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Too much fatty food could set children up for mental problems: Study in mice

First study to provide molecular mechanisms for how eating high-fat foods in excess during adolescence alters executive functions

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Summary: Chances are that children who eat excessive amounts of fatty foods will not only become obese, but will develop cognitive and psychiatric problems when they are older, a study in mice suggests. This is because, according to a recent study, diets rich in fat deplete the levels of a key protein known to help synapses in the brain to work properly. In turn, this leads to a dip in several forms of cognitive functions, such as behavioral flexibility and memory.

FULL STORY

Can eating a high fat diet in youth affect cognitive functions in adulthood?

Credit: © Tatyana Gladskih / Fotolia

Chances are that children who eat excessive amounts of fatty foods will not only become obese, but will develop cognitive and psychiatric problems when they are older. This is because, according to a recent study, diets rich in fat deplete the levels of a key protein known to help synapses in the brain to work properly. In turn, this leads to a dip in several forms of cognitive functions, such as behavioral flexibility and memory.

"These changes from a young age onwards are more the result of the fatty foods themselves, and the impact they have on young brains, rather than arising from the mere fact of being obese," notes Urs Meyer from ETH Zurich in Switzerland in Springer Nature's journal *Molecular Psychiatry*. Together with Pascale Chavis from the INMED Institute in Marseille in France, they co-directed the first study providing molecular mechanisms for how high-fat diets during adolescence negatively affect normal brain functioning and cognition.

The researchers conducted a study in mice, and observed cognitive defects as early as four weeks after the mice were fed high-fat foods. These were evident even before the animals started gaining weight and appeared specifically in mice fed high-fat foods during adolescence, and not in mice fed the same diets during adulthood.

In order to get at the mechanisms underlying such observations, the authors focused on a frontal region in the brain known as the prefrontal cortex. In humans, the prefontal cortex is associated with the planning of complex actions and decision making, expressing one's personality and controlling one's social behavior. Several human studies had shown how fat-rich diets can reduce performance on executive tasks such as problem solving and working memory, in particular in adolescents. This seems worrying in light of a marked drop in the quality of diets over the past few decades and the poor understanding of the impact these diets have on our neurons.

These effects might be particularly relevant for adolescents, according to the study authors, as adolescence is a key period of increased caloric needs and heightened appetite for young people. It is the time when they start making more choices themselves about what to eat.

Adolescents eating high-fat diets may also be prone to cognitive deficits due to the immature character of the prefrontal cortex during this time frame. "This brain region is very interesting," notes French INSERM investigator Chavis, "because, unlike the rest of the brain, it is not fully developed until early adulthood." Researchers believe this relative immaturity makes the prefrontal cortex very sensitive to suboptimal experiences occurring during adolescence such as trauma, excessive stress or drug abuse. "Our study highlights that the quality of the food eaten by teenagers may also be particularly important for an optimal maturation of the prefrontal cortex," says Marie Labouesse, lead author of the study.

"We think this adolescent vulnerability to high-fat foods might be due to the hypersensitivity of a protein known as reelin," notes Labouesse. The researchers saw that the prefrontal cortex of mice fed high-fat foods had fewer neurons expressing reelin and this only happened when the diets were fed during the adolescent period. The authors then zoomed in, looking at synapses, those small microscopic structures that allow neurons to communicate between each other. The reelin protein is known to regulate synaptic function, and in particular synaptic plasticity, i.e. the ability of synapses to become stronger or weaker in response to a change in brain activity.

"We saw that plasticity in the prefrontal cortex was impaired in animals fed high-fat foods during adolescence; and quite remarkably we then observed that when restoring reelin levels, both synaptic plasticity and cognitive functions went back to normal," notes Chavis.

"Our findings that high-fat diets during adolescence disrupt functioning of the adult prefrontal cortex suggest that a careful nutritional balance during this sensitive period is pivotal for reaching the full capacity of adult prefrontal functions," says Labouesse. "Although we still need to find out the exact mechanisms by which reelin neurons get depleted during adolescence, it looks like high-fat foods could kick-start changes in how the prefrontal cortex of younger people develops."

These findings may help explain how unhealthy foods and obesity are increasingly linked to the development of neuropsychiatric and neurological conditions.

Reelin deficiency is also a feature repeatedly documented in brain disorders such as schizophrenia or Alzheimer's disease. "Although more studies on this topic are definitely needed," warns Meyer, "high-fat diets could potentially exacerbate the reelin and synaptic deficits in patients with mental illnesses such as schizophrenia or Alzheimer's disease or even aggravate cognitive anomalies."

"Reelin is now established as being a key player in the regulation of normal brain functions. The fact that the reelin protein displays vulnerability towards the negative effects of unhealthy foods is fascinating from the scientific perspective, but also very worrying when we think of the potential impact this might have for human health," concludes Chavis.

Story Source:

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Journal Reference:

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