

Micronutrient Deficiencies in Type 2 Diabetes and Their Impact on Health

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October 05, 2026

STORY AT-A-GLANCE

- › A study that analyzed 52,501 Type 2 diabetes patients found widespread nutrient deficiencies, with vitamin D being most common (60.45%), followed by magnesium (41.95%), and vitamin B12 (28.72%)
- › Vitamin D deficiency has been associated with reduced insulin sensitivity, and with higher rates of complications including diabetic retinopathy, kidney disease, and foot ulcers
- › Magnesium deficiency and diabetes appear to reinforce each other — low intake is associated with higher diabetes risk, while diabetes increases magnesium loss through urination, a pattern linked to poorer glycemic control
- › Metformin, the most prescribed diabetes medication, is associated with lower vitamin B12 levels, and B12 deficiency can cause nerve damage, numbness, and fatigue — which is why B12 monitoring is recommended for long-term users
- › Geographic location influences deficiency rates, with the Americas showing the highest prevalence at 54.04% of diabetes patients having at least one micronutrient deficiency

Type 2 diabetes, a condition marked by chronically high blood sugar levels, is a leading driver of metabolic disease in America. Medications to control blood sugar are a standard part of care, and the research below looks at a dimension of the condition that is often assessed alongside them.

Diabetes is compounded by several factors, and research notes that nutritional deficiencies are a commonly overlooked aspect, and that when these deficiencies are addressed, managing and controlling this disease becomes easier.¹

An Overview of Micronutrient Deficiencies Among Diabetics

A meta-analysis published in BMJ Nutrition, Prevention & Health analyzed the prevalence of micronutrient deficiencies in people with Type 2 diabetes and how these deficiencies relate to the condition.

Starting with an initial list of 7,344 studies, the researchers whittled down their dataset to 132 studies with a total of 52,501 participants.² Working within these parameters, the researchers aimed to determine the most common nutrient deficiencies in people with diabetes, as well as identify how diabetics from different continents differ in their deficiencies compared to other populations.

This is a prevalence meta-analysis: It measured how common deficiencies are among people with Type 2 diabetes. It was not designed to test whether deficiencies cause the condition to worsen, or whether correcting them improves outcomes.

- **Nearly half of participants have nutrient deficiencies** — From the data collated, 45.3% of total participants were found to have multiple micronutrient deficiencies.
- **Vitamin D, magnesium and vitamin B12 were the most common deficiencies** — Vitamin D deficiency was the most widespread, affecting 60.45% of diabetics. The second highest deficiency was magnesium impacting 41.95% of diabetics. The third highest deficiency was vitamin B12, affecting 28.72% of diabetic participants — a group in which metformin use is common.
- **Women had a higher rate of deficiency than men** — Overall, the data suggests that factors like diet, metabolic dysfunction, and certain medications play a major role in these imbalances, leading to the differences between men and women.

Vitamin D Deficiency Is Associated with Insulin Function and Complication Risk

Again, the most striking finding was that 60.45% of diabetics were [deficient in vitamin D](#). This is an important matter because vitamin D influences insulin function.³

- **The link between insulin sensitivity and vitamin D levels** — Insulin is the hormone responsible for regulating blood sugar, and without enough vitamin D, insulin sensitivity decreases. As noted in a study published in the International Journal of Molecular Sciences:⁴

"Various pathways suggest that vitamin D directly improves insulin sensitivity and secretion. The level of vitamin D in the body may change the ratio of pro- to anti-inflammatory cytokines, which would impact insulin action, lipid metabolism and the development and function of adipose tissue.

Many studies have demonstrated an inverse relationship between vitamin D concentrations and pro-inflammatory markers, insulin resistance, glucose intolerance, metabolic syndrome, obesity and cardiovascular disease."

- **Vitamin D's role in immunity and inflammation** — Beyond its role in insulin regulation, vitamin D is also important for immune function and inflammation control, which are relevant to diabetes.⁵

For example, low vitamin D levels have been linked to higher rates of diabetic complications, including diabetic retinopathy (DR), diabetic kidney disease (DKD), and diabetic foot ulcers (DFU).⁶ As noted by the researchers, "DR and DKD are common microvascular complications of diabetes."

- **Foot ulcers are another common vascular complication in diabetes** — Research has examined whether vitamin D status affects wound healing. According to the researchers:⁷

"Vitamin D is essential in maintaining the normal immune system. Vitamin D could suppress T cell proliferation and inhibit the secretion of T helper type 1 cytokines (e.g., interferon- γ and interleukin-2), while augmenting the production of T helper type 2 cytokines, thereby accelerating wound healing ...

Besides, vitamin D may improve wound healing by suppressing endoplasmic reticulum stress, oxidative stress and the NF- κ B-mediated inflammatory gene expression. More importantly, vitamin D signaling may be involved in the proliferation, migration, and differentiation of epidermal stem cells and progeny during cutaneous wound repair."

Magnesium Deficiency Is Linked to Insulin Resistance

Magnesium is one of your body's most abundant minerals. It functions as a cofactor in more than 300 enzymatic processes, such as protein synthesis, muscle and nerve function, blood pressure regulation and blood glucose control.⁸ As you can imagine, the last example is important for diabetes.

- **The link between magnesium deficiency and insulin resistance** — According to a study published in *Frontiers in Nutrition*, "magnesium deficiency can increase insulin resistance, and insulin resistance can also contribute to magnesium deficiency." The researchers succinctly explain its role below:⁹

"Intracellular free magnesium levels are lower in patients with Type 2 diabetes than in nondiabetic individuals. Intracellular magnesium concentrations are essential for optimal insulin receptor bioactivity and downstream signaling events in target cells.

Low magnesium levels contribute to impaired tyrosine kinase activities of insulin receptors, causing altered cellular glucose utilization and eventual insulin resistance."

- **The role of magnesium in the context of insulin management** — In a 2020 animal study, researchers noted that increasing magnesium levels helped enhance insulin sensitivity while decreasing insulin resistance. Furthermore, boosting magnesium intake helped protect against pancreatic cell injury — an important organ that helps produce insulin and glucagon to keep blood sugar levels at a normal range.¹⁰

Note: These findings are from laboratory or animal research and may not directly apply to human health.

- **Magnesium deficiency among diabetics is a vicious cycle** — A low intake of magnesium from foods increases the risk of developing diabetes. And when diabetes does develop, more magnesium is lost via urination. And similar to the other studies mentioned, this particular study noted that magnesium deficiency "is associated with poorer glycemic control and greater insulin resistance in patients with [Type 2 diabetes]."¹¹

Metformin Use Is Linked to Vitamin B12 Deficiency

The study also reported a well-documented interaction with metformin, a drug that lowers blood sugar mainly by decreasing the glucose you absorb from your diet, reducing glucose production in the liver, and improving insulin sensitivity.¹²

- **Vitamin B12 deficiency affects your nervous system** — Among those taking metformin, 28.72% had a vitamin B12 (cobalamin) deficiency. This is concerning because vitamin B12 is essential for nerve health. Without enough vitamin B12, nerves can be damaged, producing symptoms such as numbness, a tingling feeling in the hands and feet and fatigue.¹³
- **The widespread deficiency is accepted as normal** — Metformin is one of the most ubiquitous medications related to diabetes management. According to Harvard Health Publishing, ever since its approval by the U.S. Food and Drug Administration

(FDA) in 1995, "It has since become the most widely prescribed medication for people with diabetes who cannot control their blood sugar through diet and exercise alone."¹⁴

Despite the popularity of metformin, research has shown that it has been strongly linked to vitamin B12 deficiency,¹⁵ and the risk rises as the dosage increases.¹⁶ In fact, such is the prevalence of vitamin B12 deficiency among metformin users that the U.K. government has acknowledged it "to be a common side effect."¹⁷

- **How does metformin cause a vitamin B12 deficiency?** Right now, there's no clear and definite answer, but there are some theories. According to a study published in the World Journal of Diabetes:¹⁸

"The most accepted theory is that metformin antagonizes the calcium cation and prevents the calcium-dependent IF-vitamin (intrinsic factor) B12 complex from binding to the ileal cubilin receptor and consequently will reduce the endocytosis process of vitamin B12."

In addition, the researchers noted that if you're currently taking metformin, it is recommended you get an annual vitamin B12 test and take a supplement if necessary. Talk to your healthcare provider about whether this testing is appropriate for you. Diet and lifestyle changes are a recognized part of Type 2 diabetes management, and any change to a prescribed medication is a decision for you and your prescribing clinician to make together.

Geography Also Influences Your Risk for Nutrient Deficiencies

In the featured study, researchers also found significant differences in deficiency rates depending on geographic location.

- **The highest rates were reported in the Americas** — It's estimated that 54.04% of diabetes patients in this region had at least one micronutrient deficiency. Other regions, including Southeast Asia, Europe and Eastern Mediterranean, also showed

increased rates of deficiencies, but not to the degree of the Americas.

- **Beware how your sociocultural traditions influence your risk of diabetes —**
According to the researchers, "cultural practices may contribute to geographic variations in micronutrient deficiency."¹⁹ So, be sure to consider the cultural makeup of your diet, then make the appropriate adjustments wherever possible while still adhering to your beliefs.

5 Practical Strategies for Supporting Micronutrient Status

The featured study made one thing very clear — when key nutrients are missing, your body may struggle to regulate insulin, control inflammation and maintain nerve and muscle function. Deficiency in these nutrients is associated with poorer markers of diabetes control.²⁰

Yet, despite their importance, these deficiencies are not always tested for as a matter of routine, and nutritional status can receive less attention than glycemic control in standard diabetes care.

Given the evidence linking these deficiencies to poorer diabetes outcomes, nutritional status deserves attention alongside standard care. That means improving your diet, discussing medication side effects with your clinician, and giving your body what it needs to function properly. Here are my recommendations — they are general wellness measures, not a treatment for diabetes, and none of them is a reason to change prescribed medication on your own:

1. **Discuss metformin's B12 effect with your prescriber —** As mentioned earlier, metformin is associated with lower vitamin B12 levels, and B12 deficiency can cause nerve damage, fatigue, and cognitive problems. If you have been taking metformin for a while, ask your clinician about B12 monitoring. Do not stop or reduce metformin on your own — discontinuing it without supervision can cause blood sugar to rise to dangerous levels.

Focus on eating healthy carbohydrates to support your mitochondrial function instead of ultraprocessed foods and drinks. According to a 2024 prospective cohort study, those who consumed refined sugar and artificially sweetened drinks have a 29% higher relative risk of diabetes compared to controls.²¹

- 2. Increase your vitamin B12 levels** — I recommend you consume high-quality animal foods like eggs, raw grass fed dairy and ruminant meats, as these are the best natural sources of B12. Eliminate alcohol, too — it interferes with B12 absorption (as well as other important nutrients) and increases oxidative stress in your body.²²
- 3. Get more vitamin D from sunlight** — Vitamin D deficiency is the most common micronutrient problem among diabetics, and low vitamin D status is associated with reduced insulin sensitivity.

Ideally, spending time outside in natural sunlight, especially around midday when UVB rays are strongest, is the best strategy. However, this is only applicable if you've been minimizing your intake of vegetable oils for four to six months. That's because vegetable oil is high in linoleic acid (LA), a polyunsaturated fat that is prone to oxidation and accumulates in skin tissue, increasing susceptibility to sunburn.

Until then, I recommend spending time outdoors only in the early morning or late afternoon. Also, make sure to have your vitamin D levels tested regularly. The recommended range for optimal health is between 60 and 80 ng/mL. Talk to your healthcare provider about whether this testing is appropriate for you.

- 4. Boost your magnesium intake** — As mentioned earlier, magnesium is required for proper insulin function, energy production and nerve health. In addition, it's also important to more than 300 enzymatic processes.

I generally advise getting nutrients from whole foods, but magnesium is a rare exception. Most people are deficient and meeting the recommended daily intake of 400 mg through diet alone can be difficult.

One key reason is soil depletion. Modern farming practices have significantly reduced the mineral content of soil, so even magnesium-rich vegetables contain much lower levels than they once did. This means that even if you follow a plant-based, whole-food diet, you may still fall short.

Another challenge is that some of the best dietary sources of magnesium — nuts and seeds — are also high in linoleic acid, an omega-6 fat. Since most people already consume excessive linoleic acid from vegetable oils, eating large amounts of these foods can contribute to inflammation and mitochondrial dysfunction. Balancing magnesium intake while avoiding excess omega-6 fats can be tricky.

For these reasons, supplementing with magnesium is often a wise choice. I prefer magnesium glycinate and magnesium malate, as they are well-absorbed and easy on the digestive system. To find your ideal dose, start with magnesium citrate and increase gradually until your stools loosen, then back off slightly — that level is your ideal dose. You can then switch to glycinate or malate.

5. Remove the root causes of nutrient deficiencies — If you're constantly losing key nutrients, you must repair and rebuild your cellular health, which requires a multifaceted approach:

- **Minimize vegetable oils from your diet** — These fats contribute to inflammation, oxidative stress and mitochondrial damage, making your body less efficient at using key vitamins and minerals.
- **Reduce exposure to electromagnetic fields (EMFs)** — Limit your time on wireless devices and avoid sleeping near a Wi-Fi router. EMFs disrupt calcium and magnesium balance at the cellular level. Place your phone far away from you when in your room and use an analog alarm clock when sleeping.
- **Address gut health issues that interfere with nutrient absorption** — For most adults with ordinary digestive complaints, start with white rice and whole fruits before moving on to other complex carbohydrates. If your gut is severely

compromised, start with dextrose water sipped slowly, then fruit juice with pulp, then pulp-free juice, then whole fruit, and finally complex carbohydrates such as white rice.

- **Limit your exposure to xenoestrogens** — Microplastics are filled with various endocrine-disrupting chemicals such as bisphenol A (BPA) phthalates and parabens, and these have been linked to an increased risk of diabetes.²³

To protect your health, reduce your reliance on plastics as much as possible by switching to glass containers and swapping out any plastic items you have with safe, sustainable materials. For more tips on this matter, read my article "[Airborne Microplastics Linked to Multiple Health Problems](#)."

Frequently Asked Questions (FAQs) About Common Micronutrient Deficiencies Among Diabetics

Q: What are the most common nutrient deficiencies in people with Type 2 diabetes?

A: Vitamin D, magnesium, and vitamin B12 are the most common deficiencies. Over 60% of diabetics are deficient in vitamin D, 42% in magnesium, and nearly 29% in B12 (primarily due to metformin use). These deficiencies are associated with poorer insulin sensitivity and higher inflammation.

Q: How does vitamin D deficiency affect diabetics?

A: Vitamin D is essential for insulin sensitivity and immune function. Deficiency has been associated with impaired insulin regulation and with the risk of diabetic complications like kidney disease, retinopathy, and foot ulcers. Proper sun exposure and regular vitamin D testing are worth discussing with your healthcare provider.

Q: Why is magnesium important for managing diabetes?

A: Magnesium supports over 300 enzymatic functions, including insulin receptor activity. Low magnesium is associated with insulin resistance and poor blood sugar control. Due to soil depletion and dietary challenges, supplementation with magnesium glycinate or malate may be worth considering, depending on where you live.

Q: What are the risks of taking metformin long-term?

A: Metformin, a common diabetes medication, is linked to vitamin B12 deficiency, which can result in nerve damage, fatigue, and cognitive issues. Patients on metformin are advised to get annual B12 tests and to discuss any concerns about the medication with their prescribing clinician. Do not stop or change metformin without medical supervision.

Q: How can diabetics address micronutrient deficiencies naturally?

A: Here are key strategies to include in your health routine:

- Discussing metformin's effect on B12 with your prescribing clinician
- Eating B12-rich animal foods and avoiding alcohol
- Getting safe, daily sun exposure for vitamin D while avoiding vegetable oils
- Supplementing magnesium
- Minimizing EMF exposure and cutting down on plastic usage to limit xenoestrogens

This article is for informational purposes only and does not constitute medical advice. Consult a qualified healthcare provider before making changes to your health regimen. Do not start, stop or change any prescribed medication without speaking to the clinician who prescribed it.

Sources and References

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