

Fatty food before surgery may impair memory in old, young adults

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Eating fatty food in the days leading up to surgery may prompt a heightened inflammatory response in the brain that interferes for weeks with memory-related cognitive function in older adults—and new

research in animals suggests, even in young adults.

The study, building upon [previous research](#) from the same lab at The Ohio State University, also showed that taking a DHA omega-3 fatty acid supplement for a month before the unhealthy eating and surgical procedure prevented the effects on memory linked to both the high-fat diet and the surgery in aged and young adult rats.

Three days on a high-fat diet alone was detrimental to a specific type of fear-related memory in aged rats for as long as two weeks later—the same type of impairment seen in younger rats that ate fatty food and had a [surgical procedure](#). The team has traced the brain inflammation behind these effects to a protein that activates the [immune response](#).

"These data suggest that these multiple insults have a compounding effect," said senior author Ruth Barrientos, an investigator in Ohio State's Institute for Behavioral Medicine Research and associate professor of psychiatry and behavioral health and neuroscience in the College of Medicine.

"We've shown that an unhealthy diet, even in the short term, especially when it's consumed so close to a surgery, which in and of itself will cause an [inflammatory response](#), can have damaging results," Barrientos said. "The high-fat diet alone might increase inflammation in the brain just a little bit, but then you have surgery that does the same thing, and when put together in a short amount of time, you get a synergistic response that can set things in motion toward a longer-term memory issue."

The study was published recently in the journal [Brain, Behavior, and Immunity](#).

Barrientos' lab studies how everyday life events might trigger

inflammation in the aging brain as the nervous system responds to signals from the immune system reacting to a threat. Decades of research have suggested that with aging comes long-term "priming" of the brain's inflammatory profile and a loss of brain-cell reserve to bounce back.

Researchers fed young adult and aged rats a diet high in saturated fat for three days before a procedure resembling exploratory abdominal surgery—an event already known to cause about a week of cognitive issues in an older brain. Control rats ate regular food and were anesthetized but had no surgery. (Barrientos' lab has determined anesthesia alone does not cause [memory problems](#) in rats.)

In this study, as in previous research on [aged rats treated with morphine after surgery](#), the team showed that an immune system receptor called TLR4 was the culprit behind the [brain inflammation](#) and related memory problems generated by both surgery and the high-fat diet, said first author Stephanie Muscat, assistant clinical professor of neuroscience at Ohio State.

"Blocking the TLR4 signaling pathway prior to the diet and surgery completely prevented that neuroimmune response and memory impairments, which confirmed this specific mechanism," Muscat said. "And as we had found before in another model of an unhealthy diet, we showed that DHA supplementation did mitigate those inflammatory effects and prevent memory deficits after surgery."

There were some surprising memory findings in the new work. Different behavioral tasks are used to test two types of memory: contextual memory based in the hippocampus and cued-fear memory based in the amygdala. In contextual memory tests, rats with normal memory freeze when they re-enter a room in which they had an unpleasant experience. Cued-fear memory is evident when rats freeze in a new environment

when they hear a sound connected to that previous bad experience.

For aged rats in this study, as expected, the combination of a high-fat diet and surgery led to problems with both contextual and cued-fear memory that persisted for at least two weeks—a longer-lasting effect than the researchers had seen before.

The high-fat diet alone also impaired the aging rats' cued-fear memory. And in young adult rats, the combination of the high-fat diet and surgery led to only cued-fear memory deficits but no problems with memory governed by the hippocampus.

"What this is telling us in aged animals, along with the fact we're seeing this same impairment in young animals after the [high-fat diet](#) and surgery, is that cued-fear memory is uniquely vulnerable to the effects of diet. And we don't know why," Barrientos said. "One of the things we're hoping to understand in the future is the vulnerability of the amygdala to these unhealthy diet challenges."

With increasing evidence suggesting that fatty and highly processed foods can trigger inflammation-related memory problems in brains of all ages, the consistent findings that DHA—one of two omega-3 fatty acids in fish and other seafood and available in supplement form—has a protective effect are compelling, Barrientos said.

"DHA was really effective at preventing these changes," she said. "And that's amazing—it really suggests that this could be a potential pretreatment, especially if people know they're going to have surgery and their diet is unhealthy."

More information: Stephanie M. Muscat et al, Post-operative

cognitive dysfunction is exacerbated by high-fat diet via TLR4 and prevented by dietary DHA supplementation, *Brain, Behavior, and Immunity* (2023). [DOI: 10.1016/j.bbi.2023.12.028](https://doi.org/10.1016/j.bbi.2023.12.028)

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