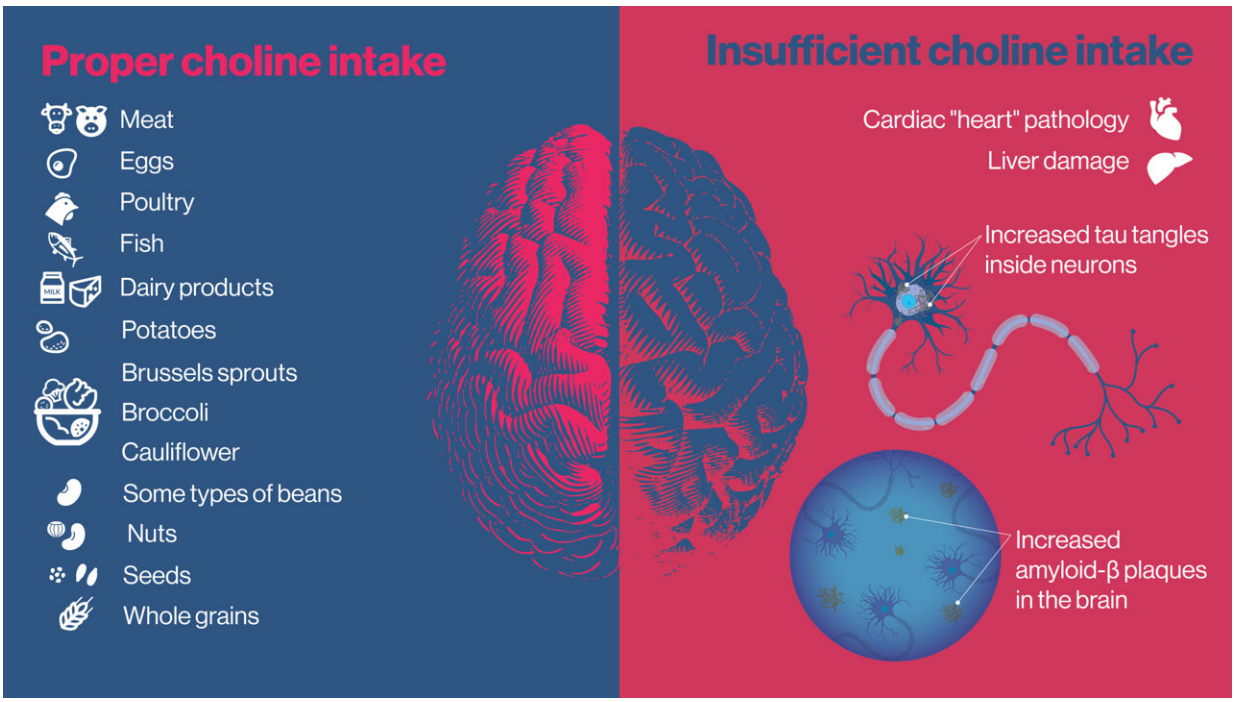
Study explores effects of dietary choline deficiency on neurologic and system-wide health

January 17 2023



Choline is a vital nutrient for brain and body health. While it is available in a variety of foods, most Americans do not meet the required amount for proper health. A new study suggests that insufficient choline can lead to pathologies in the heart and liver and is associated with the development two hallmarks of Alzheimer's disease: amyloid plaques and tao tangles. Credit: Shireen Dooling

Choline, an essential nutrient produced in small amounts in the liver and

found in foods including eggs, broccoli, beans, meat and poultry, is a vital ingredient for human health. A new study explores how a deficiency of dietary choline adversely affects the body and may be a missing piece in the puzzle of Alzheimer's disease.

It's estimated that more than 90% of Americans are not meeting the recommended daily intake of choline. The current research, conducted in mice, suggests that dietary choline deficiency can have profound negative effects on the heart, liver and other organs.

Lack of adequate choline is also linked with profound changes in the brain associated with Alzheimer's disease. These include pathologies implicated in the development of two classic hallmarks of the illness: amyloid plaques, which aggregate in the intercellular spaces between neurons; and tau tangles, which condense within the bodies of neurons.

The new research, led by scientists at Arizona State University and published in *Aging Cell*, describes pathologies in normal mice deprived of dietary choline and in choline-deficient transgenic mice, the latter of which already exhibit symptoms associated with the disease. In both cases, dietary choline deficiency results in liver damage, enlargement of the heart and neurologic alterations in the AD mice, typically accompanying Alzheimer's disease and including increased levels of plaque-forming amyloid-beta protein and disease-linked alterations in tau protein.

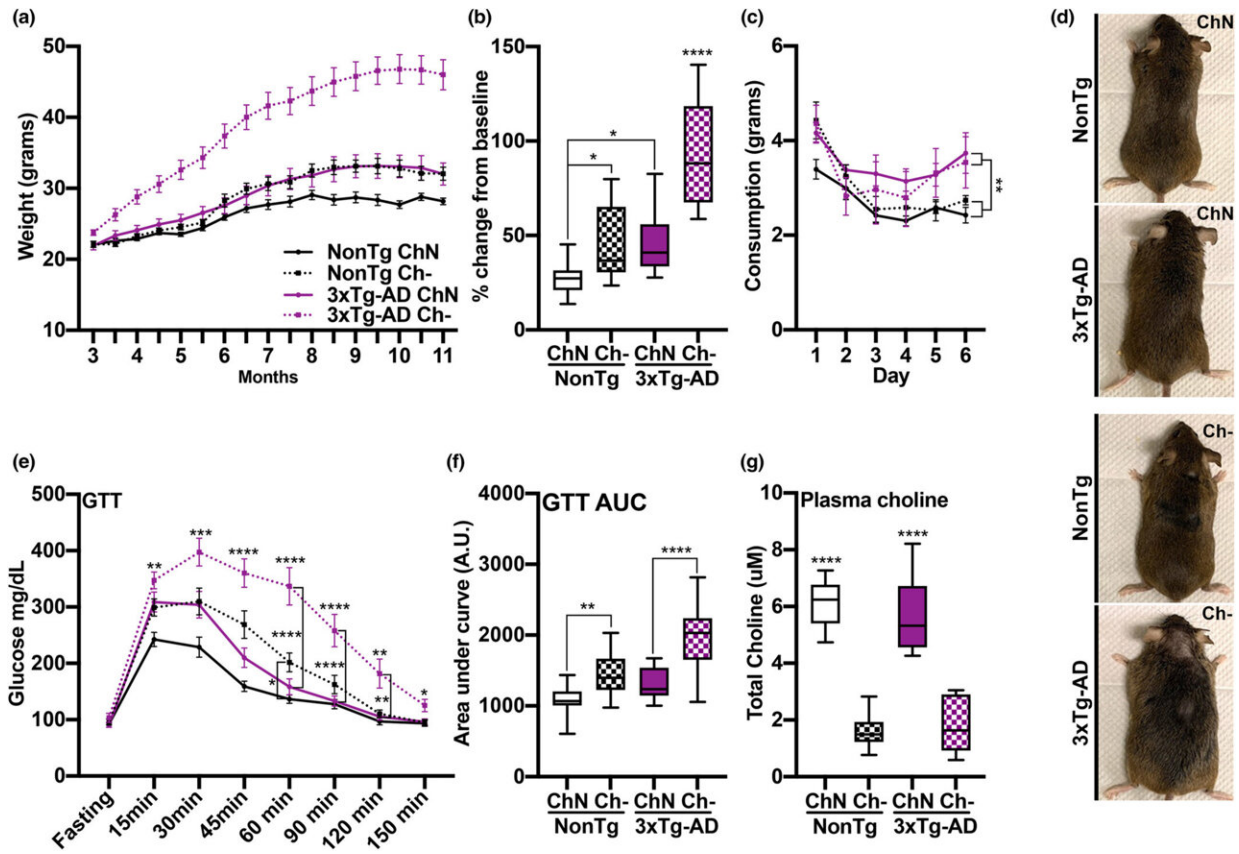
Further, the study illustrates that choline deficiency in mice causes significant weight gain, alterations in glucose metabolism (which are tied to conditions such as diabetes), and deficits in motor skills.

In the case of humans, "it's a twofold problem," according to Ramon Velazquez, senior author of the study and assistant professor with the ASU-Banner Neurodegenerative Disease Research Center. "First, people

don't reach the adequate daily intake of choline established by the Institute of Medicine in 1998. And secondly, there is vast literature showing that the recommended daily intake amounts are not optimal for brain-related functions."

Ramon Velazquez led the new study on the importance of dietary choline for the brain and other organs. He is a researcher in the ASU-Banner Neurodegenerative Disease Research Center.

The research highlights a constellation of physical and neurological changes linked to choline deficiency. Sufficient choline in the diet reduces levels of the amino acid homocysteine, which has been recognized as a neurotoxin contributing to neurodegeneration, and is important for mediating functions such as learning and memory through the production of acetylcholine.



Ch- increases body weight, impairs glucose metabolism, and reduces plasma choline levels. (a) Body weight across age. (b) Percent weight change from baseline shows elevated levels in the NonTg Ch- mice compared to NonTg ChN mice ($p = 0.026$) and in the 3xTg-AD Ch- mice compared to 3xTg-AD ChN mice (p