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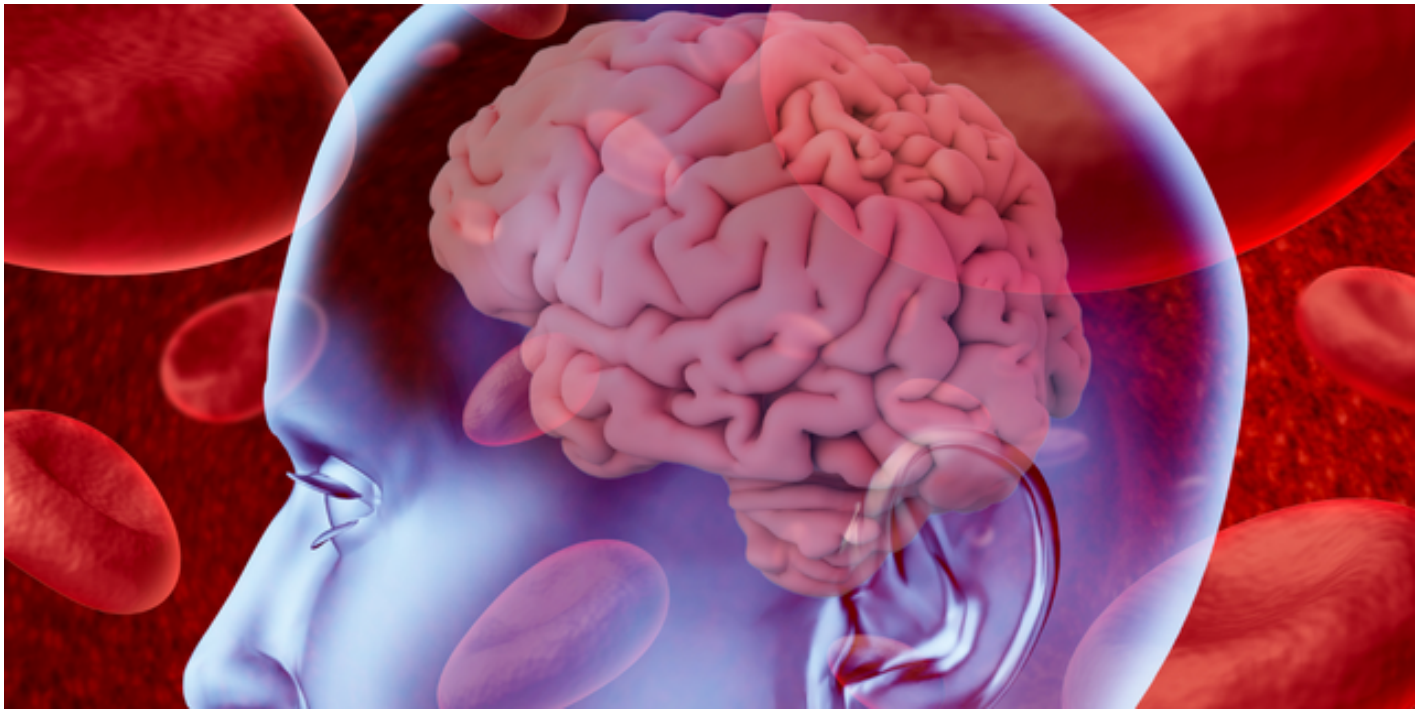
Glyphosate Weed Killer Crosses Blood-Brain Barrier, Linked to Alzheimer's and Other Neurodegenerative Diseases



(*Beyond Pesticides,* August 4, 2022) An Arizona State University (ASU) study shows that the popular herbicide glyphosate can infiltrate the brain through the blood (blood-brain barrier), increasing neurological disease risk. The blood-brain barrier filters various molecules entering the brain from the circulatory system. However, the permeation of glyphosate molecules elevates the expression of TNFα and the accumulation of soluble beta-amyloid (Aβ) proteins in the brain and has associations with immune, inflammatory, and neurodegenerative diseases like Alzheimer's disease (AD).

More than 6 million people in the U.S. are living with Alzheimer's, and cases are expected to double by 2050. Although Alzheimer's research has focused heavily on finding genetic causes of the disease, fewer than half of cases are genetic. Thus, researchers are now evaluating how environmental contaminants may increase disease risk. Over 300 environmental contaminants and their byproducts, including pesticides, are chemicals commonly present in human blood and urine samples and can increase neurotoxicity risk when crossing the brain barrier. Therefore, studies like this highlight the importance of understanding how chemical accumulation in the body can impact long-term health and disease prognosis. The study notes, "Brain glyphosate correlates with increased TNFα levels, suggesting that exposure to this herbicide may trigger neuroinflammation in the brain, which may induce changes that are seen in neurodegenerative disorders. [...] Collectively, given that a large subset of the population may be exposed to this chemical agent, these results raise awareness of the detrimental effects glyphosate exposure may have on the brain and human health."

Several studies demonstrate that glyphosate is detectable in the brain tissue of animals. However, this research investigates if persistent exposure to glyphosate leads to detectability in brain tissue and how the chemical's presence affects TNFα levels in the brain. Using urine, plasma, and brain samples from mice in the study, researchers examined gene expression associated with dose-dependent exposure to glyphosate. Moreover, the study employs a novel one-step glyphosate extraction method using liquid chromatography-mass spectrometry (LC-MS)-based quantification to measure the level of glyphosate and its breakdown product aminomethylphosphonic acid (AMPA) in brain tissues. The results confirm that glyphosate infiltrates brain tissue, elevating TNFα levels and soluble Aβ, causing cell death among exposed cortical neurons. The novel one-step glyphosate extraction method provides the first evidence of dose-dependent glyphosate accumulation in the brain. Moreover, the extraction method finds a small amount of AMPA in brain tissue, indicating glyphosate is also breaking down in the body. Therefore, glyphosate exposure has implications for neurodegenerative diseases like AD, resulting from elevated protein levels and expression.

The nervous system is an integral part of the human body and includes the brain, spinal cord, and a vast network of nerves and neurons, all of which are responsible for many bodily functions—from sensation to movement. However, exposure to chemical toxicants, like pesticides, can cause neurotoxic effects or exacerbate preexisting chemical damage to the nervous system. The impacts of pesticides on the nervous system, including the brain, are hazardous, especially for chronically exposed individuals (e.g., farmworkers) or during critical windows of vulnerability and development (e.g., childhood, pregnancy). Mounting evidence over the past years shows that chronic exposure to sublethal (low) levels of pesticides adversely affects the central nervous system (CNS) and neural receptors such as connections between nerves, the brain, enzymes, and DNA. Specifically, researchers identify agricultural chemical exposure as a cause of many adverse CNS impacts and neurological diseases, including Alzheimer's, amyotrophic lateral sclerosis (ALS), and Parkinson's disease. Therefore, advocates say it is essential to avoid toxic chemical exposure to lessen potential acute and chronic health risks.

The study highlights that glyphosate crosses the blood-brain barrier in vitro (in an artificial environment outside the body), but this study verifies this in vivo (in a living organism). Glyphosate exposure increases inflammatory cytokine proteins in the blood, especially TNFα. The overexpression of the TNFα protein has associations with cancer, rheumatoid arthritis, psoriasis, multiple sclerosis, and other diseases. Although this study adds to the growing body of research surrounding pesticide neurotoxicity, it is the first to demonstrate that glyphosate successfully crosses the blood-brain barrier, accumulating in the brain in a dose-dependent manner. However, this is not the first time that toxic compounds transfer from the blood to other organs and vice versa. Several studies find pesticide compounds in a mother's blood can transfer to the fetus via the umbilical cord. Furthermore, a 2021 study finds that pregnant women already have over 100 detectable chemicals in blood and umbilical cord samples, including banned persistent organic pollutants (POPs). However, 89 percent of these chemical contaminants are from unidentified sources, lack adequate information, or were not previously detectable in humans.

Pesticides themselves, mixtures of chemicals such as Agent Orange or dioxins, and therapeutic hormones or pharmaceutical products possess the ability to disrupt neurological function. These chemicals can pass through the skin (dermal) and mucosal membranes, including the lungs (inhalation) and gut (ingestion), and into blood circulation. For instance, studies suggest pesticide formulants (adjuvants), such as POEA (polyoxyethylene tallow amine), have neurotoxic activity. POEA is present in some glyphosate-based herbicides like Roundup and has higher nervous system toxicity than the active ingredient (glyphosate).

The study concludes, "While there are many correlations between glyphosate and various illnesses, our goal is to shed light on the correlation between glyphosate application and AD [Alzheimer's diseases]. Future work will focus on uncovering the molecular overlap between glyphosate exposure and AD pathology. Specifically, we will focus on determining if glyphosate exposure is capable of exacerbating amyloid [Aβ] pathology and inducing cell death, in vivo in mouse models of AD."

There is a lack of complete understanding of the etiology of pesticide-induced diseases, including predictable lag time between chemical exposure, health impacts, and epidemiological data. Pesticides themselves can possess the ability to disrupt neurological function. Pesticides' impact on the nervous system, including the brain, are hazardous, especially for chronically exposed individuals or during critical windows of vulnerability and development. Therefore, studies related to pesticides and neurological disorders can help scientists understand the underlying mechanisms that cause neurodegenerative diseases. Although occupational and environmental factors, like pesticides, adversely affect human health, regulatory reviews are plagued by numerous limitations in defining real-world poisoning, as captured by epidemiologic studies in Beyond Pesticides' Pesticide-Induced Diseases Database (PIDD) and Daily News Blog. The adverse health effects of pesticides, exposure, and the aggregate risk of pesticides showcase a need for more precise research surrounding occupational and residential pesticide exposure in order to make complete determinations and the importance of fully recognizing uncertainty in regulatory decisions that are precautionary. Existing information, including this study, supports the clear need for a strategic shift away from pesticide dependency. For more information on the effects of pesticide exposure on neurological health, see Beyond Pesticides' PIDD pages on brain and nervous system disorders, including dementia-like diseases, such as Alzheimer's, and other impacts on cognitive function.

Alzheimer's disease has no cure, but preventive practices like organics can eliminate exposure to toxic AD-inducing pesticides. Organic agriculture represents a safer, healthier approach to crop production that does not necessitate pesticide use. Beyond Pesticides encourages farmers to embrace regenerative, organic practices. A compliment to buying organic is contacting various organic farming organizations to learn more about what you can do.

All unattributed positions and opinions in this piece are those of Beyond Pesticides.

Source: Arizona State University, *Journal of Neuroinflammation*