

Cockroach allergy in a group of Turkish children with respiratory allergies

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Exposure to cockroach may lead to exacerbations of bronchial asthma and/or allergic rhinitis in sensitized patients. Although there is a widespread belief that cockroach allergy is a common problem in patients with respiratory allergies, little is known in Turkish children. In order to investigate the prevalence and characteristics of cockroach allergy in respiratory allergic children, we performed a study in newly referred children with respiratory allergies. All patients underwent questionnaire-interview and skin prick tested with common inhalant allergens in addition to two cockroach allergens: *Blattella germanica* (Bg) and *Periplaneta americana* (Pa). A subgroup of patients was also serologically investigated for specific IgE against Bg and house dust mite.

Three hundred- and thirty-seven children aged 2-16 years were recruited for the study and 77.7% of these were atopic, with the most common indoor and outdoor allergens of house dust mite (47.5%) and grass pollens (45.1%), respectively. According to the prick test results, allergies to Bg and Pa were 11.9% and 7.4%, respectively, and there was a weak correlation between size of the prick test and specific IgE levels for Bg allergen. Almost 30% of the cockroach-sensitive patients were allergic to both cockroach antigens. Seventy percent of cockroach-sensitive patients were also sensitive to house dust mite, and only 1% were monosensitive. Dwellings in the Middle Anatolia and Black Sea regions were less commonly infested by cockroach compared to the dwellings in other regions.

In conclusion, our preliminary study showed that cockroach sensitization is common among children with respiratory allergies irrespective of infestation history, suggesting that addition of cockroach allergen to the routine allergy screening panel is critical.

Key words: cockroach allergy, Turkish children, respiratory allergies.

Environmental factors such as allergens and nonspecific irritants are known to play an important role in inducing symptoms of respiratory allergies. A number of studies have demonstrated that indoor environment has a greater impact on this population than outdoor or occupational environment^{1,2}. The most important indoor allergens are house dust mites, molds, cockroach and animal danders. For at least 30 years, cockroach has been known as an important indoor sensitivity source³⁻⁸, and the first study was performed in 1964 where 28% of asthmatics were found to be allergic⁹.

Cockroach allergens may trigger both bronchial asthma and allergic rhinitis in sensitive patients. A number of studies have also shown that

cockroach-sensitive asthmatics had more severe disease^{10,11}. Although over 4000 species of cockroaches have been described worldwide, only a few species are reported to be allergic. The most commonly encountered cockroaches are *Blattella germanica* (German cockroach), *Periplaneta americana* (American cockroach) and *Blattella orientalis* (Oriental cockroach). Among them, the German cockroach, which is an indoor organism, is the most common and immunogenic, while the other two are both indoor and outdoor organisms^{7,12}. There are more than 20 different cockroach species in Turkey, and *Blattella germanica* is reported as the most common¹³. A number of studies have demonstrated that up to 58% of atopic

asthmatic patients in some parts of the USA are sensitized to cockroach allergens, particularly those living in multiple dwellings in larger urban areas. However, in Europe this prevalence seems to be lower^{14,15}. Although house dust mite is reported to be the most frequently sensitized indoor allergen in Turkey, there is little information regarding the possible role of cockroaches in respiratory allergies, especially in childhood¹⁶. This study has been carried out in order to determine the prevalence and characteristics of cockroach allergy in a group of Turkish children with respiratory allergies. Our observations form the basis of this report.

Material and Methods

The study has been carried out in Hacettepe University Pediatric Allergy and Asthma Outpatient Clinic by enrolling all newly referred children due to respiratory allergies during a five-month period. This clinic is the largest allergy clinic in the country, with a wide spectrum of patients from different regions of the country. A total of 337 children aged 2-16 years with asthma and/or allergic rhinitis from five different regions of Turkey completed the study. All had relevant recurrent symptoms of bronchial asthma and/or allergic rhinitis. Diagnoses were made mainly by referred physicians but were confirmed by the physicians of the study center including documentation of reversible airway obstruction for asthmatics¹⁷. Patients were studied if they had no usage of antihistaminic during the past month, no history of immunotherapy and no exacerbation during the last two weeks. While recruiting subjects, social class and economic status were not taken into consideration. Participants included both inner city and rural small town residents.

Patients were recruited if their parents gave informed consent and were questioned in person by a single physician (AY). Age, sex, cockroach infestation of the house, presence of cat at home, and home location were recorded.

The following standardized common inhalant allergen extracts were used from Center Laboratories (Port Washington, New York, USA) for skin prick tests: Dermatophagoides pteronyssinus, D. farina, grass, tree and weed pollens, cat and dog epithelium, Alternaria alternate and Cladosporium herbatum, as well as two cockroach allergens: Blattella germanica

(Bg) and Periplaneta americana (Pa). The puncture method was used in skin prick tests (Duotip, bifurcated needles, Lincoln Diagnostic, Decatur, IL, USA), and a mean wheal diameter (longest plus shortest divided by two) was recorded after 15 min. The test was considered as positive with a wheal size of a minimum of 3 mm larger than negative control. Histamine dihydrochloride (10 mg/ml) and buffer solution were used as positive and negative controls, respectively. The same physician (AT) performed and evaluated all skin tests to prevent interobserver variability. Patients who had dermatographism were excluded from the study and those who had at least one positive skin prick test were classified as atopic.

Venous blood was drawn into serum separation tubes and stored 60 min at room temperature and spun at 1200 g for 10 min to separate the serum. All the samples were frozen at -20°C not more than 180 days and studied on two occasions. Using kits from Dr. Fooke Laboratories and UniCAP fluorezyme immunoassay (FEIA, Pharmacia Upjohn, Uppsala, Sweden), serum total IgE and specific IgE levels (for house dust mite and Blattella germanica) were studied according to manufacturers' instructions, respectively.

Results were given as mean±standard deviation for demographic data or as ratio of the positive results. Group comparisons were made using Student's t test or chi-square for quantitative data and frequencies, respectively. Pearson test was used for correlation analyses. A two-sided p value less than 0.05 was considered significant. The Statistical Package for Social Sciences (SPSS) version 6.0 was used for analyses.

Results

In the study group, mean age was 8.6±0.22 years and there were more boys (male/female=1.4/1), asthmatics (81.6%) and atopics (n=262, 77.7%). Nonatopics were younger than atopics (6.8±0.45 vs. 9.1±0.24 years, respectively, p<0.01) and there was no sex difference between these two subgroups (Table I). The most commonly sensitized indoor and outdoor allergens were house dust mites (61.1%) and grass pollens (58.0%), respectively, and distribution of allergies is shown in Table II with regard to their diagnoses. The frequency of pollen sensitivity was higher

Table I. Characteristics of the Study Group

	Atopic	Nonatopic	Total
Number	262	75	337
Age#	9.1±0.24	6.8±0.45	8.6±0.22
Sex (boys/girls)	1.4/1	1.8/1	1.4/1
Asthmatics*	43.3	17.2	60.5
Asthmatics & Rhinitics*	17.8	3.3	21.1
Rhinitics*	18.4	-	18.4
Total IgE# (IU/ml)	360.7±0.27	211±0.17	302.7±0.22
Origin			
Mediterranean region*	8.9	3.9	12.8
Black Sea region*	29.1	5.3	34.4
Middle Anatolia region*	25.8	7.1	32.9
East-Southeast region*	8.0	4.2	12.2
Aegean region*	5.9	1.8	7.7

#: mean±standard error of the mean, *: percentage of the total group.

in rhinitics ($p<0.0001$) compared to asthmatics, whereas dermatophagoid sensitivity was higher in asthmatics ($p<0.001$). 14.8% (50/337) of the study group (19% [50/262] of the atopics) were sensitive to cockroach assessed by skin prick test, and sensitivity to Pa and Bg were 7.4% and 11.9% (9.5% and 15.3% in atopics), respectively. Although it did not reach statistical significance, asthmatics were more frequently sensitized to cockroaches compared to rhinitics (Table II). There was no difference between cockroach-sensitive and nonsensitive patients with regard to sex, age (data not shown) and reported cockroach infestation (Table III). Seventy-two percent of Pa-sensitive and 70% of

Bg-sensitive patients were also sensitive to dermatophagoids, and there was a significant difference between cockroach-sensitive and nonsensitive patients with regard to dermatophagoid sensitivity (71.5% vs 42.3%, $p<0.001$). Most patients (60%) sensitized to either cockroach species were also sensitive to the other ($p<0.001$). Except for four children, cockroach-sensitive patients were also sensitized to other aeroallergens.

Almost 29% of the study group reported cockroach infestation in their homes, and the majority were Bg (70.7%). Most of the study patients were from Middle Anatolia (87 atopics and 24 nonatopics, 32.9% of the study group)

Table II. Aeroallergen Sensitivity in the Study Group (n=337)

	Asthmatics n (%)	Asthmatics/Rhinitics n (%)	Rhinitics n (%)	Total n (%)
Cockroach	30 (14.7)	14 (19.7)	6 (9.6)	50 (14.8)
PA	18 (8.8)	5 (7.0)	2 (3.2)	25 (7.4)
BG	24 (11.7)	11 (15.4)	5 (8.0)	40 (11.9)
Dermatophagoid	95 (46.5)	42 (59.1)	23 (37.0)	160 (47.5)
Grass pollens	68 (33.3)	41 (57.7)	43 (69.3)	152 (45.1)
Tree pollens	36 (17.6)	15 (21.1)	20 (32.2)	71 (21.1)
Weed pollens	20 (9.8)	20 (28.1)	26 (41.9)	66 (19.6)
Cat danders	21 (10.2)	13 (18.3)	11 (17.7)	45 (13.4)
Molds	57 (27.9)	22 (30.9)	24 (38.7)	103 (30.6)

PA: *Periplaneta americana*; BG: *Blattella germanica*.

Table III. Cockroach Sensitivity According to Infestation

	Cockroach infestation n (%)		Total
	No	Yes	
Sensitized to cockroach	29 (58)	21 (42)	50 (14.8)
Not sensitized to cockroach	209 (72.8)	78 (27.2)	287 (85.2)
Total	238 (70.7)	99 (29.3)	337 (100)

and Black Sea regions (98 atopics and 18 nonatopics, 34.4% of the study group) of the country, and these patients also reported less frequent infestation of their houses ($p < 0.001$). There was no difference for atopy, sex and cockroach sensitivity between the different geographical regions (data not shown).

Serum total IgE levels were measured in 320 of 337 patients because of errors in laboratory settings. Mean total IgE levels were 302.7, 360.7 and 211 IU/ml in the study group and atopic and nonatopic subgroups, respectively. As expected, total IgE levels were higher in atopics ($p < 0.05$) compared to nonatopics. Total IgE levels of cockroach, cat or grass pollen-sensitive patients were higher than nonatopics and house dust mite-sensitive patients (data not shown, $p < 0.005$ for each).

Although there was a good correlation between skin prick test results and specific IgE levels for dermatophagoids ($r = 0.89$, $p < 0.001$), this was not the case for cockroach ($r = 0.19$, $p > 0.05$). Eight of the patients declared presence of cat. However, there were no associations for cockroach and cat sensitivity with regard to presence of cat in the home ($p > 0.05$).

Discussion

We believe that the experience documented here clearly indicates the necessity of inclusion of cockroach antigen in routine allergy screening panels for Turkish children with respiratory allergies, as it may have a prevalence of up to 15%. It is most frequent in asthmatics and its sensitivity is often associated with house dust mite allergy. We also documented that presence of cockroach infestation history is less reliable to guide the search for sensitivity.

To our knowledge, this is the first study addressing the prevalence and characteristics of cockroach sensitivity in a group of Turkish children with respiratory allergies. We were surprised to find that almost 15% of children with respiratory allergies were sensitized to cockroach assessed by skin prick test. Our findings of cockroach sensitization in 14.7% of atopic asthmatics, 19.7% of children with both asthma and rhinitis and finally, in 9.6% of rhinitics are comparable with the frequencies achieved in Europe, but lower than the results of the USA. One potential explanation for these results is genetic factors of our population.

However, our results from high-risk children cannot be compared directly with previous studies where significant differences existed between study populations.

Cockroach sensitivity in children is reported to be up to 70% in some regions of the USA¹⁹, 24% in France, 6% in Sweden and 15% in Spain²⁰⁻²². In our study skin test reactivity to cockroach among atopic Turkish children demonstrated a lower prevalence than the other two studies performed in our country which were done in both pediatric and adult populations. The first one was conducted in the Middle Anatolian region and found that 25.7% of adult asthmatic patients were cockroach-sensitive¹⁶. The other one, conducted in the East Mediterranean area, interestingly found that 51.4% of asthmatic children were cockroach-sensitive²³. Although our results are comparable with the first study, the latter seems to report a very high rate. There are some possible reasons for this difference, such as study method, study population and regional differences; however, our study does not allow us to reach any conclusion in that regard.

The German cockroach has been regarded as the most widespread of the cockroaches with a high allergic potential^{6,19}. Based on previous reports, it has been demonstrated that *B. germanica* is the most common and *P. americana* one of the commonest cockroach species in our country¹³. Like this previous study, we also showed that *Bg* appeared to be the most commonly infested cockroach. Furthermore, prevalence of sensitivity to *Bg* (11.9%) was higher than sensitivity to *Pa* (7.4%) and most *Pa*-sensitive patients were also sensitive to *Bg*. Our results seem to support the previous reports where presence of allergenic crossreactivity between different cockroach species has been reported²⁴. Therefore it seems prudent to consider that the addition of only *Bg* allergen extracts to the routine allergy batteries of skin tests may provide satisfactory results to determine cockroach sensitivity.

In accordance with previous studies a great majority of our cockroach-sensitive patients (except for 4 subjects) have multiple additional inhalant allergies evident from skin prick testing. Therefore, it is quite difficult to consider the extent to which cockroach allergen is contributing to the allergic inflammation

aside from other allergens. Interestingly, four patients had isolated cockroach sensitivity both to Bg and Pa, which supports crossreactivity between different cockroach species^{11,14,22,26}.

Cockroaches usually prefer to live in high temperatures and humid environments, so we were expecting higher frequencies of cockroach sensitivities among patients living in seaside regions because of increased exposure⁵. Our results showed that there were higher frequencies of cockroach infestation in patients coming from the Black Sea and Middle Anatolian regions; however, there was no interregional difference for the sensitivity. The most likely explanations for this inconsistency are age, sex and socio-economical differences between the subgroups studied.

Although we found a significant and good correlation between prick test and specific IgE levels in regard to house dust mite allergen, this was not the case for cockroach, which indicates further standardization of cockroach allergen is required. However, our study design did not investigate a possible reason.

Previous studies reported inconsistent results in terms of crossreactivity between cockroach and other allergens^{3,8,16}. We observed that almost 70% of our patients with cockroach allergy were also sensitive to house dust mite, suggesting crossreactivity between two allergens. Supporting this, Mungan et al.¹⁶, in an adult study from Turkey, also reported that 70% of their cockroach allergic patients were also sensitive to house dust mites.

In conclusion, our preliminary study showed that cockroach sensitization is frequent among children with respiratory allergies regardless of the infestation history of the houses. The addition of Bg allergen in allergy screening panels may give satisfactory results. As skin prick test and specific IgE detection were not correlated, as in the house dust mite, further standardization of the allergen is required. Further studies are needed to document the characteristics of the patients and their effect on prognosis.

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