

Asthma and Its Environmental Triggers

What is asthma?

Asthma is an inflammatory disease of the lung. This inflammatory process can occur along the entire airway from the nose to the lung. Once the airway becomes swollen and inflamed, it becomes narrower, and less air gets through to the lung tissue. This causes symptoms like wheezing, coughing, chest tightness, and trouble breathing. During an asthma attack, the muscles around the airways tighten up and the asthma symptoms become even worse than usual.

Once considered a minor ailment, asthma is now the most common chronic disorder in childhood. The prevalence of asthma has progressively increased over the past 15 years. In the United States alone, nearly 40 million people — 13.3 percent of adults and 13.8 percent of children — have been diagnosed with asthma.¹

Does asthma run in families?

Asthma does run in families, which suggests that genetics play an important role in the development of the disease. If one or both parents have asthma, the child is much more likely to develop the condition — this is known as genetic susceptibility. An NIEHS study of 615 Mexico City families showed that variations in two genes, *ORMDL3* and *GSDML*, were associated with an increased risk of childhood asthma.² These results confirm a similar study conducted among European populations.

Simple steps for decreasing indoor allergens:

- Vacuum carpets and upholstered furniture every week
- Wash sheets and blankets in hot water every week
- Encase mattresses, pillows, and box springs in allergen-impermeable covers
- Steam clean carpets and floor mats every 8 weeks
- Replace carpeting with smooth surfaces such as hardwood or vinyl



Are allergies related to asthma?

Asthma can be triggered by substances in the environment called allergens. Indoor allergens from dust mites, cockroaches, dogs, cats, rodents, molds, and fungi are among the most important environmental triggers for asthma.

NIEHS scientists, along with researchers from the U.S. Department of Housing and Urban Development, conducted an extensive survey known as the National Survey of Lead Hazards and Allergens in Housing, which showed that 46 percent of the homes had dust mite allergens high enough to produce allergic reactions, while nearly 25 percent of the homes had allergen levels high enough to trigger asthma symptoms in genetically susceptible individuals. The survey also showed that nearly two-thirds of American homes have cockroach allergens.³

What can I do to reduce allergens and asthma attacks?

NIEHS scientists identified several strategies that reduce indoor allergens and asthma symptoms — cockroach extermination, thorough professional cleaning, and in-home visits to educate the occupants about asthma management. Using these strategies, cockroach allergens were reduced by 84 percent, well below the threshold for producing asthma symptoms.⁴

Other research showed that some simple steps — washing bedding in hot water; putting allergen-impermeable covers on pillows, box springs, and mattresses; and vacuuming and steam cleaning carpets and upholstered furniture — can significantly reduce dust mite allergen levels.⁵

NIEHS has also collaborated with the National Institute of Allergy and Infectious Diseases to conduct the National Cooperative Inner-City Asthma Study aimed at reducing asthma among children in the inner-city.

The program targeted six allergens that trigger asthma symptoms — dust mites, cockroaches, pet dander, rodents, secondhand smoke, and mold. Allergen-impermeable covers were placed on the mattress and box spring of the child's bed, and families were given vacuum cleaners equipped with high-efficiency particulate air (HEPA) filters. A HEPA air purifier was set up in the child's bedroom to remove tobacco smoke, dog and cat allergens, and mold. Children who received the help had 19 percent fewer clinic visits, a 13 percent reduction in the use of albuterol inhalers, and 38 more symptom-free days than those in the control group.⁶

What about mold?

After Hurricane Katrina and the subsequent flooding in New Orleans, NIEHS partnered with the National Institute on Minority Health and Health Disparities to establish the Head-off Environmental Asthma in Louisiana (HEAL) Project. Preliminary data from the HEAL project indicates there may be an association between mold sensitivity and asthma symptoms, but more research is needed.

New Directions

NIEHS grantees at the Environmental and Occupational Health Sciences Institute have developed PIPER, the Pre-toddler Inhalable Particulate Environmental Robotic sampler, a robot that mimics children's floor activities and collects more accurate samples than stationary air samplers. This personal monitoring of exposure to indoor contaminants and allergens will provide researchers with valuable information for treating asthma.



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What about the air pollution outside?

While much of the asthma research has focused on indoor allergens, scientists know that outdoor pollution also plays a major role. NIEHS-funded researchers at the Keck School of Medicine of the University of Southern California studied air pollution in 10 Southern California cities and found that children living within 150 meters of a freeway were more likely to be diagnosed with asthma than children who lived further away. The researchers also found that children who had higher levels of nitrogen dioxide in the air around their homes were more likely to develop asthma symptoms. Nitrogen dioxide is one of many pollutants emitted from motor vehicles.⁷

Scientists with the Columbia Center for Children's Environmental Health found that New York City mothers who were exposed during pregnancy to both polycyclic aromatic hydrocarbons, air pollutants from gasoline and other fossil fuels, and secondhand tobacco smoke had children who were more likely to have asthma.⁸

Research conducted by NIEHS-funded scientists at Yale University also suggests that asthmatic children who use medication to control asthma symptoms are particularly vulnerable to the effects of ground-level ozone, a highly reactive form of oxygen that is a primary ingredient of urban smog.⁹

¹ CDC (Centers for Disease Control and Prevention). 2009 National Health Interview Survey Data: Lifetime Asthma Estimates. Available: <http://www.cdc.gov/asthma/nhis/09/table1-1.htm> [accessed 13 February 2012].

² Wu H, et al. 2009. Genetic variation in ORM1-like 3 (ORMDL3) and gasdermin-like (GSDML) and childhood asthma. *Allergy* 64(4):629-635.

³ Arbes SJ Jr, et al. 2003. House dust mite allergen in U.S. beds: Results from the First National Survey of Lead and Allergens in Housing. *J Allergy Clin Immunol* 111(2):408-414.

⁴ Arbes SJ Jr, et al. 2003. Abatement of cockroach allergen (Bla g 1) in low-income, urban housing: A randomized controlled trial. *J Allergy Clin Immunol* 112(2):339-345.

⁵ Vojta PJ, et al. 2001. Effects of physical interventions on house dust mite allergen levels in carpet, bed, and upholstery dust in low-income, urban homes. *Environ Health Perspect* 109(8):815-819.

⁶ Kattan M, et al. 2005. Cost-effectiveness of a home-based environmental intervention for inner-city children with asthma. *J Allergy Clin Immunol* 116(5):1058-1063.

⁷ Gauderman WJ, et al. 2005. Childhood asthma and exposure to traffic and nitrogen dioxide. *Epidemiology* 16(6):737-743.

⁸ Rosa MJ, et al. 2011. Prenatal exposure to polycyclic aromatic hydrocarbons, environmental tobacco smoke and asthma. *Respir Med* 105(6):869-876.

⁹ Gent JF, et al. 2003. Association of low-level ozone and fine particles with respiratory symptoms in children with asthma. *JAMA* 290(14):1859-1867.