Adolescents' high-fat diet impairs memory and learning

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A high-fat diet in adolescence appears to have long-lasting effects on learning and memory during adulthood, a new study in mice finds. The results were presented Saturday at The Endocrine Society's 95th Annual Meeting in San Francisco.

Adolescent mice fed a normal-calorie but high-fat diet became moderately obese but not diabetic, and they displayed significantly impaired spatial memory, according to the study authors, from CEU-San Pablo University (Universidad CEU-San Pablo) in Madrid. Spatial memory allows recording of information needed to navigate in a familiar environment and is pivotal for learning, said the lead author, Mariano Ruiz-Gayo, PhD, a professor of pharmacology at the university.

Adult mice that received the same diet had intact performance on memory tasks, showing that, unlike the adolescents, they were not sensitive to the effects of the fatty diet, he reported.

"This study shows that normocaloric diets containing high amounts of saturated fat might have deleterious and long-lasting effects on the developing brain, even in the absence of apparent diabetes," Ruiz-Gayo said.

In their study, the investigators gave 15 male adolescent mice an eight-week, high-fat diet in which 45 percent of the calories came from unhealthy, saturated fat. Another 15 male mice received a conventional diet with the same number of calories (the control group). A similar study was carried out in adult mice so the researchers could test the effects of a high-fat diet starting later in life.

To test the rodents' spatial memory, the researchers used the novel location recognition test. In this test, the mice were placed in an open-field box—an open but walled box with a single chamber—containing two objects, plastic toy (Lego) pieces. The mice were already familiar with the box and one of the objects, but the other object was new to them. The mice explored the box for 10 minutes initially. One hour and 24 hours later, the mice returned to the box, where each time the new object was in a different position. The researchers recorded how long it took the rodents to find the new object.

The scientists found that it took mice significantly longer to find the new object if they had received the high-fat diet when their brains were immature. Ruiz-Gayo said this demonstrated impaired spatial memory in the mice whose high-fat diet started in adolescence. The memory damage reportedly did not reverse after these mice received a reduced-calorie diet, suggesting that the changes were long-lasting.

Additionally, laboratory analyses of the brain showed corresponding long-lasting brain changes in the mice with memory deficits, according to the authors. In the brain regions related to memory (the hippocampus), these mice had changes in the structure of their neurons, or nerve cells. The researchers also found, in the brain, a partial loss of leptin, a hormone released by fat tissue that helps support cognitive function.

Ruiz-Gayo speculated that the brain's memory centers are susceptible to a high-fat diet during adolescence because of hormonal changes in the brain, most prominently in leptin.

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