



# Asthma and Its Environmental Triggers

## What is asthma?

Asthma is a chronic lung disease. Common symptoms are wheezing, coughing, chest tightness, and shortness of breath. During an asthma attack, the sides of the airways in lungs swell and the airways shrink, making it harder to breathe.

Once considered rare, asthma is now a common disease in childhood. In the United States, more than 26 million people have asthma, of which six million are children.<sup>1</sup>

Asthma is a major cause of missed time from school and work. Severe asthma attacks may require emergency room visits and hospitalizations, and they can be fatal. Asthma affects people of all races, sexes, and ages across every region of the U.S.

## What asthma research is the National Institute of Environmental Health Sciences (NIEHS) doing?

NIEHS conducts and supports asthma research from basic studies in laboratories to human clinical trials. This research focuses on complex relationships among the environment and people's genetics and immune systems. Projects have included:

- Development of sensors that measure personal environmental triggers of asthma.
- Clinical trials that examine if reduced indoor air pollution can improve asthma symptoms.
- Data science methods that combine environmental data gathered across the U.S.

## What are some inside triggers of asthma?

Asthma can be triggered by the same substances that cause allergies. Dust mites, pests such as cockroaches and rodents, pets, molds, and fungi create allergens, which are common indoor triggers for asthma.

Allergens are widespread, but the types vary in U.S. homes. NIEHS researchers reported that more than 90% of homes had three or more allergens, and 73% had at least one allergen at a high level.<sup>2</sup>



Research also demonstrates the importance of healthy school environments for reducing asthma risk. A study of inner-city students linked airborne mouse allergens in schools to increased asthma symptoms and decreased lung function in children.<sup>3</sup> This study suggests schools can take steps to improve air quality and help children who have asthma.

Indoor air pollution is also a major concern for lung health. NIEHS-funded research has shown that obese inner-city children living in homes with high levels of indoor air pollution may have worse asthma symptoms if they are also deficient in vitamin D.<sup>4</sup>

### Lower allergen levels 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.

## What are outside triggers of asthma?

NIEHS-funded researchers have found that air pollution and a changing climate can also trigger asthma. Various forms of air pollution, including ozone, nitrogen dioxide,

and traffic-related pollution, may make people with asthma sicker. NIEHS-funded researchers found babies who breathe high levels of traffic-related air pollution are more likely to have persistent wheezing when they are older, and children exposed to high levels of traffic-related air pollution through age 7 were more likely to develop asthma.<sup>5</sup> Another NIEHS-funded study found that adolescents exposed to the air pollutant nitrogen dioxide experience shifts in hormone levels that affect their response to stress, suggesting a way that air pollution makes asthma worse.<sup>6</sup>

In addition, climate can affect the severity of asthma. Research has shown that natural disasters and extreme weather events can create conditions that may worsen asthma in several ways.<sup>7</sup> For example, heat and drought make wildfires more widespread and severe, leading to large spikes in air pollution. More intense rainfall and flooding can lead to mold growth in homes and commercial buildings. Prolonged drought can worsen dust storms in dry areas.

## Join NHALES asthma study

Through the Natural History of Asthma with Longitudinal Environmental Sampling (NHALES) study, NIEHS seeks to better understand how bacteria and other factors in the environment affect people who have moderate to severe asthma. The study, conducted on the NIEHS campus in Research Triangle Park, North Carolina, is recruiting participants.

Moderate to severe asthmatics, 18-60 years old, may join.

For more information, email [nhales@mail.nih.gov](mailto:nhales@mail.nih.gov).

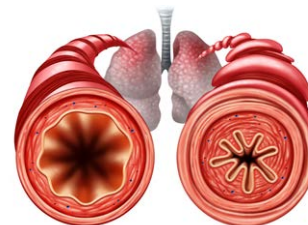
## Does asthma run in families?

Asthma often runs in families, which suggests that genetics plays a role in disease development. NIEHS researchers have shown that asthma patients with a specific genetic makeup who live close to a highway are more likely to have intense symptoms.<sup>8</sup> Another NIEHS study finds that certain indicators within DNA may indicate a newborn's risk of asthma.<sup>9</sup> This information may help researchers identify which children may develop asthma, and how to develop a treatment for preventing the disease.

## What is the immune system's role in asthma?

The immune system, our body's defense against infection, has a complex role in the development of asthma. An NIEHS-funded study showed that children who live on traditional Amish farms, which use animals rather than machines, were less likely to have asthma. The researchers suggest that the rich microbial environment on Amish farms may help build a stronger immune response in those children.<sup>10</sup>

Although exposure to some bacteria and similar microbes can benefit the immune system, exposure to others can be harmful. Scientists funded by NIEHS showed that children who were exposed to high levels of molds were more likely to have asthma at age 7.<sup>11</sup> For children with allergies, the association was especially strong.



This diagram compares a healthy (left) to an unhealthy (right) bronchial tube that would cause constricted breathing from asthma.

For more information on the National Institute of Environmental Health Sciences, visit [www.niehs.nih.gov](http://www.niehs.nih.gov).

- 1 CDC (U.S. Centers for Disease Control and Prevention). 2018. Most recent national asthma data. Available: [https://www.cdc.gov/asthma/most\\_recent\\_national\\_asthma\\_data.htm](https://www.cdc.gov/asthma/most_recent_national_asthma_data.htm) [accessed April 17, 2019].
- 2 Salo PM, et al. 2018. Bedroom allergen exposures in US households. *J Allergy Clin Immunol* 141(5):1870-1879.
- 3 Sheehan WJ, et al. 2017. Association between allergen exposure in inner-city schools and asthma morbidity among students. *JAMA Pediatr* 171(1):31-38.
- 4 Bose S, et al. 2019. Vitamin D status modifies the response to indoor particulate matter in obese urban children with asthma. *J Allergy Clin Immunol Pract*; doi: <https://doi.org/10.1016/j.jaip.2019.01.051> [Online 11 February 2019].
- 5 Brunst KJ, et al. 2015. Timing and duration of traffic-related air pollution exposure and the risk for childhood wheeze and asthma. *Am J Respir Crit Care Med* 192(4):421-7.
- 6 Wing SE, et al. 2018. Chronic exposure to inhaled, traffic-related nitrogen dioxide and a blunted cortisol response in adolescents. *Environ Res* 163:201-207.
- 7 NCA (National Climate Assessment). 2018. Fourth National Climate Assessment: Human Health. Available: <https://nca2018.globalchange.gov/chapter/14/> [accessed April 11, 2019].
- 8 Schurman SH, et al. 2018. Toll-like receptor 4 pathway polymorphisms interact with pollution to influence asthma diagnosis and severity. *Sci Rep* 8(1):12713.
- 9 Reese SE, et al. 2018. Epigenome-wide meta-analysis of DNA methylation and childhood asthma. *J Allergy Clin Immunol*; doi:10.1016/j.jaci.2018.11.043 [Online 21 December 2018].
- 10 Stein MM, et al. 2016. Innate immunity and asthma risk in Amish and Hutterite farm children. *N Engl J Med* 375(5):411-421.
- 11 Zhang Z, et al. 2017. Beta-glucan exacerbates allergic asthma independent of fungal sensitization and promotes steroid-resistant TH2/TH17 responses. *J Allergy Clin Immunol*. 139(1):54-65.