

# This Widely Used Pesticide May Raise Your Parkinson's Risk by Over 2.5 Times

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## STORY AT-A-GLANCE

- › Parkinson's disease is a neurological disorder that gradually interferes with movement, coordination, and cognitive function. New research points to environmental exposures, not just age or genetics, as a risk factor
- › Research links long-term chlorpyrifos exposure to a more than 2.5-fold increase in Parkinson's disease risk, especially when exposure occurred 10 to 20 years before diagnosis
- › Chlorpyrifos, a widely used organophosphate pesticide, has remained part of agriculture for decades, creating repeated low-level exposure through food, air, water, and agricultural drift that affects large populations
- › Beyond Parkinson's, chlorpyrifos has been linked to reduced IQ, developmental delays, thyroid disruption, impaired fertility, and respiratory problems
- › You can protect yourself and your family from pesticides by choosing organic foods, filtering drinking water, and improving indoor air quality

**Parkinson's disease** is a slow, degenerative condition that affects how you move, speak, and carry out daily tasks.<sup>1</sup> An estimated 1.1 million Americans currently live with it, and the numbers continue to climb globally.<sup>2</sup> While researchers have long understood that age and genetics influence who develops Parkinson's, mounting evidence suggests that environmental exposures may be playing a far larger role than previously recognized.

One chemical drawing increasing scrutiny is chlorpyrifos, a widely used organophosphate pesticide that has remained part of industrial agriculture despite long-standing concerns about neurotoxicity. A new study from the University of California, Los Angeles (UCLA) Health now establishes a direct connection between long-term exposure to this chemical and your risk of developing Parkinson's disease.<sup>3</sup>

## What Is Chlorpyrifos? A Legacy of Toxic Exposure

Classified as a chlorinated organophosphate, chlorpyrifos was first introduced to the American market in 1965. Its initial appeal came from its ability to target a wide range of insects with a single product, making it useful for both agricultural and residential pest control. Farmers relied on it to protect crops like corn and wheat, while municipalities used it for mosquito abatement. It also found its way into homes, schools, lawns, and public buildings for decades.<sup>4</sup>

- **The chemical's utility across so many environments led to widespread adoption** — At its peak, chlorpyrifos was one of the most heavily used insecticides in the United States, applied through aerial spraying, tractor-mounted systems, and direct soil treatment. Its residues were detected in food, drinking water, household dust, and ambient air, especially near agricultural regions.<sup>5</sup>
- **Restrictions rolled out slowly and inconsistently** — In the late 1990s, routine environmental monitoring had begun to reveal how far and how persistently chlorpyrifos could spread. Although the U.S. Environmental Protection Agency (EPA) began restricting residential uses of chlorpyrifos in 2001, agricultural applications continued for decades.

In 2021, the EPA issued a final rule revoking all food crop tolerances, effectively banning chlorpyrifos use on food. However, that decision was overturned in November 2023 by the U.S. Court of Appeals, which ruled that the EPA had not sufficiently justified the revocation. As a result, food tolerances were reinstated in December 2023, and chlorpyrifos is once again legally permitted on food crops in the U.S. unless further regulatory action is taken.<sup>6</sup>

- **You can be exposed to chlorpyrifos in several ways** — Inhalation is the most common route, as the chemical becomes airborne during spraying and drifts into nearby homes. Food is another source, since residues often remain on produce even after washing. Chlorpyrifos also enters drinking water through runoff. Farmworkers and their families experience far higher levels due to close contact.<sup>7</sup>
- **The same mechanism that kills insects threatens human health** — Chlorpyrifos blocks an enzyme that regulates communication between nerve cells. When that enzyme is inhibited, the nervous system cannot transmit normal signals. This is how the insecticide kills pests, but the problem is that this mechanism does not distinguish between insects and other forms of life.<sup>8</sup>

Because of how many people are exposed to this chemical and how persistent it is in the environment, researchers have continued to investigate its long-term effects on human health. Findings now shed new light on how chlorpyrifos may contribute to the development of serious neurological diseases.

## **New Study Shows How Chlorpyrifos Damages the Brain**

The featured study, published in the journal *Molecular Neurodegeneration*, examined whether long-term exposure to chlorpyrifos was linked to a higher risk of developing Parkinson's disease. Researchers focused on people who had lived or worked near areas in California where the pesticide was applied repeatedly over many years and compared their disease rates with those of unexposed individuals.<sup>9</sup>

- **Long-term residential exposure tied to sharply higher Parkinson's risk** — Individuals with sustained exposure to chlorpyrifos experienced more than a 2.5-fold increase in Parkinson's disease risk compared to unexposed individuals. The strongest associations appeared when exposure occurred 10 to 20 years before diagnosis. This long latency period reflects how Parkinson's develops silently.

- **Animal models reproduced Parkinson's-like motor impairment** – To test biological relevance, researchers exposed mice to chlorpyrifos at levels designed to reflect human inhalation exposure. After 11 weeks, exposed mice developed measurable motor deficits, including reduced performance on coordination and strength tasks. These impairments persisted after a washout period, indicating underlying neurological damage rather than temporary toxicity.
- **Selective loss of dopamine-producing neurons mirrored human disease** – When researchers examined the mice's brains, they found that chlorpyrifos had destroyed about one-quarter of the dopamine-producing neurons in the substantia nigra, the exact brain region that degenerates in human Parkinson's patients. Meanwhile, nearby dopaminergic regions remained largely intact.

This selective pattern matched human Parkinson's pathology rather than generalized neurotoxicity, strengthening the disease-specific link. Dopamine-producing neurons control movement, motivation, and reward, which explains why their loss causes the tremors, stiffness, and slowness that define Parkinson's disease.

- **The study also found abnormal buildup of a protein called alpha-synuclein** – This protein normally helps nerve cells communicate, but in Parkinson's disease, it becomes altered and begins to accumulate in harmful forms. The affected brain cells also showed signs that their waste removal system wasn't working properly, making it harder to clear out these damaging protein clumps.
- **Autophagy disruption emerged as a central mechanism** – To understand why these proteins accumulated, the researchers examined cellular waste-processing systems responsible for clearing damaged proteins. They found that key markers of autophagy, the cell's primary recycling pathway, were reduced within dopaminergic neurons following chlorpyrifos exposure.

- **Low-dose experiments reinforced autophagy as the weak point** — Even at low exposure levels, chlorpyrifos caused selective loss of dopaminergic and other aminergic neurons while nearby sensory neurons remained unaffected. When researchers genetically disrupted autophagy-related proteins, the same pattern of neuron loss appeared without chlorpyrifos, tying neuronal vulnerability directly to impaired cellular cleanup rather than the pesticide alone.
- **The study also examined microglial activation** — This refers to changes in the brain's resident immune cells when they sense damage or stress. These cells shifted into an activated state, showing physical changes that signal an ongoing inflammatory response in the brain.

However, limiting this immune activation did not stop nerve cells from being lost, indicating that inflammation occurred alongside the damage rather than being the main cause of it.

Together, these findings show that long-term exposure to chlorpyrifos is linked not only to a higher risk of Parkinson's disease, but also to the same kinds of brain changes seen in people who already have it. The study ties real-world exposure to clear damage inside nerve cells, making the connection hard to dismiss as a coincidence.

## **Other Health Conditions Linked to Chlorpyrifos**

The evidence linking chlorpyrifos to Parkinson's disease represents only one strand in a larger web of health concerns associated with this pesticide. Multiple studies have documented its effects on nearly every stage of human development, from the womb through adulthood, with children bearing a particularly heavy burden of harm.

- **Neurodevelopmental delays and cognitive impairment** — Prenatal and early-life exposure to chlorpyrifos has been associated with measurable impacts on children's brain development. Studies that followed birth cohorts found that higher levels of chlorpyrifos biomarkers in umbilical cord blood predicted lower IQ scores,

slower motor skills, and structural differences in brain imaging later in childhood. These differences reflect altered neural development rather than short-term effects.<sup>10</sup>

- **Attention and behavior disorders** – Children with detectable chlorpyrifos exposure during pregnancy or early childhood have shown higher rates of attention problems and behaviors consistent with attention deficit disorders. These associations appear in multiple cohort studies that measured exposure levels and tracked behavioral outcomes over time.<sup>11</sup>
- **Reduced birth weight and impaired physical growth** – Higher chlorpyrifos levels in cord plasma have been linked with lower birth weight and shorter length at birth in epidemiological research. These findings suggest that even low-level environmental exposure during pregnancy can influence physical development markers at birth.<sup>12</sup>
- **Respiratory disease and lung function impairment** – Farmworkers and children living in agricultural communities experience higher rates of asthma, wheezing, and reduced lung capacity linked to organophosphate pesticide exposure.<sup>13</sup>
- **Endocrine disruption and thyroid problems** – Chlorpyrifos and some of the chemicals can interfere with hormonal signaling by binding to estrogen receptors and disrupting enzymes involved in growth, development, and metabolism.<sup>14,15</sup>

Early-life exposure to chlorpyrifos has also been shown to interfere with thyroid hormone signaling in the liver, leading to low thyroid activity and disrupted blood sugar control. In animal studies, this disruption caused the liver to keep producing glucose even when insulin was present, resulting in chronically elevated blood sugar.<sup>16</sup>

- **Reduced fertility** – A systematic review and meta-analysis of organophosphate pesticide exposure reported associations with semen quality parameters and male reproductive hormones across available human case-control evidence, placing chlorpyrifos within a class of exposures repeatedly examined for reproductive effects.<sup>17</sup>

- **Acute organophosphate poisoning** – At high doses, chlorpyrifos can cause symptoms such as muscle twitching, sweating, vomiting, respiratory distress, and seizures. These effects have been documented in cases of occupational exposure and pesticide accidents, requiring hospitalization and, in severe cases, resulting in death.<sup>18</sup>

With so many documented effects, reducing your exposure to chlorpyrifos and other pesticides is one of the most important steps you can take to protect your health.

## **How to Protect Yourself from Pesticides and Lower Your Parkinson's Risk**

Long-term pesticide exposure is hard to avoid completely, but there are meaningful steps you can take to reduce the burden on your body and protect your brain. The strategies below support detoxification, strengthen neurological resilience, and reduce your day-to-day exposure to harmful chemicals like chlorpyrifos:

- 1. Choose organic whenever possible** – Pesticide residues are most concentrated on conventionally grown fruits and vegetables. Choosing organic versions of heavily sprayed produce – like strawberries, spinach, kale, apples, and grapes – can significantly lower your intake. Refer to the Environmental Working Group's (EWG) annual "Dirty Dozen" list for guidance.<sup>19</sup>

If buying organic isn't always possible, washing produce in a baking soda solution and peeling the skins when appropriate can help remove more residue from the surface.

- 2. Sweat regularly to support detoxification and brain health** – Your skin is one of your body's primary detox pathways, and sweating helps eliminate stored pesticide residues.<sup>20</sup> Activities like walking, strength training, or cycling promote circulation and toxin release. Regular sauna use enhances this effect, increasing the excretion of organophosphates through sweat.

Beyond detoxification, physical activity activates dopamine signaling and supports brain plasticity, which are keys to protecting against Parkinson's-related cognitive decline.

- 3. Filter your water** — If you're drinking unfiltered tap water, especially in areas near farms, golf courses, or public parks, you're likely taking in small amounts of pesticides like glyphosate along with fluoride, chlorine, and heavy metals. Installing a high-quality filtration system removes these hidden exposures.
- 4. Improve your indoor air quality** — Pesticides aren't just in the foods you eat. They're also in the air you breathe, drifting into your home and landing on surfaces. Using a HEPA air purifier helps capture airborne particles, and frequent cleaning with nontoxic products reduces buildup. If you live near active farmland or landscaping operations, keeping windows closed during spraying hours also lowers your risk of inhaling chemical particles.
- 5. Protect your sleep to support neurological repair** — **Deep, uninterrupted sleep** is essential for your brain to clear waste and protect dopamine-producing cells. Even mild sleep disruption interferes with this cleanup process, increasing vulnerability over time. Make your bedroom dark, **cool**, and quiet.

Stay off screens in the hour before bed and keep a consistent schedule throughout the week. If you wake often or feel unrefreshed, that's a signal your brain's cleanup system is falling behind. **Prioritizing sleep** directly strengthens your brain's natural defenses against environmental stressors and slows neurological decline.

For more ways to support brain health and lower your risk of Parkinson's, read "**Parkinson's Disease Is Rising and Lifestyle Choices Play a Major Role.**" To learn additional strategies for reducing pesticide exposure, check out "**Prenatal Pesticide Exposure Linked to Brain Damage and Sleep Problems.**"

# **Frequently Asked Questions (FAQs) About Chlorpyrifos and Parkinson's Disease**

**Q: How is chlorpyrifos linked to Parkinson's disease?**

**A:** Long-term exposure to chlorpyrifos significantly increases your risk of developing Parkinson's disease. The UCLA study found that people who lived near fields where chlorpyrifos was applied faced more than 2.5 times the risk of Parkinson's compared to those who weren't exposed.

**Q: Is chlorpyrifos still used on food in the U.S.?**

**A:** Yes. Although the EPA banned its use on food crops in 2021, that decision was overturned in 2023. As it stands, chlorpyrifos is once again allowed on U.S. food crops, and residues can remain on fruits and vegetables you buy unless you're choosing organic.

**Q: Are children more vulnerable to chlorpyrifos exposure than adults?**

**A:** Yes. Research shows that exposure during pregnancy and early childhood is associated with changes in brain development, behavior, and growth. Because your child's nervous system is still developing, early exposure carries greater long-term risk.

**Q: I don't live near a farm. Should I still be concerned?**

**A:** Yes. Even if you're not near agricultural areas, you can still be exposed through conventionally grown produce, drinking water, household dust, or air that carries pesticide drift. Chlorpyrifos has been detected in indoor environments and food

across the country, meaning your exposure isn't limited to where you live.

**Q: Is there anything I can do to reduce my body's pesticide load?**

**A: Yes.** While your body eliminates pesticides slowly, you can support this process by sweating regularly through exercise or sauna use, drinking clean filtered water, eating organic when possible, and minimizing new exposures. These steps reduce the chemical load your body has to process and help eliminate stored residues over time.

## Sources and References

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