Runaway algae growth causes neurological problems for those with liver disease

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Credit: Texas Parks and Wildlife Department

Researchers from the Center for Oceans and Human Health on Climate Change Interactions (OHHC2I) have leveraged their collective expertise in environmental health sciences to reveal additional health concerns posed by the overgrowth of harmful algae blooms. The scientists previously identified an increased risk of gastrointestinal problems for individuals with liver disease who are exposed to these blooms. Now, they have uncovered that those with liver disease (up to 25 percent of the population) are also more likely to experience neurological problems.

The culprit is a specific microcystin the blooms produce. This toxin finds its way into source waters (e.g., lakes, rivers, groundwater), which provide public drinking water and recreational areas for swimming, boating and fishing.

Consuming the contaminated water can negatively impact the gut microbiome and the immune system among individuals with nonalcoholic fatty liver disease. With their latest study, environmental health sciences associate professor Saurabh Chatterjee and his team have discovered that the toxin also causes neuroinflammation, blood-brain barrier dysfunction and neurodegeneration.

"Non-alcoholic fatty liver disease occurs when too much fat is stored in liver cells," says Chatterjee, whose Environmental Health and Disease Laboratory focuses on how environmental toxins contribute to liver disease, metabolic syndrome and obesity. "This condition can remain benign and asymptomatic for years before possibly developing into a full-blown disease. Exposure to toxins, such as those created by harmful algal blooms, can trigger the progression of the disease from fatty liver into a much more serious inflammatory condition known as non-alcoholic steatohepatitis."

Harmful algal blooms can be found in both fresh and marine water ecosystems and can rapidly grow out of control (i.e., bloom) in warm, nutrient-rich, slow-moving water. Due to climate change and human activities, the scope and frequency of these blooms are increasing worldwide. Fueled by rising global temperatures and abundant nutrients (e.g., fertilizer, sewer runoff), they can grow rapidly—appearing in a variety of colors (e.g., red, green, brown, blue) and often looking like paint or foam on the surface of the water.

"Previous research has already shown that the toxins released from harmful algal blooms can directly affect the nervous system," says Geoff

Scott, principal investigator for OHHC2I and the chair of the Arnold School of Public Health's Department of Environmental Health Sciences at UofSC. "As a result of this latest groundbreaking study, we now know that consuming the toxin through drinking and recreational use of water can also affect the brain—it just does it through the digestive tract."

"Observations in the present study are timely, necessary and important to understand how cyanobacterial blooms elicit adverse health outcomes in local communities throughout the United States and around the world," adds Bryan Brooks, Baylor University Distinguished Professor and lead researcher for OHHC2I's Harmful Algal Bloom Project. "Unfortunately, microcystins and other toxins produced by harmful algal blooms are not routinely examined as part of recreational and drinking water surveillance efforts, yet the risks these contaminants of emerging concern present to people deserve our increased attention."

More information: Ayan Mondal et al, Environmental Microcystin exposure in underlying NAFLD-induced exacerbation of neuroinflammation, blood-brain barrier dysfunction, and neurodegeneration are NLRP3 and S100B dependent, *Toxicology* (2021). DOI: 10.1016/j.tox.2021.152901

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