

Effect of pesticides on human health, especially in children

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Pesticides are used in agriculture, homes, schools, public-health programs, gardens, and commercial settings to control insects, weeds, fungi, rodents, and other organisms. Their benefits are real: they can protect crops, reduce vector-borne disease, preserve food, and control infestations that themselves create health risks. At the same time, pesticides are biologically active substances, and some can harm human health when exposure is high enough, occurs repeatedly, or takes place during a sensitive period of development. The central public-health question is therefore not whether all pesticides are “safe” or “dangerous,” but how toxicity, dose, timing, route of exposure, and individual vulnerability interact.

Children deserve particular attention because early life differs from adulthood biologically and behaviorally. The U.S. Environmental Protection Agency’s 2026 children’s health policy explicitly recognizes that exposures during conception, infancy, childhood, and adolescence can create different risks from those experienced later in life. Children breathe more air, consume more food and water relative to body weight, spend more time close to floors and soil, frequently place hands and objects in the mouth, and have organs and metabolic systems that are still developing (EPA, 2026a). These characteristics can increase exposure and may alter susceptibility to particular chemicals.

Risk Depends on the Pesticide, the Dose, and the Developmental Window

The word *pesticide* covers many different chemical classes and products. Organophosphates, carbamates, pyrethroids, herbicides, fungicides, rodenticides, and disinfectant products act through different biological mechanisms. Some interfere with neural signaling, some irritate skin or eyes, some affect endocrine pathways, and some create toxicity through entirely different processes. For that reason, health claims should identify the substance or class whenever possible rather than treating every pesticide exposure as equivalent.

The EPA explains pesticide risk as a combination of hazard and exposure. A highly toxic substance may create little risk when exposure is extremely low, while a less hazardous product can still become dangerous if a child receives a large dose. This distinction is especially important in household settings, where accidental ingestion of concentrated products may create an acute emergency even

though normal labeled use would result in much lower exposure (EPA, 2026b).

Acute poisoning can produce symptoms such as nausea, vomiting, dizziness, weakness, excessive sweating or salivation, breathing difficulty, muscle twitching, confusion, seizures, skin irritation, or eye injury depending on the product involved. Organophosphate and carbamate insecticides are particularly important because they can inhibit acetylcholinesterase and disrupt normal nerve transmission. Suspected poisoning should be handled as a medical problem rather than treated with home remedies. The product label and container can be valuable to clinicians, but no one should induce vomiting unless specifically directed by an appropriate poison-control or medical professional.

Long-term exposure is more difficult to study. Researchers must estimate or measure exposure over months or years, distinguish among mixtures of chemicals, and account for nutrition, poverty, air pollution, housing, genetics, and other factors that can influence development. Recent systematic reviews nonetheless suggest that some pesticide exposures are associated with important health outcomes in children. Coleman et al. (2025), reviewing 31 studies from low- and middle-income countries, reported adverse associations between pesticide exposure and at least one neurodevelopmental domain in 23 studies. The affected outcomes included cognition, executive function, motor development, and behavior, although heterogeneity in exposure measurement prevented a single pooled estimate.

A 2024 systematic review and meta-analysis of 38 studies involving more than 118,000 children found associations between pesticide exposure and asthma, wheezing, and lower respiratory tract infection, while also reporting substantial heterogeneity for several outcomes (Keleb et al., 2024). These findings are important, but they do not imply that every exposed child will develop respiratory disease. Association at the population level is not the same as certainty for an individual patient.

The immune system is another area of growing research. A 2025 systematic review and meta-analysis by Sherif et al. examined prenatal and early-childhood pesticide exposure and found changes in several immune parameters across the included studies. Again, the evidence is strongest as a reason for preventive policy and further research rather than as proof that any one household exposure will produce a specific immune disorder.

Children Can Be Exposed Before Birth, at Home, and Through Work or Agriculture

Exposure can begin during pregnancy. Some pesticide compounds or metabolites can cross the placenta, making timing especially important because fetal organs and neural networks develop through sensitive stages. Prenatal exposure may occur through agricultural work, residential proximity to treated fields, household pesticide use, food, contaminated dust, or other environmental pathways. This is one reason regulatory risk assessment pays special attention to developmental and reproductive toxicity and may apply additional safety factors for infants and children under the Food

Quality Protection Act.

After birth, children can encounter pesticides through food residues, household dust, soil, drinking water, treated pets, indoor sprays, gardens, school grounds, or products stored in the home. Young children's hand-to-mouth behavior can turn a small environmental residue into repeated ingestion. Crawling also places them closer to floors and carpets where dust and residues accumulate. The EPA therefore recommends keeping children away from treated areas until the label indicates re-entry is safe and storing pesticides in locked locations and original containers (EPA, 2026c).

Agricultural communities face additional pathways. Spray drift can move droplets or particles beyond the target area depending on wind, equipment, formulation, and application technique. Farmworkers may also carry residues on clothing, shoes, vehicles, or equipment, creating a "take-home" pathway. Families living close to treated fields may experience exposure that households in nonagricultural areas do not. These patterns make pesticide health an environmental-justice issue as well as a toxicology issue because the ability to avoid exposure is shaped by occupation, housing, language, legal protections, and access to healthcare.

Food residues deserve a more balanced discussion than either reassurance or alarm. Pesticide tolerances are set using toxicology and exposure estimates, and monitoring programs generally find most tested foods within legal limits. Yet legal compliance does not eliminate the need for ongoing surveillance, especially for children. Families can reduce residues on many fruits and vegetables by washing produce under running water and removing damaged outer leaves. They should not avoid fruits and vegetables out of fear, because poor diet also carries substantial health risk.

Household storage is a more preventable source of danger. Children can be poisoned when pesticides are left within reach or transferred into beverage containers. EPA guidance specifically warns against putting pesticides in food or drink containers and recommends keeping products locked away from children and pets (EPA, 2026c). These simple measures are important because accidental ingestion often results from preventable handling errors rather than from unavoidable environmental exposure.

Evidence on Neurodevelopment Requires Caution but Supports Prevention

Neurodevelopment is one of the most debated areas of pesticide research because the developing brain is sensitive to environmental disruption. The 2025 review by Coleman et al. found repeated associations between several pesticide classes and poorer outcomes in domains such as executive functioning, cognition, motor development, and behavior, but it also emphasized substantial methodological limitations. Exposure was measured in different ways across studies, some relied on biomarkers while others used residence or questionnaire data, and the studies involved different products and populations.

This uncertainty should not be misrepresented in either direction. It would be inaccurate to claim that pesticide exposure automatically causes autism, ADHD, learning disability, or reduced intelligence in every child. It would also be inappropriate to dismiss the literature simply because not every study reaches the same conclusion. Environmental epidemiology often works with imperfect measurements because controlled experiments that intentionally expose pregnant women or children to potentially harmful chemicals would be unethical.

The strongest interpretation is therefore precautionary and product-specific. Where credible evidence links a particular pesticide or exposure pattern with developmental harm, regulation and prevention should reduce exposure while researchers refine causal understanding. This is especially true when safer alternatives exist and when exposure occurs during pregnancy or early childhood.

Respiratory research demonstrates a similar principle. Children with asthma may be vulnerable to irritant sprays or vapors, yet uncontrolled cockroach and rodent infestations can also worsen asthma. Simply replacing pesticide use with no pest control at all can therefore create another health problem. Integrated pest management is preferable because it combines sanitation, repair, removal of food and water sources, physical barriers, traps, monitoring, biological controls, and targeted chemical treatment when necessary.

Schools and child-care centers are particularly appropriate settings for integrated pest management. Routine broadcast spraying can expose many children unnecessarily, while ignored infestations also create health and sanitation problems. A better approach identifies the pest, corrects building conditions, uses the least hazardous effective method, schedules treatment when children are absent, and communicates clearly with families and staff.

Protecting Children Requires More Than Telling Parents to “Be Careful”

Household behavior is important, but responsibility cannot rest entirely on parents. Employers, schools, landlords, manufacturers, applicators, regulators, and public-health agencies also shape exposure. Farmworkers cannot prevent drift if application rules are ignored. Families cannot eliminate infestation if housing has persistent structural problems. A school cannot reduce exposure if staff use unapproved products without a coordinated pest-management policy.

Regulation therefore matters. The EPA evaluates pesticide toxicity, exposure, residues, environmental fate, and risks to children before and during registration and reevaluation. The Food Quality Protection Act requires consideration of infants and children and allows an additional safety factor when evidence or data gaps justify it. Registration does not mean a product is harmless under every condition; it means specific uses are permitted under defined restrictions.

Surveillance and research are equally important. Pesticide exposure changes over time as products

are restricted, formulations change, agricultural practices evolve, and new compounds enter the market. Historical poisoning estimates should not be repeated indefinitely as though they represent current global conditions. Better biomonitoring, poison-center data, farmworker health surveillance, and child-specific research are needed to identify which exposures remain most important.

Families can still take meaningful steps. Pesticides should be stored in original containers, locked away from children, and used only according to the label. Children and pets should be removed during application and kept away for the required re-entry period. Adults who work with agricultural chemicals should follow employer and label requirements for protective equipment, decontamination, clothing, and handling. Toys, bedding, food, and dishes should be protected during household treatment, and unnecessary mixing of products should be avoided.

The broader public-health goal is risk reduction rather than fear. Pesticides are useful tools, but their benefits do not justify avoidable exposure. Children are especially important because development occurs through time-sensitive stages and because they have less control over where they live, what adults apply around them, or how workplaces and schools manage chemicals. The most defensible policy is therefore to use pesticides only when needed, select less hazardous effective options where possible, prevent exposure through integrated pest management and regulation, and continue monitoring health outcomes as the evidence develops.

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