IgE Mediated Skin Test Reactivity to Indoor Allergens Correlates with Asthma Severity at Jeddah, Saudi Arabia

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Citation

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Abstract

Background: There is an increase attention on the role of indoor allergens in asthmatics.

Objective: To examine the spectrum of skin test reactivity (sensitization) to indoor allergens and its correlation with asthma severity.

Methodology: Asthmatics referred to allergy clinic at King Abdulaziz University Hospital and living in Jeddah were studied. Clinical severity was determined using international and national asthma guidelines. Degree of sensitization was assessed by the wheal size (positive ≥ 3 mm) of standard skin prick test to common indoor inhalant allergens: House dust mites (HDMs): Dermatophagoides pteronyssinus (Dp) and D. farinae (Df), Cat, and Cockroach.

Results: Out of 151 asthmatics, 113 asthmatics were skin test positive to one or more allergen (74.8%). Their ages ranged between 9 to 63 years (mean= 30 ±13) and females constituted 65.5%. The predominant asthma severity level was moderate persistent 55.8%, followed by mild persistent 33.6%. Prevalence of sensitization to indoor allergens was as follow: DP 87% (3 – 25 (mean = 7) mm), DF 84% (3 – 20 (mean = 7) mm), Cat 44% (3 – 15 (mean = 6) mm), and Cockroach 33% (3 – 12 (mean = 4) mm). Higher asthma severity levels were significantly correlated with the number of allergens with positive sensitization (R=0.3, P< 0.001), and the degree of sensitization to HDM Dp (df= 16, p<0.001) and Df (df=17, p<0.01), but not to Cat (df=10, p<0.24) or Cockroach (df=8, p<0.36).

Conclusions: The IgE skin test reactivity to indoor allergens, particularly to HDMs, was common in asthmatics at Jeddah city. Its elevated degrees were clearly associated with higher asthma severity, which is compatible with the literature. This advocates the importance of identification of sensitization of clinically relevant allergens in asthmatics, and promotes tailored educational strategies of avoidance measures for enhanced asthma control.

INTRODUCTION

Asthmatic airways are characterized by an immunological chronic inflammation that has been documented to occur after exposure to allergen [1,2]. Several studies have suggested a correlation between allergen exposure and the prevalence of asthma [3,4,5]. Exposure to airborne allergens in sensitized individuals is a risk factor for asthma exacerbations, the persistence of asthma symptoms, and significant changes in the pulmonary functions [6,7,8].

Worldwide, the documented increase in the prevalence of asthma has been almost entirely in perennial asthma, and a large proportion of them are allergic to allergens found all year round in houses (indoor) [9,10]. This has lead to an increase attention on the immunological role of allergenic substances that accumulate indoors. Indoor allergens today have increased in developed countries where homes have been insulated for energy efficiency, carpeted, heated, cooled, and humidified–changes that have also made homes ideal habitat for indoor allergens [11,12].

Globally, the most abundant indoor allergens include those derived from house dust mites (HDMs), cat, and cockroach [12,13]. The principal HDM species are the pyroglyphid mites Dermatophagoides pteronyssinus (Dp), D. farinae (Dp), and others, which usually account for 90 percent of the mite species in house dust from temperate regions [9,14]. According to some local studies, similar allergens have been isolated

from the indoors of asthmatics living in different regions at Saudi Arabia [15] .

Recent progresses in allergy and immunology have promoted extensive studies on identification of sensitization to indoor allergens. In vivo and in-vitro allergy tests to allergen has been considered a valuable tool for exploring the presence of an IgE mediated immune response in atopic disorders, like bronchial asthma, and it is a reflection of sensitization to that allergen [16,17,18] . A direct relationship between the positive allergy skin tests or sensitization to inhalant indoor allergens and the increase in severity of asthma has been demonstrated by pervious investigators [19,20] . However, no study focused primarily on the clinical severity of asthma assessed by international and national asthma management guidelines in relation to common indoor allergens detected in Saudi Arabia.

Hence, this study was initiated to explore the spectrum of IgE mediated skin test reactivity or sensitization to common indoor inhalant allergens in asthmatics seen at King Abdualziz University Hospital (KAUH) at Jeddah, Saudi Arabia. This work focuses on the hypothesis that the skin test reactivity to indoor allergens may have a relationship with higher levels of clinical severity of asthma.

METHODS

One hundred and fifty one patients with a primary diagnosis of bronchial asthma examined at the allergy clinic of King Abdulaziz University hospital (KAUH) from January 1997 to December 1999 were sequentially selected. Only patients who were living in Jeddah city were included in the study. Jeddah is a coastal city located at the western region of the Kingdome of Saudi Arabia on the Red sea. It is characterized by high humidity particularly in the summer season. The diagnosis and the assessment of the levels of clinical severity of each asthmatic were conducted according to international and Saudi national guidelines for asthma management [21,22] . Patient's charts were reviewed for demographic data, asthma severity level, results of skin prick test to common inhalant allergens. Patients who were smokers, pregnant, on antihistamines, oral steroids, and beta-blockers were excluded because of their negative effect on skin tests results.

The results of skin test reactivity (sensitization) were obtained from reviewing the results of reactions to standard skin prick test (SPT) after 15 miutes. A verbal consent was obtained from candidates prior to SPT. The panel of indoor allergen extracts appropriate for SPT was obtained from Greer ® Laboratories at United States of America at 1:10 dilutions, except for house dust mites (Dp&Df) and Cat hair extracts which exists in 10,000 AU/ml. The indoor allergens used include: the two common species of house dust mites (DP and DF), cat and cockroach. The cockroach extract contained a mixture of the two common species: German and American cockroaches (Blattella germanica and Periplaneta Americana).

After sterilization of the forearm with propyl alcohol swap, a drop of each allergen extract was put on one-centimeter mark apart. Then inside the allergen drops on the skin was performed a prick with gauge 24 needle. Additionally, a drop of histamine phosphate at a concentration of 2.7 mg/ml and the diluents were used as a positive control and negative control respectively. A five millimeter (mm) wheal or more reaction to histamine is considered adequate for the competency of the test. A 3mm diameter wheal and more (more than the negative control) were considered as a positive test for sensitization to that peculiar allergen. The wheal size for each indoor allergen was recorded, and was used as a reflection of the degree of skin test reactivity (sensitization).

The degree of skin test reactivity for each case was classified according to the wheal diameter size into: mild sensitization (3-5mm), moderate sensitization (6-10mm) severe sensitization (≥11mm). Furthermore the number of indoor allergens with positive reaction was recorded for each case.

The data were entered into a personal computer. Frequency tables, correlation analysis by Pearson's test and analysis of variance by ANOVA test were performed using SPSS statistical program (version 11).

RESULTS

Out of 151 different asthmatics living in Jeddah, 113 asthmatics were skin test positive to one or more indoor allergen, which account to 74.8% of the studied group. The ages of the cases with positive skin test ranged between 9 to 63 years (mean= 30± 13SD). Female sex was in 74 cases and constituted 65.5% of them. The predominant levels of asthma severity were the moderate persistent in 63 cases 55.8%, followed by the mild persistent in 38 (33.6%), see table-1.

Figure 1

Table 1: Levels of the clinical severity of asthma

Asthma severity levels	Number	Percent	Cumulative Percent
Intermittent	8	7.1	7.1
Mild persistent	38	33.6	40.7
Moderate persistent	63	55.8	96.5
Severe persistent	4	3.5	100.0
Total	113	100.0	

The prevalence of positive skin reactivity to the different indoor allergens in the asthmatics was highest to HDM Dp in 98 cases (87%) and to HDM Df in 95 cases (84%), the rest of the data is shown in table-2. The frequency of the number of allergens with positive skin test reaction is shown in tabl-3.

Figure 2

Table 2: Prevalence of positive skin reactivity to the different indoor allergens

Allergen	Number	Percent	Wheal /mm	Mean ±SD
HDM DP	98	87	3 – 25	7 ±4
HDM DF	95	84	3 – 20	7 ±4
Cat	50	44	3 – 15	6 ±2
Cockroach	38	33	3 – 12	4 ±2

Figure 3

Table 3: Number of allergens with positive skin test reactivity (sensitization)

	Number	Percent	Cumulative Percent
Sensitization to one allergen	17	15.0	15.0
Sensitization to two allergens	39	34.5	49.6
Sensitization to three allergens	40	35.4	85.0
Sensitization to four allergens	17	15.0	100.0
Total	113	100.0	

The frequency of asthma cases in each sensitization category is shown in graph-1. There was a very mutual correlation between sensitization to the two species of HDMs (Df and Dp) ($P< 0.001$), which represent a known cross reactivity between them.

Statistically, the increasing levels of the clinical severity of theses asthmatics were significantly correlated to the number of indoor allergens with positive skin test reactivity (sensitization) ($R=0.3$, $P< 0.001$), and the degree of skin test reactivity (wheal size) to the two species of HDMs: Dp ($df= 16$, $p<0.001$) and Df ($df=17$, $p<0.01$), but did not reached statistical significance to Cat ($df=10$, $p<0.24$) or Cockroach ($df=8$, $p<0.36$). The relationship between the severity of asthma and the degree of skin test reactivity to the different indoor allergens are demonstrated in graph-2. The linearity between the severity of asthma and the mean of the degree of skin test reactivity is demonstrated in graph-3

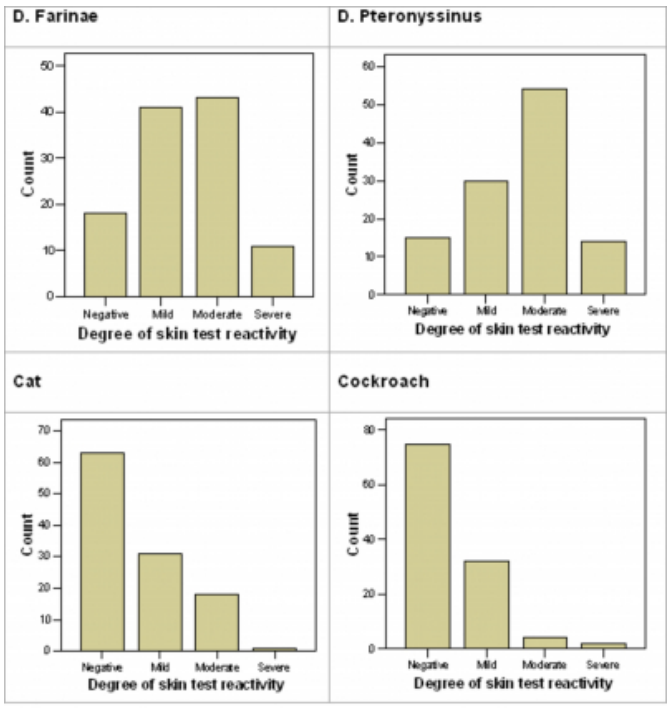
DISCUSSION

Increases in asthma must relate to some aspect of our predominantly sedentary indoor lifestyle; this could be either increased exposure to allergens or an increase in factors that enhance the response of the lungs to foreign proteins [9] . Clearly, exposure to allergens can provoke acute asthma attacks as well as chronic allergic symptoms [10] .

In this study, the prevalence of positive skin test reactivity in asthmatics to indoor allergens was common in up to three quarter of the participated asthmatics, which is compatible with some international figures [9,23] . Sensitization to the two species of HDMs was the predominant indoor allergens in more than 80 % of the asthmatics. This pattern of sensitization is expected in a humid coastal city like Jeddah. Conditions for mite growth are a temperature between 22 and 26° C and a relative humidity greater than 55%. Dp is the dominant mite in constantly damp climates and Df survives better in somewhat drier climates. Modern houses are featured by wall to wall carpet, mattresses with boxes, optimal temperature for the growth of HDM. Worldwide, there is evidence to suggest that HDMs are the most common indoor allergen associated with asthma [8,9] .

Figure 4

Figure 1: The degree of skin test reactivity (sensitization) to the indoor allergens



Wheal size in mm	The degree
0 – 2	Negative
3 – 5	Mild
6 – 10	Moderate
> 10	Severe

Figure 5

Figure 2: Boxplot of skin test reactivity to the different indoor allergens

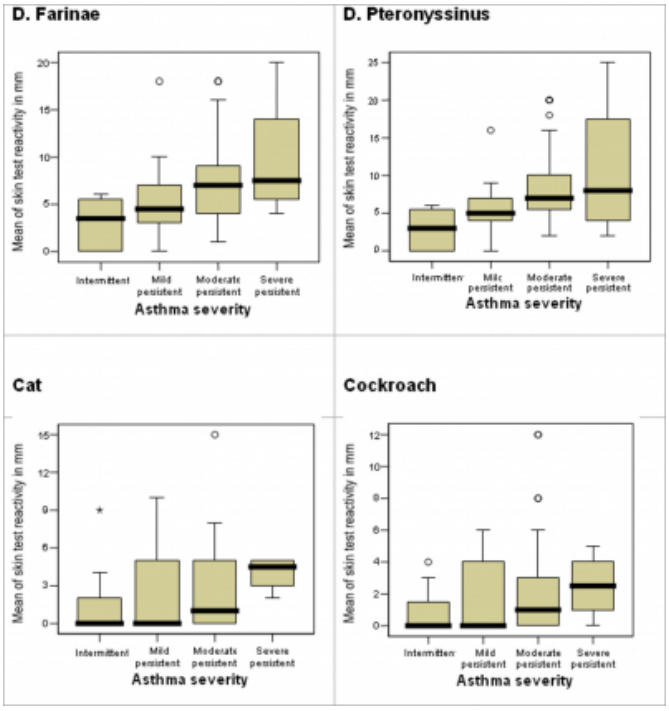


Figure 6

Figure 3: Mean skin test reactivity (wheal size) in millimeter to indoor allergens

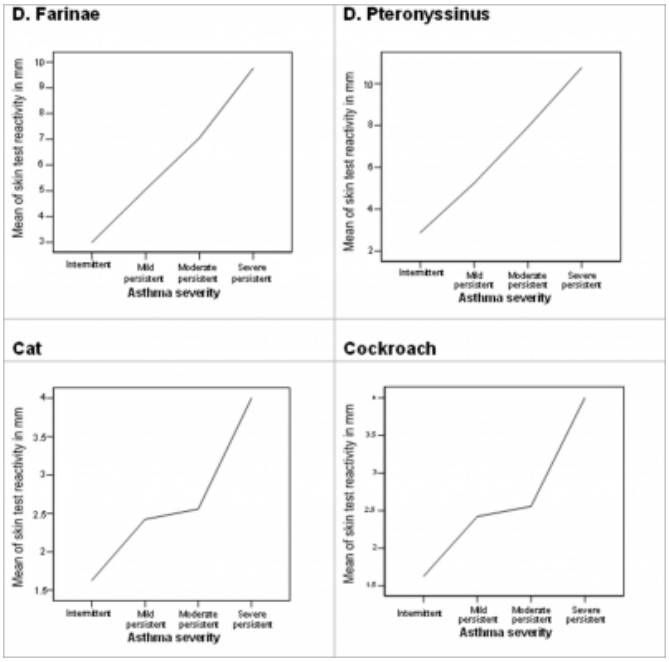
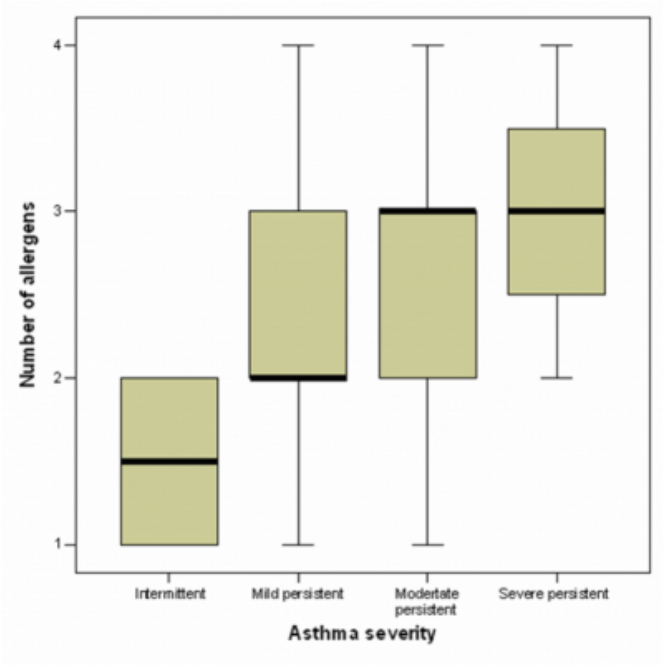


Figure 7

Figure 4: Number of allergens sensitization against asthma severity



Alferah et al conducted a study in order to analyzing HDMs contents in samples collected from asthmatics' indoor environment at four regions of Saudi Arabia [15] . The humid western region showed a high concentration of HDM more of the Der f I. Variations in both qualitative and quantitative assessment of HDMs may be attributed to variation in geography and climate, particularly humidity. SPT results with HDMs allergens also revealed a considerable number of IgE-mediated reactions, consistent with the frequency of HDMs in the region [15] . This indicates the possible influence of mites in the allergic manifestations of many patients, which is not only common, but increasing in parts of the country. Airborne allergens were identified to be risk factors for asthma and other allergic diseases in other Arabian Gulf Countries [24] .

In this study, sensitization to cat allergen was evident in nearly half of the skin test positive cases and sensitization to cockroach allergens was evident in one third of them. Cat allergens are responsible for the rapid onset of respiratory symptoms in cat-sensitized persons entering an indoor environment containing a cat, and may constitute a relevant risk factor for asthma exacerbations [25,26] . Additionally, Homes without a cat and public places may contain sufficient allergenic protein to induce clinical symptoms in highly sensitized subjects [27,28] . In some locations, sensitization to cockroach allergen may be as common as sensitization to domestic mite allergens and can have a greater effect on asthma morbidity [29,30,31] .

Some of the indoor fungi (molds) are an established risk factor for asthma in various populations [6,32] . Future studies on the impact of other indoor allergens, such as molds, on asthma severity in Saudi Arabia are recommended.

This study demonstrated clearly the parallel correlation between the degrees of an IgE mediated skin test reactivity to indoor allergens, particularly HDMs, and the higher levels of clinical severity of asthma. In other regions of the world, such correlation has been recognized by several investigators [20,33,34] . The strength of the IgE antibody response to HDM in humid climates could contribute to the increased prevalence and severity of asthma [30,34] .

Recent asthma guidelines established that although pharmacological intervention to treat asthma is highly effective in controlling symptoms and improving quality of life, every attention should be given to measures to prevent this chronic, lifelong, and incurable disease [35] . Some measures for the prevention of asthma involve avoidance of allergens and non-specific triggers when asthma is established. Several studies have documented an improvement of asthma after exposure to allergens ceases [36,37,38] . Thus, indoor environmental control measures to reduce exposure to allergens might be important, although it is difficult to achieve complete control, and there is conflicting evidence about whether such control measures are effective at reducing asthma symptoms [39,40] . Effective control strategies should be tailored to individual allergens, flexible to suit individual needs, and cost effective [35,41] .

HDMs are especially important in humid areas at Saudi Arabia like the cities of Jeddah and Dammam [15] . According to recent international and national asthma guidelines, anti-mite measures that significantly reduce their exposure should be employed when asthma is poorly controlled or requires significant medication or whenever there is a suggestion that exposure to mites is playing a role [35,42] . The most effective and probably most important avoidance measure is to use mattress, pillow, and duvet covers that are impermeable to mite allergens (Evidence level B) [43,44,45] .

In conclusion, this work demonstrated that the prevalence of sensitization to common indoor inhalant allergens was in three quarter in asthmatics living in Jeddah. Additionally,

there was a clear association between the degree of skin test reactivity to common indoors inhalant allergens and higher levels of clinical severity of bronchial asthma. Based on this, asthmatics, particularly if symptoms are not controlled with appropriate pharmacological therapy, should be offered a fair amount of education about the importance of exploring their sensitization to relevant environmental allergens. Subsequently, for better symptoms control, health care workers have to be encouraged to apply individualized educational strategies for avoiding the clinically relevant allergens in that particular asthmatic. Eventually, this will be of significant help in the overall management of asthma symptoms.

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References

1. American Thoracic Society: Progress of the interface of inflammation and asthma. Am J Respir Crit Care Med 1995; 152: 385-389.
2. Robinson D. Allergen-induced airways inflammation in asthma. Monaldi Arch Chest Dis. 1996 Dec; 51(6): 469-74.
3. Sporik R, Holgate ST, Platts-Mills TA, Cogswell JJ. Exposure to house-dust mite allergen (Der p I) and the development of asthma in childhood. A prospective study. N Engl J Med 1990; 323: 502-7.
4. Platts-Mills TA. Role of allergens in asthma and airway hyperresponsiveness: relevance to immunotherapy and allergen avoidance. In: Kaliner MA, Persson CG, eds. Asthma: its pathology and treatment. New York: Marcel Dekker; 1991.
5. Newman-Taylor A. Environmental determinants of asthma. Lancet 1995; 345: 296-9.
6. 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.
7. Djukanovic R, Feather I, Gratziou C, Walls A, Peroni D, Bradding P, et al. Effect of natural allergen exposure during the grass pollen season on airways inflammatory cells and asthma symptoms. Thorax 1996; 51: 575-81.
8. Nelson HS. The importance of allergens in the development of asthma and the persistence of symptoms. J Allergy Clin Immunol 2000; 105: S628-32.
9. Platts-Mills TTA, Vervloet D, Thomas WR, Aalberse RC, Chapman MD.T Indoor allergens and asthma: report of the Third International Workshop. J Allergy Clin Immunol. 1997 Dec; 100(6 Pt 1): S2-24. Review.
10. Gold DR. Environmental tobacco smoke, indoor allergens, and childhood asthma. Environ Health Perspect 2000; 108 Suppl 4: 643-51.
11. Harrison PT. Creature comforts-living with mites and moulds. Clin Exp Allergy 1999; 29: 148-9.
12. Hirsch T, Hering M, Burkner K, Hirsch D, Leupold W, Kerkmann ML, et al. House-dust-mite allergen concentrations (Der f 1) and mold spores in apartment bedrooms before and after installation of insulated windows and central heating systems. Allergy 2000; 55: 79-83.
13. Sporik R, Ingram JM, Price W, Sussman JH, Honsinger RW, Platts-Mills TA. Association of asthma with serum IgE and skin test reactivity to allergens among children living at high altitude. Tickling the dragon's breath. Am J Respir Crit Care Med 1995; 151: 1388-92.
14. Platts-Mills TA, Thomas WR, Aalberse RC, Vervloet D, Champman MD. Dust mite allergens and asthma: report of a second international workshop. J Allergy Clin Immunol 1992; 89: 1046-60.
15. Al-Frayh AS, Hasnain SM, Gad-El-Rab MO, Schwartz B, Al-Mobairek K, Al-Sedairy ST. House dust mite allergens in Saudi Arabia: Regional variations and immune respnse. Ann Saudi Med 1997; 17(2): 156-160.
16. 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.
17. Eriksson NE. Diagnosis of IgE mediated allergy in clinical practice. Allergol Immunopathol (Madr). 1994 Jul-Aug; 22(4): 139-51.
18. Gordon BR. Allergy skin tests for inhalants and foods. Comparison of methods in common use. Otolaryngol Clin North Am. 1998 Feb; 31(1): 35-53.
19. Ingram J.M. et al. Association between sensitization to indoor allergens and symptoms. Ann J Respir Crit Care Med 1995; 5: 1388-92.
20. Sarpong SB, Karrison T. Skin test reactivity to indoor allergens as a marker of asthma severity in children with asthma. Ann Allergy Asthma Immunol 1998; 80(4): 303-308.
21. National Asthma Education Prevention Program NAEPP. Expert Panel Report-2. National Institutes of Health, USA. Publication No. 97-3659 March 1997.
22. The National Protocol for the Management of Asthma. Al-Rayes H, Mobaireek K, Shimemreri A, Majeed S, eds. Scientific Committee Members: Al- Frayh A, Khoja T, Al-Rayes Majeed S, UKoshak EU, Al-Amoudi O, Neyaz A, Al-Hadad N, AL-Malik S, Iskendarani T. 2nd Edition, Ministry of Health, Saudi Arabia 1997.
23. Gerritsen J, Koeter GH, deMonchy JGR. Allergy in subjects with asthma from childhood to adulthood. J Allergy Clin Immunol 1990; 85: 116-25.
24. Bener, A; Safa, W; Abdulhalik, S; Lestringant, GG; An analysis of skin prick test reactions in asthmatics in a hot climate and desert environment; Allerg Immunol (Paris). 2002 Oct; 34 (8): 281-6.
25. Custovic A, Simpson A, Woodcock A. Importance of indoor allergens in the induction of allergy and elicitation of allergic disease. Allergy 1998; 53: 115-20.
26. Liccardi G, Cazzola M, D'Amato M, D'Amato G. Pets and cockroaches: two increasing causes of respiratory allergy in indoor environments. Characteristics of airways sensitization and prevention strategies. Respir Med 2000; 94: 1109-18.
27. Partti-Pellinen K, Marttila O, Makinen-Kiljunen S, Haahtela T. Occurrence of dog, cat, and mite allergens in public transport vehicles. Allergy 2000; 55: 65-8.
28. Simpson A, Custovic A. Pets and the development of allergic sensitization. Curr Allergy Asthma Rep. 2005 May; 5(3): 212-20.
29. Rosenstreich D, Eggleston P, Kattan M, Baker D, Slavin R, 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.
30. Wood RA. House dust mite and cockroach exposure: risk factors for asthma. J Aerosol Med 2004 Summer; 17(2): 165-8.
31. Gruchalla R, Pongracic J, Plaut M, Evans R 3rd, Visness CM, Walter M, Crain EF, Kattan M, Morgan WJ, Steinbach S, Stout J, Malindzak G, Smartt E, Mitchell H. Inner City Asthma Study: relationships among sensitivity, allergen exposure, and asthma morbidity. J Allergy Clin Immunol. 2005 Mar; 115(3): 478-85.
32. Halonen M, Stern DA, Wright AL, Taussig LM, Martinez FD. Alternaria as a major allergen for asthma in children raised in a desert environment. Am J Respir Crit Care Med 1997; 155: 1356-61.
33. Kupczyk M, Kuprys I, Gorski P, Kuna P. Aspirin intolerance and allergy to house dust mites: important factors associated with development of severe asthma. Ann Allergy Asthma Immunol. 2004 Apr; 92(4): 453-8.
34. Erwin EA, Wickens K, Custis NJ, Siebers R, Woodfolk J, Barry D, Crane J, Platts-Mills TA. Cat and dust mite sensitivity and tolerance in relation to wheezing among children raised with high exposure to both allergens. J Allergy Clin Immunol. 2005 Jan; 115(1): 74-9.
35. Global Strategy for Asthma Management and Prevention NIH Publication No 02-3659 Issued January, 1995 (updated 2002) Management Segment (Chapter 7): Updated 2004 from the 2003 document.
36. von Mutius E, Martinez FD, Fritzsch C, Nicolai T, Roell G, Thiemann HH. Prevalence of asthma and atopy in two areas of West and East Germany. Am J Respir Crit Care Med 1994; 149: 358-64.
37. Leung R, Ho P. Asthma, allergy, and atopy in three South-east Asian populations. Thorax 1994; 49: 1205-10.
38. Becker AB. Primary prevention of allergy and asthma is possible. Clin Rev Allergy Immunol. 2005 Feb; 28(1): 5-16.
39. Gotzsche PC, Hammarquist C, Burr M. House dust mite control measures in the management of asthma: meta-analysis. BMJ 1998; 317: 1105-10; discussion 10.
40. Gotzsche PC, Johansen HK, Hammarquist C, Burr ML. House dust mite control measures for asthma (Cochrane Review). Cochrane Database Syst Rev 2001;2.
41. Custovic A, Simpson A, Chapman MD, Woodcock A. Allergen avoidance in the treatment of asthma and atopic disorders. Thorax 1998; 53: 63-72.
42. The National Protocol for the Management of Asthma. Members of the Saudi national scientific committee for the diagnosis and management of bronchial asthma: Al- Frayh A, Khoja T, Al-Majed S, Al- Rayes H, Neyaz A, UKoshak EU, Al-Amoudi O, Al-Hadad N, Iskendarani T, AL-Malek S, eds. 3nd Edition, Ministry of Health, 2000.
43. 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.
44. Carswell F, Birmingham K, Oliver J, Crewes A, Weeks J. The respiratory effects of reduction of mite allergen in the bedrooms of asthmatic children-a double-blind controlled trial. Clin Exp Allergy 1996; 26: 386-96.
45. van der Heide S, Kauffman HF, Dubois AEJ, de Monchy JGR. Allergen reduction measures in houses of allergic asthmatic patients: effects of air-cleaners and allergen-impermeable mattress covers. Eur Respir J 1997; 10: 1217-23.

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