

# New research indicates causal link between vitamin D, serotonin synthesis and autism

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A new study by Rhonda Patrick, PhD and Bruce Ames, PhD of Children's Hospital Oakland Research Institute (CHORI) demonstrates the impact that Vitamin D may have on social behavior associated with Autism Spectrum Disorder (ASD). Dr. Patrick and Dr. Ames show that serotonin, oxytocin, and vasopressin, three brain hormones that affect social behavior, are all activated by vitamin D hormone. Autism, which is characterized by abnormal social behavior, has previously been linked to low levels of serotonin in the brain and to low vitamin D levels, but no mechanism has linked the two until now.

In this study, Dr. Patrick and Dr. Ames show that vitamin D hormone activates the gene that makes the enzyme tryptophan hydroxylase 2 (TPH2), that converts the essential amino acid tryptophan, to [serotonin](#) in the [brain](#). This suggests that adequate levels of vitamin D may be required to produce serotonin in the brain where it shapes the structure and wiring of the brain, acts as a neurotransmitter, and affects [social behavior](#). They also found evidence that the gene that makes the enzyme tryptophan hydroxylase 1 (TPH1) is inhibited by vitamin D hormone, which subsequently halts the production of serotonin in the gut and other tissues, where when found in excess it promotes inflammation.

This mechanism explains many of the known, but previously not understood, facts about autism including: 1) the "serotonin anomaly" low levels of serotonin in the brain and high levels in the blood of [autistic children](#); 2) the preponderance of male over female autistic children: estrogen, a similar steroid hormone, can also boost the brain levels of

serotonin in girls; 3) the presence of autoimmune antibodies to the fetal brain in the mothers of autistic children: vitamin D regulates the production of regulatory T-cells via repression of TPH1. The Patrick/Ames mechanism is relevant to the prevention of autism, and likely its treatment.

The current guidelines for adequate vitamin D levels are concentrations above 30 ng/ml. Most Americans' vitamin D is made in the skin from exposure to UVB radiation; however, melanin pigment and sunscreen inhibit this action. This is an important cause of the well-known widespread vitamin D deficiency among dark-pigmented Americans, particularly those living in Northern latitudes. The most recent National Health and Examination survey reports that greater than 70% of U.S. population does not meet this requirement and that adequate vitamin D levels have plummeted over the last couple of decades. This precipitous drop in adequate levels of vitamin D in the US is concurrent with the rise in autism rates.

The study suggests dietary intervention with vitamin D, tryptophan and omega 3 fatty acids would boost brain serotonin concentrations and help prevent and possibly ameliorate some of the symptoms associated with ASD without side effects. There is little vitamin D present in food and fortification is still inadequate as is the amount in most multivitamin and prenatal supplements. Vitamin D supplements are inexpensive and offer a simple solution to raise vitamin D levels to an adequate status. In addition, vitamin D levels should be routinely measured in everyone and should become a standard procedure in prenatal care.

Provided by Children's Hospital & Research Center Oakland

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