

The surprising connection between obesity, choline and brain inflammation

Study finds that obesity-related health issues and low choline levels in young adults may set the stage for neurodegeneration later in life

By Richard Harth, ASU News
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For decades, scientists have known that what harms the body often harms the brain. Conditions such as obesity, high blood pressure and insulin resistance strain the body's vascular and metabolic systems. Over time, that stress can speed up cognitive decline and increase the risk of Alzheimer's disease.

Now, researchers at Arizona State University and their collaborators report that these effects may begin far earlier than expected. In young adults with obesity, the team identified biological markers of inflammation, liver stress and detection of markers indicative of early damage to brain cells — subtle changes that reflect patterns also seen in older adults with cognitive impairment.

The study also highlights a surprising companion finding: These young adults had unusually low blood levels of choline, a key nutrient and organic compound crucial for liver function, inflammation control and long-term brain health.

"This research adds to the growing evidence that choline is a valuable marker of metabolic and brain dysfunction — and reinforces the importance of sufficient daily intake, as it is essential for human health," Professor [Ramon Velazquez](#) said. "Several new reports published this month further link reduced blood choline levels to behavioral changes, including anxiety and memory impairment, as well as broader metabolic dysfunction."

Velazquez, who led the study, is a researcher with the [ASU-Banner Neurodegenerative Disease Research Center](#). He is joined by ASU colleagues in the [School of Life Sciences](#), and researchers from Banner Sun Health Research Institute and Mayo Clinic in Arizona.

The findings appear in the journal [Aging and Disease](#).

Early markers link obesity to brain health

While obesity is well known to increase the risk of heart disease and Type 2 diabetes, the study shows that obesity-related changes in the body may also influence the brain early in adulthood.

The researchers found high levels of proteins that drive chronic inflammation, as well as enzymes associated with liver stress and neurofilament light chain (NfL), a protein released when neurons are damaged. NfL levels were associated with low blood choline levels at ages well before any form of behavior changes would be expected.

Elevated NfL is increasingly recognized as an early marker of neurodegeneration. It appears at high levels in people with mild cognitive impairment and Alzheimer's disease.

Seeing these signals in young adults is striking and suggests that obesity may leave measurable fingerprints on the brain long before outward symptoms of disease appear.

The findings underscore how metabolic stress, inflammation and indicators of neuronal health may form an interconnected pathway — one that begins far earlier than previously assumed.

A nutrient at the center of the puzzle

One of the study's most notable findings involved choline, an essential nutrient required for liver health, inflammation regulation, cell-membrane structure and the production of the neurotransmitter acetylcholine.

Participants with obesity had dramatically lower levels of circulating choline, which strongly correlated with increased inflammation, insulin resistance, liver-enzyme elevations and NfL.

Choline is produced in small amounts by the liver, and mainly obtained through diet, with rich sources including eggs, fish, poultry, beans and cruciferous vegetables such as broccoli, cauliflower and brussels sprouts.

Importantly, women exhibited lower levels than men, a striking observation considering that cognitive aging and Alzheimer's disease disproportionately affect women.

[National nutrition surveys](#) show that most Americans fall short of recommended choline intake, particularly adolescents and young adults. Because choline supports both liver function and brain health, chronically low intake may leave individuals more vulnerable to metabolic stress, creating a biological environment in which the effects of obesity on the brain become even more pronounced.

"Most people don't realize they aren't getting enough choline," said Wendy Winslow, first co-author of the new study. "Adding choline-rich foods to your routine can help reduce inflammation and support both your body and brain as you age."

How the study was conducted

The study examined 30 young adults, half with obesity and half of "normal" weight, all in their 20s and 30s. Each participant provided a fasting blood sample, allowing the researchers to measure circulating choline, inflammatory cytokines, insulin and glucose levels, liver-related enzymes, other metabolic measures and NfL.

By comparing these measures across groups, the team identified a clear pattern linking obesity to lower choline levels, higher inflammation, metabolic stress and early signs of neuron damage. To better understand the brain implications, the researchers then compared these findings with choline and NfL levels from older adults diagnosed with mild cognitive impairment or Alzheimer's disease.

The same relationship of lower choline paired with higher NfL appeared in both groups. This suggests that some of the biological pathways leading to Alzheimer's may be active decades before symptoms emerge, particularly in individuals with obesity or metabolic stress.

Taken together, the results point to a link between obesity, inflammation, choline status and early neuronal stress — a connection that may help explain why metabolic disorders increase the risk of cognitive decline later in life.

While the study does not show causation, it reveals a constellation of biomarkers that resemble patterns seen in older adults with mild cognitive impairment and Alzheimer's disease. It is also consistent with [earlier reports](#) showing that lack of dietary choline in mice models results in obesity and metabolic dysfunction, and increase Alzheimer's disease pathogenesis.

"Our results suggest that, in young adults, good metabolic health and adequate choline contribute to neuronal health, laying the groundwork for healthy aging," says [Jessica Judd](#), co-author of the study.

Continued research will clarify how early metabolic stress shapes long-term neurodegenerative risk and may ultimately point to new ways to preserve brain health decades ahead of cognitive decline.

What about next-generation weight-loss drugs?

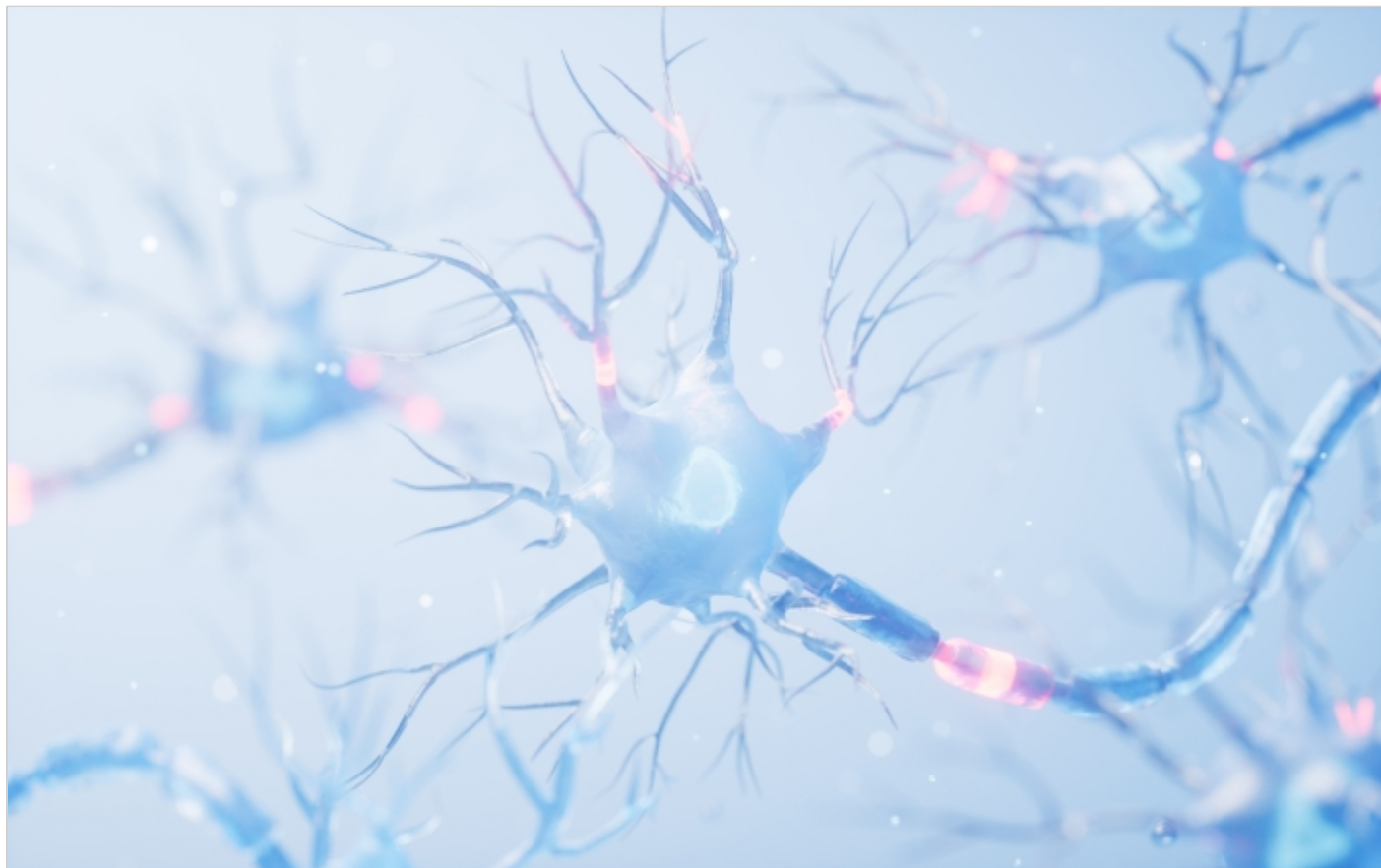
The new generation of weight-loss drugs has reshaped obesity treatment, thanks to their strong effects on body weight, metabolic function and cardiovascular risk.

However, because GLP-1 drugs sharply reduce calorie intake and alter eating patterns, people taking them may not consume enough choline and other key nutrients — highlighting the need to consider supplementation to support essential metabolic and brain health processes.

Velazquez says that future studies are needed to determine whether pairing GLP-1 therapies with adequate dietary choline can help maintain metabolic resilience and support overall health.

This story originally appeared on [ASU News](#).

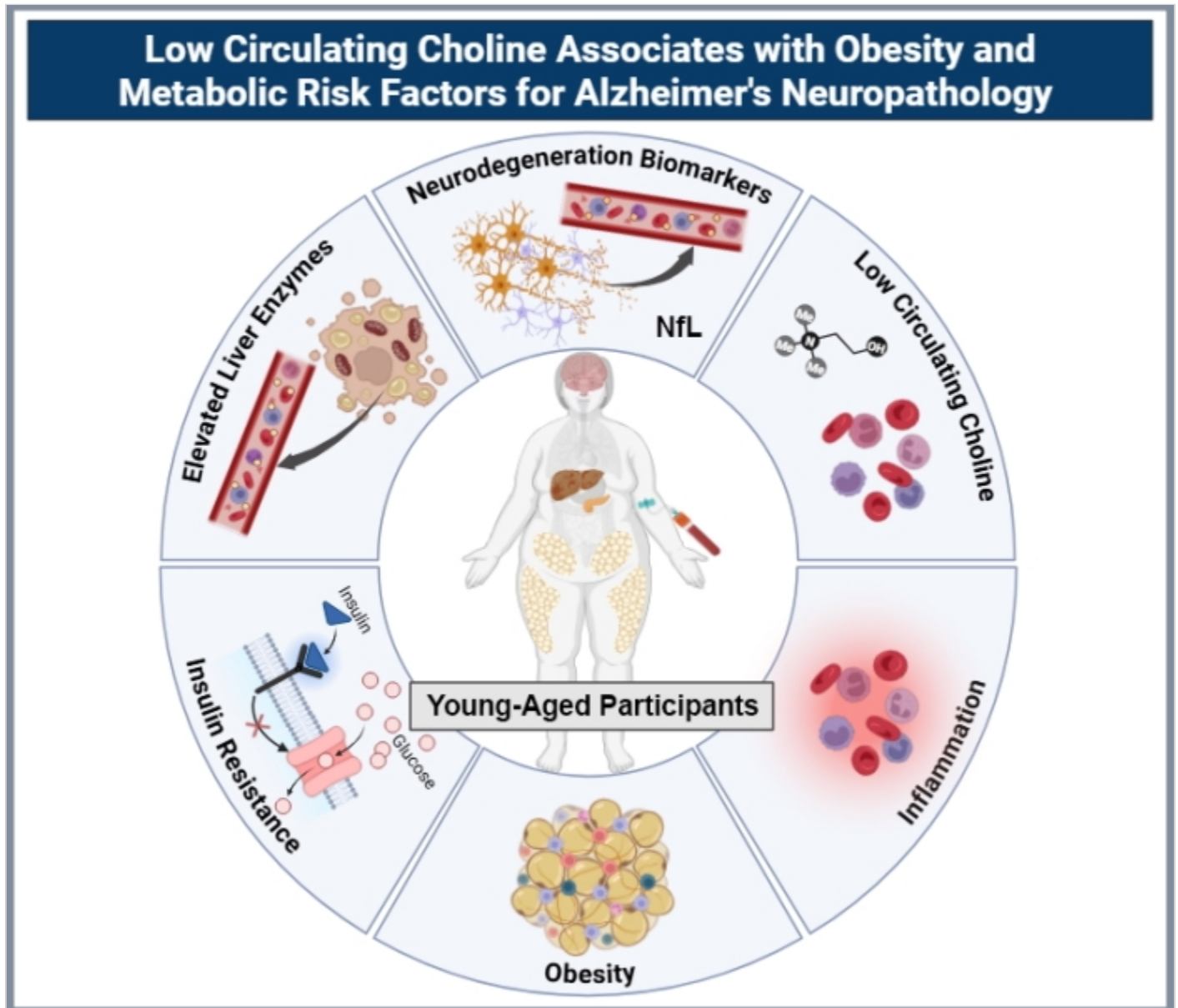
Main image



Researchers uncover a surprising link between obesity, low levels of the nutrient choline and early brain changes that echo patterns seen in Alzheimer's disease. Shutterstock image

Text image(s)





This graphic shows how obesity in young adults is linked to higher inflammation, liver stress, low choline levels and early signs of neuronal injury, a pattern also seen in people at risk for Alzheimer's disease. Credit: Ramon Velazquez Lab



Wendy Winslow



Jessica Judd