The Relationship Between Vitamin D and Insulin Resistance

STORY AT-A-GLANCE -

- Vitamin D is a steroid hormone that influences virtually every cell in your body. Low levels are linked to poor bone health, as well as heart, brain, immune and metabolic dysfunction
- Animal studies have shown vitamin D is a foundational factor necessary for normal insulin secretion, and that vitamin D improves insulin sensitivity
- Atypical antipsychotics such as quetiapine, a bipolar medication, can increase your risk of hyperglycemia and diabetes. Research suggests vitamin D3 may counteract these effects

By Dr. Mercola

Vitamin D is a steroid hormone that influences virtually every cell in your body, which is why maintaining a healthy level is so important. **Low vitamin D levels** are widely known to harm your bones, leading them to become thin, brittle, soft or misshapen.

But vitamin D is equally important for your heart, brain, immune function and much more. For example, there's an important connection between insufficient vitamin D and insulin resistance and/or **diabetes**, both type 1[1] and type 2.

Vitamin D Deficiency May Influence Your Type 2 Diabetes Risk

According to recent research, vitamin D deficiency affects your glucose metabolism and may actually be more closely linked to diabetes than obesity. In a study of 118 people, those with low vitamin D levels were more likely to have type 2 diabetes, pre-diabetes or metabolic syndrome, regardless of their weight.

Among obese people, those without metabolic disorders had higher levels of vitamin D than those with such disorders, and among lean people, those with metabolic disorders were more

likely to have low levels of vitamin D. According to one of the study's authors:[2]

> "*The study suggests that vitamin D deficiency and obesity interact synergistically to heighten the risk of diabetes and other metabolic disorders. The average person may be able to reduce their risk by maintaining a healthy diet and getting enough outdoor activity.*"

It's not the first time vitamin D has been shown to play a role in diabetes. One Indian study found that vitamin D and calcium supplementation, in combination with exercise, can prevent pre-diabetes from progressing into full-blown diabetes.

For every unit increase in vitamin D levels, the risk of progression to diabetes in people with pre-diabetes went down by 8 percent.[3]

Another study[4] published in 2013 found that type 2 diabetics given 50,000 IUs of oral vitamin D3 per week for eight weeks experienced "a meaningful reduction" in fasting plasma glucose and insulin. Other research showing this link includes but is not limited to the following:

- Animal studies have shown vitamin D is a foundational factor necessary for normal insulin secretion[5,6] and that vitamin D improves insulin sensitivity[7,8]
- One study involving nearly 5,680 individuals with impaired glucose tolerance showed that vitamin D supplementation increased insulin sensitivity by 54 percent[9]
- The mechanisms by which vitamin D reduces insulin resistance include its effect on calcium and phosphorus metabolism and by upregulating the insulin receptor gene[10]

Vitamin D May Lower Risk of Hyperglycemia in Those Taking Atypical Antipsychotics

Certain drugs can raise your risk of metabolic dysfunction. For example, statin drugs can trigger drug-induced diabetes. Atypical antipsychotics such as quetiapine, a bipolar medication, have also been linked to an increased risk of hyperglycemia and diabetes.

In the latter case, research suggests vitamin D3 may counteract these effects. As reported by The American Journal of Managed Care:[11]

"Atypical antipsychotics have long been associated with an increased risk of hyperglycemia — which can lead to new-onset diabetes, diabetic ketoacidosis, coma and even death.

Some proposed mechanisms for this effect include weight gain, decreased insulin secretion from pancreatic beta cells and insulin resistance.

To determine whether there were any medications that could decrease this likelihood of hyperglycemia, researchers analyzed the FDA's Adverse Event Reporting (FAERS) system — a database that logs self-reported adverse effects or medication errors submitted by patients.

By cross-referencing atypical antipsychotics and hyperglycemia, the study authors found that patients who had been simultaneously prescribed to take vitamin D and quetiapine were somehow less likely to have hyperglycemia."

Subsequent animal studies produced similar results. Mice given vitamin D and quetiapine had significantly lower blood sugar levels compared to mice given quetiapine alone. According to lead author Takuya Nagashima, vitamin D inhibits quetiapine from reducing an enzyme that causes hyperglycemia.

Based on these results, the authors suggest combining antipsychotics with vitamin D supplementation to "efficaciously safeguard against antipsychotic-induced hyperglycemia accompanied by insulin resistance."

Other Benefits of Vitamin D

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Researchers have pointed out that raising levels of vitamin D among the general population could prevent chronic diseases that claim nearly 1 million lives throughout the world each year.

Incidence of several types of cancer could also be slashed in half, or more. Recent research reveals raising your serum 25-hydroxyvitamin D to 40 ng/ml can slash your risk of invasive

cancers by 67 percent!

In the interview above, Dr. Michael Holick — a well-known vitamin D researcher — expands on these and many other health benefits of vitamin D. For instance, optimizing your vitamin D levels can help protect against:

Cardiovascular disease

Vitamin D is very important for reducing hypertension, atherosclerotic heart disease, heart attack and stroke. According to Holick, one study showed that vitamin D deficiency increased the risk of heart attack by 50 percent.

Autoimmune diseases

Vitamin D is a potent immune modulator, making it very important for the prevention of autoimmune diseases, like multiple sclerosis (MS) and inflammatory bowel disease (IBD).

Infertility

Vitamin D may help stimulate the production of hormones including testosterone and **progesterone**, and has been shown to **boost fertility** in both men and women.

Vitamin D is also associated with semen quality in men and may improve menstrual frequency in women with polycystic ovary syndrome (PCOS).[12]

DNA repair and metabolic processes

One of Holick's studies showed that healthy volunteers taking 2,000 international units (IUs) of vitamin D3 per day for a few months upregulated 291 different genes that control up to 80 different metabolic processes.

Some of these processes help improve DNA repair and boost immune function, while others affect autoxidation (oxidation that occurs in the presence of oxygen and /or UV radiation, which has implications for aging and cancer, for example).

Migraine

Recent research also suggests vitamin D can play a role in **migraines**. Researchers at Cincinnati Children's Hospital Medical Center found that many who suffer from migraines have deficiencies in vitamin D, **riboflavin (B2)** and **coenzyme Q10 (CoQ10)**.[13]

Girls and women who suffered migraines were particularly prone to having CoQ10 deficiency, while boys and men were more likely to be deficient in vitamin D. Those with chronic migraines were more likely to have CoQ10 and riboflavin deficiencies, compared to those with episodic migraines.

Neurological/psychological/mental disorders

Vitamin D also plays a major role in neurotransmission, and vitamin D deficiency has been associated with a number of neurological and brain disorders, including cognitive dysfunction and Alzheimer's disease (in one study, those who were most vitamin D deficient had a 31 percent increased relative risk of suffering neurocognitive decline), schizophrenia, Parkinson's disease, stroke, epilepsy and depression.

Cold and flu

Vitamin D has potent infection-fighting abilities, and can be beneficial for both the prevention and treatment of tuberculosis, pneumonia, **colds and flu**.

What's the Best Way to Optimize Your Vitamin D Level?

There is no doubt that vitamin D is imperative for good health and disease prevention. It may even help counteract some of the deleterious metabolic effects caused of certain drugs. But there's no lack of controversy when it comes to the issue of *how* to optimize your vitamin D. Most of the researchers specializing in vitamin D agree that sensible sun exposure is the *ideal* way though.

First of all, vitamin D3 supplements do not confer the identical effects as the vitamin D your skin generates in response to UV exposure. Secondly, **sun exposure** has additional health benefits that are unrelated to vitamin D production.

For example, UVA exposure produces nitric oxide (NO), which has a blood pressure-lowering effect. In fact, the entire solar spectrum is important for optimal health. We're not dependent solely on the narrowband wavelength of about 295 nanometers (nm), which is where vitamin D is made.

However, unless you make a concerted effort, chances are you're simply not getting enough sun exposure to raise your vitamin D level. As noted in a recent British study, adolescent Britons are not getting enough sun exposure even in the middle of summer to elevate their vitamin D to a healthy level, prompting the authors to suggest changes to the U.K.'s vitamin D guidelines.

As reported by Endocrine Today,[14] "more than one-quarter of the adolescents in the study had inadequate vitamin D levels even during summer, the period when participants spent the most time outdoors." According to the authors:

> "*Current U.K. national guidance on vitamin D acquisition assumes those aged 4 to 64 years gain their vitamin D requirements from sunlight alone, thus there is no recommended nutrient intake. Meanwhile, substantial proportions of the global population, including the U.K., are reported to have low vitamin D status, and rickets has returned as a clinical concern …*
>
> *As U.K. current sun exposure patterns do not provide an adequate source of vitamin D, amendments are required to recommendations on vitamin D acquisition in this age group. While wider skin surface area exposure to sunlight might safely increase vitamin D status, oral vitamin D supplements may be beneficial during this critical time for bone development*."

When to Take a Vitamin D3 Supplement

Indeed, while sun exposure is the ideal route, it can be difficult for many to achieve an optimal vitamin D level this way. Your lifestyle, location, age, ethnicity, time of year, weather conditions and a number of other factors influence how much vitamin D your skin will make in response to sun exposure. The fact that vitamin D insufficiency and deficiency is widespread even in sundrenched areas like India attests to this difficulty.

In some cases, making changes to your routine in order to get more regular sun exposure may do the trick. Key points to remember is that you need to expose large areas of skin to the sun, and on a frequent basis (ideally daily). However, under ideal conditions you may not need more than a few *minutes* of exposure.

The worst thing you could do is to bake in the sun for hours on end on the weekends. You definitely want to avoid burning your skin, as this will only cause skin damage that could potentially increase your risk for skin cancer.

If sensible sun exposure is either not feasible or isn't sufficient to raise your vitamin D to a healthy level, then taking an oral vitamin D3 supplement is a wise choice. If you decide to supplement with vitamin D please consider using one that also has **vitamin K2**, as it works synergistically with vitamin D to maximize the benefits.

The only way to know how your sun exposure is affecting your vitamin D level is to get your vitamin D tested. I recommend doing this twice a year, in January and June/July, to get a reading on your lowest and highest levels. This will tell you whether you might be in need of a supplement. It will also guide you in terms of dosage.

In short, your ideal dosage is one that will help you maintain a clinically relevant vitamin D level of 40 to 60 ng/ml year-round. For some this may be 2,000 IUs a day. For others, it could be 8,000 IUs a day or more.