

Allergy to mites: relation to lung function and airway hyperresponsiveness

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Exposure to house-dust-mite allergens is an important cause of allergic reactions in sensitized patients. In community-based studies, sensitization to house-dust mites, as ascertained by a positive skin test or by an increased allergen-specific IgE level in serum, is associated with both diminished lung function and enhanced airway hyperresponsiveness. Sensitization to house-dust mites is an independent risk factor for the development of asthma, especially in areas which favor the growth of house-dust mites. In studies with asthmatic patients, however, the relationship between sensitization to mites and lung function or airway hyperresponsiveness is less clear. The selection of asthmatic individuals (with sensitization to other inhalant allergens) and the use of medication such as inhaled steroids may interfere with the demonstration of a possible association between mite allergy and lung function or airway hyperresponsiveness in asthmatic patients.

Key words: airway hyperresponsiveness; allergy, asthma; house-dust mites; lung function.

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Exposure to airborne allergens is an important trigger for allergic reactions in sensitized asthmatic patients. In regions that promote the survival of house-dust mites (HDM), sensitization to mite allergens occurs frequently among atopic patients, as demonstrated by positive skin tests or the presence of specific IgE antibodies in serum (1–3). Allergy to mites has been shown to be a significant factor in the development of asthma (4, 5). Thus, exposure to allergens, sensitization to allergens, and the development of asthma and airway hyperresponsiveness (AHR) seem to be related. Allergen-avoidance measures may play a significant role in the treatment of allergic asthmatic patients. However, knowledge of the patient characteristics that determine which patients will derive optimal benefit from such measures is lacking. Therefore, information about the relationship among allergic sensitization, lung function, and AHR can contribute to better patient selection for allergen-avoidance measures.

Allergy to mites and lung function

Allergy to mites is most often determined by assessment of sensitization to mite allergens by skin testing or measurement of specific IgE in serum. Nevertheless, sensitization to mites is not the same

as mite allergy, which implies the presence of clinical symptoms.

For assessment of the severity of asthma, measurement of lung function, by forced expiratory flow rate in 1 s (FEV₁) and peak expiratory flow (PEF) rate are essential tools.

Several studies have shown that sensitization to mites is a significant and independent risk factor for the development of asthma in areas where HDM proliferate (4–6). The relationship between mite sensitization and lung function (FEV₁, PEF), however, is less clear and may be obscured by pharmacotherapy with inhaled steroids and the resultant improvement of lung function.

In a community-based study population, Omenaas et al. demonstrated that allergy to HDM is an independent predictor of reduced lung function (FEV₁ – % predicted) in Norwegian adults over a wide age range, after adjustment for smoking habit, age, etc., as shown in Table 1. (7). This study was performed in a relatively humid region where sensitization to mites is more common than in other regions of Norway. During a 6-year follow-up study of a group of children in New Zealand by Sherrill et al., children sensitized to HDM had a lower mean FEV₁/VC ratio (Tiffeneau index) than the nonsensitized group (8). Comparable results were obtained by

Table 1 Sex-, age-, and height-standardized residuals of FEV₁ (SFEV₁) in Norwegian adults without or with five specific IgE antibodies ($n=1239$)

Specific IgE antibodies	n	Mean SFEV ₁ $\pm$ SE	P value*
None	1134	0.37 $\pm$ 0.04	
House-dust mite	44	1.00 $\pm$ 0.20	<0.01
Timothy	59	0.46 $\pm$ 0.18	0.64
Birch	43	0.17 $\pm$ 0.20	0.43
Cat	24	0.80 $\pm$ 0.32	0.13
Mold	5	1.45 $\pm$ 0.66	0.08

*Two-tailed significance probabilities comparing subjects with each specific IgE antibody with those without any. Reproduced with permission from Omenaas et al. (7).

Gottlieb et al. in 1025 men with no history of asthma (9). In the latter study, however, skin reactivity to house dust instead of HDM was assessed. In another community-based study, PEF variation was not associated with skin sensitivity to HDM or to other common allergens (10).

In studies of asthmatic patients, the relationship between lung function and sensitization to mites is more complex. In a group of 261 patients with diagnosed asthma, Cline et al. found no relationship between FEV₁ – % predicted and skin test reactivity to mites or to other allergens (11). Schwartz & Weiss, however, observed a significant association between skin test reactivity to HDM and decrements in FEV₁ in a random sample of children with asthma or frequent wheezing (12). A comparable result was found by Clough et al., using skin sensitivity to a panel of common allergens instead of the skin sensitivity to HDM alone (13). In this study, variation in PEF was also associated with the degree of skin sensitivity to common allergens. Several factors may influence and obscure a possible relationship between mite sensitization and lung function in asthmatic patients. Patient selection, sensitization to other aeroallergens, and medication are important candidates.

Allergy to mites and airway hyperresponsiveness (AHR)

AHR is a characteristic feature of asthma. Changes in natural allergen exposure, as well as during allergen-inhalation provocation challenges, are often followed by changes in the degree of AHR, especially in young asthmatic patients (14–19). However, the pathogenesis of AHR is still poorly understood. Moreover, the degree of measured AHR may be influenced by the stimulus used (e.g., methacholine, histamine, adenosine, exercise). For example, there is evidence that AHR measured by adenosine is more sensitive to allergen-avoidance measures than AHR detected by histamine or

methacholine (20). In community-based studies, it has been shown that AHR is clearly associated with allergen sensitization, especially to HDM. In schoolchildren from Germany, Frischer et al. found an increased risk of bronchial response to exercise in children sensitized to HDM, whereas sensitization to animal dander was not a risk factor (21). A similar result was found by Backer et al. in a random population of 527 children and adolescents (22). In children from New Zealand, Burrows et al. found that sensitization to cat and dog, as well as sensitization to HDM, was an independent risk factor for AHR as measured by challenge with methacholine (23).

In asthmatic patients, however, the degree of AHR in asthmatic patients is not closely associated with the degree of sensitization to mite allergens. Takeda et al. found no correlation between PC₂₀ methacholine and serum levels of IgE antibody against the mite *Dermatophagoides farinae* in asthmatic children (24). However, in a group of children with a history of lower respiratory illness, Henderson et al. found mite allergy to be significantly associated with increased prevalence of AHR (25). In a recent study of the relationship between natural exposure to HDM allergens and AHR (17), a seasonal variation in concentration of HDM allergens in floor dust appeared to be associated with a seasonal variation in AHR only in patients sensitized to HDM, who showed the most severe AHR (lower PC₂₀ histamine) in autumn (Fig. 1). In patients without sensitization to HDM, AHR did not change significantly over the seasons.

As mentioned before, sensitization to other allergens and medication (inhaled steroids) may also influence the relationship between mite sensitization and AHR in asthmatic patients.

The different associations between mite allergy (mite sensitization) and lung function and AHR are summarized in Table 2.

Discussion

Sensitization to mite allergens is an important risk factor for the development of allergic diseases, especially for asthma. Furthermore, sensitization to mites is also a risk factor for the development of

Table 2. Association of mite sensitization with lung function and airway hyperresponsiveness (AHR) in community and in asthmatic population

	Mite sensitization	
	In community population	In asthmatic population
Lung function	++	+
AHR	+++	±

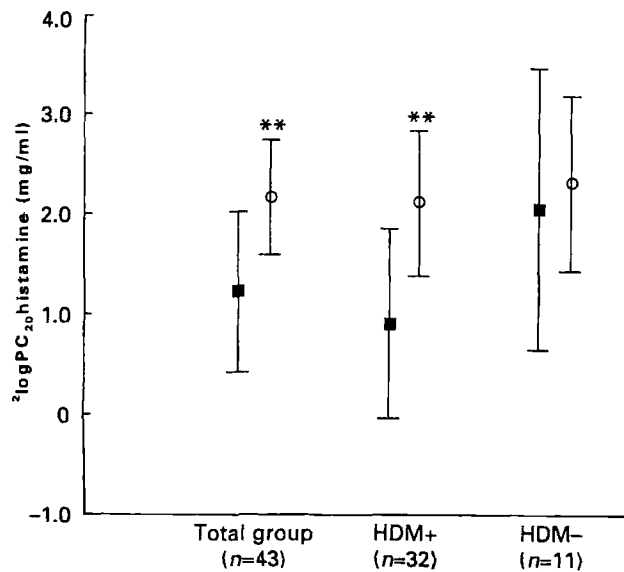


Fig. 1. Influence of sensitization to house-dust mites (HDM) on seasonal variation of airway hyperresponsiveness ($2 \log PC_{20}$ histamine, means, error bars: 95% CI). ■: autumn 1990; ○: spring 1991. ** $P < 0.01$, both compared to autumn 1990. Reproduced with permission from van der Heide et al. (17).

AHR. AHR is strongly associated with asthma and may be regarded as an indirect indicator of airway inflammation.

In community populations, both lung function and AHR are associated with sensitization to mites, a fact which clearly underlines the importance of exposure to mite allergens in causing asthmatic reactions.

In several studies, it has been shown that AHR is sensitive to changes in exposure to relevant allergens (14–18), especially when measured by challenge with adenosine (20). Thus, in individuals with a genetic predisposition and living in an area where HDM proliferate sufficiently, exposure to mite allergens can result in sensitization followed by the development of AHR and asthma. In a number of studies, a relationship between exposure to mite allergens and severity of asthma has been documented (26–28). Assessment of AHR can be used as a sensitive clinical parameter for monitoring the effects of allergen-avoidance measures. Lung function parameters (FEV_1 , PEF) seem less sensitive to changes in indoor allergen exposure. Although knowledge of the relationship between allergen exposure, allergic sensitization, and the development of AHR and asthma has greatly increased during the last decade, we still need more information about the factors which determine which individuals are at greatest risk of the development of asthma. Additionally, we need more information about characteristics of patients and their homes to

predict which patients will most benefit from allergen-avoidance measures.

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