

A Look at Indoor Allergen Environmental Control

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ABSTRACT

Environmental control is important in the management of allergy, particularly indoor environmental control. These measures may be helpful not only in allergic rhinitis, but also asthma. House dust mite allergen is a major indoor allergen and measures to control allergen level include impermeable encasings for the bedding (perhaps the most important measure), washing bedding preferably at high temperature (130°F), decreasing relative humidity in the home, not having carpet, or if so, using an effective vacuum system, and using air filter devices. The use of chemicals called acaricides have been marketed to kill dust mite as well. Animal dander, another clinically important indoor allergen is best managed by removal of the pet from the home. However, using encasings in the bedroom, vacuuming with an effective vacuum system, using an air filter in the home, and possibly washing the cat, are modalities used to decrease animal dander. The majority of patients tend to benefit most from avoidance of allergens (pet), using encasings, and the more basic measures. For those who do not respond, other measures of environmental control may then be reasonably considered. (Pediatr Asthma Allergy Immunol 2000;14[4]:301-305.)

INTRODUCTION

BECAUSE THE MAINSTAY for allergic disease is avoidance of offending allergens, environmental control is obviously important to allergic individuals and to the medical professionals caring for these patients. Seasonal aeroallergens are often difficult to avoid short of limiting outdoor exposure or wearing masks to decrease exposure to allergens. However, much more can be done to modify indoor allergens, which typically cause perennial symptoms. Importantly, indoor allergens, particularly dust mite and cat dander, are highly associated with the development of chronic asthma.⁽¹⁾ Studies have shown that if asthmatic patients are sent to communities at high altitudes, which have lower mite levels, there is significant improvement in asthma symptoms, bronchial hyperresponsiveness, and need for medication. The beneficial effect of allergen avoidance demonstrated a benefit in house dust mite-specific bronchial challenge as well as decreased hyperresponsiveness to nonspecific challenges of exercise, methacholine, and histamine.⁽²⁾ Therefore it is important for patients to understand the significance of environmental control in the home. There are a number of modalities of environmental control that are commonly being used. The medical literature has stud-

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ied a number of these and some basic principles can be taken away and hopefully used in educating patients about appropriate, step-wise, and cost-effective ways to control allergens in the home.

House dust mite allergen is perhaps the most clinically important allergen with respect to asthma and perennial allergic rhinitis. The bedroom (particularly the bed) is the most important source for dust mite allergen.⁽³⁾ This is particularly important because most individuals spend one-third or more of their day not only in the bedroom, but in physical contact with the mite allergen. Particularly for those allergic to dust mites (but also in order to potentially prevent sensitization to mites) the use of impermeable encasings for pillows, mattresses, and boxsprings is routinely recommended to decrease exposure to this allergen. This appears to be the most important environmental control measure for this allergen as levels of antigen can be dramatically reduced (up to 15-fold to 65-fold).⁽⁴⁾ Importantly, it has been shown that reducing mite levels (using encasings) in homes with high allergen amounts has been associated with a significant reduction in bronchial hyperresponsiveness after 8 months of treatment (PC₂₀ increasing up to 4.5-fold).⁽⁵⁾ However, there are a number of encasings available that have different types of fabric and different pore sizes. A study by Vaughan et al.⁽⁶⁾ showed that the most effective encasings seem to be those that have pore sizes less than 10 μm , which tend to block dust mite allergen. It also showed that those with pore sizes less than 6 μm will block cat allergen as well.⁽⁶⁾ In addition to encasing the pillows, it is recommended to cover the mattresses with encasings also.⁽⁷⁾ It is important to wipe down the encasings weekly to remove allergen.⁽⁴⁾ Laundry should be washed at 130°F because this water temperature will kill the dust mite. However, washing in lower temperatures will still wash out much of the allergen and reduce allergen levels even if killing does not occur.⁽⁸⁾

Carpeting is another potential source of indoor allergens. Carpets are a reservoir for indoor allergens and homes with carpets contain more allergen than those without. For this reason, replacement of fitted carpets with smooth flooring is probably useful.⁽⁹⁾ Because removal of carpet may be costly or undesirable, vacuuming may be the next best way to decrease allergen from the floors. Frequent vacuuming may be beneficial, although it is essential to use a quality vacuum cleaning system. A study showed that even among vacuum cleaners claiming to capture 99.9% of particles 0.3 μm or larger, there were still significant differences between products in amount of allergen recovered. They found that those with single layer vacuum bags do not recover as much allergen as those that are two or three layered.⁽¹⁰⁾ There may also be added benefit of wet vacuum cleaning because this may remove more allergen by washing it out.⁽¹¹⁾ Vacuuming with super-heated steam may be even more effective because it actually can kill mites in the carpet.⁽¹²⁾

Another commonly used environmental control method is the use of room high-efficiency particulate air (HEPA) filters. Van der Heide et al.⁽¹³⁾ showed that in combination with other allergen avoidance measures (allergen impermeable encasings), there was additional improvement of airway hyperresponsiveness over using the encasings alone, with the provocative dose causing a 20% drop in forced expiratory volume in 1 second (FEV₁) increasing from 5.96 to 9.02 ng/mL. This was found to be statistically significant.⁽¹³⁾ Another study showed that air filtration may reduce the amount of airborne cat allergen by twofold to fourfold.⁽¹⁴⁾ In another study by Reisman et al.⁽¹⁵⁾ the benefit of HEPA filters on allergic symptoms was examined. These filters remove almost 100% of particles greater than 0.3 μm in diameter. Although the study showed that there may be some improvement in clinical symptoms (particularly nasal congestion) in some individuals, a substantial number of subjects did not benefit over placebo filters.⁽¹⁵⁾

In addition to the above measures to control house dust mite levels in the home, there have been several relatively new chemicals termed acaricides, which have been marketed to kill house dust mites. These may not be important adjuncts to management because one study in dust mite allergic asthmatic children showed that the addition of an acaricide along with typical house dust measures did not give any additional clinical benefit over the house dust mite avoidance measures alone. In asthmatics using basic avoidance measures and those using these same measures plus acaricide, there was no statistical difference between the groups in FEV₁ or morning and evening peak expiratory flow rates.⁽¹⁶⁾ These treatments additionally have the drawback of being somewhat costly (about \$60 per application for a 9 × 12 bedroom) and must be reapplied at regular intervals, generally every 3 months.⁽⁷⁾

House dust mites are known to thrive at relative humidities greater than 60%. In fact, at lower humidity levels the mites die of dehydration.⁽¹⁷⁾ They thrive at higher humidities, so in theory, mite allergic individuals may benefit from a lower humidity environment. It was shown by Korsgaard et al.^(18,19) that the ef-

fectiveness of mite reduction measures are limited if the relative humidity is above 60%. Therefore it is suggested to control humidity so that the indoor relative humidity is kept below 50%.⁽²⁰⁾ However in environments with very high humidity, a portable room dehumidifier may not be adequate to significantly change the relative humidity to a degree that is helpful.⁽²¹⁾

Another common and clinically significant indoor allergen is the cockroach. This was first recognized to be relevant in poor urban communities more than 30 years ago.⁽²²⁾ In a study by Rosenstreich et al.⁽²³⁾, it was found that in representative U.S. inner cities more than one-half (50.2%) of dwellings had high levels of cockroach allergen in the dust, a higher percentage than either dust mite or cat. In this population it was found that those exposed to cockroach who were allergic to this allergen had more days of wheezing, missed school days, unscheduled medical visits, and hospital admissions than other children.⁽²³⁾ Therefore, measures to decrease exposure to cockroach allergen may be helpful in decreasing asthma symptoms. In a study by Sarpong et al.⁽²⁴⁾ it was found that levels of Bla g 2, a major cockroach allergen, were significantly lower 2 weeks after professional extermination. Initial median levels of allergen were 5.2 U/g and 2 weeks later were decreased to 0.95 U/g, an 85% decrease in median level.⁽²⁴⁾ This decrease likely would be clinically significant as similar reductions in mite allergen showed clinical efficacy.⁽⁵⁾ To keep levels low, it is important to decrease reinfestation, which may be minimized by removing food and water sources, especially dirty dishes and open food containers. Also cracks and crevices in the home should be sealed to minimize access into the home.⁽²⁴⁾

Last, the other major perennial indoor allergen is animal dander, with cats being the most important pet allergen. Many homes in the United States have a cat, and it has been shown that exposure to cat is a risk factor for precipitating asthma attacks requiring emergency room care.⁽²⁵⁾ Although evicting the cat is the most effective way to eliminate the allergen, this is unacceptable to many pet owners.⁽²⁶⁾ Fortunately, there are several measures that can decrease the amount of dander in the environment. Practical measures include removing the cat from the bedroom, having noncarpeted floors, and reducing the amount of upholstered furniture.⁽⁷⁾ In fact, by removing a cat from a room the allergen level will drop up to 70%.⁽²⁷⁾ A study by Van der Heide et al.⁽²⁸⁾ showed that using air cleaners in living rooms and bedrooms resulted in a significant improvement in airway hyperresponsiveness, however there was no change in lung function (FEV₁) or in symptom scores when compared to those using sham cleaners.⁽²⁸⁾ Pillow and mattress encasings are recommended as adjuncts (as for mite allergen) although fabrics with smaller pore size are needed because cat allergen is generally smaller than dust mite allergen. Fel d 1, the major cat allergen is generally blocked if using fabrics with pore sizes less than 6 μm .⁽⁶⁾ As for dust mite allergen, using an effective vacuuming device may be useful in removing pet allergen, however, the cleaners should be effective in capturing antigen and have an effective bag so captured antigen does not leak out.⁽¹⁰⁾ Last, washing the cat has been proposed as a way to decrease cat allergen in the home.⁽²⁰⁾ However, a study by Klucka et al.⁽²⁶⁾ demonstrated that there were not significant reductions in Fel d I with cat washings. Another study showed that washing cats by immersion will remove significant allergen from the cat. However, by the end of a week the cat is shedding normal amounts of Fel d 1 again.⁽²⁹⁾ Dogs can also be an important source of allergen, although it seems to be less important than cat allergen as a cause of asthma.⁽³⁰⁾ Avoidance measures for dog allergen are similar to those used for cat, for example keeping the pet outdoors and limiting close contact (facial contact or sleeping with animal).⁽³¹⁾ Washing the dog may also be quite beneficial. However, to maintain a low level of recoverable Can f 1 (a major dog allergen), it appears necessary to wash the dog at least twice a week.⁽³²⁾

As one can see, there are a number of potential methods and adjuncts currently used and recommended for patients with allergic asthma as well as perennial allergic rhinitis. Many, if not all, of them may be helpful in decreasing the amount of allergen in one's environment. Some of the most effective means to decrease allergen are the most simple—not having carpet, avoiding items that collect dust, and not having pets to which one is allergic (or at least keeping them out of the bedroom). The use of encasings in the bedroom is one of the most effective means to decrease indoor allergen. Many of the remaining modalities (vacuuming, air cleaners, acaricides) may help to further decrease the amount of allergen in the environment. However, as discussed previously, these generally have no significant additional clinical benefit over many of the more simple measures. These may more wisely be reserved for the patients who do not respond well to the basic measures.

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