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Is This Common Weed Killer Aging Your Brain?

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STORY AT-A-GLANCE

- Atrazine, a widely used herbicide in agriculture, spreads through water systems and air, exposing people through drinking water, food consumption and environmental contact
- Recent research shows atrazine exposure accelerates brain aging and increases risks of neurodegenerative diseases, with mice studies demonstrating impaired memory, learning, and motor skills
- The herbicide disrupts brain cell function by increasing oxidative stress and inflammation, while also interfering with cellular cleanup processes and energy production in mitochondria
- A 2024 study found people in counties with the highest atrazine exposure were 31% more likely to develop Parkinson's disease compared to those with lowest exposure
- Reduce your atrazine exposure by using certified whole-house water filters, choosing organic produce, washing fruits and vegetables thoroughly, and supporting farmers who practice sustainable agriculture

Atrazine is one of the most commonly used herbicides in the United States, particularly in agriculture. While its environmental impacts have been studied for years, growing research suggests it also has significant adverse effects on human health, especially on our brains.

According to recent studies, there's increasing evidence linking atrazine exposure to faster brain aging and a higher risk of developing neurodegenerative diseases like

Parkinson's and Alzheimer's.

From Farm to Fork — How We're Exposed to Atrazine

Atrazine is primarily used in agriculture to control weeds in crops like corn, sorghum and sugarcane.[1] Farmers spray it on fields to protect their crops from unwanted plants that compete for sunlight and nutrients.

This widespread use allows atrazine to easily spread into the environment. Rain washes atrazine from fields into nearby streams, rivers and lakes, contaminating surface water. It also seeps into the ground, polluting groundwater sources that many people rely on for drinking water.[2]

Because atrazine is so widely used and persists in the environment, it travels far from where it's initially applied. Studies have shown that it can be found in water sources and even in the air far from agricultural areas.[3] This persistence and mobility mean that many people are exposed to atrazine, even if they don't live near farms.

The Environmental Protection Agency (EPA) sets limits on the amount of atrazine allowed in drinking water.[4] However, there are growing concerns about the effects of long-term exposure to even low levels of this chemical.

There are several ways people are exposed to atrazine. The most common route is through contaminated drinking water. Small amounts of atrazine are also found in some foods, especially crops grown in areas where the herbicide is used heavily.

People who work directly with atrazine, like farmers and pesticide applicators, have a higher risk of exposure through skin contact and inhalation.[5] Atrazine is also present in dust and air, particularly in agricultural areas, posing another potential exposure route.

It's important to understand that even small amounts of atrazine consumed regularly can add up over time, like adding a little sugar to your coffee every day. Though one small amount seems insignificant, it can accumulate and cause problems in the long

run. According to a statement from the Agency for Toxic Substances and Disease Registry:

> *"Larger atrazine particles may deposit before reaching the lungs and be coughed up and swallowed. If your skin comes in contact with atrazine-contaminated soil or water, a small amount of it may pass through your skin and into your bloodstream. If you swallow food, water, or soil containing atrazine, most of it will pass through the lining of your stomach and intestines and enter your bloodstream.*
>
> *Once atrazine enters your bloodstream (is absorbed), it is distributed to many parts of your body."*[6]

Perhaps most concerning is the potential for exposure during pregnancy and early childhood, when the brain is still developing and is especially vulnerable to toxic substances.[7] One study found that women who live in areas with high atrazine exposure had higher odds of preterm birth.[8]

While the EPA regulates atrazine use in the United States, other countries have taken a different approach. The European Union, for example, has banned the use of atrazine due to concerns about its potential health and environmental risks.[9] This difference in regulation highlights the ongoing scientific debate about the safety of atrazine and the need for continued research.

Atrazine Exposure Accelerates Brain Aging in Mice, Study Finds

In a recent study published in the journal Research,[10] researchers investigated the potential link between atrazine exposure and accelerated brain aging in mice. They designed the experiment to expose mice to environmentally relevant levels of atrazine throughout their drinking water for an extended period, mimicking potential chronic low-dose exposure in humans.

The researchers subjected the mice to a battery of behavioral tests to assess their cognitive function and motor skills. According to their observations, the atrazine-

exposed mice exhibited a range of concerning changes in their brains, performing significantly worse on tasks requiring memory, learning and spatial navigation compared to the control group. They also exhibited decreased motor coordination and balance.

These findings suggest that chronic atrazine exposure leads to cognitive decline and motor impairments, mimicking symptoms observed in neurodegenerative diseases.

Another key point of the study was that atrazine affected the neurotransmitters, the chemical messengers that facilitate communication between brain cells. They found that atrazine exposure led to imbalances in crucial neurotransmitters like dopamine and acetylcholine.

Dopamine plays a key role in movement, reward and motivation, while acetylcholine is essential for memory and learning. These alterations in neurotransmitter signaling could explain some of the behavioral changes observed in the atrazine-exposed mice.

> *"[O]ur findings identify a previously unrecognized mechanism of AT-induced hypothalamic toxicity and provide preliminary evidence linking pesticide exposure to the development of NDs* [neurodegenerative diseases]," the researchers concluded.[11]

Hacking the Brain's Biological Clock — How Atrazine Speeds Up Aging

Aging is a natural process that affects all parts of the body, including the brain. Two key processes that contribute to brain aging are oxidative stress and inflammation. According to the featured animal study, atrazine exposure triggers both processes in mice brain cells.

The researchers discover elevated markers for oxidative stress and inflammation in the brains of atrazine-exposed mice.[12] Oxidative stress is like rust forming on metal; it's damage to cells caused by unstable molecules called free radicals.

On the other hand, inflammation is the body's natural response to injury or infection, but if it's chronic, it also damages cells over time. Both oxidative stress and inflammation are strongly linked to aging and the development of neurodegenerative diseases.

When atrazine enters the brain, it disrupts normal cellular processes, leading to the production of more free radicals and setting off an inflammatory response. These processes damage important parts of brain cells, like DNA, proteins and fats, much like rust weakens metal. Similar animal studies also found that atrazine exposure have shown increased levels of markers for oxidative stress and inflammation in their brains.[13]

Healthy brain cells rely on several important processes to function properly. Two of these processes are autophagy and mitochondrial function. Autophagy is like a cellular cleanup system that removes damaged or unnecessary parts of the cell. Mitochondria are like the power plants of the cell, providing energy for all cellular activities. According to the featured study, atrazine interferes with both vital processes as well.[14]

The researchers observed that atrazine exposure significantly impaired both autophagy and mitochondrial function in the mice. This disruption could lead to a buildup of cellular waste and decreased energy production, further compromising brain cell health and contributing to age-related decline.

This chemical also affects the mitochondria's ability to produce energy. This is like disrupting the power supply to the brain, impacting its ability to function correctly. Research has demonstrated that atrazine negatively impacts mitochondrial function and induces oxidative stress in different cell types.[15]

The Link Between Atrazine and Parkinson's Disease

Parkinson's disease, a neurodegenerative disorder that affects movement, is characterized by the loss of brain cells that produce dopamine, a neurotransmitter crucial for controlling movement. Emerging research suggests a possible link between exposure to atrazine and an increased risk of developing Parkinson's disease.

Studies have shown that people living in agricultural areas with high atrazine use have a higher incidence of Parkinson's disease.[16] In February 2024, a preliminary study looked at pesticide exposure and Parkinson's disease rates in the Rocky Mountain and Great Plains regions. According to study author Brittany Krzyzanowski, Ph.D., of Barrow Neurological Institute in Phoenix, Arizona:

> *"We used geographic methods to examine the rates of Parkinson's disease across the United States and compared those rates to regional levels of pesticide and herbicide use.*
>
> *Our methods enabled us to identify parts of the nation where there was a relationship between most pesticides and Parkinson's disease and subsequently pinpoint where the relationship was strongest so we could explore specific pesticides in that region. In the Rocky Mountain and Great Plains region, we identified 14 pesticides associated with Parkinson's disease."*

The authors found that the pesticides and herbicides atrazine, simazine and lindane were strongly linked to Parkinson's disease. When they divided counties into 10 groups based on exposure to pesticides, they observed that counties with the highest amount of application of the herbicides have higher rates of Parkinson's disease. According to a news release from the American Academy of Neurology:

> *"[P]eople living in the counties with the highest amount of application of the herbicide simazine were 36% more likely to have Parkinson's disease than people living in the counties with the lowest amount of exposure.*
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> *For the herbicide atrazine, those exposed to the highest amount were 31% more likely to have Parkinson's disease than those with the lowest exposure. For the insecticide lindane, those with the most exposure were 25% more likely to have the disease."*[17]

This study suggests a correlation between exposure to atrazine (and other pesticides) and the development of this debilitating disease. While more research is needed to fully

understand the connection, it is thought that atrazine's effects on dopamine neurons could be a contributing factor.

Atrazine Also Contributes to a Higher Risk of Alzheimer's Disease

Alzheimer's disease is another neurodegenerative disorder that affects memory, thinking and behavior. It is characterized by the formation of amyloid plaques and neurofibrillary tangles in the brain.[18] While the exact causes of Alzheimer's are still being researched, there is growing concern about the potential link between atrazine exposure and an increased risk of developing this disease and other forms of cognitive decline.

Research in animal models has explored the effects of atrazine on memory and learning. These studies have shown that exposure to atrazine impairs cognitive function,[19] suggesting a potential link between the herbicide and Alzheimer's-like symptoms. It's also possible that chemicals like atrazine worsen existing risk factors for Alzheimer's, making individuals more susceptible to the disease.[20]

Some people are more vulnerable to the harmful effects of atrazine on the brain, such as children whose brains are still developing, pregnant women and individuals with certain genetic predispositions. It's particularly important to minimize atrazine exposure during critical periods of brain development, such as during pregnancy and early childhood.

Further research is needed to understand the long-term effects of low-level atrazine exposure, especially in these vulnerable groups. The potential health consequences of atrazine and other pesticides raise important ethical considerations about how we must balance agricultural needs with public health.

Take Control and Reduce Your Exposure to Atrazine

If you're concerned about atrazine exposure, there are several steps to help protect yourself and your family. One of the most important steps is to ensure your drinking water is safe. Using whole-house water filters that are certified to remove atrazine, such

as those with activated carbon, will help reduce your exposure. Ideally, filter water both at the point of entry and at exit points like showers and kitchen sinks.

If you have a private well, it's a good idea to have your water tested regularly for atrazine and other contaminants. When preparing food, especially baby formula, using filtered water is a good way to minimize potential exposure.

Your dietary choices can also play a role in reducing atrazine exposure. Washing fruits and vegetables thoroughly will help remove any pesticide residues that may be present. Choosing organic produce whenever possible will further reduce your exposure to atrazine and other pesticides.

Supporting local farmers who use sustainable farming practices also helps reduce the overall use of atrazine in agriculture. Reducing your consumption of processed foods is another way to minimize potential exposure to pesticide residues that are present in these products.

You help protect the welfare of humans, animals, insects and the environment alike every time you shop organic, biodynamic and grass fed, as you are "voting" for less pesticides and herbicides with every organic and pastured food and consumer product you buy.

In addition, take steps to make your own backyard healthier for everyone by eliminating the use of pesticides and other chemicals and planting a diverse variety of native flowers and other plants.

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