significance of the deficiency and make a conscientious effort to ameliorate the deficiency, ultimately normalizing your biological magnesium stores. This will involve testing your magnesium via a trusted laboratory, preferably with the guidance of a medical professional. A medical professional can help you interpret your laboratory results and recommend the most efficient and effective ways to optimize your magnesium levels. Though it may take awhile to perfectly optimize your magnesium stores, eventually the symptoms associated with your deficiency should subside.

1. ***Test your magnesium levels***: There are several ways to test for magnesium levels to determine the significance of your deficiency. The most accurate form of testing is the EXA (Energy Dispersive X-ray) test, whereas the least accurate way to test magnesium is the standard serum magnesium test. Another reasonably

accurate testing method involves analyzing magnesium concentrations within red blood cells (RBCs).

- EXA test: This is a non-invasive diagnostic test that measures intracellular concentrations of electrolytes, including magnesium. The test involves collecting a sample of buccal cells via scraping the inside of your cheek. These cells are then analyzed by professionals using Analytical Scanning Electron Microscopy (ASEM) or an Energy Dispersive X-Ray (EXA). Since up to 99% of magnesium is stored in soft tissue, EXA testing is superior to a standardized magnesium serum test.
- RBC test: The RBC test analyzes the concentrations of magnesium within your red blood cells. When levels of magnesium throughout the body are low, magnesium will be pulled from red blood cells to help normalize intracellular magnesium stores. For this reason, if your body is starving for magnesium, it'll show on the RBC test. If you don't have access to the EXA test, you may want to opt for the RBC.
- Serum test: Since around 1% of the body's total magnesium will be present within blood plasma, a serum test is not an accurate means of determining intracellular magnesium deficiency. Serum magnesium concentrations do not always correlate with intracellular magnesium, and for this reason, the serum test is fairly useless. Nonetheless, serum tests will reveal whether you're currently dealing with hypomagnesemia (low serum magnesium) or hypermagnesemia (high serum magnesium). (Read the following: http://www.ncbi.nlm.nih.gov/pubmed/20170394).

2. ***Assess deficiency***: Once you've tested your magnesium levels, it may take between several days and several weeks to get the results. You'll want to work with a medical professional with experience interpreting the data to determine the significance of your deficiency. A professional can help you come up with a strategy to increase your magnesium levels and reverse the deficiency. If you don't know the degree to which you are deficient, you may risk supplementing with too little or too much magnesium for your own good.
3. ***Increase magnesium intake***: Assuming your doctor has informed you of the degree to which you were deficient in magnesium, you can begin systematically increasing magnesium stores through diet and supplements. You'll want to consume foods with high magnesium concentrations that are prepared in such a way that your body can actually absorb the magnesium content. For example, you may want to chop and steam spinach, while adding some healthy fat to maximize absorption of magnesium (and other nutrients). Depending on the severity of your deficiency, you may also want to add a daily magnesium supplement. Several forms of magnesium that are considered useful for supplementation include: *magnesium glycinate, magnesium malate, magnesium chloride, magnesium citrate, and magnesium taurate*. That said, talk to your doctor to confirm bioavailability and safety of a particular supplement given your current medical status.
4. ***Avoid magnesium depleters***: Although you may ramp up your magnesium intake via diet and/or supplements, this might not make a big difference if you're depleting magnesium quickly. Things that deplete magnesium quickly include: alcohol and caffeine, diarrhea, dietary supplements (e.g. calcium), pharmaceutical drugs (e.g. contraceptives, proton pump inhibitors, psychostimulants, etc.) stress or anxiety, sweating, vomiting, and more. Medical conditions, if left untreated, such as: diabetes, hyperthyroidism, IBS, kidney disease, and ulcerative colitis can also deplete magnesium reserves. For this reason, you'll want to make an effort to avoid as many depleters as possible and/or offset their impact with additional magnesium intake.
5. ***Re-test magnesium status***: Assuming you've committed to increasing magnesium intake for awhile to reverse a deficiency, you'll eventually want to re-test your magnesium status to gauge the efficacy of your efforts. Re-testing your magnesium status is the only way to know how much your magnesium levels have increased since initial diagnosis of the deficiency. It doesn't make sense to re-test your magnesium levels too quickly (e.g. 1 week after supplementation), however, 2-6 months will be enough time to observe significant intracellular changes. Nearly everyone treating a magnesium deficiency should notice improvements on their lab work within a 2 to 6-month duration. That said, a subset of persons might be surprised to learn that they are still slightly deficient and need a bit more magnesium than initially suspected to treat the deficiency.
6. ***Maintenance of intake***: If attempting to treat a severe magnesium deficiency, a professional may initially advise taking larger doses of magnesium supplements to saturate your intracellular stores. Eventually, as your intracellular magnesium stores accumulate magnesium, you may be able to scale back on your magnesium supplementation and/or intake. After several magnesium and electrolyte panels, you should be able to come up with a maintenance dosing strategy to fit your specific magnesium needs. For example, in the early months of

correcting your deficiency, you may be supplementing with 600 mg magnesium per day. Once your deficiency is fully corrected, you may end up dropping down to a maintenance supplement dose of 200-300 mg per day along with spinach. You'll want to work with a professional to help you optimize a daily magnesium dose that fits your individual needs.

7. ***Symptoms should subside***: In many cases, persons with magnesium deficiencies will experience significant symptomatic reduction within the first couple weeks of increasing their magnesium intake (through diet and supplementation). That said, the length of time necessary for noticeable symptomatic reduction and/or complete cessation will be subject to individual variation. Some individuals will notice symptomatic improvement within a few days and full abatement within weeks. Others may report that their symptoms improve within a few weeks, but fully cease after several months of increasing magnesium intake. Within 6 months, nearly all individuals who are properly treated should've completely recovered from their magnesium deficiency. If you're still experiencing symptoms after 6 months, you may have been improperly treated OR your symptoms may be unrelated to your magnesium levels.

Have you experienced a magnesium deficiency?

If you've dealt with a magnesium deficiency, feel free to share your experience in the comments section below. To help others get a more accurate understanding of your situation, share some details such as: the underlying cause(s) of your magnesium deficiency (e.g. imbalanced diet, medical conditions, prescription drugs, etc.), whether you underwent testing (e.g. EXA) to confirm the deficiency, and a time estimation of how long you lived with the deficiency before suspecting it. What were some of the most debilitating symptoms you endured as a result of your magnesium deficiency?

Upon recognizing the deficiency, mention some of the steps you took to properly restore your magnesium levels from the previously-deficient state such as: consuming more magnesium-rich foods, taking magnesium supplements, reducing stress, etc. Also discuss how long it took for your magnesium deficiency symptoms to subside after treating the deficiency. Did you experience any unexpected positive changes from increasing your magnesium intake such as: improved cognition, reduced anxiety, stabilized mood, or deeper sleep?

What are some of your favorite magnesium-rich foods to consume and/or which format of magnesium supplement do you find to be most effective (or bioavailable) for reducing a deficiency? Understand that magnesium deficiency is likely more common than most professionals suspect and a severe deficiency can cause a host of debilitating symptoms that may overlap with other medical conditions. Nonetheless, even if you are deficient in magnesium, do not assume that every symptom you're experiencing is somehow related to the magnesium – always work with a professional to rule out serious health conditions.

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Carmen spence

December 24, 2017 at 1:43 pm

I HAVE been suffering from Crohns Disease for most of my adult life and now for the last 5 years, I am so depressed because I am continually breathless and cannot do much at all. On reading this extensive excellent article, I am going to start taking Magnesium Citrate daily, and pray that it will help my poor body survive in comfort.

Reply

Beryl

August 31, 2016 at 12:34 pm

Thank you for this extensive info, quite thorough and remarkable for a non-healthcare professional. I have many of the symptoms listed, and my doctor and I have been somewhat baffled as to what's been causing them, as most testing comes out well within normal ranges. Although certainly not definitive, this gives me a new avenue to pursue, including the EXA test. I have certainly noticed feeling calmer after eating green salad, but I don't eat salad nearly often enough.

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