

# Linked to Schizophrenia, Easy-to-Fix Nutrient Deficiency

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✓ Fact Checked

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## STORY AT-A-GLANCE

- › Schizophrenia has a physiological basis, beginning with improperly distributed neural progenitor cells in the developing brain. As a result, few mature neurons appear in the cortex — an area associated with memory, attention and processing of language — in the schizophrenic brain
- › There is a lifelong impact for children born of vitamin D deficient mothers, ranging from childhood allergies and more frequent colds and flu, to a greater risk for diabetes, cardiovascular disease and, as recently confirmed, schizophrenia
- › Children who were vitamin D deficient at birth had a 44% increased risk of developing schizophrenia as adults; vitamin D status could account for 8% of the schizophrenia cases in Denmark
- › Vitamin D deficiency during pregnancy has also been shown to increase autism-related traits in 6-year-old children
- › To optimize your and your child's health, get your vitamin D level tested — ideally before you get pregnant and routinely during pregnancy and breastfeeding — and take whatever amount of vitamin D3 you need to reach and maintain a level of 60 to 80 ng/mL

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Despite being simple and inexpensive to address, vitamin D deficiency is epidemic around the world, and evidence suggests vitamin D deficiency during pregnancy plays

an important role in the development of several chronic health problems, and raises the risk of complications for the mother as well.

For example, research<sup>1</sup> by GrassrootsHealth shows 40% to 60% of preterm births could be prevented by raising pregnant women's vitamin D to a level of 40 nanograms per milliliter (ng/mL). Vitamin D optimization also reduces the mother's risk of preeclampsia, gestational diabetes and prenatal infections by approximately 50%.<sup>2</sup>

Research also confirms there is a lifelong impact for children born of vitamin D deficient mothers, ranging from childhood allergies and more frequent colds and flu, to a greater risk for diabetes, autism, strokes, cardiovascular disease,<sup>3,4,5</sup> and, as recently confirmed, schizophrenia — a mental condition characterized by hallucinations, delusions and cognitive impairment.

## **Schizophrenia Is Caused by Faulty Brain Construction**

In 2017, research<sup>6</sup> concluded schizophrenia might have its origins in pregnancy; the groundwork being laid as early as the first trimester. The scientists were able to demonstrate that schizophrenia has a physiological basis, beginning with improperly distributed neural progenitor cells in the developing brain.

As a result, few mature neurons appear in the cortex — an area associated with memory, attention and processing of language — in the schizophrenic brain. One of the researchers explained:<sup>7</sup>

*"Our research shows that the disease likely starts during the first trimester and involves accelerated cell divisions, excessive migration and premature differentiation of the neuroectodermal cells into neurons.*

*Neurons that connect different regions of the cortex, the so-called interneurons, become misdirected in the schizophrenia cortex, causing cortical regions to be misconnected, like an improperly wired computer.*

*We now can state that schizophrenia is a disorder of faulty brain construction that occurs early in development, corresponding to the first trimester, and involving specific malformation of neuronal circuits in the cortex."*

## **Schizophrenia Linked to Vitamin D Deficiency in Utero**

Knowing that schizophrenia has its roots in abnormal brain development during early pregnancy, it makes sense to look at what might influence brain development. Vitamin D appears to be one crucial factor.

The human brain contains vitamin D receptors, suggesting vitamin D is important for proper brain development and function, and recent research appears to confirm suspicions that vitamin D plays a role in this tragic and difficult to treat condition.

More than 2,600 individuals with schizophrenia were included in the study,<sup>8</sup> which concluded that children who were vitamin D deficient at birth had a 44% increased risk of developing schizophrenia as adults. According to the researchers, vitamin D status could account for 8% of the schizophrenia cases in Denmark, where the study took place. As reported by Science Alert:<sup>9</sup>

*"The clue was a previously identified link between being born in winter or spring in high-latitude regions such as Denmark – a time when there is considerably less sunlight, which promotes vitamin D production in the body – and an increased risk of schizophrenia.*

*They hypothesized that the reason might be a vitamin D deficiency, and used the Denmark database to investigate ... Previous studies have also identified a genetic link between schizophrenia and autism, and a link between autism and prenatal vitamin D deficiency."*

The research team, led by neuroscientist John McGrath, is now planning randomized clinical trials to determine whether vitamin D supplementation during pregnancy might lower the incidence of schizophrenia in the offspring. McGrath told Science Alert:<sup>10</sup>

*"The holy grail is to prevent individuals going on to get schizophrenia in the first place, and I think the experience with the links between folate and spina bifida is a good example that sometimes safe, simple, cheap public health interventions can prevent brain disorders."*

The idea that vitamin D might play a role in schizophrenia is not entirely new. A clinical review<sup>11</sup> published in 2016 noted that "Vitamin D deficiency is common in patients with severe mental illness such as schizophrenia," and that "The biological mechanism is most likely related to vitamin D's action on the regulation of inflammatory and immunological processes, consequently affecting the manifestation of clinical symptoms and treatment response of schizophrenia."

## **B Vitamins Are Also Important for Psychiatric Health**

Several vitamin B deficiencies also have the ability to produce symptoms of neuropsychiatric disorders and can be a valuable adjunct in the treatment of everything from attention deficit disorder (ADD) and anxiety to schizophrenia and dementia. This includes vitamins B1, B2, B6, B9 and B12.

B12 deficiency can trigger mania, psychosis and paranoid delusions,<sup>12,13</sup> and research<sup>14,15,16</sup> has shown high doses of vitamins B6, B9 and B12 in combination are very effective for improving schizophrenic symptoms – more so than standard drug treatments alone, and particularly when implemented early on. Low doses were ineffective.

Previous research and work by the late Dr. Abram Hoffer linked psychiatric disorders such as schizophrenia with severe and chronic niacin (B3) deficiency or niacin dependency specifically – a state that necessitates far more niacin on a regular basis than normal.

To learn more, see my interview with Dr. Andrew W. Saul (above), who cowrote an excellent book on this topic, "Niacin: The Real Story," with Hoffer. As noted by Saul:

*"When vitamin B3 or niacin was first added as an enrichment or as a fortification to flour, about half of the people in mental institutions went home. This is not a well-known fact. They were there not because they were mentally ill – because of genetic, environment or social reasons – but because they were malnourished ...*

*He wondered about the half that didn't go home. What about the people that had a little bit of niacin, but didn't get better? ... [H]e started giving what at the time were preposterously high doses of niacin: 3,000 milligrams a day.*

*And he was curing schizophrenia in 80% of the cases. This is astonishing. The cure rate for schizophrenia with drug therapy is not particularly good. Hoffer saw again and again that niacin worked."*

One of the reasons for B vitamins' effect on a wide range of mood disorders and neurological and psychiatric conditions relates to the fact that these vitamins have a direct impact on the methylation cycle, and are required for the production and function of neurotransmitters and the maintenance of myelin, the fatty sheath surrounding your nerve cells.

Without this protective coating, nerve signals become slow and sporadic, which can lead to motor function problems, cognitive losses and changes in mood. B8 also aids in cell communication, allowing your cells to properly interpret chemical messages and respond accordingly.<sup>17</sup>

Meanwhile, B6, folate (B9) and B12 (in combination with S-adenosylmethionine or SAMe) regulate the synthesis and breakdown of brain chemicals involved in mood control, including serotonin, melatonin and dopamine. Hence, a deficiency in one or more of these B vitamins can also play a role in depression.<sup>18</sup>

Vitamin B3 (niacin) is also an important precursor of NAD<sup>+</sup> which helps redox regulation as explained in the next section. This is likely why Hoffer's high dose niacin therapy was so effective in schizophrenics.

## Mitochondrial Dysfunction and Schizophrenia

Another recent study<sup>19</sup> points out links between schizophrenia and mitochondrial dysfunction, which also makes sense, considering these energy-producing organelles inside your cells are crucial for the normal functioning of cells, including your brain cells.

More specifically, schizophrenia is associated with high oxidation in cells, which impedes cellular energy production and triggers inflammation and adverse immune responses. As explained in the abstract:

*"Balance between the redox pair of nicotinamide adenine dinucleotides (oxidized NAD<sup>+</sup> and reduced NADH), reflects the oxidative state of cells and the ability of biological systems to carry out energy production.*

*A growing body of evidence suggests that an "immuno-oxidative" pathway including oxidative stress, mitochondrial dysfunction, neuroinflammation and cell-mediated immune response may contribute to disruption in brain activity in schizophrenia ...*

*We found a significant reduction in the NAD<sup>+</sup>/NADH ratio in chronically ill schizophrenic patients compared to a matched healthy control group ... These findings provide evidence for redox imbalance in the brain in all phases of schizophrenia, potentially reflecting oxidative stress."*

The answer here is part and parcel of my metabolic mitochondrial therapy (MMT) detailed in "[Fat for Fuel](#)." My MMT program specifically focuses on strategies that optimize mitochondrial function and minimize oxidative stress.

## Prenatal Vitamin D Deficiency Linked to Autism

According to a 2013 report by the U.S. Department of Health and Human Services and the Centers for Disease Control and Prevention (CDC), data collected from the 2007 and

2011–2012 National Survey of Children's Health suggested 1 in 50 children between the ages of 6 and 17 had autism spectrum disorder (ASD).<sup>20,21</sup>

In April 2016, the CDC reported an ASD rate of 1 in 68.<sup>22</sup> However, that rate is based only on 8-year-olds in 11 states. Despite that limitation, the 1 in 68 prevalence is the one listed on the CDC's Autism Data and Statistics website,<sup>23</sup> and the one most frequently reported in the news. Meanwhile, a government survey issued in 2015 claims the ASD rate may be as high as 1 in 45 children between the ages of 3 and 17.<sup>24,25</sup>

Stephanie Seneff, Ph.D., a senior research scientist at MIT, projects that within the next two decades, half of all children born will have some form of autistic disorder if the current trend continues unabated.<sup>26</sup> Here, vitamin D may again turn out to be a crucial piece of the puzzle.

A large multi-ethnic population-based cohort study<sup>27</sup> published in 2016 found that vitamin D deficiency during pregnancy was associated with an increase in autism-related traits in 6-year-old children. McGrath was also part of this investigation, which was the first study examining the association between gestational vitamin D deficiency and autism in general population samples. According to McGrath and his coauthors:

*"[T]hose who were 25OHD [25-hydroxyvitamin D] deficient had significantly higher (more abnormal) SRS [Social Responsiveness Scale] scores.*

*The findings persisted (a) when we restricted the models to offspring with European ancestry, (b) when we adjusted for sample structure using genetic data, (c) when 25OHD was entered as a continuous measure in the models and (d) when we corrected for the effect of season of blood sampling ...*

*It is feasible that a safe, cheap and publicly accessible vitamin D supplement in at risk groups may reduce the prevalence of this risk factor. Just as prenatal folate supplementation has reduced the incidence of spina bifida, we speculate that prenatal vitamin D supplementation may reduce the incidence of autism."*

## **How Vitamin D Influences Autism Risk**

Biological scientist Rhonda Patrick, Ph.D., has published two papers<sup>28,29</sup> in which she presents a hypothesis for how vitamin D may influence autism. In summary:

- Vitamin D gets converted into a steroid hormone. As such it regulates over 1,000 different physiological processes, and is thought to control at least 5% of the human genome. When you have enough vitamin D in your body, it binds to vitamin D receptors located throughout your body, thereby acting like a key that opens the proverbial door.

The vitamin D receptor complex can go deep inside the DNA, where it recognizes the telltale sequence of code that instructs the vitamin D receptor complex to either turn the gene on (making it active), or off (making it inactive).

- There's a vitamin D-regulated gene that encodes tryptophan hydroxylase (TPH), an enzyme responsible for converting tryptophan (which you get from dietary protein) into serotonin, a neurotransmitter involved in mood regulation and brain development.

You have two different TPH genes in your body – one in your brain and one in your gut. The one in your brain makes serotonin in the brain, and the one in your gut converts tryptophan into serotonin in the gut.

Here, scientific opinion is mixed: Some, including Patrick, claim serotonin made in your gut is unable to cross the blood-brain barrier to get into your brain and therefore cannot influence brain function. Others claim gut serotonin is released from the gut into your bloodstream, and that it does act on your brain, particularly your hypothalamus, which is involved in the regulation of emotions.<sup>30</sup>

Be that as it may, gut serotonin has a number of important functions, but too much of it will activate T-cells, causing them to proliferate and promote inflammation. Gut inflammation, in turn, is a common symptom associated with autism, and is thought to play a role in its development by flooding the brain with toxins.



- What Patrick discovered is that, in the gut, vitamin D deactivates the gene responsible for making TPH (the enzyme that converts tryptophan into serotonin). In this way, vitamin D helps combat inflammation in your gut caused by excessive serotonin levels.

Meanwhile, in the brain, the TPH gene has a sequence that causes the opposite reaction. Here vitamin D activates the gene, thereby increasing serotonin production. In other words, when you have sufficient amounts of vitamin D, two things happen simultaneously that improve brain function:

- Gut inflammation is reduced, courtesy of deactivating the gene associated with serotonin production
- Serotonin levels in the brain are increased by gene activation, and in the brain, serotonin plays an important role in mood, impulse control, long-term planning, long-term behavior, anxiety, memory and many other cognitive functions and behaviors, including sensory gating – the ability to filter out extraneous or unimportant stimuli

Since the publication of Patrick's first paper<sup>31</sup> in 2014, an independent group at the University of Arizona has biochemically validated her findings, confirming that vitamin D does activate the tryptophan hydroxylase 2 (TPH2) gene in a variety of neuronal cell types.

Prior to the publication of that paper, this simply wasn't known, and it's a significant finding that can help shed a great deal of light on vitamin D's influence in autism, as a majority of autistic kids have not only brain dysfunction, but also gut inflammation. Her research clearly shows how important it is to have enough vitamin D to prevent and treat both of these problems. To learn more, please listen to Patrick's interview, included above for your convenience.

**Optimize Vitamin D During Pregnancy for Your Child's Health**

Based on the evidence, it seems clear that optimizing your vitamin D is one of the easiest and least expensive ways to reduce not only your risk of pregnancy complications but also your child's risk of brain disorders such as autism and schizophrenia, not to mention a number of other chronic health conditions.

So please, make sure you get your vitamin D level tested — ideally before you get pregnant and routinely during pregnancy and breastfeeding — and take whatever amount of vitamin D3 you need to reach and maintain a level of 60 to 80 ng/mL. Certainly, it should be no lower than 40 ng/mL.

Although vitamin D testing is not yet a routine part of prenatal care, you can request a vitamin D blood test from your health care provider or enroll in GrassrootsHealth's [Protect Our Children NOW!](#) project, which seeks to resolve vitamin D deficiency among pregnant women and children, and raise global awareness about the health risks associated with vitamin D deficiency.

While sunlight is the ideal way to optimize your vitamin D, winter and indoor work prevent a large majority of people from achieving ideal levels without supplementation. Just remember to also increase your vitamin K2 and magnesium intake (either from food or supplements) when taking oral vitamin D3, as these nutrients all work in tandem.

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