Indoor Environmental Interventions for Furry Pet Allergens, Pest Allergens, and Mold: Looking to the Future

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Target Audience: Physicians and researchers within the field of allergic disease.

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List of Design Committee Members: Sharon K. Ahluwalia, MD, and Elizabeth C. Matsui, MD, MHS (authors); Michael Schatz, MD, MS (editor)

Learning objectives:

1. To describe the evidence accumulated related to indoor environmental control interventions and asthma.

2. To describe findings from recent trials of home-based environmental interventions.

3. To describe the patient populations most likely to benefit from home-based environmental control interventions.

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Over the last 2 to 3 decades, significant advances have been made in understanding the role that indoor allergen exposures play with regard to respiratory health. Multiple studies have confirmed that sensitization and exposure to indoor allergens can be a risk factor for asthma morbidity. Environmental interventions targeting key indoor allergens have been evaluated with the aims of examining their causal effects on asthma-related outcomes and identifying clinically efficacious interventions to incorporate into treatment recommendations. Historically, it appeared that the most successful intervention, as performed in the Inner-City Asthma Study, was individually tailored, targeting multiple allergens in a predominantly low-income, minority, and urban pediatric population. Recent studies suggest that single-allergen interventions may be efficacious when targeting the most clinically relevant allergen for a population. In this article, we review recent literature on home environmental interventions and their effects on

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Abbreviations used
ICAS- Inner-city Asthma Study
IPM- Integrated pest management

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INTRODUCTION

Over the last 2 to 3 decades, significant advances have been made in understanding the role that indoor allergen exposures play with regard to respiratory health. Epidemiologic studies have confirmed that individuals with asthma with sensitization to indoor allergens tend to have a more severe asthma phenotype, and that sensitization and exposure to allergens can be a driving factor in asthma morbidity.[1-6] Modern society has shifted toward spending more and more time indoors,[7] making these correlations between allergen exposure and disease severity increasingly relevant. Many studies have evaluated various indoor environmental interventions targeting key indoor allergens with the aims of examining their causal effects on asthma-related outcomes and identifying clinically efficacious interventions to incorporate into treatment recommendations. However, synthesizing the home environmental intervention literature is difficult because of the heterogeneity of these types of studies.[8]

Environmental intervention studies are tailored to specific populations, designed to evaluate specific interventions, and powered to measure specific outcomes, and these features vary from one study to another. Even though most US-based studies are performed in low-income, urban populations, and generally involve children, there are still substantial differences between studies in the allergens targeted, the methods used to intervene on those allergens, and the outcomes evaluated. In addition, because the clinical relevance of an allergen varies on the basis of ecology, geography, and housing stock among other factors, outcomes from one population may not be reproducible in another geographically or ecologically different population or location. Furthermore, studies approach the environmental interventions to reduce these allergens with myriad techniques. Although some studies take the approach of using pragmatic, easily deliverable interventions targeted at allergen reduction (ie, single interventions or simply education for participants about how allergens can be reduced), others are designed as multifaceted complex interventions targeting multiple allergens in the home environment along with provision of education about allergens. The methods by which studies measure everything from study eligibility (presence of allergen in the home, sensitization status of participants, evidence of clinical reactivity to the allergen, etc) to allergen reduction (decrease in major allergen levels, decrease in report of pest sightings, etc) to clinical outcomes (health care utilization, symptoms, medication usage, etc) also vary. Although this degree of heterogeneity among study designs makes it difficult to draw broad conclusions about the efficacy of indoor environmental interventions generally, the literature is informative for understanding which allergens are likely to be most relevant for a patient or a community, which patients or communities would be most likely to benefit from allergen interventions, and which interventions are most likely to result in clinically meaningful reductions in the target allergen. In this article, we review recent literature on home environmental interventions and their effects on specific indoor allergen levels and asthma-related outcomes.

FURRY PET ALLERGENS

Cats and dogs are the most common furry pets found in American homes. Market research statistics published by animal food suppliers estimate that approximately 50% of households in developed countries have pets, with slightly higher dog ownership (~47%) than cat ownership (~37%).[9] Fel d 1 and Can f 1, the respective major allergens for cats and dogs, are found in the saliva, skin, and hair follicles of these animals. These pet allergens are predominantly carried on small particles (<10-20 μm), allowing them to remain airborne for long periods of time and adhere to clothing and surfaces.[10] As a result, pet allergens are carried long distances, and are passively transferred to environments where no pets may be present. Can f 1 and Fel d 1 can be found in almost all homes, although the concentrations are 10 to 1000 times higher in homes with pets than in homes without pets.[11,12] These pet allergens are also ubiquitous in public places such as schools and office buildings.[13,14]

Allergic sensitization to cat and dog is quite common; approximately 12% of the general population and 25% to 65% of children with persistent asthma are sensitized to cat or dog allergens.[1,2,15-17] Pet allergen exposure has been linked to worse asthma outcomes in animal-sensitized adults and children with asthma.[4,17,18]

The most effective long-term strategy for environmental remediation in pet-sensitized individuals is to remove pets from the home.[19] Even after removing a pet from the home, it can take several months before significant reductions in allergen levels are achieved.[20] The only study of pet removal was a prospective, controlled, but nonrandomized trial of pet removal for 20 adults with newly diagnosed pet-allergic asthma, which demonstrated that pet removal was associated with substantial reductions in controller medication needs. At 1-year follow-up, none of the subjects in the pet removal group required inhaled corticosteroids compared with 9 of 10 in the control group that kept their pets ($P < .001$).[21] Although removing the pet from the home is an effective strategy, it is difficult to implement in practice due to most patients' reluctance to give up their pets. As a result, there have been several studies examining the efficacy of other interventions aimed at reducing indoor pet allergen levels to improve asthma in sensitized individuals.

Frequent washing of animals has been evaluated as a means of reducing airborne allergen levels. Unfortunately, washing cats demonstrated no benefit or transient benefit in airborne Fel d 1 levels that was not sustained, even at 1 week postwashing.[22,23] Dog washing reduced recoverable allergen levels from dog hair and dander, but the results were short-lived unless the dog was washed twice a week.[24] Given the difficulty in maintaining