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What Are the Key Micronutrients for Your Brain?

Analysis by Dr. Joseph Mercola Fact Checked | October 09, 2023

STORY AT-A-GLANCE

- Micronutrients refer to food-based vitamins and minerals your body requires for optimal functioning. The four primary types are water-soluble vitamins, fat-soluble vitamins, macrominerals and trace minerals
- Micronutrients catalyze enzymatic processes, have antioxidant activity and modulate your immune system
- Long-term micronutrient deficiencies can contribute to the development of neurodegenerative processes and neurological diseases such as Alzheimer's disease, Parkinson's disease, Huntington's disease and amyotrophic lateral sclerosis (ALS)
- Some of the most important micronutrients involved in Alzheimer's disease are vitamins A, B, C, D and E, selenium, copper, zinc, iron and manganese. In the case of copper, iron and manganese, elevated levels are typically the problem
- In the case of Parkinson's disease, key micronutrients include vitamins A, D, E, B1, B6, B9 and C

Micronutrients refer to food-based vitamins and minerals your body requires for optimal functioning, and even mild deficiencies can contribute to chronic disease. Micronutrients can be divided into four primary types:

- **Water-soluble vitamins such as B vitamins and vitamin C**
- **Fat-soluble vitamins such as vitamins A, D, E and K**

- Macrominerals such as calcium, magnesium, sodium and potassium (minerals your body needs in larger amounts)
- Trace minerals such as iron, zinc, copper and selenium (minerals your body needs in very small amounts)

Micronutrient Deficiencies Can Drive Neurodegeneration

A recent scientific review[1,2] published in the peer-reviewed journal Nutrients discusses the role of micronutrients in neurological disorders specifically, noting that long-term deficiencies may be involved in the cause and subsequent development of neurodegenerative processes and neurological diseases such as Alzheimer's disease, Parkinson's disease, Huntington's disease and amyotrophic lateral sclerosis (ALS).

As noted in this paper, the primary function of micronutrients is their "catalytic effect in enzyme systems, either as cofactors or as components of metalloenzymes." Other essential roles include antioxidant activity and immune modulation.

When you're deficient in micronutrients, especially long term, peripheral nerve damage and/or damage to the central nervous system can result, which in turn can contribute to a variety of neurological diseases, including Alzheimer's and Parkinson's.

Key Nutrients Involved in Alzheimer's Disease

While any number of nutrients can impact your risk for Alzheimer's disease, some of the most important players are vitamins A, B, C, D, and E, selenium, copper, zinc, iron and manganese. In the case of copper, iron and manganese, elevated levels are typically the problem. As explained by the authors:[3]

> *"Elevated levels of Hcy [homocysteine] are associated with cognitive impairment. Because of the involvement of vitamins B9, B12, and B6 in Hcy metabolism, hypovitaminosis of these vitamins [i.e., lack of these vitamins] lead to hyperhomocysteinemia [elevated homocysteine].*

Substitution of these vitamins helps to decrease the levels of Hcy. However, it has been reported that high doses of vitamins B9, B12, and B6 do not influence the cognition of patients with mild AD [Alzheimer's disease].

Other vitamins are also associated with AD pathogenesis: thiamine (B1) deficiency has been observed in patients with cognitive impairment, and supplementation improved the symptoms. Vitamin B12 has a direct effect on tau proteins — it inhibits their fibrilization. Vitamin B3 (niacin) may have protective properties against AD and other types of cognitive decline.

Prolonged treatment with vitamin E is in consideration as beneficial in the management of AD, but the outcome is still unclear. Vitamin A inhibits amyloid-β plaque formation.

Vitamin D hypovitaminosis is acknowledged as a risk factor for AD. The pathogenic and therapeutic effects of vitamin D are not yet fully known, but its neuroprotective and anti-inflammatory functions are crucial. It was proposed as a potential therapeutic option for individuals with AD.

Detection of copper can be useful when diagnosing and preventing AD. Significantly higher levels of copper have been found in the brain tissue of AD patients. Copper supports oxidative stress, and it induces neurofibrillary tangle formation by tau hyperphosphorylation.

Another element involved in the pathogenesis of AD is zinc. Low plasmatic levels of zinc are repeatedly associated with decreases in learning ability and memory. Zinc status affects the progression of AD.

The neurotoxicity of manganese can also be associated with AD: it influences the function of astrocytes and the synthesis and degradation of glutamate. Monitoring of manganese can be one of the strategies for preventing AD.

The correlation of higher selenium levels with higher cognitive abilities in the elderly was reported. It is also believed that selenium deficiency may be linked

to AD causation. Imbalance in iron metabolism and its accumulation also participates in AD development. One of the proposed novel strategies for Alzheimer's disease prevention is a diet rich in antioxidants."

Important Notes on Iron

Unfortunately, this review does not go into detail about iron. The key issue with iron is you don't want elevated iron levels. Most adults have excessive iron and do not need more.

Instead, they need to lower their iron, which is easily done by donating blood on a regular basis. What's more, low ferritin is typically a sign that **copper insufficiency is preventing proper iron recycling**. In this case, increasing copper will allow the stored iron to recycle, thereby correcting the problem. To learn more about the hazards of high iron and simple ways to screen for and lower it, please see "**Why Managing Your Iron Level Is Crucial to Your Health**."

Key Nutrients Involved in Parkinson's and ALS

In the case of Parkinson's disease, key micronutrients include:[4]

Vitamin A
Vitamin D — Has anti-inflammatory effects and lowers oxidative stress. Deficiency is associated with dopaminergic neuronal death. according to the authors, it's been "proven that adequate vitamin D serum levels might avoid Parkinson's disease onset and possibly improve clinical outcomes." Higher serum concentration of vitamin D has also been shown to improve motor symptoms, and getting at least 15 minutes or more of sunlight exposure per week is associated with a lower risk of Parkinson's

Vitamin E — Improves the function of the dopaminergic receptors, and higher levels are associated with lower Parkinson's incidence. Vitamin E-rich diets have been shown to be protective, reducing the risk of Parkinson's more than carotenoids or vitamin C

Thiamine (B1) — Low thiamine speeds up the degeneration of dopaminergic neurons. Thiamine and folate play important roles in the olfactory system, and many Parkinson's patients develop impaired taste and smell, which is indicative of a deficiency in one or both of these B vitamins

B6 — Low B6 is a known risk factor for Parkinson's

Folate (B9) — Elevated homocysteine is a risk factor for Parkinson's and induces dopaminergic neuron death in Parkinson's patients. B6, B9 and B12 help keep homocysteine levels in check

Vitamin C — Parkinson's patients routinely have lower plasma vitamin C levels than healthy controls

The featured paper also reviews the key micronutrients involved in ALS and other motor neuron diseases, myasthenia gravis (an autoimmune disorder affecting the neuromuscular junction), multiple sclerosis (MS), Huntington's disease (a neurodegenerative disorder resulting in involuntary movements and cognitive impairment), epilepsy, ischemic stroke, myopathy (a muscle disorder), neuropathy, restless leg syndrome and injuries to the central and peripheral nervous systems.

Signs and Symptoms of Nutrient Deficiency

In most cases, symptoms of micronutrient deficiencies do not become apparent until your body is severely depleted, and even then, they can be difficult to identify if there's no test available.

Oftentimes, symptoms are nonspecific, and include things like frequent infections and skin problems, and as your health deteriorates, more micronutrients are used up, thereby speeding up their depletion. Some micronutrient deficiencies do have more identifiable symptoms, though, such as:

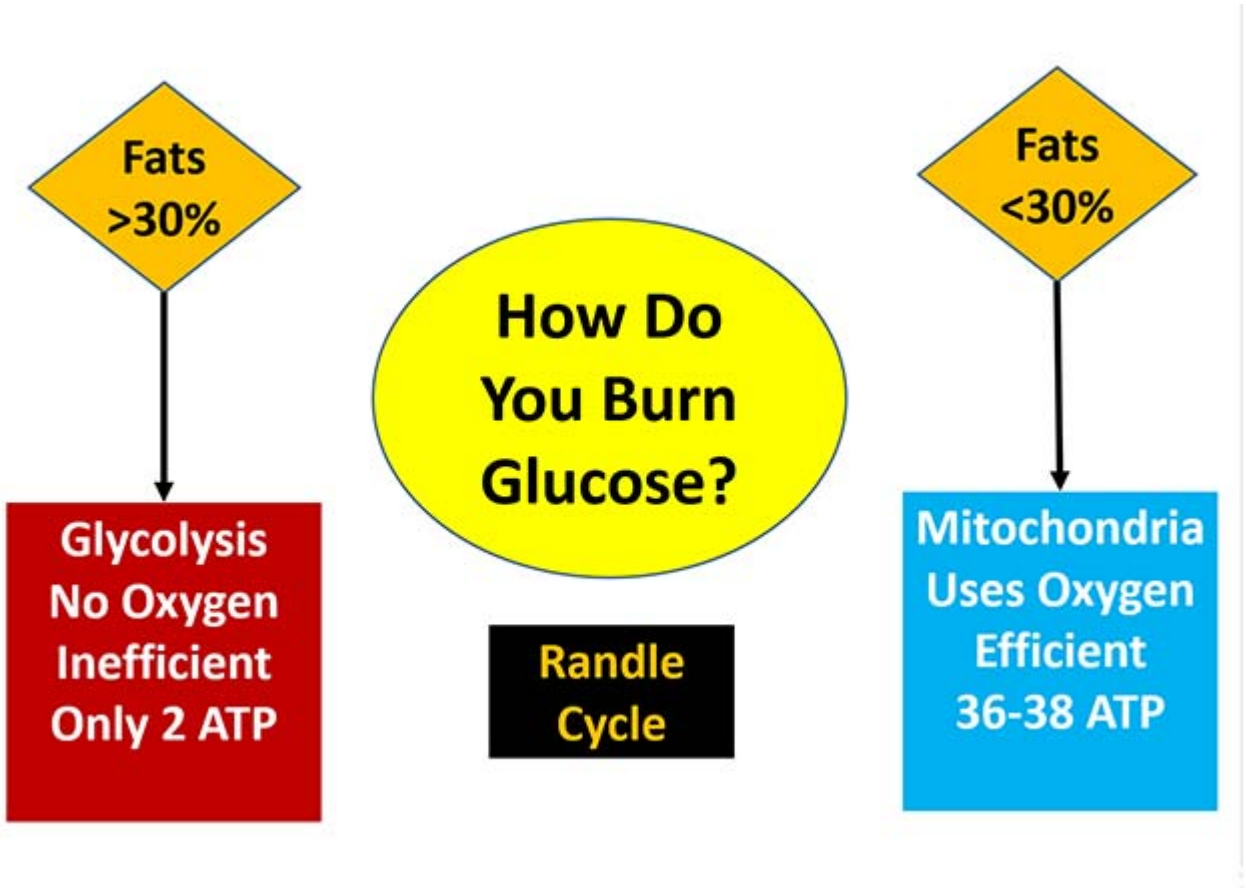
Anemia (iron, copper and/or B12 deficiency)	Scurvy (vitamin C)
Osteomalacia or softening of the bones (vitamin D)	Pellagra (niacin)
Hemorrhagic diseases (vitamin K)	Night blindness (vitamin A)

Your Brain Needs Glucose for Optimal Function

It's important to recognize that, of all the organs in your body, your brain has the highest energy requirement, and as you age, the mitochondrial genes that drive energy production become less active, leaving your brain more susceptible to disease.[5]

The mitochondria tend to be less dense and more fragmented, and generate much lower amounts of energy. That does not mean that neurodegeneration is a given, however. You can effectively prevent this fate by eating correctly and having a healthy lifestyle in general.

Free radicals catalyzed by excessive reactive oxygen species (ROS) formed at the level of the mitochondria are typically extremely harmful, and one of the most effective ways to minimize them is to make sure you're eating enough healthy carbs, such as fruit, because glucose is the optimal fuel for creating energy in your mitochondria.



Your mitochondria can only burn one fuel at a time — either fat or glucose. As illustrated above, fats are broken down in a process called beta oxidation into acetyl-co A, which gets fed into the Krebs cycle. Carbs are broken down to pyruvate, which cannot enter the electron transport chain until they are converted to Acetyl-Co-A by pyruvate dehydrogenase.

The key here is that there's a stealth switch that controls which of these fuels your mitochondria will burn. The switch has been given the name the Randle Cycle, but it is more helpful to visualize it as a railroad switch that changes the tracks of the train. The train can only travel down one track: not both. This is because only one type of fuel can be burned at a time.

> **“ Burning glucose in your mitochondria creates more energy and fewer ROS, raises your metabolic rate, and produces carbon dioxide, which protects against**

> **oxidative (reductive) stress and oxygenates cells. All of these things will help protect your brain function.”**

In a best-case scenario, you will metabolize, or burn, glucose in your mitochondria with minimal reductive stress. When you do this, you will only generate 0.1% ROS.

This route is also incredibly efficient at energy production, creating 36 to 38 adenosine triphosphates (ATP) for every molecule of glucose that is metabolized. However, for this to occur, you need to consume less than 30 to 40% of your calories as fat. When you consume significantly more than that amount, the switch changes to burn fat in your mitochondria and your ability to burn glucose will be impaired.

Chronically oxidizing fats as your primary fuel will also tend to increase your cortisol level, resulting in chronic inflammation, both of which accelerate the aging process.

So, in summary, burning glucose in your mitochondria creates more energy and fewer ROS, and raises your metabolic rate. It also produces carbon dioxide as a byproduct, which protects against oxidative (reductive) stress and oxygenates cells. All these things will help protect your brain function.

For more details about the Randle Cycle and how your metabolism works, see "Crucial Facts About Your Metabolism" and "Crucial Facts About Your Metabolism, Part 2."

Gut Problems Also Likely Cause of Parkinson’s Disease

A new study[6] in the October 2023 issue of Molecular Psychiatry showed that the presence of damaged mitochondrial DNA in the bloodstream is sufficient to cause all symptoms of Parkinson’s disease. The mitochondrial debris is then activated by the endotoxin (lipopolysaccharide) receptor TLR4.

Endotoxin is produced in your gut when you eat fermentable carbs that you are unable to digest in your stomach and small intestine. The carbs then travel to the large intestine,

where they fuel the growth of gram-negative bacteria that grow and die. When they die, the endotoxin in their cell wall is released, activating the TLR4 receptor.

The Ray Peat approach is to increase the amount of simple carbs in your diet so your mitochondria can be optimally fueled. But there is strict caution to avoid fermentable carbs for the very reason that they can create endotoxin and activate the TLR4 receptor.

When introducing carbs, it is important to do it slowly, and make sure you are not having digestive symptoms like belching, bloating or gas, which are signs that the carbs aren't being digested in your upper digestive system. If this is the case, you will need to use small amounts of fruit juices without pulp until your gut can digest the carbs without symptoms.

Lion's Mane Mushroom May Protect Your Cognitive Function

In addition to basic micronutrients, a number of other supplements can also help protect your cognitive function. One interesting one is lion's mane mushroom (Hericium erinaceus), which has a long history of use in traditional medicine.

Buddhist monks, for example, traditionally used lion's mane mushroom tea to enhance brain function and heighten focus. In modern times, several studies have confirmed lion's mane's neuroprotective and cognition-enhancing effects, including the following:

A 2023 study[7] found that Lion's mane extract can enhance memory by promoting neuron projections and connections to other neurons.

In a 2020 study,[8] patients with mild Alzheimer's disease who were given three 350-milligram capsules of lion's mane mushroom per day for 49 weeks improved their cognitive test scores.

An epidemiological study[9] published in 2017, which included 13,230 participants 65 years of age and older, found those who ate mushrooms at least once a week had "a lower risk of incident dementia, even after adjustment for possible confounding

factors." The greatest risk reduction was among those ate mushrooms three times or more per week.

A similar but smaller study[10] published in 2019 reported that those who ate the most mushrooms had a 43% lower risk of developing mild cognitive impairment, independent of confounding factors such as alcohol consumption, cigarette smoking and high blood pressure.

A 2016 study found extracts from lion's mane mushroom reduced symptoms of memory loss in mice and prevented neuronal damage caused by amyloid beta plaques known to accumulate in the brain with Alzheimer's disease.

A 2010 study[11] involving seniors between the ages of 70 and 74 found higher intakes of fruits, vegetables, grain products and mushrooms improved cognitive performance.

You can consider adding mushrooms like lion's mane to your diet as they can be an excellent addition to nearly any meal. They complement all kinds of grass-fed meats and wild-caught fish, go well in nearly any salad and can be added to soups, casseroles and other meals.

However, it is crucial to choose organically grown mushrooms as fungi easily absorb air and soil contaminants. Alternatively, you could opt for an organic supplement or extract.

Sources and References

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