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Vitamin D in brain function

Vitamin D supplementation for high risk groups may be warranted

In a definitive critical review, scientists at Children's Hospital & Research Center Oakland ask whether there is convincing biological or behavioral evidence linking vitamin D deficiency to brain dysfunction. Joyce C. McCann, Ph.D., assistant staff scientist and Bruce N. Ames, Ph.D., senior scientist at Children's Hospital Oakland Research Institute (CHORI) conclude that there is ample biological evidence to suggest an important role for vitamin D in brain development and function, and that supplementation for groups chronically low in vitamin D is warranted. Their conclusions will be published on April 22, 2008 in the Federation of American Societies for Experimental Biology (FASEB) Journal.

This critical analysis of vitamin D function and the brain is a model of careful thinking about nutrition and behavior, says Gerald Weissmann, MD, Editor-in-Chief of the FASEB Journal 徹ne wishes that all studies of nutritional supplements or requirements were this thoughtful. Drs. McCann and Ames deftly show that while vitamin D has an important role in the development and function of the brain, its exact effects on behavior remain unclear. Pointing to the need for further study, the authors argue for vitamin D supplementation in groups at risk.

Vitamin D has long been known to promote healthy bones by regulating calcium levels in the body. Lack of sufficient vitamin D in very young children results in rickets, which can be easily prevented by vitamin D supplements. Only recently the scientific community has become aware of a much broader role for vitamin D. For example, we now know that, in addition to its role in maintaining bone health, vitamin D is involved in differentiation of tissues during development and in proper functioning of the immune system. In fact, over 900 different genes are now known to be able to bind the vitamin D receptor, through which vitamin D mediates its effects. In addition to protecting against rickets, evidence now strongly indicates that a plentiful supply of vitamin D helps to protect against bone fractures in the elderly. Evidence also continues to accumulate suggesting a beneficial role for vitamin D in protecting against autoimmune

diseases, including multiple sclerosis and type I diabetes, as well as some forms of cancer, particularly colorectal and breast.

Vitamin D is present in only a few foods (e.g., fatty fish), and is also added to fortified milk, but our supply typically comes mostly from exposure to ultraviolet rays (UV) in sunlight. UV from the sun converts a biochemical in the skin to vitamin D, which is then metabolized to calcitriol, its active form and an important hormone. Formation of vitamin D by UV can be 6 times more efficient in light skin than dark skin, which is an important cause of the known widespread vitamin D deficiency among African Americans living in northern latitudes. Dark skin has been selected during evolution because it protects against the burning UV rays of the sun in the tropics. White skin has been selected for allowing as much UV exposure to make sufficient vitamin D in Northern (high) latitudes. Thus, fair-skinned northerners are at risk in Australia or Arizona for sunburns and UV-induced cancer, while dark-skinned people in the Northern U.S. or European latitudes with little exposure to the sun are at risk for rickets, bone fractures and possibly other diseases including several types of cancer due to a lack of vitamin D. Fortunately sun-screens and vitamin D supplements are inexpensive.

McCann & Ames point out that evidence for vitamin D′s involvement in brain function includes the wide distribution of vitamin D receptors throughout the brain. They also discuss vitamin D′s ability to affect proteins in the brain known to be directly involved in learning and memory, motor control, and possibly even maternal and social behavior. The review also discusses studies in both humans and animals that present suggestive though not definitive evidence of cognitive or behavioral consequences of vitamin D inadequacy. The authors discuss possible reasons for the apparent discrepancy between the biological and behavioral evidence, and suggest new, possibly clarifying avenues of research.

Many vitamin D experts advise that the currently recommended level of vitamin D intake is much too low and should be raised to protect against bone fractures and possibly cancer in addition to rickets (2). Indeed, even using present guidelines, too many Americans have low vitamin D blood levels. McCann & Ames propose that, despite uncertainty regarding all of the deleterious effects of vitamin D inadequacy, the evidence overall indicates that supplementation, which is both inexpensive and prudent, is warranted for groups whose vitamin D status is exceptionally low, particularly nursing infants, the elderly, and African Americans (e.g., see (3)).

This review is the fourth in a series by McCann & Ames that critically evaluate scientific evidence linking deficiencies in micronutrients (the approximately 40 vitamins, minerals, amino acids,

and fatty acids required for the body to function) to brain function. Other reviews in the series discuss the long-chain polyunsaturated fatty acid docosahexaenoic acid (DHA) (4, 5), choline (6), and iron (7).

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Research at Children's Hospital & Research Center Oakland, CA

Research efforts at Children's Hospital & Research Center Oakland are coordinated through Children's Hospital Oakland Research Institute (CHORI). Children's Hospital Oakland is Northern California's only freestanding and independent children's hospital. CHORI's internationally renowned biomedical research facility brings together seven centers of excellence that are devoted to clinical and basic science research to treat and prevent disease. CHORI has approximately 300 staff members and an annual budget of more than $49 million. The National Institutes of Health is CHORI's primary funding source. The institute is a leader in translational research, bringing bench discoveries to bedside applications. These include providing cures for blood diseases, developing new vaccines for infectious diseases and discovering new treatment protocols for previously fatal or debilitating conditions such as

cancers, sickle cell disease and thalassemia, diabetes, asthma, HIV/AIDS, pediatric obesity, nutritional deficiencies, birth defects, hemophilia and cystic fibrosis.