

Controlling indoor allergens

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Purpose of review

Epidemiological surveys indicate that there has been a notable increase in the prevalence of asthma and other allergic diseases in children and adults. The purpose of this review is to report and comment on recent studies about the role of allergen in primary prevention and to seek new insights on the effects of allergen control in allergic patients.

Recent findings

This paper deals with allergen reduction in primary prevention, the effect of early exposure to pets on atopic diseases and the development of new occupational activity improving allergen control in allergic patients.

Summary

The role of allergen dose involved in the onset of atopy is controversial. Studies hypothesizing that a reduction of allergen dose might reduce atopy failed to confirm the data from the Isle of Wight study and found no effect on the frequency of immunoglobulin E sensitization. This effect might nonetheless occur later in life. Other studies indicate that high doses of allergen early in life have a protective effect against cat and dog sensitization. Only one retrospective study found that cat exposure was protective against cat sensitization. A German prospective study suggested, however, that it is more probable that cat allergen exposure is harmfully related to sensitization, by increasing IgE synthesis. The effect of high doses must be clarified by further prospective studies. Accordingly, we must be very careful when giving advice on primary prevention, particularly about the protective effect of cat and dog allergens. Secondary prevention may be dramatically improved with the help of a new occupational activity: the medical indoor environment counsellor.

Keywords

allergens, primary prevention, secondary prevention, medical indoor environment counsellor

Curr Opin Allergy Clin Immunol 3:165–168. © 2003 Lippincott Williams & Wilkins.

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Current Opinion in Allergy and Clinical Immunology 2003, 3:165–168

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1528-4050

Introduction

Increases in the prevalence of asthma and other allergic diseases in recent decades have focused attention on the need for prevention, specifically, by limiting exposure to allergens. The concept of allergen reduction was first proposed during the 17th century, and by the mid-1920s, Americans and Europeans began to suspect that home dust played a role in asthma symptoms.

Ten years ago, the Isle of Wight study indicated that allergen reduction in the environments of genetically at-risk infants could reduce the onset of atopy; these findings seemed to demonstrate the role of primary prevention of allergies. More recently, however, larger studies have failed to confirm these results and have also, surprisingly, suggested that high levels of exposure to cat and dog allergens help protect against the onset of atopy and asthma.

Role of allergen reduction in primary prevention

The Isle of Wight study appeared to demonstrate that primary prevention was effective in the reduction of the onset of atopy [1]. Larger studies have recently followed, however, with different results. In Manchester, Custovic *et al.* [2**] studied four groups of infants prospectively, beginning before birth. Three groups were at high risk of atopy (two atopic parents), of which 140 had pets and 291 did not. Among the 291 high-risk couples (both parents atopic, no pets), mite allergen reduction methods were implemented in the homes of 133 and 118 received no intervention. A fourth group was composed of 126 children at low risk of atopy (two non-atopic parents). Dust mite allergen reduction measures were completed by the 16th week of pregnancy and included covering the mother's bed and use of a high filtration vacuum cleaner. At 36 weeks of pregnancy, any carpet was removed from the rooms intended for the babies, and the parents received new custom-made carrycot mattresses, encased in allergen-proof material. These methods were very effective against mite allergen exposure, since the total amount of allergen recovered at age 1 year was 29 times higher (95% CI 15.1–56.7) among the control (no intervention) group than in the families with active mite reduction.

The principal result of this study, however, was that, contrary to the Isle of Wight results, the groups did not differ in sensitization to mites, cats, dogs, grasses, milk, or eggs at the age of 1 year. The most pronounced difference between the active and control groups

concerned the relative risks for severe wheezing with shortness of breath (RR 0.44; 95% CI 0.2–1.0) and for the prescription of medication for wheezing attacks (RR 0.58; 95% CI 0.36–0.95) in the active group. The relative risk of atopy (at least one positive skin test) was significantly higher in the high-risk groups than in the group considered to be at low risk (RR 2.6; 95% CI 1.23–5.73).

In another prospective prenatally randomized controlled study, Chan-Yeung *et al.* [3] assessed the effectiveness at 1 year of a multifaceted intervention program in Canada for the primary prevention of asthma among 493 high-risk infants. Intervention consisted of encasing all mattresses and box springs in the parents' and the infants' bedrooms, pet avoidance measures (removing cats, dogs, and other furry pets, or keeping pets outside the house), smoke-free environment, breastfeeding and dietary avoidance. Like the Manchester study, they found that the incidence of positive skin test results for one or more inhaled allergens was similar in both groups and that the risk of probable asthma in the intervention group was significantly reduced, by 46% (RR: 0.62; 90% CI: 0.35–1.12). The mite allergen levels were significantly lower in the intervention group from 2 weeks to 1 year. For cat allergen, however, the difference stopped being significant after 6 months.

A European multicentre study (United Kingdom, Greece and Lithuania) [4•] involving older atopic children, aged from 5 to 7 years, found that mite sensitization was significantly lower in the intervention group (OR: 0.14; 95% CI: 0.03–0.79). These results suggest that sensitization may occur after infancy, but the authors stressed that 15 children needed to be treated to prevent sensitization in one child. Mite allergen levels were not measured in that study [4•]. Another publication, including German data, found the same results [5•].

Role of exposure to pets in the onset of atopy, the modulation of immunoglobulin E synthesis and asthma

Like studies of preventive dust mite reduction, assessments of pet exposure and the risk of atopy and asthma report conflicting results. In a prospective study [6•] 474 children were evaluated by the age of 7 years. The risk of atopy was significantly lower among those who had two or more cats or dogs during their first year of life (OR 0.23; 95% CI 0.09–0.6). Nonetheless, the presence of a dog or cat in the home had no effect on sensitization to dogs or cats. This result conflicts with another prospective study that found no effect on the onset of atopy from the presence of a dog or cat in the home [7]. Moreover, high exposure to birch pollen in the first year

of life significantly increased the frequency of birch-allergic children 4 years later [8••]. Pet exposure was found to be related to the modulation of specific immunoglobulin E synthesis in one prospective study [9]. Exposure to cat allergen and the levels of specific immunoglobulin E to cat were associated, although there was no dose–effect relationship [9]. The study prospectively followed 939 children from birth to 7 years of age. The result was subsequently questioned by Platts-Mills *et al.* [10], however. In a cross-sectional study including 226 teenagers aged from 12–14 years, they found that the percentage of teenagers with significant levels of specific immunoglobulin G to Fel d 1, but not the percentage of those with significant levels of immunoglobulin E, was related to their exposure to cat allergen. They concluded that high levels of Fel d 1 induced the production of immunoglobulin G4, corresponding to a modified T helper cell type 2 response. Among 2254 adults, Custovic *et al.* [11] found that the prevalence of sensitization to cats was significantly lower in the groups with the lowest and highest levels of exposure to cat allergen. Since then, cross-sectional studies have suggested the possible negative effect of cat allergen exposure on immunoglobulin E synthesis, while prospective studies seem to find a positive relation. It is far from clear that patients can be safely advised to keep a cat at home to decrease cat sensitisation.

In a prospective follow-up of 1246 children from birth to the age of 13 years, Remes *et al.* [7] found that children exposed to dogs from birth onwards had asthma less frequently than those kept away from these animals. The difference, however, was significant only among children with a parent with asthma.

In the Finnish Environment and Asthma Study, Jaakkola *et al.* [12] studied 521 case participants and 932 controls and showed that parental asthma was the strongest predictor of asthma (OR 1.88; 95% CI 1.47–2.41). Moreover, the presence of a pet at home was inversely related to the risk of asthma (OR 0.74; 95% CI 0.57–0.96). Nevertheless, the presence of a pet at home for more than 12 months was associated with an increased risk of asthma (OR 1.39; 95% CI 1.05–1.84).

These findings echo the conclusions from the review by Apelberg *et al.* [13]. They analysed 32 studies on the subject and concluded that the association between exposure to pets and the risk of asthma is difficult to quantify because of issues of study design. In particular, selection bias may be a major source of error.

Allergen control in allergic patients

In the past 2 years, new information has been reported about secondary prevention, that is, allergen reduction among allergic patients. Moreover, a new occupational

activity has been created to help increase compliance with allergen reduction methods.

Several studies have focused on housing characteristics in allergen reduction. Simpson *et al.* [14] analysed 15 published studies. They found the following factors associated with higher mite allergen levels: carpeted floor, increased number of occupants, older homes, dampness in the home and older mattresses.

Clinical studies have assessed interventions to reduce allergen levels. Htut *et al.* [15] combined steam and dry heat treatment of home furnishings and assessed its clinical efficacy with histamine bronchial challenge tests. The surfaces of carpets and upholstery of the homes of two groups were steam-cleaned. Mattresses were dry heated ($>110^{\circ}\text{C}$) until their surface temperature reached 80°C . Patients were given new pillows, and bed linen was washed at 60°C . Homes in a third group were sham-treated with the same equipment, but without heat. A positive ventilation system was installed in the bedrooms of the second group of patients. The Der p 1 and Der p 2 levels fell after a single heat treatment of the home, compared with sham treatment. Allergen levels differed significantly within each group over time ($P=0.05$). Bronchial hyperresponsiveness (BHR) was reduced to one-quarter the level measured at the beginning, in the first group of patients, at 9 months, and throughout the post-treatment period in the second group (with the ventilation systems).

The long-term results of allergen reduction were recently published. A group of 71 patients with asthma and sensitized to mites was carefully selected and followed for 1 year. The reduction methods were not precisely described. At the end of the study, the methacholine PD_{20} value increased from 57 to $123\ \mu\text{g}$ in the study group whereas no change was observed in the controls [16].

Allergen reduction in atopic dermatitis is still controversial. A controlled study of 86 patients aged from 8 to 50 years found that mite allergen reduction failed to induce significant changes in clinical parameters [17•].

Compliance is an important issue in achieving avoidance among mite-allergic patients. A new paramedical speciality has been created to improve patients' compliance: the medical indoor environment counsellor. A randomized prospective study [18••] included 378 patients from four French centres. In group A, patients received advice from doctors only and in group B, from doctors and a counsellor who made two visits. Compliance for mite allergen reduction methods, such as covering mattresses, changing their bases, removing or treating the carpets, washing duvets, pillows and stuffed animals,

were higher in group B than group A. Moreover, mite allergen levels in mattress-bases and in carpets decreased significantly (in group B).

Conclusion

The role of the allergen dose involved in the onset of atopy is controversial. Studies hypothesizing that the reduction of dose might reduce atopy failed to confirm the data from the Isle of Wight study and found no effect on the frequency of immunoglobulin E sensitization. This effect might nonetheless occur later in life. Other studies indicate that high doses of allergen early in life have a protective effect against cat and dog sensitization. Only one retrospective study found that cat exposure was protective against cat sensitization. The German prospective study suggested, however, that it is more probable that cat allergen exposure is harmfully related to sensitization, by increasing immunoglobulin E synthesis. The effect of high doses must be clarified by further prospective studies. Secondary prevention may be dramatically improved with the help of a new occupational activity: the medical indoor environment counsellor. Right now, it appears that allergen exposure can modulate IgE synthesis in atopic patients and those patients who are sensitized and exposed are at risk to develop allergic respiratory symptoms. Accordingly, we must be very careful when giving advice on primary prevention, particularly about the protective effect of cat and dog allergens but secondary prevention appears to be logical in respiratory allergic diseases.

References and recommended reading

Papers of particular interest, published within the annual period of review, have been highlighted as:

- of special interest
- of outstanding interest

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