# THE STUDY OF COCKROACH ALLERGY IN IRANIAN CHILDREN WITH ASTHMA

**A. Farhoudi[1], Z. Pourpak[*1], M. Mesdaghi[1], A. Kazemnejad[2] and Z. Chavoshzadeh[1]**

1) Immunology, Asthma and Allergy Research Institute, Tehran University of Medical Sciences, Tehran, Iran
2) Department of Biostatistics, School of Medicine, Tarbiat Moddares University, Tehran, Iran

**Abstract-** Asthma is the most common chronic disease of childhood. Exposure to allergens plays an important role in asthma. Recently, cockroach has attracted attentions as an important allergen. This study was performed to evaluate cockroach allergy in Iranian children with asthma. One hundred children with definite diagnosis of asthma were selected. After obtaining primary information, the severity of their disease was determined according to their history, physical exam and measurement of PEFR (Peak Expiratory Flow Rate) with a mini peakflowmeter. Also, serum total IgE and blood eosinophil count were measured. The patients were skin prick tested with cockroach (Blattella germanica), trees, weeds, grasses, cats, mite, feather and common food allergens. According to cockroach skin prick test (SPT) results, the patients were divided into two groups (sensitive and non-sensitive) and compared. Positive SPT for cockroach was detected in 29% of patients. Cockroach sensitive group had a more severe asthma than non-sensitives ($P<0.02$). Also, asthmatic patients with cockroach allergy had perennial symptoms ($P<0.05$). A remarkable number of sensitive patients were born in winter ($P<0.05$). Eosinophilia was more common in sensitive group ($P<0.02$) and they had a higher level of serum total lgE ($P<0.04$). Prevalence of cockroach allergy was near to other common aeroallergens. Cockroach sensitive group had perennial symptoms, which is compatible with other indoor allergens. Cockroach allergy was more prevalent in children born in winter. Maybe these children are kept at home during their first months of life and are more exposed to cockroaches. The higher prevalence of eosinophilia and higher lgE level in sensitive group may be the reasons of more severe asthma in this group.
Acta Medica Iranica, 41(3): 150-155; 2003

**Key Words:** Asthma, child, cockroaches, hypersensitivity, Iran, skin tests

## INTRODUCTION

Repeated episodes of wheezing are a common, widespread problem in children (1) and asthma is the most common chronic disease (2) and so the most frequent diagnosis on admission in childhood (3). Asthma has a great impact on children's activities and it causes a wide range of psychological problems in them and their families (3,4). It seems that asthma's prevalence, morbidity and mortality have increased dramatically during recent decades (2-5). Different contributors have been discussed as triggers for asthma. Exposure to perennial, indoor allergens is very common in young children and infants with asthma (6,7). It is now well known that exposure to indoor allergens such as mite plays an important role (2,3). Recently cockroach has attracted attention as a prevalent and on important allergen, causing and aggravating asthma (8-12). There is some evidence that cockroach allergy aggravates asthma symptoms (13-15). Rosensterich et al. in 1993 manifested that the most common allergen in asthmatic children among cockroach, mite and cat is cockroach. They also indicated that asthmatic children with cockroach allergy have more severe asthma than others (13). In a study, performed by Sarpong et al. in 1998, 60% of asthmatic children, living in cities had cockroach allergy (16). A high prevalence of cockroach allergy was reported from Brazil, as high as 55% in asthmatic patients (17), but it has a lower prevalence in Poland (14), Italy (18) and Germany (19). The most common types of cockroaches are Blattella germanica, Priplaneta ameicana and Blattella orientalis (20). In urban areas, German cockroach is more prevalent (21). Different data on prevalence of cockroach allergy is available. This study was designed to elucidate cockroach allergy in asthmatic children, referring to Allergy and Immunology Department of Children Medical Center and Karaj Allergy Clinic.

Received: 28 september 2002, accepted: 16 April 2003

*** Corresponding Author:**
Z. Pourpak, Immunology, Asthma and Allergy Research Institute (IAARI), Tehran University of Medical Sciences, Tehran, Iran
Tel: +98 21 6935855
Fax: +98 21 6428995
E-mail: zpourpak@yahoo.com

## MATERIALS AND METHODS

A sample of 100 children (6 month-12 year-old) with definite diagnosis of asthma, referring to Allergy and Immunology Department of Children Medical

Center and Karaj Allergy Clinic was collected. After obtaining primary information including age, sex, season of birth, geographic area of their living, socioeconomic data and characteristics of their disease, the severity of their disease was determined according to their personal history, physical examination and measurement of PEFR (Peak Expiratory Flow Rate) (3). PEFR was measured with a single mini peakflowmeter, which was tested by one of the researchers every morning. Serum total IgE was measured, using ELISA method. The kits were obtained from IFCI CloneSystems SPA. Bologna, Italy. Also blood-circulating eosinophils were counted (The eosinophil counts more than 350/mm are considered eosinophilia) (22). The patient's stool was examined for parasites in 3 sessions, and the result was negative for all of them.

**Skin prick test (SPT):** The patients were skin tested, using prick method. A negative control (normal saline) and a positive control (histamine, 1 mg/mL) were also included. Patients with no response to negative control and positive response to positive control (with wheal diameter at least 5 mm) were skin tested with extracts of German cockroach (as the most prevalent existing cockroach in urban areas) (21), cat, mite (Dertntophagoides peteronyssinus), mixed trees (containing Birch, Beech, Oak, Alder, Hazel, Poplar, Plane tree, Elm and Willow), mixed grasses (containing Velvet, Orchard, Timothy, Kentucky blue and Meadow fescue), mixed weeds (Mugwort, Nettle, Dandelion and Engl plantain), feather and some food allergens (milk, egg, wheat, fish, tomato). The extracts were obtained from Allergopharma Company, Hamburg, Germany. Wheals and flare were read for histamine at 10 minutes and for allergens at 20 minutes. Responses were measured in millimeter. The test was considered positive if the diameter of the wheal was 3 mm or more (23) . The diameters of cockroach SPT responses were compared to histamine diameter and graded from 1+ to 4+ (24). According to cockroach SPT, the patients were categorized into two groups (sensitive and non-sensitive) and compared. It is obvious that cockroach non-sensitive group contains asthmatic patients with other allergies rather than cockroach.

T test was used to compare the means and chi-square and Fisher's exact tests were employed to evaluate the relations between quantitative data. Mann-Whitney test was used to compare the severity of asthma in cockroach sensitive patients, with and without positive SPT to cat, mite (DP), feather, grasses, weeds and trees. Statistical evaluation was done, using SPSS (version 10.5) software.

## RESULTS

Our patients' range of age was 6 months to 12 years (mean 6.2 ± 3.1 y) from which 32% were female and 68% male. Positive SPT for German cockroach (Blattella germanica) was seen in 29% of the patients. Of the patients, 33.3% (20/60) had positive SPT to trees, 31% (18/58) to mite (DP), 26.6% (16/60) to grasses, 23.3% (14/60) to weeds, 20% (10/50) to feather and 15% (9/60) to cat. Only 10% of the patients (6/60) had positive SPT to egg and 5% (3/60) to milk. Only one of the patients had positive wheat SPT. In grading of cockroach SPT responses, compared with histamine response diameter, the responses were 1+ in 10.3% (3/29), 2+ in 24% (7/29), 3+ in 44.8% (13/29) and 4+ in 20.6% (6/29).

Severity of asthma in both sensitive and non-sensitive groups is shown in Fig.1. Severe asthma was seen in 30.8% of sensitive and 8.1% of non-sensitive patients, but the number of patients with mild and moderate asthma was similar in both groups ($P<0.02$). Also in cockroach sensitive patients, there was no significant difference between severity of asthma in:

Cat sensitive and non-sensitive patients ($P>0.4$)

Mite (DP) sensitive and non-sensitive patients ($P>0.6$)

Feather sensitive and non-sensitive patients ($P>0.54$)

Grasses sensitive and non-sensitive patients ($P>0.4$)

Weeds sensitive and non-sensitive patients ($P>0.37$)

Trees sensitive and non-sensitive patients ($P>0.4$)

The seasons with intensified symptoms are shown in detail in table 1. In contrast with non-sensitive group in which only 28.4% had perennial symptoms, 61.5% of the sensitive patients had perennial symptoms, which is statistically significant ($P<0.05$). The patients' season of birth is manifested in table 2. Of sensitive patients, 34.6% were born in winter, during which time only 13.5% of the non-sensitive patients were born ($P< 0.05$). Eosinophilia was more frequent in asthmatic children with cockroach allergy ($P<0.02$), and it was detected in 41.2% of sensitive and 21.6% of non-sensitive patients. The mean and standard error of serum total IgE level in sensitive

group was 375 ± 70 IU/ml and in non-sensitive group was 212 ± 32 IU/ml. It is obvious that the IgE level difference in two groups is remarkable (P<0.02). Also, as it is shown in Fig. 2, we divided the patients' IgE level into four categories and compared them.

There was also a statistically significant difference (P< 0.04). No socioeconomic and geographic difference was noted between sensitive and non-sensitive groups.

**Table 1.** Seasons with intensified symptoms in cockroach sensitive and non-sensitive patients

| Seasons \ Patients | Sensitive | Non-sensitive |
|---|---|---|
| Spring | 3.8% | 13.5% |
| Summer | 7.7% | 10.8% |
| Fall | 3.8% | 13.5% |
| Winter | 23.1% | 33.8% |
| All seasons | 61.5% | 28.4% |

**Table 2.** Seasons of birth in cockroach sensitive and non-sensitive patients

| Seasons \ Patients | Sensitive | Non-sensitive |
|---|---|---|
| Spring | 26.9% | 27% |
| Summer | 19.2% | 32.4% |
| Fall | 19.2% | 27% |
| Winter | 34.6% | 13.5% |

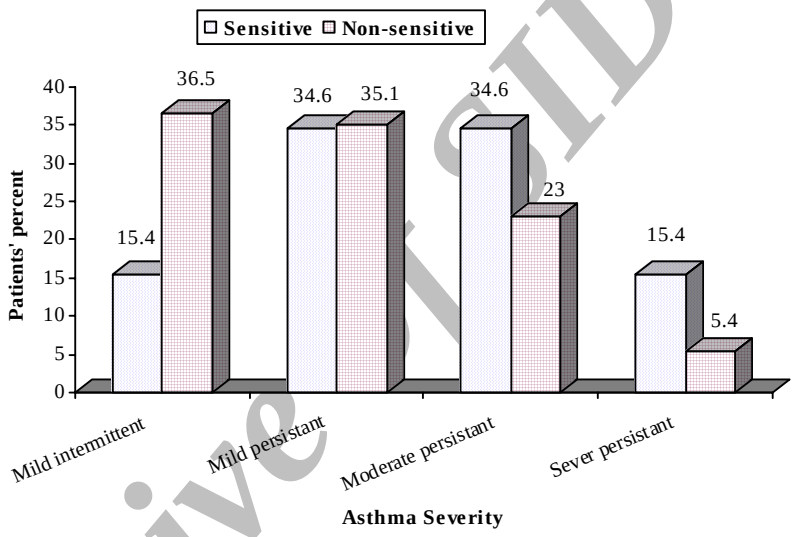


**Fig. 1.** Comparison of asthma severity in cockroach sensitive and non-sensitive groups

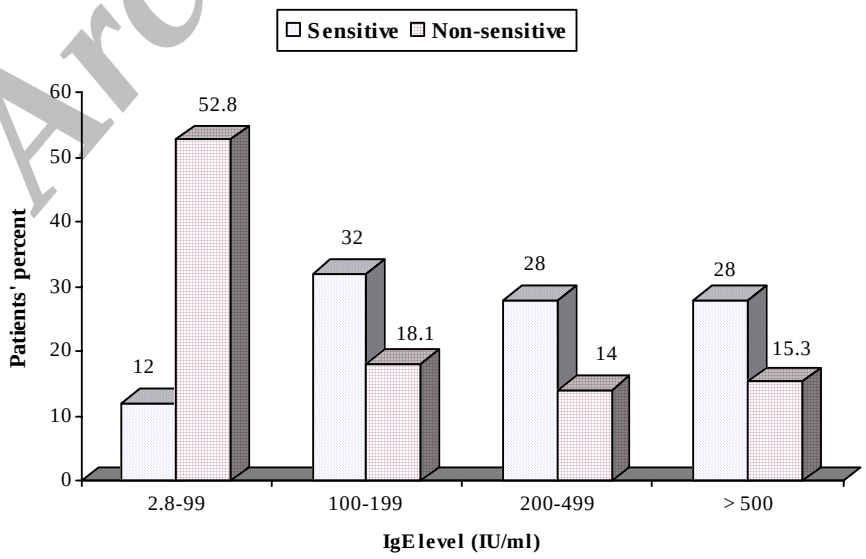


**Fig. 2.** IgE level classification in cockroach sensitive and non-sensitive patients

## DISCUSSION

Bernton and Brown described cockroach allergy in 1967 (25) . After it, several studies were performed to clarify this allergy. Recent studies have suggested a relationship between cockroach allergy and asthma (8-12). This study was designed to elucidate this allergy in Iranian asthmatic children, referring to Allergy and Immunology Department of Children Medical Center and Karaj Allergy Clinic. Comparing results of SPT to common aeroallergens (cat, mite, trees, weeds, grasses and feather) and cockroach, it is shown that cockroach is one of the main aeroallergens and it is worth enough notification especially in children, who have more exposure to indoor allergens. As seen in our results, a small numbers of our patients had food allergy. Our patients' range of age was 6 months to 12 years (mean 6.2± 3.1 y), but food allergies are common in the first year of life (26). Positive SPT for German cockroach seen in 29% of our patients; which is close to Harmanci's data from Turkey (27). Maybe there are some geographic reasons that our data and the data of our neighboring country (Turkey) are similar, but our data is different from USA (30-60%) (11,16), Italy (13 %) (18) and Germany (8%) (19). As shown in Fig. 1, asthma in cockroach sensitive group is more severe than non-sensitive group ($P<0.02$), that shows cockroach allergy causes asthma to become a more severe disease, which is compatible with other studies (13-15). Considering comparison of asthma severity in cockroach sensitive patients, with and without sensitivity to other aeroallergens (cat, mite, feather, grasses, weeds and trees), which was not significant for any of these aeroallergens ($P>0.37$-$0.6$), the role of cockroach in asthma intensification is better supported.

For the first time, Sarpong et al. in 1998 found that asthmatic children born in winter are at a higher risk for cockroach allergy (16). This point was confirmed in this study. This higher risk is possibly due to keeping children born in winter at home during the first months of life and consequently higher exposure to cockroach allergens during these months. According to the results of this study, a great number of the sensitive patients had perennial symptoms. Cockroach is an indoor allergen, so symptoms in asthmatic children with cockroach allergy are commonly perennial.

Rosensteich in 1997 suggested that there was no relationship between socioeconomic state and cockroach allergy (13). Recently, a correlation between low socioeconomic state and higher cockroach exposure and sensitization has been explained by Leaderer et al. (28). No relation between cockroach allergy and socioeconomic state was found in this study. It seems that even children with good socioeconomic state, are exposed to this allergen. As explained in results, eosinophilia was more common in sensitive patients than non-sensitives. With regard to the significant role of eosinophils in asthma pathophysiology (29), it can be a cause for the more severe asthma in sensitive group. Also, serum IgE level in sensitive group was higher non-sensitive group. Some studies have shown that children with higher IgE levels have more severe asthma (30). So, higher IgE level and eosinophilia in patients with cockroach allergy may explain the severity of asthma in these patients. Further studies are recommended to prove these relations. In conclusion, cockroach allergy may be a significant contributor to children asthma. Also it may cause asthma to become more severe, so cockroach allergen should be noticed carefully in children asthma, especially in severe types and avoiding these insects should be considered as the first step of asthma treatment in children. However, to introduce cockroach as a cause of children asthma, the results of this study should be verified in a case-control or cohort study.

### Acknowledgement

With special thanks to all our colleagues in Immunology, Asthma and Allergy Institute and to Mrs. Moghaddasian, for editing the article.

## REFERENCES

1. Christie G, Helms P. Childhood asthma: what is it and where is it going? Thorax 1995; 50(10): 1027-1030.

2. Lemanske RF, Green CG. Asthma in infancy and childhood. In: Middleton E, et al. editors. Allergy, principles and practice. 5th ed. St Louis: Mosby 1998; p: 877-896.

3. Buckley RH. Allergic disorders (Asthma). In: Behrman RE, Kliegman RM, Jenson BB, editors. Nelson textbook of pediatrics. 16th edition. Philadelphia: W B Saunders 2000; p: 664-79.

4. Shapiro GG, Stout JW. Childhood asthma in the United States: urban issues. Pediatr Pulmonol 2002; 33(l): 47-55.

5.Burr ML. Epidemiology of childhood asthma. Allerg Immunol (Paris) 1991; 23(8): 348-350.

6. Platts-Mills TA, Carter MC. Asthma and indoor exposure to allergens. N Engl J Med 1997; 336(19): 1382-1384.

7. Murray CS, Woodcock A, Custovic A. The role of indoor allergen exposure in the development of sensitization and asthma. Curr Opin Allergy Clin Immunol 2001; 1(5): 407-412.

8. Arruda LK, et al. Cockroach allergens: environmental distribution and relationship to disease. Curr Allergy Asthma Rep 2001; 1(5):466-473.

9. Call RS, et al. Risk factors for asthma in inner city children. J Pediatr 1992; 121(6): 862-866.

10. Sarpong SB, Karrison T. Sensitization to indoor allergens and the risk for asthma hospitalization in children. Ann Allergy Asthma Immunol 1997; 79(5): 455-459.

11. Pollart SM, et al. Epidemiology of acute asthma: IgE antibodies to common inhalant allergens as a risk factor for emergency room visits. J Allergy Clin Immunol 1989;83(5):875-882.

12. Custovic A, Murray CS, Gore RB, Woodcock A. Controlling indoor allergens. Ann Allergy Asthma Immunol 2002; 88(5): 432-441.

13. Rosenstreich DL, et al. The role of cockroach allergy and exposure to cockroach allergen in causing morbidity among inner-city children with asthma. N Eng J Med 1997; 336: 1356-1363.

14. Stelmach I, et al. Cockroach allergy and exposure to cockroach allergen in Polish children with asthma. Allergy 2002; 57(8): 701-705.

15. Lewis SA, et al. The role of indoor allergen sensitization and exposure in causing morbidity in women with asthma. Am J Respir Crit Care Med 2002; 165(7): 961-966.

16. Sarpong SB, Karrison T. Season of birth and cockroach allergen sensitization in children with asthma. J Allergy Clin Immunol 1998; 101 (4 Pt 1): 566-568.

17. Santos AB, et al. Cockroach allergens and asthma in Brazil: identification of tropomyosin as a major allergen with potential cross-reactivity with mite and shrimp allergens. J Allergy Clin Immunol 1999; 104(2 Pt 1): 329-337.

18. Peruzzi M, et al. Incidence of cockroach allergy in atopic Italian children. Ann Allergy Asthma Immunol 1999; 83(2): 167-171.

19. Hirsch T, et al. Exposure and allergic sensitization to cockroach allergen in East Germany.Clin Exp Allergy 2000; 30(4): 529-537.

20. Rozend JA. Vector control, methods for use by individuals and communitis. 2nd edition. Geneve: WHO. 1997; p: 288-300.

21. Solomon WR, Platts-Mills TAE. Aerobiology and inhalant allergens in: Middleton E, et al. editors. Allergy principles and practice. 5th edition. St Louis: Mosby 1998; p: 367-401

22. Weller PF. Eosinophilia. J Allergy Clin Immunol 1984;73(1 Pt 1): 1-14.

23. Demoly P, Michel FB, Bousquet J. In vivo methodes for study of allergy, skin prick test, techniques and interpretations. In: Middleton E, et al, editors. Allergy principles and practice. 5th edition. St Louis: Mosby 1998; p: 430-439.

24. Bousquet J. In vivo methods for study of allergy. In: Middleton E, et al. editors. Allergy principles and practice. 4th edition. St Louis: Mosby 1993; p: 573-594.

25. Bernton HS, Brown H. Cockroach allergy II: the relation of infestation to sensitization. South Med J 1967; 60(8): 852-855.

26. Sampson HA. Immunologic mechanism in adverse reactions to foods. Immunol Allergy Clin North Am 1991; 11(4): 701-716.

27. Harmanci E, et al. Low prevalence of allergy to cockroach and latex in asthmatic patients in Eskisehir

(Anatolia), Turkey. J Investig Allergol Clin Immunol 2000; 10(3): 162-165.

28. Leaderer BP, et al. Dust mite, cockroach, cat. and dog allergen concentrations in homes of asthmatic children in the northeastern United States: impact of socioeconomic factors and population density. Environ Health Perspect 2002; 110(4): 419-425.

29. Menzies-Gow A, Robinson DS. Eosinophils, eosinophilic cytokines (interleukin-5), and antieosinophilic therapy in asthma. Curr Opin Pulm Med 2002;8(l): 33-38.

30. Wright RJ, Weiss ST. Epidemiology of allergic diseases. In: Holgate ST, Church MK, Lichtenstein LM, editors. Allergy. 2nd edition. ST Louis: Mosby 2001; p: 203-212.