

Autism and Vitamin D

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This study has 89 references.

FROM ABSTRACT:

Any theory of autism's etiology must take into account its strong genetic basis while explaining its striking epidemiology.

The apparent increase in the prevalence of autism over the last 20 years corresponds with increasing medical advice to avoid the sun, advice that has probably lowered vitamin D levels and would theoretically greatly lower activated vitamin D (calcitriol) levels in developing brains.

Animal data has repeatedly shown that severe vitamin D deficiency during gestation dysregulates dozens of proteins involved in brain development and leads to rat pups with increased brain size and enlarged ventricles, abnormalities similar to those found in autistic children.

Children with vitamin D deficient rickets have several autistic markers that apparently disappear with high-dose vitamin D treatment.

Estrogen and testosterone have very different effects on vitamin D's metabolism, differences that may explain the striking male/female sex ratios in autism.

Vitamin D down-regulates production of inflammatory cytokines in the brain, cytokines that have been associated with autism.

Consumption of vitamin D containing fish during pregnancy reduces autistic symptoms in offspring.

Autism is more common in areas of impaired UVB penetration such as poleward latitudes, urban areas, areas with high air pollution, and areas of high precipitation.

Autism is more common in dark-skinned persons and severe maternal vitamin D deficiency is exceptionally common in the dark-skinned.

Conclusion: simple Gaussian distributions of the enzyme that activates neural calcitriol combined with widespread gestational and/or early childhood vitamin D deficiency may explain both the genetics and epidemiology of autism.

If so, much of the disease is iatrogenic, brought on by medical advice to avoid the sun.

THIS AUTHOR ALSO NOTES:

The male:female ratio for autism is 4:1.

The prevalence in African Americans (dark skinned people) is increasing at the greatest rate.

The incidence of autism does not follow classic Mendelian inheritance.

Autistic children probably have a predisposing genetic lesion, and the expression of the genotype is influenced by something in the environment.

Hypovitaminosis D is a candidate risk factor for neurodevelopmental disorders, because vitamin D:

- 1) Functions as a neurosteroid
- 2) Is a potent up-regulator of nerve growth factor
- 3) Is found in a wide variety of brain tissue very early in embryogenesis
- 4) Offers neuroprotection, antiepileptic effects, and immunomodulation

Prenatal, neonatal, and postnatal vitamin D supplementation is important for normal brain functioning.

About 0.5% of the human genome (200 genes) are primary targets of vitamin D, and the list is steadily growing.

“Ninety percent of human vitamin D stores come from skin production, not oral intake.”

“Large populations of pregnant women putting small amounts [of vitamin D] in their mouths – in the form of prenatal vitamins – instead of generating large amounts in their skins, is novel to human brain development.”

“The skin’s production of vitamin D is remarkably rapid and extraordinarily robust, easily exceeding recognized dietary sources by an order of magnitude.”

When fair-skinned adults sunbathe in the summer (full-body) for 20 min, they input about 20,000 units of vitamin D to their systemic circulation within 24 h.

“In 1989 the American Medical Association’s Council on Scientific Affairs warned about the dangers of sun-exposure and advised mothers to, ‘keep infants out of the sun as much as possible.’ The increase in autism appears to have begun at the same time. Indeed, most of the graphs showing rising prevalence rates of autism over the last 20 years would be strikingly similar to graphs showing the rising rates of programs promulgating sun-avoidance.”

Levels of vitamin D during brain development directly depend on maternal blood levels, which, in turn, “directly depend on the amount of vitamin D the mother makes in her skin or puts in her mouth.”

“Human behavior, be it the step into the sun, the step to the supplements, the step into the shade, or the step to the sunscreen, determine brain [vitamin D] levels.”

Studies show that vitamin D deficiency in late gestation disrupts adult brain function.

“Vitamin D deficiency dysregulates 36 proteins involved in mammalian brain development, including biological pathways for oxidative phosphorylation, redox balance, cytoskeleton maintenance, calcium homeostasis, chaperoning, post-translational modification, synaptic plasticity, and neurotransmission.”

“Both the brain and the blood of autistic individuals show evidence of ongoing chronic inflammation and oxidative stress.”

Vitamin D has “powerful anti-inflammatory properties.”

Vitamin D is “remarkably neuroprotective by stimulating neurotrophin release, reducing toxic calcium levels in the brain, inhibiting the production of nitrous oxide, and by its immunomodulating properties – especially in reducing inflammatory cytokines – and by increasing brain glutathione.”

“This last function of vitamin D, increasing cellular levels of glutathione, may explain the purported link between heavy metals, oxidative stress, and autism.”

“The primary route for the neurotoxicity of most heavy metals is through depletion of glutathione and subsequent generation of reactive oxygen and nitrogen species. Besides its function as a master antioxidant, glutathione acts as a chelating agent to remove heavy metals, including mercury.”

Estrogen increases neural vitamin D levels, but testosterone does not. This may explain the higher incidence of autism in males.

Vitamin D supplementation in autistic children improves a number of brain function markers.

“The vitamin D theory of autism predicts that consumption of vitamin D-rich fish during pregnancy would improve the offspring’s mentation.”

Higher fish consumption during pregnancy is associated with better infant cognition with the greatest effect for infants whose mothers consumed the most fish.

Low maternal seafood consumption is associated with infants who have lower verbal IQs and suboptimal outcomes for fine motor, communication, and social development.

Autism appears to escalate when children wean from formula and begin drinking juice instead of vitamin D enriched formula.

Northern states with lower levels of UVB light and reduced ability to form skin vitamin D have higher incidence of autism as compared to southern states.

Autism rates go up when children watch more television or when it rains more. Both issues reduce vitamin D production.

Amish children of Pennsylvania spend much more time outdoors, and have very low rates of autism.

If childhood vitamin D deficiency is involved in autism, symptoms should improve in the summer, and studies show dramatic improvements in both sleep and behavioral problems in the summer.

Dark skinned people are poor at making vitamin D and they also have higher incidences of autism. 96% of pregnant black women and 63% of pregnant white women do not have adequate vitamin D blood levels.

"Prenatal vitamins containing 400 IU of vitamin D (10 mcg) offered little protection for mother or infant, 90% of the women in the study reported taking them."

"Low vitamin D levels in the dark-skinned may explain its [autism] increased prevalence in African Americans."

To achieve and maintain ideal vitamin D levels "requires the daily ingestion of thousands – not hundreds" – units of vitamin D per day. Natural levels found in humans who live or work in the sun, are around 50 ng/ml – "levels obtained by a tiny fraction of modern humans."

A 2006 article published in Lancet reported the prevalence of autism spectrum disorder in 56,000 British children was 1 in 86 children. **[WOW!]**

"The lifetime additive societal cost of autism is \$3.2 million per case."

"Autism may be caused by gestational and early childhood vitamin D deficiency, an iatrogenic deficiency brought on by medical advice to avoid the sun, advice that tragically failed to compensate for the consequent 'epidemic of vitamin D deficiency'."

KEY POINTS FROM DAN MURPHY

- 1) "The apparent increase in the prevalence of autism over the last 20 years corresponds with increasing medical advice to avoid the sun, advice that has probably lowered vitamin D levels and would theoretically greatly lower activated vitamin D (calcitriol) levels in developing brains."
- 2) "Consumption of vitamin D containing fish during pregnancy reduces autistic symptoms in offspring."
- 3) "Autism is more common in areas of impaired UVB penetration such as poleward latitudes, urban areas, areas with high air pollution, and areas of high precipitation."
- 4) "Autism is more common in dark-skinned persons and severe maternal vitamin D deficiency is exceptionally common in the dark-skinned."
- 5) "Widespread gestational and/or early childhood vitamin D deficiency may explain both the genetics and epidemiology of autism. If so, much of the disease is iatrogenic, brought on by medical advice to avoid the sun."
- 6) The male:female ratio for autism is 4:1.
- 7) Hypovitaminosis D is a candidate risk factor for neurodevelopmental disorders, because vitamin D:
 - A) Functions as a neurosteroid
 - B) Is a potent up-regulator of nerve growth factor
 - C) Is found in a wide variety of brain tissue very early in embryogenesis
 - D) Offers neuroprotection, antiepileptic effects, and immunomodulation
- 8) Prenatal, neonatal, and postnatal vitamin D supplementation is important for normal brain functioning.
- 9) Vitamin D affects at least 200 human genes.
- 10) "Ninety percent of human vitamin D stores come from skin production, not oral intake."
- 11) "Large populations of pregnant women putting small amounts [of vitamin D] in their mouths – in the form of prenatal vitamins – instead of generating large amounts in their skins, is novel to human brain development."
- 12) "The skin's production of vitamin D is remarkably rapid and extraordinarily robust, easily exceeding recognized dietary sources by an order of magnitude."
- 13) When fair-skinned adults sunbathe in the summer (full-body) for 20 min, they input about 20,000 units of vitamin D to their systemic circulation within 24 h.

- 14) "In 1989 the American Medical Association's Council on Scientific Affairs warned about the dangers of sun-exposure and advised mothers to, 'keep infants out of the sun as much as possible.' The increase in autism appears to have begun at the same time. Indeed, most of the graphs showing rising prevalence rates of autism over the last 20 years would be strikingly similar to graphs showing the rising rates of programs promulgating sun-avoidance."
- 15) "Human behavior, be it the step into the sun, the step to the supplements, the step into the shade, or the step to the sunscreen, determine brain [vitamin D] levels."
- 16) "Both the brain and the blood of autistic individuals show evidence of ongoing chronic inflammation and oxidative stress. "Vitamin D has" powerful anti-inflammatory properties."
- 17) Vitamin D is remarkably neuroprotective by "increasing brain glutathione." "This may explain the purported link between heavy metals, oxidative stress, and autism."
- 18) "The primary route for the neurotoxicity of most heavy metals is through depletion of glutathione and subsequent generation of reactive oxygen and nitrogen species. Besides its function as a master antioxidant, glutathione acts as a chelating agent to remove heavy metals, including mercury."
- 19) Estrogen increases neural vitamin D levels, but testosterone does not. This may explain the higher incidence of autism in males.
- 20) Vitamin D supplementation in autistic children improves a number of brain function markers.
- 21) "The vitamin D theory of autism predicts that consumption of vitamin D-rich fish during pregnancy would improve the offspring's mentation."
- 22) Higher fish consumption during pregnancy is associated with better infant cognition with the greatest effect for infants whose mothers consumed the most fish.
- 23) Low maternal seafood consumption is associated with infants who have lower verbal IQs and suboptimal outcomes for fine motor, communication, and social development.
- 24) Autism appears to escalate when children wean from formula and begin drinking juice instead of vitamin D enriched formula.
- 25) Autism rates go up when children watch more television or when it rains more. Both issues reduce vitamin D production.

- 26) Amish children of Pennsylvania spend much more time outdoors, and have very low rates of autism.
- 27) If childhood vitamin D deficiency is involved in autism, symptoms should improve in the summer, and studies show dramatic improvements in both sleep and behavioral problems in the summer.
- 28) Dark skinned people are poor at making vitamin D and they also have higher incidences of autism. 96% of pregnant black women and 63% of pregnant white women do not have adequate vitamin D blood levels.
- 29) To achieve and maintain ideal vitamin D levels "requires the daily ingestion of thousands – not hundreds" – units of vitamin D per day. Natural levels found in humans who live or work in the sun, are around 50 ng/ml – "levels obtained by a tiny fraction of modern humans."
- 30) A 2006 article published in Lancet reported the prevalence of autism spectrum disorder in 56,000 British children was 1 in 86 children. **[WOW!]**
- 31) "The lifetime additive societal cost of autism is \$3.2 million per case."
- 32) "Autism may be caused by gestational and early childhood vitamin D deficiency, an iatrogenic deficiency brought on by medical advice to avoid the sun, advice that tragically failed to compensate for the consequent 'epidemic of vitamin D deficiency'."