EDITORIAL

Are Environmental Controls Effective for House-Dust-Mite Allergies?

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Allergic diseases are becoming more common; indeed, predictions suggest that by the year 2020, more than 50% of the population will suffer from some type of allergy. Respiratory allergies will predominate, and many of them will be triggered by house dust mites. The World Health Organization has therefore declared these mites a global health concern. The presence of indoor allergens such as house dust mites is the main risk factor for sensitization and development of allergic rhinitis and asthma, and other allergic diseases. One million people in Spain are thought to suffer from allergy to house dust mites—the leading cause of allergic asthma (53%) and the second cause of rhinitis (39%). The most prevalent genus of mite in dust samples is *Dermatophagoides* (*pteronyssinus* and *farinae*). In Spain, house dust mites are most abundant on the coast of the Bay of Biscay, the Mediterranean coast, and coastal regions of the Canary Islands. They thrive less well away from the coasts, in regions where the climate is dry and the temperature variations are greater.

House dust mites feed mainly on flakes of human skin. A single adult person sheds between 0.5 and 1 g per day, enough to feed 100 000 house dust mites a day. Respiration—or gas exchange—in mites is cutaneous, so they are particularly susceptible to desiccation or loss of body moisture. Their life cycle is dependent on temperature and humidity, the optimum conditions for development being between 20ºC-25ºC with a relative humidity of 70%-75%.[1]

Most house-dust-mite allergens are proteases related to the digestive process. In fact, fecal particles carry most of the allergens produced by house dust mites, each of which produces around 20 fecal particles a day. These particles are spherical with a diameter between 10 μm and 40 μm, and are readily suspended and transported in the air.[2]

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Many individuals allergic to mites are sensitized to a range of species because of cross-reactivity due to common antigenic determinants.[3] Although genetic predisposition is a fundamental condition for susceptibility to allergic respiratory diseases,[4] diseases would not manifest without exposure to environmental allergens.[5,6] It has been shown that the probability of sensitization and development of asthma,[5,7,8] rhinitis, and atopic dermatitis[9,10] increases with greater exposure to allergens.

Exposure to allergens is most commonly estimated by quantifying allergens in samples of house dust. Samples are vacuumed from beds, floors, rugs, and sofas. Quantification of particles in suspension by collecting particles suspended in a given volume of air may be more representative of exposure to allergens than quantification of sedimented dust, but it is more difficult due to the aerodynamic characteristics of these allergens.

There is no full agreement on the threshold allergen concentrations that provoke allergic sensitization, but concentrations of particles above 100 to 200 ng/g of dust are considered to put the individual at risk of developing an allergy. At concentrations above 10 μg/g, the individual is at risk of suffering acute asthma attacks. Exposure to concentrations above 10 μg/g in the early years of life increases the risk of asthma 4-fold. Moreover, the presence of more than 100 mites/g of dust has been associated with allergic sensitization, and more than 500 mites/g with clinical symptoms of asthma.[11]

Concentrations that might induce clinical symptoms of rhinitis have not been established.

In recent years, many studies have investigated the impact of environmental controls on reducing allergen load and clinical symptoms of allergy to house dust mites. In fact, implementation of such controls currently constitutes 1 of the 3 fundamental pillars of the management of allergies, along with pharmacological treatment and administration of allergen vaccines. At present, environmental controls can be classed as either physical or chemical measures. Physical measures can be subdivided into those that

control environmental humidity and temperature, mechanical measures (collection and filtration), and physical barriers (impermeable covers). Chemical measures comprise pesticides to eliminate house dust mites and substances to denature the allergens.

Many studies have shown a cause-effect relationship between sensitization to house dust mites and development of allergic rhinitis and asthma. Recent consensus documents have detailed the role of house dust mites in the sensitization process, as well as the importance of environmental controls in the management of these diseases.[12,13] In relation to the natural course of respiratory allergic disease, these controls could be performed before sensitization itself takes place (primary prevention), after sensitization but before the appearance of symptoms (secondary prevention), or once the disease has become established (tertiary prevention).[14]

Although greater exposure to an allergen seems to clearly increase the possibility of sensitization,[15] few studies have assessed the effectiveness of environmental controls as an intervention in primary or secondary prevention.

Two recent studies have evaluated the effect of impermeable covers on the sensitization of children to house dust mites.[16,17] One of these was a randomized, double-blind, placebo-controlled study,[16] which included 2 groups of children of different ages—2 to 4 years and 5 to 7 years. As conditions of entry, all patients had a family history of atopy and were not sensitized to house dust mites. The findings showed a significant decrease in the incidence of sensitization to house dust mites in both age groups when patients used impermeable covers.

In another study, Koopman et al[18] evaluated the effect of impermeable covers used from the prenatal period to the first year of life on the development of sensitization, respiratory symptoms, and atopic dermatitis. The results showed no differences between the 2 groups for development of sensitization to mites. The group who used impermeable covers had a lower incidence of nighttime cough but not of other respiratory and cutaneous symptoms.

Most studies to evaluate environmental controls have assessed people with established allergic rhinitis and/or asthma (tertiary prevention). In most cases, the measures used were impermeable mattress and pillow covers.[19-22] These studies have shown the efficacy of these controls in that the number of mites or allergens is reduced, but their effectiveness, that is, clinical improvement, has not been demonstrated, as most patients received no measurable benefit in terms of lung function or symptoms.

The relationship between allergen concentrations and presence of symptoms does not seem to obey a linear, direct, and predictable relationship. It is noteworthy that the use of impermeable covers reduces the allergen load by up to 8 times compared to a placebo cover, but with no relevant clinical improvement. Application of a single measure, despite its efficacy at reducing allergen load, is therefore often concluded to be of no clinical use. Notwithstanding, it remains difficult to understand why a reduction in allergen load does not correspond to a clinical improvement.

Several factors could explain this contradiction. First, sensitivity and response vary greatly from individual to individual. Thus some people (with high sensitivity and low response threshold) may benefit whereas others (with low sensitivity and high response threshold) do not. That is, a several-fold reduction in allergen concentration could be of great help in patients with a high threshold, but in those with a low threshold, a several-fold reduction in allergen concentration may still not be enough to cause clinical benefit. Second, the concentrations of house dust mites in each home vary according to a series of factors such as geographic location, temperature, humidity, building characteristics, decoration, domestic pets (dogs or cats), and the number of people living in the home. Concentrations of house dust mites in places of work and leisure also vary according to similar factors. Finally, environmental control may not be appropriately applied despite a reduction in allergen load. These factors make it quite difficult to design a "perfect" clinical trial. Of the studies that have been published, those of Woodcock et al[20] and Terreehorst et al[22] may be the ones best designed to evaluate the clinical efficacy of impermeable covers in asthma and rhinitis, respectively.

The usefulness of environmental controls in allergic respiratory diseases caused by house dust mites has been extensively discussed in recent systematic Cochrane reviews.[23,24] For asthma, 29 studies were included, of which 15 assessed physical measures, 9 chemical measures, and 5 a combination of both. Statistically significant differences in scores on scales for assessing asthma symptoms, use of medication, or morning peak expiratory flow were not found. If these reviews had analyzed the study of Woodcock et al,[20] they would have reached firmer conclusions.

The review of the effectiveness of environmental controls in allergic rhinitis included only 4 studies, all small and poorly designed and the study by Terreehorst et al[22] was not included. The reviewers argued that they could not carry out an appropriate analysis due to differences in the patients studied and they concluded that, in these circumstances, it is hard to make any recommendations.

In short, what has been discussed so far provides no evidence that environmental controls are effective as part of the management of allergic rhinitis and asthma. Paradoxically, in contrast to clinical studies which have not shown any benefit of environmental controls, daily clinical practice does seem to suggest that such controls can be beneficial. However, we should remember how difficult it is to conduct studies with an "ideal" design, due to the many factors that can influence exposure to house dust mites and the presence of symptoms.[25] It might be necessary to promote large-scale controlled studies to

accurately identify patients who stand to benefit from application of house-dust-mite avoidance measures, determine what degree of benefit can be expected, and predict whether long-term benefit can be obtained in the natural course of allergic respiratory disease.

In conclusion, although studies have yet to confirm the usefulness of environmental controls, we think that long-term application of feasible environmental controls can be recommended and the cost-benefit relationship assessed for each individual patient.

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