

Cockroach Sensitivity in Iranian Asthmatic Children under the Age of Five years

Astımı Olan İran'lı Beş Yaş Altı Çocuklarda Hamam Böceği Duyarlılığı

Mojgan Safari¹, Reza Amin², Sara Kashef², Soheila Aleyasin², Maryam Ayatollahi²

¹Hamadan University of Medical Sciences, Hamadan, Iran

²Shiraz University of Medical Sciences, Shiraz, Iran

ABSTRACT

Introduction: Exposure to cockroaches was reported to be a cause of asthma in many parts of the world. The aim of the study was to determine the prevalence of cockroach sensitivity in asthmatic children under 5 years of age in Iranian children with asthma.

Material and Method: Ninety two (33 female/59 male) patients were asked to complete a questionnaire covering demographic characteristics, and were subjected to skin prick testing for cockroach allergen. Blood samples were also withdrawn for assessment of total serum IgE and eosinophilia.

Results: Twenty seven percent (n=25) of subjects had positive skin test results for cockroach allergen. There were no significant correlations between the prevalence of cockroach skin test positivity in male and female children, rural and urban areas or infants under 2 years and older. The age of the youngest subject with a positive skin test for cockroach was 2 months. Moreover, the parent's level of education and the type and age of children's residence had no effect on the prevalence of cockroach skin test positivity. There was also no significant correlation between the total serum IgE and eosinophilia and the prevalence of cockroach skin test positivity.

Conclusion: Cockroach is an important source of domestic infestations in the city of Shiraz. Sensitization to cockroach allergens may develop early in life. Skin test for cockroach allergen in asthmatic children may provide information for programming environmental control strategies.

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Key words: Asthma, cockroach, children

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ÖZET

Giriş: Dünyanın pek çok yerinde hamam böceklerinin astıma yol açabileceği gösterilmiştir. Bu çalışmanın amacı da astımı olan İran'lı çocuklarda 5 yaş altında hamam böceğine bağlı astım prevalansını belirlemektir.

Gereç ve Yöntem: Otuz üç kız, 59'u erkek toplam 92 olgu, demografik özellikleri ve hamam böceği duyarlılığını içeren anketi cevapladı. Olgulara hamam böceği alerjisini belirlemek için cilt testi yapıldı ve serumda total IgE ve eozinofil düzeylerine bakıldı.

Bulgular: Olguların %27'sinin (n=25) cilt testlerinde hamam böceğine karşı pozitif reaksiyon görüldü. Hamam böceğine karşı cilt testi pozitif olan en küçük çocuk 2 aylıktı. Hamam böceği için yapılan cilt testi taramalarında erkek ya da kız çocuklar arasında, kentsel ya da kırsal yörede yaşayan çocuklar arasında ve 2 yaş altında ve üstündeki çocuklar yönünden istatistiksel düzeyde anlamlı bir farklılık görülmedi. Çocukların yaşadığı şehrin özellikleri ve ailenin eğitim düzeyi de hamam böceği için yapılan cilt testinin pozitifliğine herhangi bir etki yapmıyordu. Diğer taraftan total serum IgE düzeyi ve eozinofili ile hamam böceği için pozitif cilt testi arasında da anlamlı bir ilişki bulunamadı.

Sonuç: Hamam böcekleri Shiraz şehri için ev içi salgın haline gelen önemli bir sorundur. Bu nedenle hamam böceğine duyarlılık hayatın daha erken dönemlerinde ortaya çıkabilmektedir. Astımlı çocuklarda hamam böceklerine olan duyarlılığın belirlenmesi ve çevresel kontrol stratejilerinin geliştirilmesinde cilt testleri yararlı olabilir. (*Tur Toraks Der* 2009;10:26-30)

Anahtar sözcükler: Astım, hamam böceği, çocuklar

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INTRODUCTION

The prevalence of asthma and related allergic disorders in childhood has increased considerably during the last few decades [1]. Sensitivity to allergens is the hallmark of childhood asthma. There is evidence showing high prevalence of atopic conditions in children with asthma and a link between skin test sensitivity and severity of asthma [2-7]. Asthma prevalence, morbidity and mortality have been dramatically increasing despite the

advances in medical technology and the development of new pharmacologic agents for the treatment of asthma [8-10]. Residents living in poor inner-city areas are at disproportionately high risk to asthma morbidity and mortality [11,12]. One of the reasons for this might be due to chronic exposure to indoor allergens, and high indoor allergen exposure is a significant risk factor for asthma. The major indoor allergens in the inner-city causing asthma are house-dust mites and cockroaches

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Address for Correspondence / Yazışma Adresi:

Mojgan Safari, Pediatric ward, Besat Hospital, Hamadan, Iran
Phone: 0098 811 826 88 55 Fax: 0098 811 2640064 E-mail: mo_sfr@yahoo.com

[13, 14]. Although it is now clear that cockroach allergen is a significant contributor to asthma [15,16], the data on the prevalence of cockroach allergy in young inner-city children are limited. Moreover, most of the recent studies have examined the prevalence of cockroach allergy in 5 year old and older children [17,18]. Children under 4 years old have the highest hospitalization rates for asthma [19]. However, very few studies have examined the prevalence of cockroach allergy in children younger than 5 years old. Therefore this study was designed 1) To determine the prevalence of cockroach allergy in young asthmatic children, 2) To compare the prevalence of cockroach allergy in rural and urban places, and 3) To determine the association between the results of cockroach skin prick test and serum IgE, eosinophilia, parent's level of education, type of residence, or patient's sex.

MATERIAL and METHOD

Patients

We evaluated 92 patients referred to our clinic (Clinic of Allergy and Clinical Immunology, Department of Pediatrics, Shiraz University of Medical Sciences, Shiraz, Iran).

To be enrolled, children had to meet at least one of the following criteria: 1) Wheezing at least three times in their lifespan 2) Patient diagnosed with asthma by a pediatrician. 3) Prolonged cough after each upper respiratory tract infection 4) Frequent use of asthmatic drugs (salbutamol, teophylline, short courses of corticosteroids).

All patients were under the age of 5 years. Their mean age was 2.7 ± 1.4 years.

Children who had severe skin conditions precluding skin testing, had used antihistamine 72 hours before testing, had a history of anaphylaxis to previous cockroach skin testing or had severe respiratory or cardiac diseases were excluded.

Questionnaire

As a part of the evaluation, the subject's parents were asked to complete a questionnaire that included questions with respect to their level of education, their living area (rural or urban), type and age of their residence home, presence of cockroaches in their homes, species of cockroach and parents' levels of education.

Skin testing

Skin testing was performed by pricking the forearm skin with a standard needle and reading the results in 15 minutes. Positive (10 mg/ml histamine base) and negative (normal saline) controls were simultaneously applied along with cockroach, cat, mite, mixed trees, mixed grasses, feather mix, aspergillum, and some food allergens including milk, egg, tomato and cacao (Stallergenes, France).

The result of a test was considered positive if it produced either a wheal with a mean diameter of at least 3 mm greater than the negative control test with flare of any size, or a wheal with a diameter of less than 3 mm and a flare with a mean diameter of at least 10 mm (20).

Total serum IgE and eosinophilia

Total serum IgE (IU/ml) was quantified by ELISA (RADIM). Allergy was not probable if serum IgE was lower than 20 IU/ml, questionable if it was between 20 to 100 IU/ml, and very probable if it was higher than 100 IU/ml. Differentiation of white blood cells was done manually. Eosinophilia was considered if the absolute count of eosinophils was over than 450 per micro liter.

Statistical analysis

The data were analyzed using Pearson Chi-Square and Fisher's Exact Test. Analysis was performed with SPSS software. A P-value of ≤ 0.05 was considered as statistically significant.

RESULTS

Of 92 children (59 male, 33 female), 25 subjects (27.2%) had positive skin test results to cockroach allergen. Sociodemographic characteristics are shown in Table 1.

Eight of the female subjects (24.2%) and 17 of the male subjects (28.8%) had positive skin test results for cockroach ($\chi^2=0.22$, $P=0.63$).

Of the patients, 27.3% had positive skin test results to mite, 27.2% to mixed trees, 9% to mixed grasses, 18.2% to feather mix, 8.5% to cat, 9.5% to aspergillum, 8.7% to tomato, 19% to cow's milk and 17% to egg.

Seven subjects (7.6%) were sensitive to mite and cockroach together. Of cockroach sensitive patients, 28% were also sensitive to mite allergen.

Of subjects with positive results of skin tests, 21 (84%) were living in urban and 4 (16%) in rural areas. There is no difference in cockroach sensitivity between those patients living in urban and rural areas ($P=0.08$).

Of subjects with positive results of skin tests, 5 (20%) were living in apartments and 20 (80%) in houses. Ten (40%) subjects were living in houses newer than 10 years and 15 (60%) subjects in houses older than 10 years. There was no difference in cockroach sensitivity between those patients living in apartments and houses or between those patients living in houses newer than 10 years or houses more than 10 years ($\chi^2=0.28$, P value =0.5 and $\chi^2=0.44$, P value=0.5, respectively).

Eleven (12%) of the mothers had college degrees. The child of one of these mothers had a positive skin test result (9.1%) and 10 (90.9%) children had negative skin test results. There is no significant relationship between the mother's education level and results of the cockroach skin prick tests ($\chi^2=2.3$, $P=0.3$).

Seventeen (18.5%) of the fathers had college degrees. Two (11.8%) of their children had positive skin test results and 15 (88.2%) had negative skin test results. There is a relationship between father's education level and results of the cockroach skin prick tests ($\chi^2=6.6$, $P=0.03$).

Of 25 subjects with positive skin test results, 6 (24%) were ≤ 2 years of age and 19 (76%) were > 2 years ($\chi^2=0.47$, P value=0.4).

Table 1. Sociodemographic characteristics (number)

		*CS+	†CS-	Total
Sex	male	17	42	59
	female	8	25	33
Age	≤2 years	6	21	27
	>2 years	19	46	65
Living site	urban	21	64	85
	rural	4	3	7
House building	apartment	5	17	22
	home	20	50	70
House building's age	≤20 years	10	32	42
	>20 years	15	35	50
Mother's education level	Primary school	12	32	44
	High school	12	25	37
	College degree	1	10	37
Father's education level	Primary school	12	39	51
	High school	11	13	24
	College degree	2	15	17

*CS+=cockroach sensitivity is present
†CS-=cockroach sensitivity is absent

Serum IgE was measured in 80 subjects. Twenty-one (26.3%) subjects had positive skin test results. Seven of them (33.3%) had serum IgE levels above 100 IU/ml (Figure 1). No relationship was found between serum IgE levels and skin prick test results ($\chi^2=0.29$, P value=0.24).

Six (6.5%) subjects had eosinophilia. Two of them (33.3%) had positive skin test results. No relationship was found between eosinophilia and positive skin test results (P=0.6).

Twenty-four (96%) subjects with positive skin test results and 58 (86.6%) subjects with negative skin test results reported the presence of cockroaches in their houses. (American cockroach 14%, German cockroach 40.2%, and both species 45.1%). There is no difference in cockroach sensitivity between those patients reporting the presence and absence of cockroach in houses (P=0.27).

DISCUSSION

The prevalence of positive skin test results to cockroaches in asthmatic children under the age of five years is 27.2% in our study, which is comparable to the results of other studies. This prevalence was 29% in another study from Iran [21]. Wilson et al [22] reported that 26% of the asthmatic children younger than 3 years of age had positive skin test responses to cockroaches.

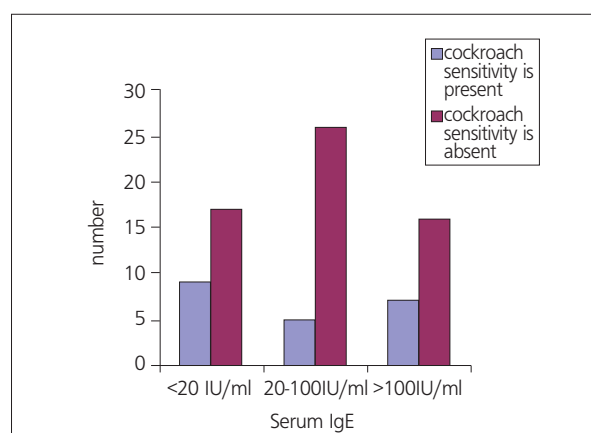


Figure 1. Serum IgE levels in Iranian Asthmatic Children

Alp et al [23] reported that 23.8% of 63 asthmatic children younger than 4 years of age had positive skin test responses to cockroach. The prevalence of cockroach allergy was reported to range from 17% to 41% in various studies involving both children and adults [2,23,24]. Vera et al [25] evaluated 75 children who were not previously diagnosed as having asthma or other atopic diseases. They evaluated results of the aero-allergen skin testing and association with wheezing.

Fifteen percent of the subjects had positive skin responses to cockroaches. Cockroach sensitivity was the only allergen that correlated significantly with previous episodes of wheezing [25].

While Turkey is Iran's neighbour, the rate of cockroach sensitization in asthmatic children is different from that of Iran. In the study of Yilmaz A, allergies to *Blattella germanica* and *Periplaneta Americana* were reported as 11.9% and 7.4%, respectively [26].

The results of the present study show a trend towards association between cockroach skin test positivity and living in rural areas ($P=0.08$). The insignificant result could be due to the small number of the patients from rural areas in the present study (7 patients). Therefore we propose repeating this study on a larger sample size to verify if there was any association between cockroach skin positivity and the living areas. Numerous studies demonstrated that cockroach allergy was a major cause of asthma in older, inner-city children. Kang et al [27] reported that 76% of the houses of urban asthmatics were infested by cockroaches, and 60% had a positive skin test to that allergen. Rosenstreich et al [18] found that, in 476 of the inner-city children with asthma, 37% were allergic to cockroaches and a high allergen level was present in half of their bedrooms. Garcia et al [28] compared the cockroach sensitization rates for urban, suburban, and rural areas of Kentucky. They found that 43% of the adults and children from rural areas had skin tests positive to cockroaches compared to 41% of inner-city patients.

There was no difference in the frequencies of positive skin test responses to cockroach in infants (<2 years of age) and older children in our study. This finding demonstrates that the cockroach allergy can start from a very early age. However, other aeroallergens such as pollens would induce allergy after some years. In the present study the youngest subject with positive skin response was 2 months old. Skin test positivity to allergen (cockroach and dust mite) in a 4 months-old infant was reported by Vera [25]. Because cockroach sensitization may be related to recurrent wheezing, the young age of sensitization indicates the timing at which avoidance measurements or other interventions must be performed to have any influence.

Alp et al [23] found that twice as many young children were sensitized to cockroach as to dust mites, whereas the prevalence of sensitization to the two allergens was comparable in older children. They suggested that not only was the cockroach the most common sensitizing allergen, but also possibly the first one to appear. Moreover it was proposed that allergen avoidance might be effective, especially in monosensitized patients.

Although boys are known to be at greatest risk for atopy in general [29], we found no difference between the prevalence of skin prick test positivity in male and female children. Matsui et al [30] reported the male sex as one of the significant risk factors for cockroach sensitization among city residents. However the small sample

size of this subgroup and the fact that this was not seen in the other analyses make it difficult to draw any exact conclusions about the risk associated with male sex.

Mungan et al [31] found that in 206 subjects with asthma, a female predominance was observed in cockroach-sensitive patients. They reported that 44% of the atopic women and 34% of the atopic men had positive skin tests with cockroach allergen.

We found no significant relationship between the mother's education level and the results of the cockroach skin prick tests, but the father's level of education was negatively related to the skin test positivity. There was no reason for this finding, however it might be related to the major role of men in the Iranian families. A study reported that lower education level, mainly that of mothers, was one of the major risk factors for the presence of cockroach allergen [32].

In a study using 339 asthmatic subjects, Matsui et al [30] reported sociodemographic factors that decreased the risk of exposure to cockroach allergen where the family income is greater than \$50,000 per year and the mother had a college degree. Our study was focused on the patients of a clinic that have an income range varying between the lowest to middle income level of society. Whether the findings of the present study can be generalized or not needs clarification.

Cockroaches spread from house to house through common walls, and the housing type has been reported to be associated with the presence of cockroach allergen [33,34]. Therefore we evaluated the association between types of houses and skin test positivity. The type and age of the houses had no effect on the results of the skin prick test responses in our study. It seems that the sewage system contributes more to the presence of cockroaches in the houses than their type or age. Cockroach allergen was reported to be common in detached houses [30].

Some studies reported cross-reactivity between cockroach and mite allergens [26,35] but this cross-reactivity was not observed in our study because only 7.2% of cases were sensitive to both allergens.

We found no relationship between serum IgE and the results of skin prick tests to cockroaches. However, in future, studies of whether the high serum level of IgE in some of our patients is due to parasitic infestations or not must be evaluated. It is preferable to check specific IgE antibodies to cockroaches. Higher serum IgE in asthmatic patients with positive skin test results to cockroach was reported [21].

Only 6 subjects in our study had eosinophilia. No relationship was present between eosinophilia and results of the skin prick tests.

One of the problems in this study was the diagnosis of asthma in children aged 5 years and younger. That is because episodic wheezing and cough are common in children who do not have asthma. In this age group, clinical judgment and evaluation of symptoms and physical examination play major roles in the diagnosis of asthma. A trial therapy with short acting bronchodilators can be helpful.

We conclude that the cockroach is an important source of domestic infestation, and cockroach sensitization is frequent in asthmatic children. Sensitization to cockroach allergens can develop early in life, even as early as 2 months of age. More than 57% of infants in the rural setting, which previously was not thought of as a high cockroach environment, had positive skin test results to cockroach. Therefore strategies to reduce exposure of children to cockroach allergen should start in infancy. It seems that the type of sewage systems in Shiraz, Iran is a significant factor contributing to an increasing presence of cockroaches in homes. Evaluation and finding of some ways to improve the sewage system, is essential. Moreover, consideration of cockroach allergen in the routine skin tests in this geographic location seems reasonable.

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Footnote

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