Position Statement

Environmental allergen avoidance in allergic asthma
February 1999

AAAAI Position Statements and Work Group Reports are not to be considered to reflect current AAAAI standards or policy after five years from the date of publication. For reference only.

Ad Hoc Working Group on Environmental Allergens and Asthma From the American Academy of Allergy, Asthma and Immunology.*

The statement below is not to be construed as dictating an exclusive course of action nor is it intended to replace the medical judgment of healthcare professionals. The unique circumstances of individual patients and environments are to be taken into account in any diagnosis and treatment plan. The above statement reflects clinical and scientific advances as of the date of publication and is subject to change.

** The Ad Hoc Working Group on Environmental Allergens and Asthma is composed of Peyton A. Eggleston, MD, chair; Peter S. Creticos, MD; Richard Lockey, MD; Thomas A. E. Platts-Mills, MD, PhD; Albert Sheffer, MD; Virginia S. Taggart, MPH, National Heart Lung and Blood Institute; Annette Miller, Allergy Control Products, Inc; Armin Clobes, SC Johnson, Inc; William Scheuttenberg, Honeywell, Inc; and Theodore J. Shapas, PhD, The Clorox Co.*

Asthma morbidity and mortality has increased over the past 2 decades in all age groups but especially in children who live in the inner city.[1-5] This has occurred despite better understanding of the pathophysiology of the disease and the availability of better treatment modalities. The reasons for these trends are complex but include inappropriate medication use, increased exposure to indoor and outdoor pollutants, poor access to quality medical care, and increased environmental allergen exposure. As a result of this increase in the prevalence of asthma, medical organizations throughout the world have issued guidelines describing optimal asthma management; all of these guidelines include environmental allergen avoidance.[6,7] Environmental allergen avoidance is one of the 4 primary goals of good asthma management recommended in all asthma guidelines, including the National Asthma Education and Prevention Program sponsored by the National Heart, Lung and Blood Institute of the National Institutes of Health.[7] It is clear that both physician and patient efforts are needed to implement these guidelines and to make environmental avoidance a reachable goal.[5-10] The purpose of this article is to inform physicians and patients with asthma about the importance of environmental allergen avoidance in the treatment of allergic asthma.

Relationship of environmental allergens to asthma
The association between environmental allergens, IgE-mediated hypersensitivity, and asthma is supported by the following evidence[11]:

- Between 60% and 80 % of adults and children with asthma have 1 or more positive immediate wheal-and-flare skin test responses to environmental allergens.[12-15]
- Bronchial challenge studies show that acute asthma can be induced in sensitized asthmatic subjects by inhaling extracts of these aeroallergens.[16,17]
- Epidemics of asthma have been associated with unusually heavy and widespread exposure to airborne allergens such as soybean debris.[18]
- Sensitization, with production of specific IgE antibodies, is a strong risk factor for acute severe asthma, especially when these sensitized persons are exposed to high concentrations of allergen in their homes.[19-25]
- The severity of chronic asthma and airway hyperresponsiveness correlates with the degree of sensitivity to indoor allergens.[13,25,26]
- Asthmatic symptoms, peak expiratory flow rate, and bronchial hyperresponsiveness improve when patients avoid environmental allergens to which they are allergic.[27-34]

Case control studies have shown an association between acute asthma exacerbations and IgE-dependent sensitization to indoor allergens. Gelber et al[21] compared 114 patients with asthma receiving care in an emergency department to 114 age- and sex-matched control patients treated in the emergency department for other reasons. The rate of sensitization to one of 3 indoor allergens was 39% in the patients with asthma and 4% in the control subjects (OR 14, P < .001). The risk of sensitization was largely restricted to homes with high levels of allergen. Call et al[22] conducted a similar study on 144 children who were cared for in an inner-city emergency department. Fifty-eight percent of children with asthma had IgE antibodies to mite, cockroach, or cat allergens compared with 19% of control patients. Seventy-nine percent of home dust samples contained excessive mite allergen, and 87% contained excessive cockroach allergen; concentrations were similar in the homes of asthmatic and control subjects. Of 35 children with asthma whose homes were sampled, 21 (60%) were both sensitized and exposed to these allergens compared with 3 of 22 (14%) control children (OR 9.5, P < .001). Nelson et al[23] compared 29 children, ages 3 to 16 years, first seen in a Florida emergency department with acute asthma with 25 control subjects.[23] They found that sensitization to mites, Alternaria spp, and cockroach allergens was associated with acute asthma that required emergency treatment. O'Hollaren et al[24] reported a strong association between exposure to high ambient Alternaria concentrations and fatal and near-fatal asthma. Taken together, these studies demonstrate that cockroach, mite, cat, Alternaria spp, and other allergens are common in homes and that a combination of exposure and sensitization to 1 or more of these allergens markedly increases the risk of morbidity from asthma.

Nature of environmental aeroallergens

Allergenic proteins are found in component parts of biologic organisms (plant pollens and mold spores) and in the excretions of furred animals, mites, and insects.[35,36] They become airborne on particles of varying size that are characteristic of the source. For example, most particles carrying house dust mite and cockroach allergens are relatively large (30 µm) and settle quickly, and therefore exposure is largely confined to intimate exposure to fabrics in bedding or carpets.[36,37] Animal allergens are found on small buoyant particles (1 to 20 µm) that remain airborne and are widely distributed indoors.[38,39] Pollen and mold spores range from 6 to 150 µm, but they are buoyant and can be found in indoor and outdoor air samples.[36,40] Thus indoor and outdoor environments contain a complex mixture of particles carrying a variety of allergenic proteins. Assays are available to allow individual allergens to be measured accurately in house dust samples and in indoor and outdoor air samples. These assays make it possible to estimate individual environmental allergen exposure and to assess the effectiveness of environmental allergen abatement programs.

Removal of allergens from the home environment

House dust mite allergen exposure is much greater in bedding than elsewhere in the home. The most effective method to reduce mite allergen levels in bedding is to install impervious covers over the mattress, pillow, and comforter and to wash sheets, pillow cases, blankets, and mattress pads at least weekly. By doing so, mite allergen exposure can be reduced 100- to 1000-fold within a month and will remain low for 6 to 12 months. Washing bedding with cold water reduces house dust mite allergen concentrations by 100-fold, but mite infestation is not affected, and the mite allergens reaccumulate within 2 weeks.[37,41] At water temperatures of 130℉ or higher, mites ar e killed, and allergen reaccumulation is slowed.[41] Maintaining indoor humidity below 50% will reduce mite allergen.[42] Acaracides are less effective in reducing mite numbers and allergen concentration.[43] When a cat is removed from a home, allergen concentration decreases steadily over 6 months to 100- to 1000-fold lower levels.[44] Less is known about cockroach allergen abatement, but in a study done in a cockroach-infested urban dormitory, extermination followed by routine cleaning reduced cockroach allergen levels on the floor by 86%.[45] In each of these cases, it appears that the use of sensible, feasible abatement strategies will reduce environmental allergen exposure dramatically.

Efficacy of allergen avoidance in asthma

Removing sensitized asthmatic subjects to allergen-free mountain institutions or hospitals results in prolonged improvement in symptoms and bronchial hyperresponsiveness.[33,34] Clinical trials of house dust mite allergen avoidance in homes suggest that asthma morbidity can be reduced when exposure to a single indoor allergen is reduced, even when exposure to other allergens is not altered. In 5 controlled

clinical trials in which mite populations or allergen concentrations have been reduced at least 100-fold, asthma symptoms or airway hyperresponsiveness were improved.[27-32] In others, mite allergen levels were not reduced significantly, and symptoms were unchanged.[30,31] Therefore avoidance measures directed at 1 allergen, without other exposure changes, appear to modify chronic asthma.

Adherence to allergen avoidance advice

Although environmental allergen avoidance is included in both the Unites States[7] and international[6] treatment guidelines, adherence by physicians and patients to these recommendations needs improvement. Patients often report that they are adherent, but home inspection shows much less adherence than patient self-reports.[8-10] Without formal educational programs, no patient had installed mattress covers.[8,9] With the usual clinic-based educational efforts, Korsgaard[9] found that only 17% had installed a mattress cover. Huss et al[8] found similar figures but also found that the adherence could be increased to 27% with repetitive clinic-based education and to 39% with a computer-based educational program. Adherence to allergen avoidance advice is generally not as good as with medication. For example, in a clinical trial that achieved better than 95% adherence to medication regimens, no more than 48% of families had installed mattress covers.[10] Thus with specific clinic-based education, between 17% and 27% of patients will adhere to recommendations for environmental avoidance, whereas more intensive clinic-based education in highly motivated patients may increase adherence to 48%. With such low rates of adherence, the therapeutic potential demonstrated in clinical trials of allergen avoidance is not likely to be realized in clinical practice without more concerted action on the part of both clinicians and patients. As with other therapies, adherence to allergen avoidance should be improved by providing more concentrated education, simplifying recommendations, and developing a partnership between physician and patient.

Therefore the AAAAI:

- endorses the National Asthma Education Program asthma management guidelines, which recommend that every patient with persistent asthma be evaluated for environmental allergen sensitivity and that patients who have sensitivities receive practical advice on allergen avoidance;
- strongly encourages the creation of a Current Procedural Terminology (CPT) category for environmental counseling;
- urges insurers, HMOs, Medicaid administration, and other third-party payers to reimburse for the costs of impermeable cases for mattresses, comforters, and pillows, as well as other proven therapies designed to reduce allergen exposure;
- supports the development of a public education process to increase the general awareness of the role of environmental allergens in the pathogenesis of allergic asthma, which would be accomplished best by cooperative input from patients, professionals, and industry.

REFERENCES

1. Asthma–United States 1980-1987. MMWR Morb Mortal Wkly Rep 1990;39:493-7.
2. Weitzman, Gortmaker SL, Sobol AM, Perrin JM. Recent trends in the prevalence and severity of childhood asthma. JAMA 1992;268:3673-7.
3. Gergen PJ, Weiss KB. Changing patterns of asthma hospitalization among children. JAMA 1990;264:1688-92.
4. Wissow LS, Gittelsohn AM, Szklo M, Starfield B, Mussman M. Poverty, race and hospitalization for childhood asthma. Am J Public Health 1988;78:777-81.
5. Weiss KB, Wagener DK. Changing patterns of asthma mortality: identifying target populations at high risk. JAMA 1990;264:1683-7.
6. Sheffer AL (chairman) for the International Asthma management Project. International consensus report on diagnosis and treatment of asthma. Eur Respir J 1992;5:601-41.
7. National Asthma Education Program. Guidelines for the diagnosis and management of asthma. National Institutes of Health; July 1997; DHHS NIH Pub no. 97-4051.
8. Huss K, Squire EN Jr, Carpenter GB, Smith LJ, Huss RJ, Salata K, et al. Effective education of adults with asthma who are allergic to dust mites. J Allergy Clin Immunol 1992;89:836-43.

9. Korsgaard J. Preventive measures in house-dust allergy. Am Rev Respir Dis 1982;125:80-4.
10. Eggleston PA, Wheeler B, Bollers N, Wood R, Adkinson NF Jr. The effect of home environmental allergen control measures in asthmatic children enrolled in a prospective clinical trial [abstract]. Am Rev Respir Dis 1992;45:213.
11. Platts-Mills TAE. Allergen-specific treatment for asthma: III. Am Rev Respir Dis 1993;148:553-5.
12. Peat JK, Britton WJ, Salome CM, Woolcock AJ. Bronchial hyperresponsiveness in two populations of Australian school children. III. Effect of exposure to environmental allergens. Clin Allergy 1987;17:291-30.
13. Burrows B, Martinez FD, Halonen M, Barbee RA, Cline MG. Association of asthma with serum IgE levels and skin test reactivity to allergens. N Engl J Med 1989;320:271-7.
14. Bryant DH, Bums MW. Skin-prick test reactions to inhalant allergens in asthmatic patients. Med J Aust 1976;1:918-24.
15. Gerritsen J, Koeter GH, deMonchy JGR. Allergy in subjects with asthma from childhood to adulthood. J Allergy Clin Immunol 1990;85:116-25.
16. Cockcroft DW, Ruffin RE, Dolovich J, Hargreave F. Allergen induced increases in non-allergic bronchial reactivity. Clin Allergy 1977;7:503-13.
17. VanMetre TE Jr, Marsh DG, Adkinson NF Jr, Fish JE, Kagey-Sobotka A, Norman PS, et al. Dose of cat (Felis domesticus) allergen 1 (Fel d I) that induces asthma. J Allergy Clin Immunol 1986;78:62-75.
18. Anto JM, Sunyer J, Rodriguez-Roisin R, Suarez-Cervera M, Vasquez L. Community outbreaks of asthma associated with inhalation of soybean dust. Toxicoepidemiological Committee. N Engl J Med 1989;320:1097-102.
19. Dowse GK, Turner IQ, Stewart GA, Alpers MP, Woolcock AJ. The association between Dermatophagoides mites and the increasing prevalence of a asthma in village communities within the Papua New Guinea highlands. J Allergy Clin Immunol 1985;75:85-3.
20. Pollart SM, Chapman MD, Fiocco GP, Rose G, Platts-Mills TAE. Epidemiology of acute asthma: IgE antibodies to common inhalation allergens as a risk factor for emergency room visits. J Allergy Clin Immunol 1989;83:475-82.
21. Gelber LE, Seltzo LH, Bouzoukis JK, Pollart SM, Chapman MD, Platts-Mills TAE. Sensitization and exposure to indoor allergens as risk factors for asthma among patients presenting to hospital. Am Rev Respir Dis 1993;147:573-8.
22. Call RS, Smith TF, Morris E, Chapman MD, Platts-Mills TAE. Risk factors for asthma in inner city children. J Pediatrics 1992;121:862-6.
23. Nelson RP Jr, DiNocolo R, Fernandez-Caldas E, Seleznick MJ, Lockey RF, Good RF. Allergen-specific IgE levels and mite allergen exposure in childhood with acute asthma first seen in an emergency department and in non-asthmatic control subjects. J Allergy Clin Immunol 1996;98:258-63.
24. O'Hollaren MT, Yunginger JW, Offord KP, Somers MJ, O'Connell EJ, Ballard DJ, et al. Exposure to an aeroallergen as a possible precipitating factor in respiratory arrest in young patients with asthma. N Engl J Med 1991;324:359-63.
25. Rosenstreich DL, Eggleston PA, Kattan M, Baker D, Slavin RG, Gergen P, et al. The role of cockroach allergy and exposure to cockroach allergen in causing morbidity among inner-city children with asthma. N Engl J Med 1997;336:1356-63.
26. Sporik R, Holgate ST, Platts-Mills TAE, Cogswell J. House dust mite allergen (Der p I) exposure and the development of sensitization and asthma: a prospective study. N Engl J Med 1990;323:502-7.
27. Ehnert B, Lau-Schadendorf S, Weber A, Buettner P, Schou C, Wahn U. Reducing domestic exposure to dust mite allergen reduces bronchial hyperreactivity in sensitive children with asthma. J Allergy Clin Immunol 1992;90:135-8.
28. Murray AB, Ferguson AC. Dust-free bedrooms in the treatment of asthmatic children with housedust or house dust mite allergy: a controlled trial. Pediatrics 1983;71:418-22.
29. Walshaw MJ, Evans CC. Allergen avoidance in house dust mite sensitive adult asthma. QJM 1986;226:199-215.
30. Burr ML, Dean BV, Merett TG, Neale E, St Leger AS, Vermier-Jones ER. Effects of anti-mite measures on children with mite sensitive asthma: a controlled clinical trial. Thorax 1980;35:506-12.

31. Dietemann A, Bessot JC, Hoyet C, Ott M, Verot A, Pauli G. A double blind, placebo controlled trial of solidified benzyl benzoate applied in dwellings of asthmatic patients sensitive to mites: clinical efficacy and effect on mite allergens. J Allergy Clin Immunol 1993;91:738-46.
32. Kneist FM, Young E, VanPmag McG. Clinical evaluation of a double blind dust-mite avoidance trial with mite allergic patients. Clin Exp Allergy 1991;21:39-47.
33. Platts-Mills TAE, Tovey ER, Mitchell EB, Moszoro H, Nock P, Wilkins SR. Reduction of bronchial hyperreactivity during prolonged allergen avoidance. Lancet 1982;3:675-8.
34. Peroni DG, Boner AL, Vallone G, Antonelli I, Warner JO. Effective allergen avoidance at high altitude reduced allergen-induced bronchial hyperresponsiveness. Am J Respir Crit Care Med 1994;149:1442-6.
35. Stewart GA. The molecular biology of allergens. In Busse WW, Holgate ST, editors. Asthma and rhinitis. Boston: Blackwell; 1995. p. 898-932.
36. Solomon WR, Platts-Mills TAE. Aerobiology of inhalant allergens. In: Middleton E Jr, Reed CE, Ellis EF, Adkinson NF Jr, Yunginger JW, Busse WW, editors. Allergy: principles and practice. 4th ed. St. Louis: Mosby; 1993. p. 469-528.
37. Tovey ER, Chapman MD, Wells CW, Platts-Mills TAE. The distribution of dust mite allergen in houses of patients with asthma. Am Rev Respir Dis 1981;124:630-5.
38. Luczynska CM, Li Y, Chapman MD, Plats-Mills TAE. Airborne concentration and particle size distribution of allergen derived from domestic cats (Felis domesticus): measurements using cascade impactor, liquid impinger and a two-site monoclonal antibody assay for Fel d I. Am Rev Respir Dis 1990;141:361-7.
39. Custovic A, Green R, Fletcher A, Smith A, Pickering CAC, Chapman MD, et al. Aerodynamic properties of the major dog allergen, Can f 1: distribution in homes, concentration and particle size of the allergen in the air. Am J Respir Crit Care Med 1997;155:94-8.
40. Burge HA. Airborne allergenic fungi. Immunol Allergy Clin North Am 1989;9:307-19.
41. McDonald LG, Tovey E. The role of water temperature and laundry procedures in reducing house dust mite populations and allergen content of bedding. J Allergy Clin Immunol 1992;90:599-608.
42. Cabrera P, Julia-Serdera G, Rodriguez de Castro F, Caminero J, Barber D, et al. Reduction of house dust mite allergens after dehumidifier use. J Allergy Clin Immunol 1995;95:635-6.
43. Hayden ML, Rose G, Diduch KB, Domson P, Chapman MD, Heymann PW, et al. Benzyl benzoate moist powder: investigation of acaricidal activity in cultures and reduction of dust mite allergen in carpets. J Allergy Clin Immunol 1992;89:536-45.
44. Wood RA, Chapman MD, Adkinson NF Jr, Eggleston PA. The effect of cat removal on allergen content household dust samples. J Allergy Clin Immunol 1989;83:730-4.
45. Sarpong SB, Wood RA, Eggleston PA. Short-term effects of extermination and cleaning on cockroach allergen Bla g 2 in settled dust. Ann Allergy 1996;76:257-9.