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Omega-3 fatty acids and vitamin D may control brain serotonin

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Although essential marine omega-3 fatty acids and vitamin D have been shown to improve cognitive function and behavior in the context of certain brain disorders, the underlying mechanism has been unclear. In a new paper published in *FASEB Journal* by Rhonda Patrick, PhD and Bruce Ames, PhD of Children's Hospital Oakland Research Institute (CHORI), serotonin is explained as the possible missing link tying together why vitamin D and marine omega-3 fatty acids might ameliorate the symptoms associated with a broad array of brain disorders.

In a previous paper published last year, authors Patrick and Ames discussed the implications of their finding that vitamin D regulates the conversion of the essential amino acid tryptophan into serotonin, and how this may influence the development of autism, particularly in developing children with poor vitamin D status.

Here they discuss the relevance of these micronutrients for neuropsychiatric illness. Serotonin affects a wide-range of cognitive functions and behaviors including mood, decision-making, social behavior, impulsive behavior, and even plays a role in social decision-making by keeping in check aggressive social responses or impulsive behavior.

Many clinical disorders, such as autism spectrum disorder (ASD), attention deficit hyperactivity disorder (ADHD), bipolar disorder, schizophrenia, and depression share as a unifying attribute low brain

serotonin. "In this paper we explain how serotonin is a critical modulator of executive function, impulse control, sensory gating, and pro-social behavior," says Dr. Patrick. "We link serotonin production and function to vitamin D and omega-3 fatty acids, suggesting one way these important micronutrients help the brain function and affect the way we behave."

Eicosapentaenoic acid (EPA) increases serotonin release from presynaptic neurons by reducing inflammatory signaling molecules in the brain known as E2 series prostaglandins, which inhibit serotonin release and suggests how inflammation may negatively impact serotonin in the brain. EPA, however, is not the only omega-3 that plays a role in the serotonin pathway. Docosahexaenoic acid (DHA) also influences the action of various serotonin receptors by making them more accessible to serotonin by increasing cell membrane fluidity in postsynaptic neurons.

Their paper illuminates the mechanistic links that explain why low vitamin D, which is mostly produced by the skin when exposed to sun, and marine omega-3 deficiencies interacts with genetic pathways, such as the serotonin pathway, that are important for brain development, social cognition, and decision-making, and how these gene-micronutrient interactions may influence neuropsychiatric outcomes. "Vitamin D, which is converted to a steroid hormone that controls about 1,000 genes, many in the brain, is a major deficiency in the US and omega-3 fatty acid deficiencies are very common because people don't eat enough fish," said Dr. Ames.

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