Abstract

J Nutr Health Aging. 2006 Sep-Oct;10(5):377-85.

Effects of nutrients (in food) on the structure and function of the nervous system: update on dietary requirements for brain. Part 1: micronutrients.

Bourre JM.

French Academy of Medicine. INSERM, U705 ; CNRS, UMR 7157 ; Universités Paris 7 et 5, Department of Neuro-pharmaco-nutrition. Hôpital Fernand Widal, 200, rue du Faubourg Saint-Denis, 75475 Paris cedex 10.

OBJECTIVE: The objective of this update is to give an overview of the effects of dietary nutrients on the structure and certain functions of the brain. As any other organ, the brain is elaborated from substances present in the diet (sometimes exclusively, for vitamins, minerals, essential amino-acids and essential fatty acids, including omega- 3 polyunsaturated fatty acids). However, for long it was not fully accepted that food can have an influence on brain structure, and thus on its function, including cognitive and intellectuals. In fact, most micronutrients (vitamins and trace-elements) have been directly evaluated in the setting of cerebral functioning.

DISCUSSION: For instance, to produce energy, the use of glucose by nervous tissue implies the presence of vitamin B1; this vitamin modulates cognitive performance, especially in the elderly. Vitamin B9 preserves brain during its development and memory during ageing. Vitamin B6 is likely to benefit in treating premenstrual depression. Vitamins B6 and B12, among others, are directly involved in the synthesis of some neurotransmitters. Vitamin B12 delays the onset of signs of dementia (and blood abnormalities), provided it is administered in a precise clinical timing window, before the onset of the first symptoms. Supplementation with cobalamin improves cerebral and cognitive functions in the elderly; it frequently improves the functioning of factors related to the frontal lobe, as well as the language function of those with cognitive disorders. Adolescents who have a borderline level of vitamin B12 develop signs of cognitive changes. In the brain, the nerve endings contain the highest concentrations of vitamin C in the human body (after the suprarenal glands). Vitamin D (or certain of its analogues) could be of interest in the prevention of various aspects of neurodegenerative or neuroimmune diseases. Among the various vitamin E components (tocopherols and tocotrienols), only alpha-tocopherol is actively uptaken by the brain and is directly involved in nervous membranes protection. Even vitamin K has been involved in nervous tissue biochemistry. Iron is necessary to ensure oxygenation and to produce energy in the cerebral parenchyma (via cytochrome oxidase), and for the synthesis of neurotransmitters and myelin; iron deficiency is found in children with attention-deficit/hyperactivity disorder. Iron concentrations in the umbilical artery are critical during the development of the foetus, and in relation with the IQ in the child; infantile anaemia with its associated iron deficiency is linked to perturbation of the development of cognitive functions. Iron deficiency anaemia is common, particularly in women, and is associated, for instance, with apathy, depression and rapid fatigue when exercising. Lithium importance, at least in psychiatry, is known for a long time. Magnesium plays important roles in all the major metabolisms: in oxidation-reduction and in ionic regulation, among others. Zinc participates among others in the perception of taste. An unbalanced copper metabolism homeostasis (due to dietary deficiency) could be linked to Alzheimer disease. The iodine provided by the thyroid hormone ensures the energy metabolism of the cerebral cells; the dietary reduction of iodine during pregnancy induces severe cerebral dysfunction, actually leading to cretinism. Among many mechanisms, manganese, copper, and zinc participate in enzymatic mechanisms that protect against free radicals, toxic derivatives of oxygen.

CONCLUSIONS: More specifically, the full genetic potential of the child for physical growth and mental development may be compromised due to deficiency (even subclinical) of micronutrients. Children and adolescents with poor nutritional status are exposed to alterations of mental and behavioural functions that can be corrected by dietary measures, but only to certain extend. Indeed, nutrient composition and meal pattern can exert either immediate or long-term effects, beneficial or adverse. Brain diseases during aging can also be due to failure for protective mechanism, due to dietary deficiencies, for instance in anti-oxidants and nutrients (trace elements, vitamins, non essential micronutrients such as polyphenols) related with protection against free radicals. Macronutrients are presented in the accompanying paper.

PMID: 17066209