A deficiency of dietary omega-3 may explain depressive behaviors

January 30 2011

How maternal essential fatty acid deficiency impact on its progeny is poorly understood. Dietary insufficiency in omega-3 fatty acid has been implicated in many disorders. Researchers from Inserm and INRA and their collaborators in Spain collaboration, have studied mice fed on a diet low in omega-3 fatty acid. They discovered that reduced levels of omega-3 had deleterious consequences on synaptic functions and emotional behaviours. Details of this work are available in the online version of the journal *Nature Neuroscience*.

In industrialized nations, diets have been impoverished in essential fatty acids since the beginning of the 20th century. The dietary ratio between omega-6 polyunsaturated fatty acid and omega-3 polyunsaturated fatty acid omega-3 increased continuously over the course of the 20th century. These fatty acids are "essential" lipids because the body cannot synthesize them from new. They must therefore be provided through food and their dietary balance is essential to maintain optimal brain functions.

Olivier Manzoni (Head of Research Inserm Unit 862, "Neurocentre Magendie", in Bordeaux and Unit 901 "Institut de Neurobiologie de la Méditerranée" in Marseille), and Sophie Layé (Head of Research at INRA Unit 1286, "Nutrition et Neurobiologie Intégrative" in Bordeaux) and their co-workers hypothesized that chronic malnutrition during intra-uterine development, may later influence synaptic activity involved in emotional behaviour (e.g. depression, anxiety) in adulthood.

To verify their hypotheses, the researchers studied mice fed a life-long diet imbalanced in omega-3 and omega-6 fatty acids. They found that omega-3 deficiency disturbed neuronal communication specifically. The researchers observed that only the cannabinoid receptors, which play a strategic role in neurotransmission, suffer a complete loss of function. This neuronal dysfunction was accompanied by depressive behaviours among the malnourished mice.

Among omega-3 deficient mice, the usual effects produced by cannabinoid receptor activation, on both the synaptic and behavioural levels, no longer appear. Thus, the CB1R receptors lose their synaptic activity and the antioxidant effect of the cannabinoids disappears.

Consequently, the researchers discovered that among mice subjected to an omega-3 deficient dietary regime, synaptic plasticity, which is dependent on the CB1R cannabinoid receptors, is disturbed in at least two structures involved with reward, motivation and emotional regulation: the prefrontal cortex and the nucleus accumbens. These parts of the brain contain a large number of CB1R cannabinoid receptors and have important functional connections with each other.

"Our results can now corroborate clinical and epidemiological studies which have revealed associations between an omega-3/omega-6 imbalance and mood disorders", explain Olivier Manzoni and Sophie Layé. "To determine if the omega-3 deficiency is responsible for these neuropsychiatric disorders additional studies are, of course, required".

In conclusion, the authors estimate that their results provide the first biological components of an explanation for the observed correlation between omega-3 poor diets, which are very widespread in the industrialized world, and mood disorders such as depression.

More information: Nutritional Omega-3 deficiency abolishes

endocannabinoid mediated neuronal functions, *Nature Neuroscience*, 30 janvier 2011 dx.doi.org/10.1038/nn.2736