



Vitamin D and Autism

A look at the evidence that links the two

John J Cannell, MD /// Vitamin D Council

"We are to admit no more causes of natural things than such as are both true and sufficient to explain their appearances. Therefore, to the same natural effects we must, so far as possible, assign the same causes."

Sir Isaac Newton



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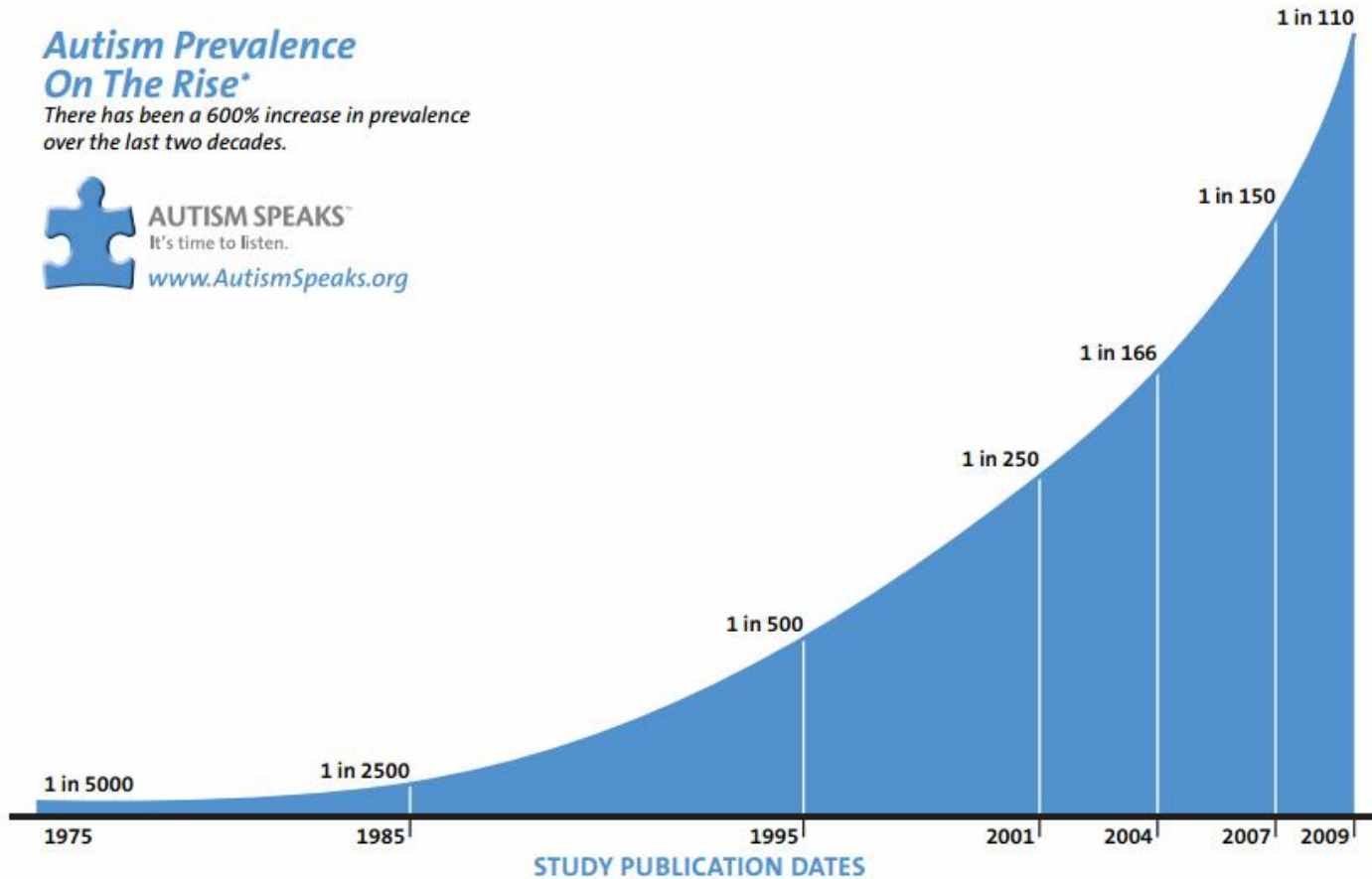
Autism Prevalence On The Rise*

There has been a 600% increase in prevalence over the last two decades.



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*Recent research has indicated that changes in diagnostic practices may account for at least 25% of the increase in prevalence over time, however much of the increase is still unaccounted for and may be influenced by environmental factors.

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► Source: Autism Speaks

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- ▶ In 2007, I published a theory that vitamin D deficiency plays a role in the etiology of autism.
- ▶ What is the theory?
 - ▶ Vitamin D deficiency during gestation and very early childhood may be a trigger in autism.



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- ▶ A fly through look at autism
 - ▶ Appears in early childhood
 - ▶ Characterized by impaired social interaction, impaired communication skills, and reciprocal interpersonal unresponsiveness
 - ▶ People with autism have stereotyped behaviors and interests
 - ▶ Phenotype in autism – how a person's genes presents itself – is widely variable, like all psychiatric conditions.

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- ▶ What are five of the most striking epidemiologic features of autism?
 1. If one monozygotic twin has autism, there's a 50% chance his/her twin also has autism; while if one dizygotic twin has autism, his/her twin only has only a 10% chance of also having autism.
 2. Even among monozygotic twins, there is still widely varying phenotypic expression.
 3. Males are 4 times more likely to have autism than females.
 4. Incidence rates of autism the past 20 years have skyrocketed.
 5. When dark skinned immigrants move away from sunny equatorial climates, their chances of getting autism starkly increase.

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- ▶ In Somalia (located right on the equator), autism has no name.
- ▶ However, Somali immigrants in Sweden call autism, the ‘Swedish disease’
- ▶ Somali immigrants in Minnesota, United States, call autism, the “American disease”



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- ▶ Fernell E, et al. Serum levels of 25-hydroxyvitamin D in mothers of Swedish and of Somali origin who have children with and without autism. *Acta Paediatr* 2010; 99: 743–7.

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- ▶ **My theory: a neurosteroid is involved in autism, explaining these five features.**
 - ▶ Since autism rates are exploding, it's unlikely that genetics are causing the increase.
 - ▶ However, something affecting the genome – like a neurosteroid – could explain the increasing incidence.
 - ▶ Especially if levels of that neurosteroid have changed dramatically, leading to a damaged genome.
 - ▶ This neurosteroid should be involved in brain development, enhanced by estrogen but not testosterone, vary with human behavior and show racial variation.
 - ▶ Vitamin D is best candidate for this neurosteroid.

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- ▶ On what evidence did I base my theory on?
 - ▶ Higher risk of autism for children born in winter, especially March, when vitamin D levels are lowest.
 - ▶ Higher risk of autism for children born in urban areas compared to rural areas (less UVB in urban environment and people less likely to seek UVB in urban environment).
 - ▶ Higher risk for children born in cloudy areas and polluted areas, too.
 - ▶ Increase in incidence of autism the past three decades has coincided with increase in sun avoidance practices.
 - ▶ High prevalence of autism in dark-skinned immigrants who move to northern latitudes.

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- ▶ Shortly thereafter, a paper was published in the *Journal of Autism and Developmental Disorders*
 - ▶ Researchers found that autistic boys have unexplained reductions in metacarpal bone thickness. At some time in their life, these children laid down less cortical bone than normal children, a finding consistent with undetected and untreated childhood or even intrauterine vitamin D deficiency.



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- ▶ Hediger ML, England LJ, Molloy CA, Yu KF, Manning-Courtney P, Mills JL. Reduced bone cortical thickness in boys with autism or autism spectrum disorder. *J Autism Dev Disord* 2008; 38: 848–56.

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- ▶ In 2010, Harvard researchers expanded upon my theory.
 - ▶ They stated that some of the genetic damage from lack of vitamin D may be done even before conception.
 - ▶ Vitamin D acts on genome to reduce mutations from toxins.
 - ▶ Authors issued a plea to immediately take steps to prevent maternal vitamin D deficiency.



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- ▶ Kinney DK, Barch DH, Chayka B, Napoleon S, Munir KM. Environmental risk factors for autism: do they help cause de novo genetic mutations that contribute to the disorder? *Med Hypotheses* 2010; 74: 102–6.

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- ▶ In 2012, scientists under the lead of world-famous autism researcher Professor Christopher Gillberg, reviewed the topic of vitamin D and autism.

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▶ Here's what they found:

▶ On vitamin D blood levels

- ▶ Four studies have looked at vitamin D levels in autistic children or their mothers and all have found low levels (<30 ng/ml) in autistic children.
- ▶ One study found Somali mothers with autistic children had average vitamin D levels of 6.7 ng/ml, about 30% lower than Somali mothers without autistic children.

▶ On vitamin D intake

- ▶ The authors examined about a dozen papers that looked at vitamin D intake in autistic children, all finding that most autistic children do not meet vitamin D intake requirements for their age.

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▶ Also what they found:

▶ On brain development and function

▶ Vitamin D is involved in numerous ways in brain development, including:

- ▶ Synaptic development
- ▶ Nerve migration and growth
- ▶ Neurotransmission, both excitatory and inhibitory
- ▶ Preventing excessive cell proliferation
- ▶ Orchestrating signaling pathways in the brain
- ▶ Cell differentiation
- ▶ Nerve growth factor expression
- ▶ Regulation of inflammatory cytokines
- ▶ Neurotransmitter synthesis
- ▶ Intra-neuronal calcium signaling
- ▶ Anti-oxidant activity
- ▶ Control of the expression of genes involved in brain structure and metabolism
- ▶ Regulation of glutathione, the master antioxidant and heavy metal remover
- ▶ Protection from glutamate toxicity

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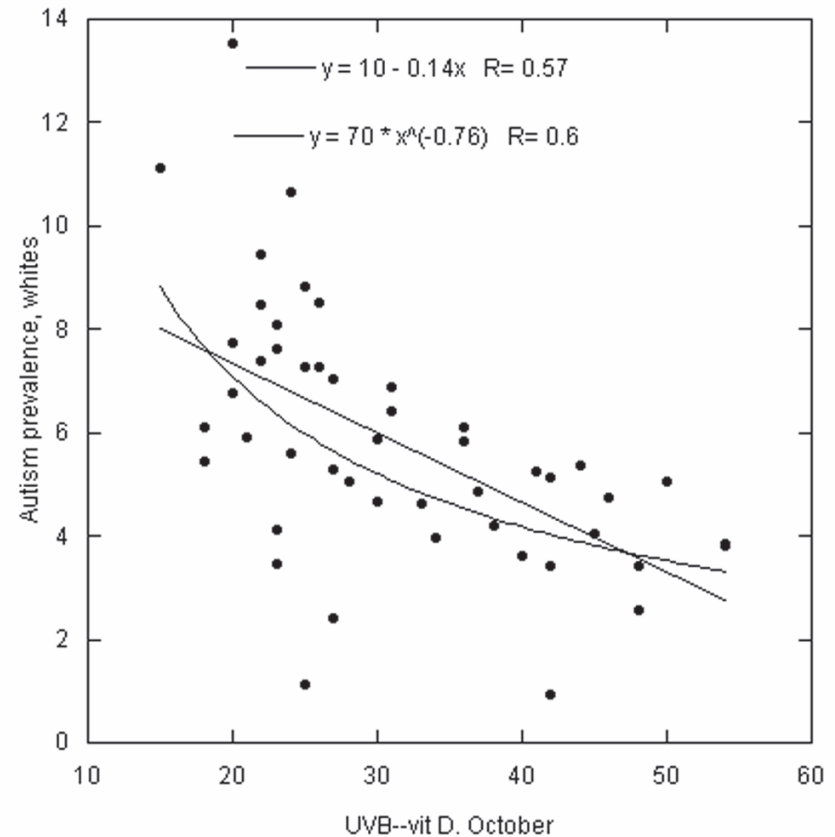
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- ▶ Also what they found:
 - ▶ On breastfeeding
 - ▶ A recent study showed in a statistically significant finding that in States where exclusive breastfeeding is the highest, autism incidence is also the highest.
 - ▶ Unless mothers take the care to supplement in high amounts, breast milk is void of vitamin D compared to formula.
- ▶ The authors called for “urgent research” into the vitamin D theory of autism.

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- ▶ Since then, Dr William Grant and I have found that the further north you live in the United States, the higher the risk you have of autism.
 - ▶ Based on incidence of autism in each State
 - ▶ Figure shows amount of UVB a State gets in October and prevalence of autism.

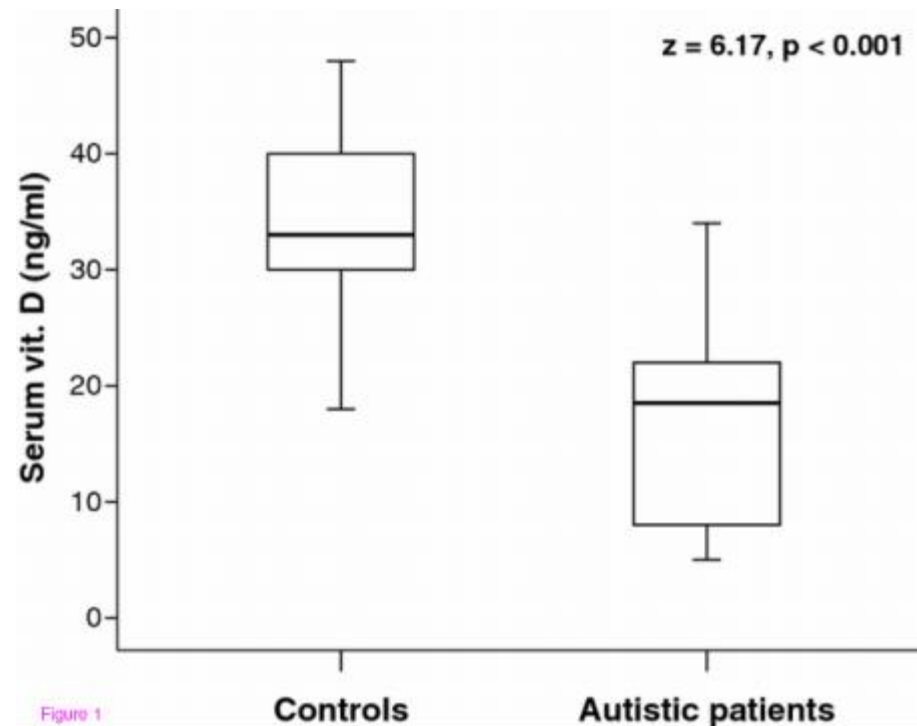


- ▶ Grant WB, Cannell JJ. Autism prevalence in the United States with respect to solar UV-B doses: An ecological study. *Dermato-Endocrinology*, 2012 Jan-Mar;5(1).

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- ▶ Researchers out of Saudi Arabia, led by Dr Gehan Mostafa, looked at 50 autistic children.
 - ▶ Compared to controls, autistic patients had much lower vitamin D levels.



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- ▶ Even more interestingly, they looked at anti-MAG levels and vitamin D levels.
- ▶ Anti-MAGs are antibodies associated with autism. Higher levels of anti-MAGs are associated with more severe autism.
- ▶ The higher your vitamin D level, the lower your anti-MAGs.

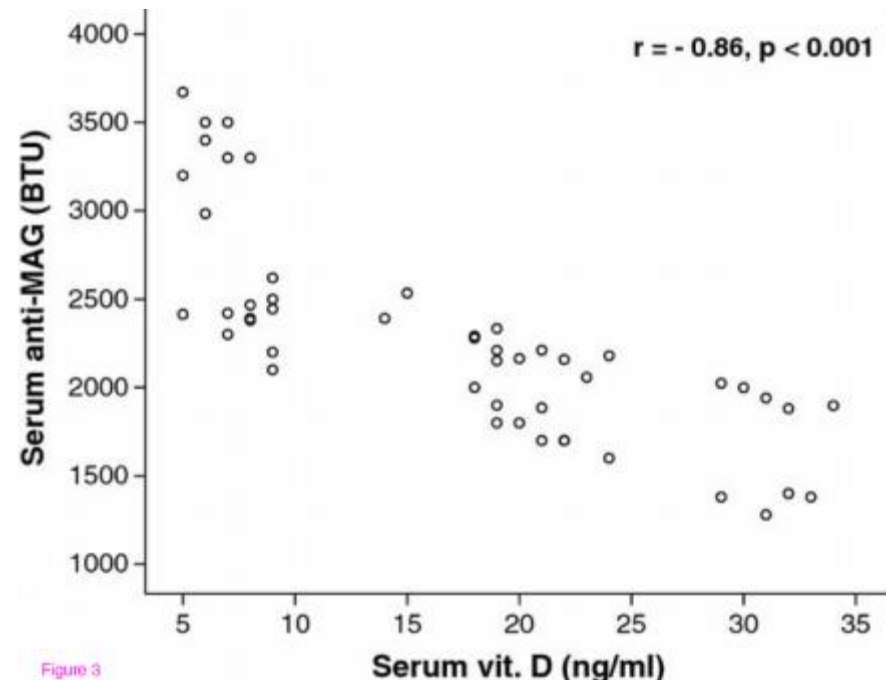


Figure 3

Vitamin D and Autism

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- ▶ This begs the question, does vitamin D have a treatment effect on autism (not just a preventative effect)?
 - ▶ Need more research, but the Dr Mostafa study is intriguing and promising.
 - ▶ I've been receiving anecdotal support that this may be the case for years now.
 - ▶ Study underway at UCSF looking at this very question, raising vitamin D levels in autistic children and seeing if their autistic symptoms improve.
 - ▶ Also urgently need more research if vitamin D has a preventative effect.
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- ▶ **Further reading on the topic with my insight:**
 - ▶ Cannell JJ. Autism and vitamin D. *Med Hypotheses*. 2008;70(4):750-9. Epub 2007 Oct 24.
 - ▶ Cannell JJ. On the aetiology of autism. *Acta Paediatr*. 2010 Aug;99(8):1128-30. Epub 2010 May 19.
 - ▶ Grant WB, Cannell JJ. Autism prevalence in the United States with respect to solar UV-B doses: An ecological study. *Dermato-Endocrinology*, 2012 Jan-Mar;5(1).
 - ▶ Cannell J, Grant W. What is the role of vitamin D in autism? *Dermato-Endocrinology* 2013; 5:19 - 18;



Thank you.

John J Cannell, MD /// Vitamin D Council