

Asthma and Its Environmental Triggers



Once considered a minor ailment affecting only a few, asthma is now the most common chronic disorder in childhood, affecting an estimated 6.2 million children under the age of 18. Despite improvements in diagnosis and management, and a better understanding of the causes of the disease, the prevalence of asthma has progressively increased over the past 15 years. In the United States alone, 30.8 million people – 10.6 percent of adults and 12.2 percent of children – have been diagnosed with 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.

Environmental Triggers: The National Allergen Survey

The fact that asthma runs in families suggests that genetic factors 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. However, environmental factors also contribute to the disease process. Asthma can be triggered by a wide range of substances called allergens.

Recent studies also show that exposure to indoor allergens from house dust mites, cockroaches, dogs, cats, rodents, molds and fungi are among the most important environmental triggers for asthma. From 1998 to 2002, NIEHS scientists, along with researchers from the Department of Housing and Urban Development, conducted an extensive survey to assess the prevalence of these indoor allergens in American homes.

The results of this survey, known as the National Survey of Lead and Allergens in Housing, showed that more than 46 percent of the homes surveyed had levels of dust mite allergens high enough to produce allergic reactions, while nearly a quarter of the homes had allergen levels high enough to trigger asthma symptoms in genetically susceptible individuals.¹ The survey results also showed that nearly two-thirds of American homes have detectable levels of cockroach allergens, with higher allergen concentrations in high-rise apartments, urban settings, older homes, and homes of low-income households. Approximately 10 percent of homes had cockroach

allergen levels above the threshold for triggering asthma symptoms.

One of the most surprising findings from the national survey was that 100 percent of U.S. homes had detectable levels of dog and cat allergens, even though dogs were present in only 32 percent of the surveyed homes, and cat ownership was reported in only 24 percent. Most homes had levels of dog and cat allergen that exceeded the threshold for allergic sensitization, while about one-third of homes had allergen levels high enough to produce asthma symptoms.



Asthma Intervention: Reducing Indoor Exposures

In addition to their research on indoor allergens, NIEHS scientists are collaborating with researchers from other asthma research centers to develop intervention strategies aimed at reducing asthma symptoms. These strategies are based on simple methods that are designed to reduce exposure to the allergens that trigger asthma. Recent evidence suggests that exposure to cockroach allergen might be the most important risk factor for asthma in inner-city households.

In 2001, NIEHS researchers conducted a 6-month trial to test a new intervention method for reducing



cockroach allergen levels in low-income, urban homes. The intervention included cockroach extermination, thorough professional cleaning, and in-home visits to educate the occupants about asthma management. At the end of 6 months, cockroach allergen levels were reduced by 84 percent on bedroom floors and in the beds, well below the threshold for producing asthma symptoms.² The researchers also observed a 96 percent reduction in allergen levels on kitchen floors, although allergen levels remained above the asthma threshold. A follow-up study conducted in 2005 showed that these reductions in allergen levels could be maintained with continued cockroach control, and that effective cockroach extermination alone could reduce allergen concentrations to a comparable level.

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Other intervention studies have targeted allergens produced by house dust mites, microscopic creatures that reside in bedding, carpets and upholstery. In 1999, Institute researchers collaborated with scientists from Harvard University and the University of Washington to evaluate some practical methods for lowering these allergens in the bedrooms of low-income Seattle homes. The research showed that some simple steps – washing the bedding in hot water, putting allergen-impermeable covers on the pillows, box springs and mattresses, and vacuuming and steam cleaning the carpets and upholstered furniture – can significantly reduce dust mite allergen levels.³

The results of the indoor allergen surveys also showed that the construction and operation of the

homes may have a significant impact on allergen levels. For example, indoor humidity and age of the house were the best predictors of dust mite allergen levels.

Helping Minority Populations: The Inner-City Asthma Study

In order to address the rising incidence of asthma among inner-city children, NIEHS has partnered with the National Institute of Allergy and Infectious Diseases to conduct the National Cooperative Inner-City Asthma Study, a long-term project that includes seven asthma study centers across the country. The study has enrolled more than 900 children, ages 5 to 11, with moderate to severe asthma. The goal of the study is to develop and implement a comprehensive, cost-effective intervention program aimed at reducing asthma incidence among children living in low socioeconomic areas.

Begun in the early 1990s, the study has already provided researchers with some positive results. Scientists developed an intervention program that targets six major classes of allergens that trigger asthma symptoms – dust mites, cockroaches, pet dander, rodents, passive smoking and mold. The environmental interventions are tailored to each child's sensitivity to the selected allergens as determined by allergy testing. They include allergen-impermeable covers on the child's mattress, box spring and pillows, air purifiers, vacuum cleaners with HEPA filters, and professional pest control. Children who received the intervention had 19 percent fewer unscheduled clinic visits, a 13 percent reduction in the use of albuterol inhalers, and 38 more symptom-free days over the course of the study than those in the control group.⁴

The Role of Outdoor Air Pollution

While much of the asthma research has focused on indoor allergens, scientists are realizing that outdoor pollutants also play a major role. NIEHS-funded researchers at the

University of Southern California's Keck School of Medicine studied air pollution levels in 10 Southern California cities, and found that the closer children live to a freeway, the greater their chances of being diagnosed with asthma. 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 the tailpipes of motor vehicles.



Armed with a better understanding of asthma's environmental triggers, researchers want to learn more about how genes interact with these exposures to influence disease risk. To address this need, NIEHS has launched a new research program to identify the genetic risk factors that predispose people to asthma. Using a technique called gene expression profiling, the researchers will screen thousands of genes to identify which genes are activated when a patient's airways become obstructed or inflamed. The ultimate goal of this program is to determine which genes make people susceptible to different types of asthma, which may help explain why some people develop asthma while others remain unaffected.

For more information on Asthma, go to our website at:
<http://www.niehs.nih.gov/>

¹ Arbes et al. (2003) House Dust Mite Allergen in U.S. Beds: Results From the First National Survey of Lead and Allergens in Housing. *Journal Allergy Clinical Immunol.* 111:408-414.

² Arbes et al. (2003) Abatement of Cockroach Allergen (Bla g 1) in Low-Income, Urban Housing: A Randomized Controlled Trial. *Journal Allergy Clinical Immunol.* 112:339-345.

³ Vojta et al. (2001) Effects of Physical Interventions on Group I House Dust Mite Allergen Levels in Carpet, Bed, and Upholstery in Inner City Homes. *Environ. Health Perspect.* 109:815-819.

⁴ Kattan et al. (2005) Cost-Effectiveness of a Home-Based Environmental Intervention for Inner-City Children with Asthma. *Journal Allergy Clinical Immunol.* 116:1058-1063.