

# BUILDING EVIDENCE



# FOR HEALTH

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## PESTICIDES

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### What are pesticides?

Pesticides are chemical or biological agents that kill or control common household pests (i.e. cockroaches, mice), microbial contamination (i.e. viruses, bacteria, protozoans), disease-carrying outdoor pests (mosquitos, ticks, rodents), and other bacteria. Pesticides come in various forms including sprays, liquids, powders, granules, pellets, and foggers, which may comprised of 2%-80% active ingredients. In some cases, the inert or chemically inactive ingredients in pesticides may also be toxic (i.e. kerosene, paraffin). Pesticides can be classified as organic (containing carbon) or inorganic (usually derived from minerals). Organic pesticides can be further classified as conventional (produced synthetically, including most "modern" organophosphate, organochloride and carbamate pesticides, such as DDT) or biological (derived from naturally occurring sources including animals, plants and bacteria).

Pesticides may also be classified by the organism or biological pathway they target. Active ingredients in insecticides and rodenticides (including neonicotinoids, organophosphates, carbamates, organochlorides, pyrethroids) often target nervous system function. However, pesticides are not specific to one organism and can have adverse impacts on other species, including humans. The World Health Organization (WHO) provides guidelines regarding safe use of pesticides based on their human health hazard classification and risk of acute and long-term exposure.<sup>1</sup> Beyond agricultural applications, the use of these pesticides in and around homes and buildings are ubiquitous. Although pesticide use has many public health benefits, such as preventing spread of infectious diseases and ensuring healthy agriculture, excessive and improper application may be associated with detrimental impacts to childhood development, birthweight, cancer, as well as water and land systems.

### How are we exposed to pesticides?

Widespread pesticide use in modern society makes it difficult to avoid exposure. One billion pounds of conventional pesticides are used annually in the U.S.,<sup>2</sup> 50-75% of which is used in agriculture (UDSA, 2014). Routes of exposure for pesticides include inhalation, absorption through the skin, ingestion and placental transfer. Pesticides delivered via powders, aerosols and fogging equipment can be inhaled, and may travel in the air over long distances. Dermal absorption can occur when splashes, dust and mists leave chemicals on skin and clothing, or from handling agricultural products containing pesticides. Ingestion of pesticides results from residues on food and from contaminated water, and especially in children, through hand-to-mouth behaviors with contaminated objects. A mother's body burden of pesticides can also be transferred to her child through breast milk<sup>7</sup> and to her fetus across the placenta.<sup>8,9</sup>

**Pesticide exposure is pervasive in both urban and agricultural areas due to building and surrounding environmental quality.**

Pesticide exposure is pervasive in both urban and agricultural areas due to building and surrounding environmental quality. In low-income urban environments, pesticides are applied frequently to control pest infestations such as cockroaches and rodents.<sup>43</sup> Therefore, urban density, residential size, geography, pest



prevalence, and policies can result in varying levels of pesticide application and exposure.<sup>48</sup> For example, a 1997 study of New York State pesticide use, showed the heaviest application was in New York City boroughs and not in the agricultural counties.<sup>42</sup> Additionally, pesticides are found in our homes and gardens, schools, offices, playgrounds, parks & fields, in the form of personal products (i.e. bug repellent), veterinary treatments (i.e. lice, pet flea and tick prevention) as well as agricultural pesticides, which may be found on food, in contaminated water bodies, or in the homes of farmworkers because it transfers from clothing to the indoor environment.<sup>47</sup> These substances collect in household dust and soil. In a representative sample of the general US population over age 6, pyrethroid insecticides, the most commonly used residential insecticides, were detected in over 70% of participants, and levels were higher in children than adolescents or adults.<sup>3</sup>

### **How do pesticides impact health?**

Pesticides have been linked to a wide range of human health and environmental impacts. The associated risk from pesticide exposure depends on the toxicity of the specific pesticide, the amount and duration of exposure, the presence of other pesticides or chemicals, and the sensitivity of the individual. Children, elderly, low-income residents, and pregnant women may be more sensitive or at higher risk for health effects due to differences in metabolism, length and intensity of exposure, behaviors (i.e. children playing on the floor), and other socioeconomic factors.<sup>10-12</sup> In addition, interactions between pesticides and other substances in our environment may result in unanticipated health outcomes.<sup>13</sup> For example, low-income, rural residents may experience poor housing conditions that result in more pesticide use as well as outdoor sources from agricultural spraying.<sup>47</sup> In the U.S., a number of pesticides have been banned because of their extreme toxicity and potential for causing disease (i.e. DDT), but some remain in use despite scientific evidence of potential adverse health effects (i.e. chlorpyrifos, a neurotoxic pesticide commonly used for killing cockroaches).

According to the World Health Organization, an estimated three million cases of pesticide poisoning occur every year, resulting in a quarter of a million deaths across the globe.<sup>14</sup> The occurrence of unintentional acute pesticide poisoning varies among developed and undeveloped countries, in part due to differences in regulations and their enforcement as well as an inability to accurately assess the magnitude of the problem in rural or remote communities.<sup>15</sup> Most often pesticide poisonings affect the nervous system. Symptoms may range from mild (i.e. headache, dizziness, nausea, sweating) to moderate (e.g. excessive salivation, blurred vision, muscular incoordination), to severe (i.e. inability to breathe, loss of reflexes, unconsciousness, death).<sup>15,49</sup> These effects may occur right away or within several hours of exposure and usually resolve quickly, however, effects of repeated poisonings may not be evident for years.

Research into the long-term health effects of particular pesticides in specific populations is ongoing, however strong evidence exists demonstrating that chronic pesticide exposure may impact a number of human physiological systems and can have deleterious effects on health. These systems include nervous, immune, endocrine and cardiovascular systems. Long-term pesticide exposure has been associated with a number of cancers including leukemia,<sup>21</sup> non-Hodgkins lymphoma,<sup>22</sup> prostate,<sup>23</sup> pancreatic,<sup>24</sup> bladder<sup>25</sup> and thyroid cancers,<sup>26</sup> and brain tumors.<sup>27</sup> Pesticides can interfere with complex systems of hormonal regulation impacting male and female reproductive systems,<sup>28,29</sup> embryonic and fetal development and birth outcomes,<sup>30,41</sup> and metabolic outcomes including diabetes and insulin resistance.<sup>31,32</sup> Nervous system impacts include a range of neurodevelopmental, neurodegenerative, neurocognitive, neuropsychiatric, and neuromuscular impairments. Various pesticides have been linked to disorders such as tremors in middle childhood<sup>46</sup> autism,<sup>33</sup> Attention Deficit Disorder (ADD),<sup>34</sup> reduced IQ and working memory,<sup>46</sup> Amyotrophic Lateral Sclerosis (ALS),<sup>35</sup> Parkinson's Disease,<sup>36</sup> Alzheimers Disease,<sup>37</sup> and depression.<sup>38</sup>

### **What can I do?**

- Use Integrated Pest Management in homes, schools and offices.<sup>39</sup>
- Use nontoxic pest control methods such as beneficial insects, non-toxic preparations, traps and barriers.
- Reduce pesticide consumption by learning about relative pesticide content of foods and shop accordingly.<sup>40</sup>
- Remove shoes before entering the house to minimize bringing chemicals in from outdoors.
- Keep floors and surfaces clean using HEPA filter equipped vacuums so that particles are not dispersed.



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