



# Asthma and Its Environmental Triggers

## What is asthma?

Asthma is a chronic lung disease with symptoms of coughing, wheezing, chest tightness, or shortness of breath. During an asthma attack, the sides of the airways in the lungs swell and the airways shrink, making it harder to breathe. Severe asthma attacks can be life-threatening and may require emergency room visits and hospitalizations. Asthma can also reduce the quality of life by contributing to emotional and physical stress and may lead to missed time from school and work.

In the United States, about 25 million people have asthma, of which more than 4.7 million are children. Asthma affects people of all ages, ethnicities, races, and sexes across every region of the U.S.<sup>1</sup>

Certain environmental factors, called triggers, can start or worsen asthma symptoms. These factors, which include pollen, viral infections like flu, or cold air, can affect people for different reasons.<sup>2</sup> People who suffer from asthma can manage it by taking medicine and avoiding the triggers that can cause an attack.

## What is NIEHS doing?

Research at the National Institute of Environmental Health Sciences (NIEHS) focuses on complex relationships among the environment and people's genetics and immune system. Discoveries can, in turn, become a basis for ways to control or prevent the disease. NIEHS conducts and supports asthma research from basic studies in laboratories to research in populations to human clinical trials.

## The genetics of asthma and environmental factors

Many factors contribute to diseases such as asthma. Some health conditions are genetic, passing from grandparents to parents to children. Some health problems may be caused by factors in the environment. Many diseases arise from an interaction between genes and the environment.



Subtle differences in genes can cause one person to respond differently to the same environmental exposure as another person. That is, one person may develop a health problem after being exposed to something in the environment while others may not.

Family history and environmental factors are both linked to asthma development. Asthma often runs in families, suggesting genetics plays a role in disease development.

An NIEHS study found that certain indicators within DNA may predict a newborn's risk of asthma.<sup>3</sup> This information may help researchers identify which children may develop asthma and ways to prevent the disease.

Researchers have also shown that asthma patients with a specific genetic makeup who live close to a highway are more likely to have intense symptoms.<sup>4</sup>

Identification of asthma triggers is helpful for disease management. But NIEHS researchers found most clinicians do not frequently assess environmental factors. A higher percentage of specialists assessed asthma triggers at home, school, or work than primary care or advanced practice providers. Overall, 46%-76% of clinicians, depending on clinician type, reported not assessing such circumstances during most asthma visits.<sup>5</sup>

## Targeting the root cause of asthma

NIEHS-funded researchers found neighborhoods with the highest levels of residential air pollution (defined as emissions of carbon dioxide, particulate matter [PM 2.5], sulfur dioxide, and volatile organic compounds) had adults with the highest rates of severe or uncontrolled asthma and inadequate symptom management. These conditions disproportionately affect Black Americans.<sup>6</sup>

According to findings of the NIEHS-funded Mobility Asthma Project, reported in the *Journal of the American Medical Association*, children who move to neighborhoods with lower rates of poverty experience significant improvements in asthma symptoms, in part by reducing stress.<sup>7</sup>

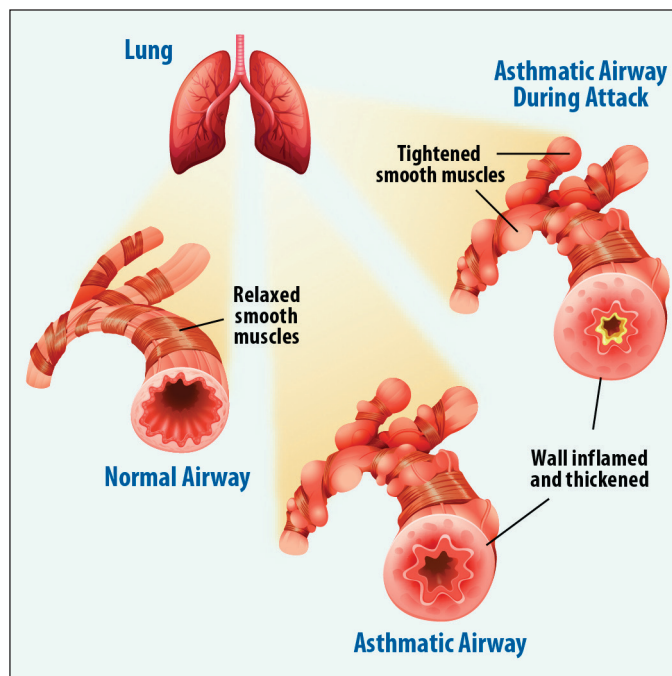
## Indoor triggers of asthma

Indoor air quality is a major concern for lung health. Dust mites, pests such as cockroaches and rodents, pet dander, molds, and fungi commonly may lead to more attacks in people with asthma.

On a positive note, NIEHS-funded research shows vitamin D appears to have a protective effect for children with asthma. Urban-dwelling children with asthma who had low blood levels of vitamin D had worse asthma than children with higher vitamin D levels.<sup>8</sup>

School environments can be sources of asthma triggers in children. A study of inner-city students linked airborne mouse allergens in schools to increased asthma symptoms and decreased lung function in children.<sup>9</sup>

At home, frequent wood burning is linked to decreased lung function in adults with asthma. In rural, colder parts of the U.S., wood is often burned indoors to supplement heating. Individuals with asthma should consider reducing indoor wood burning or adding air filtration devices, according to the scientists.<sup>10</sup>



## Outside triggers of asthma

Air pollution is a well-documented contributor to asthma attacks and is found in urban, suburban, and rural areas.

Adding to evidence linking outdoor air pollution and childhood asthma development, researchers partially funded by NIEHS found that exposure to PM<sub>2.5</sub> and nitrogen dioxide in the first three years of life was associated with more cases of asthma in early and middle childhood.<sup>11</sup>

NIEHS-funded researchers found babies who breathe high levels of traffic-related air pollution were more likely to have persistent wheezing during childhood, and children exposed to high levels of traffic-related air pollution through age 7 were more likely to develop asthma.<sup>12</sup>

Another study found that adolescents exposed to nitrogen dioxide, an indicator of traffic-related pollution, experienced shifts in hormone levels that affect their response to stress, suggesting a way that air pollution might make asthma worse.<sup>13</sup>

Six "criteria air pollutants," such as ozone, are found all over the U.S. and are regulated by the Environmental Protection Agency. Alone or together, they can damage the lung epithelium, and repeated, prolonged exposures worsen asthma with lasting health effects. To understand the biology of ozone-induced lung injury, NIEHS-funded investigators are using animal models to identify problems with immune response at the cellular level.<sup>14</sup> Initial observations suggest potential ways that therapies could help stop ozone-induced asthma.

An NIEHS-funded study was the first to link reduced emissions from coal-powered plants with health benefits.<sup>15</sup> Asthma symptoms and related hospitalizations dropped dramatically in response to reduced power plant emissions after a plant was retired and other plants were fitted with emission controls.

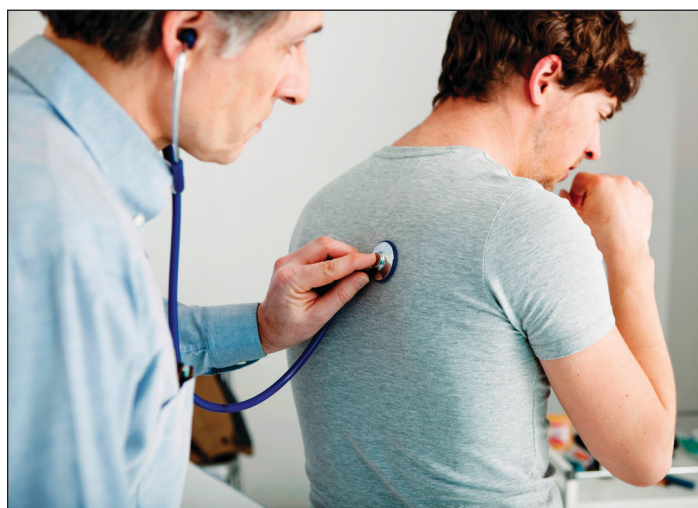
NIEHS-supported researchers found that certain agricultural practices contribute to poor air quality and asthma among children.<sup>16</sup> Particulate matter, ozone, pesticides, and ammonia, a common product of animal farming, can worsen asthma. They also found that elevated air pollution in rural agricultural communities is linked to poor respiratory health in children. The team combined high-efficiency particulate air (HEPA) cleaners and a home-based education program to reduce children's exposure to pollutants in the home and improve lung health.

### **Asthma and weather**

Research has shown that natural disasters and extreme weather events can create conditions that may worsen asthma. For example, prolonged droughts have increased the presence of wind-blown dust, which has been found to increase incidences of wheezing in children.<sup>17</sup> Heat and drought also contribute to the development of wildfires, often widespread and severe. Smoke from these blazes contains numerous particles that researchers have linked to significant spikes in respiratory disease, especially asthma.<sup>18</sup>



Extremely wet conditions also can initiate or worsen asthma attacks. Heavy rains and flooding may lead the growth of molds and other fungi that cause a variety of respiratory ailments. Scientists funded by NIEHS showed that young children exposed to high levels of mold were more likely to have asthma at age 7.<sup>19</sup> Researchers also found that levels of asthma-inducing mold climbed significantly in areas flooded by Hurricane Maria in September 2017.<sup>20</sup> Cases of respiratory allergies and asthma increased among people inundated by Hurricane Harvey earlier in August 2017.<sup>21</sup>



### **Asthma and occupational exposure**

NIEHS grant recipients conducted a study in mice that simulated agricultural dust exposures. They uncovered a novel role for the protein IL-22 in lung repair. This finding could aid in the development of therapeutics for farmworkers and others who have lung diseases, such as asthma, that are linked to environmental exposures.<sup>22</sup>

Oil spill cleanup workers during the 2010 Deepwater Horizon disaster — many of whom were exposed to airborne contaminants, such as petroleum hydrocarbons — experienced a significant increased risk of asthma in following years compared to those not involved with cleanup.<sup>23</sup> This NIEHS research, called the Gulf Long-Term Follow-Up Study with 33,000 total participants, is the first to look at specific chemicals from oil spills and link them to respiratory diseases.

### **Asthma therapies**

A large-scale study that looks at the structure and function of proteins, including the way they work and interact with each other inside cells, identified more than 100 plasma proteins associated with asthma in adults. This research may aid future diagnosis and therapies in asthma management.<sup>24</sup>

## Reduce allergens in your home

- Vacuum carpets and upholstered furniture weekly.
- Wash sheets and blankets weekly in hot water.
- Encase mattresses and pillows in special allergen-proof covers.
- Lower humidity levels indoors to below 50%.
- Limit pets' access to bedrooms.
- Seal doors and windows.
- Eliminate pests.

## Asthma management

The National Heart, Lung, and Blood Institute, part of the National Institutes of Health, issued recommendations that are designed to improve the care of people living with asthma and help primary care providers and specialists make informed decisions about asthma management.

For resources on the prevention, treatment, and management of asthma, visit the Learn More Breathe Better<sup>®</sup> program at <https://www.nhlbi.nih.gov/lmbb asthma>.

For more information on the National Institute of Environmental Health Sciences, visit <https://www.niehs.nih.gov>.

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