Genetic adaptation of fat metabolism key to development of human brain

12 April 2012

About 300 000 years ago humans adapted genetically to be able to produce larger amounts of Omega-3 and Omega-6 fatty acids. This adaptation may have been crucial to the development of the unique brain capacity in modern humans. In today's life situation, this genetic adaptation contributes instead to a higher risk of developing disorders like cardiovascular disease.

The human nervous system and brain contain large amounts of polyunsaturated fatty acids, and these are essential for the development and function of the brain. These Omega-3 and Omega-6 fatty acids occur in high quantities in just a few foods, such as fat fish. Our bodies can also produces these important fatty acids themselves from certain vegetable oils.

In a new study led by researchers at Uppsala University and now being published in the American Journal of Human Genetics scientists have investigated the genes for the two key enzymes that are needed to produce Omega-3 and Omega-6 fatty acids from vegetable oils. They have found that humans have a unique genetic variant that leads to increased production. This genetic adaptation for high production of Omega-3 and Omega-6 fatty acids is found only in humans, and not in our living primate relatives chimpanzees, gorillas, and rhesus monkeys. Nor did Neanderthals or Denisovans, another type of extinct hominin species, have this genetic variant. It appeared some 300 000 years ago in the evolutionary line that led to modern humans.

This genetic adaptation for more efficient Omega-3 and Omega-6 production from vegetable oils developed in Africa and has probably been an important factor for human survival in environments with limited dietary access to fatty acids.

"During humans' earlier development, when there was a general energy deficit, this variant made it possible for us to satisfy the great need for polyunsaturated fatty acids required for our unique brain capacity. In today's life situation, with a surplus of nourishment, this genetic adaptation contributes instead to a greater risk of developing disorders like cardiovascular disease," says Adam Ameur, a bioinformatician at the Department of Immunology, Genetics and Pathology.

"This is the first study to show a genetic adaptation of human fat metabolism. It's also one of few examples of a so-called 'thrifty gene,' that is, a genetic adaptation that contributed to enhanced survival in an earlier stage of human development, but in a life situation with an excess of food instead constitutes a risk factor for lifestyle diseases," says Ulf Gyllensten, professor of medical molecular genetics at the Department of Immunology, Genetics and Pathology.

Provided by Uppsala University