

## Sensitization to food and inhalant allergens in healthy children in Van, East Turkey

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Received: 14.03.2014

Accepted/Published Online: 15.06.2015

Final Version: 17.02.2016

**Background/aim:** The purpose of this study was to determine the most frequent food and inhalant allergens leading to allergic sensitization in children in Van Province of Turkey.

**Materials and methods:** The study included 1052 serum samples with no diagnosis of allergy. The sera were tested with the Euroline Pediatric IgE test kit (EUROIMMUN, Germany). By using the EUROLIneScan digital evaluation system, the intensity of bands was calculated with enzyme allergosorbent test classification.

**Results:** Out of the 1052 tested sera, 143 were found to be cross-reactive carbohydrate determinant-positive and were discarded from the study. Of the remaining 909 sera, 513 (56%) were from males and 296 (44%) were from females. Among the food allergens, specific IgE was most frequently found against codfish, potato, cow's milk, egg yolk, egg white, and rice, and among the inhalant allergens against cats, dogs, grass mix, *Dermatophagoides pteronyssinus*, and *Aspergillus fumigatus*, respectively.

**Conclusion:** The finding of codfish being the most frequent allergen was related to the high consumption of trout in the region and endemicity of pearl mullet in Lake Van. The results obtained could contribute to determining the etiology of allergic diseases. Additionally, regular analysis of changes in allergen sensitization is important for prevention of allergic disease.

**Key words:** Allergen, children, sensitization, specific IgE

### 1. Introduction

Immediate hypersensitivity responses have traditionally been referred to as type I hypersensitivity reaction, induced. Type I hypersensitivity reaction is an acute and generally inflammatory process triggered by certain types of antigens known as allergens that has formerly induced IgE production in the first exposure of the body to that specific antigen. Allergens are small antigens stimulating an IgE antibody response. An allergen induces humoral antibody responses, resulting in the generation of IgE-secreting plasma cells. After IgE antibody binds to Fc receptors on the surface of mast cells and basophils, these cells are sensitized. Pharmacologically active mediators (e.g., histamine and cytokines) are released from the granules (1,2). Such a response causes several systemic effects. The clinical signs of an allergy depend on the route of entrance and the localization of mast cells carrying antigen-specific IgE antibodies (3–5). The clinical manifestations of immediate hypersensitivity range from

life-threatening conditions, such as anaphylactic shock and asthma, to hay fever and eczema (1,2).

The first principle in the treatment of allergic diseases is to avoid the allergen causing the allergy. For this purpose, allergens leading to allergic sensitization should be determined (6). Allergy tests are grouped as in vivo and in vitro tests. In vitro tests are not life-threatening tests. With these tests, the serum total IgE and specific IgE levels are measured. Since the serum total IgE is increased in parasitic diseases, determination of the specific IgE level is more valuable and preferred. In vivo tests include skin sensitivity and provocation tests (7,8).

The causes of allergic diseases change from country to country or from region to region in the same country depending on climatic, geographic, cultural, and various social conditions (9). The purpose of this study was to determine the most frequent food and inhalant allergens leading to allergic sensitization in children in Van Province of Turkey.

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**2. Materials and methods**

The study was carried out on 1052 serum samples obtained from children of age 0–15 years and with no diagnosed allergy presenting to the Medical Faculty Hospital of Yüzüncü Yıl University. The sera were tested to determine allergies to food and inhalant allergens using the Euroline Pediatric IgE test kit (EUROIMMUN, Germany) according to the directions of the manufacturer. The Euroline Pediatric IgE test kit contains test strips coated with parallel lines of 28 different allergen extracts. The allergens coated on the test strips are displayed in Table 1.

By using the EUROlineScan digital evaluation system, the intensity of bands was calculated with enzyme allergosorbent test (EAST) classification from 1 to 6. EAST is a method compatible with the radioallergosorbent test (RAST) system, which is well known and widely used. Statistical evaluation of the differences between the groups was done using the Z test in Minitab 16. The study was approved by the local ethical committee.

**3. Results**

Among the tested 1052 sera, cross-reactive carbohydrate determinant (CCD) was determined to be positive in 143 (13.6%). The mean ± SE age was 5.5 ± 4.7 (range: 0–15) years. Since CCD is present in many of the allergens of

plant and animal origin, and thus causes strong cross-reactions, the CCD-positive sera were discarded from the study.

Of the 909 sera that were evaluated, 513 (56%) were from males and 396 (44%) were from females. The male:female ratio was 1.3 among CCD-negative children. The mean ± SE ages of male and female groups were 5.3 ± 4.6 years (range: 0–15 years) and 4.7 ± 4.7 years (range: 0–11 years), respectively.

The male and female groups demonstrated equal positivity at a rate of 61% to at least one specific antigen. Among the food allergens, specific IgE was most frequently found against codfish, potato, cow’s milk, egg yolk, egg white, and rice. The high rate of antibody against codfish was highly significant (P < 0.01). Among the inhalant allergens, specific IgE was most frequently found against cats, dogs, grass mix, *Dermatophagoides pteronyssinus*, and *Aspergillus fumigatus*. The rates for cat and dog were not statistically significant, but a significant difference was found between these two groups and the other groups (P < 0.01). A very high level of antibody (grade 5) was determined against grass mix in three sera. None of the sera showed an antibody titer >100 kU/L. The numbers of food- and inhalant-allergen-positive cases are presented in Tables 2 and 3, respectively.

**Table 1.** Allergens coated on test strips.

Food	Inhalant
Apple	<i>Alternaria alternata</i>
Potato	<i>Aspergillus fumigatus</i>
Carrot	<i>Cladosporium herbarum</i>
Hazelnut	Horse
Peanut	Dog
Soybean	Cat
Rice	<i>Dermatophagoides farinae</i>
Wheat flour	<i>Dermatophagoides pteronyssinus</i>
Bovine serum albumin	Mugwort
Casein	Birch
β-Lactoglobulin	Grass mix (Timothy grass and cultivated rye)
α-Lactoalbumin	
Codfish	
Cow’s milk	
Egg yolk	
Egg white	

**Table 2.** Number of food-allergen-positive cases.\*

	Degree 1			Degree 2			Degree 3			Degree 4			Degree 5			Total
	M	F	Total	M	F	Total	M	F	Total	M	F	Total	M	F	Total	
Codfish	162	135	297	8	4	12	2	-	2	-	-	-	-	-	-	311
Potato	16	13	29	5	10	15	3	-	3	-	-	-	-	-	-	47
Cow's milk	20	13	33	2	1	3	2	-	2	-	-	-	-	-	-	38
Egg yolk	18	10	28	1	2	3	1	1	2	2	-	2	-	-	-	35
Egg white	9	12	21	8	1	9	2	1	3	-	-	-	1	-	1	34
Rice	13	13	26	1	3	4	1	-	1	-	-	-	-	-	-	31
Apple	16	11	27	2	-	2	-	-	-	-	-	-	-	-	-	29
Soybean	14	9	23	2	-	2	1	1	2	-	-	-	-	-	-	27
α-Lactalbumin	10	10	20	1	-	1	2	1	3	-	-	-	-	-	-	24
Carrot	8	11	19	3	2	5	-	-	-	-	-	-	-	-	-	24
Casein	9	10	19	1	1	2	1	1	2	1	-	1	-	-	-	24
Peanut	7	8	15	3	3	6	1	-	1	-	-	-	-	-	-	22
Wheat flour	11	4	15	-	1	1	1	-	1	-	-	-	-	-	-	17
β-lactoglobulin	3	7	10	2	-	2	1	-	1	-	-	-	-	-	-	13
Hazelnut	3	5	8	1	1	2	1	-	1	-	-	-	1	-	1	12
BSA	-	2	2	-	1	1	-	-	-	-	-	-	-	-	-	3

\*: A total of 143 CCD-positive sera were discarded from the study. A level 6 response was not encountered to any of the allergens. M: Male, F: Female, BSA: Bovine serum albumin.

**Table 3.** Number of inhalant-allergen-positive cases.\*

	Degree 1			Degree 2			Degree 3			Degree 4			Degree 5			Total
	M	F	Total	M	F	Total	M	F	Total	M	F	Total	M	F	Total	
Cat	34	26	60	17	21	38	2	3	5	-	-	-	-	-	-	103
Dog	34	23	57	12	19	31	3	4	7	-	-	-	-	-	-	95
Grass mix	17	10	27	7	11	18	3	2	5	1	-	1	3	-	3	54
<i>D. pteronyssinus</i>	21	14	35	4	4	8	3	-	3	1	-	1	1	-	1	48
<i>A. fumigatus</i>	18	15	33	4	2	6	-	1	1	-	-	-	-	-	-	40
Horse	10	15	25	2	2	4	-	-	-	-	-	-	-	-	-	29
<i>A. alternata</i>	10	14	24	-	1	1	-	-	-	-	-	-	-	-	-	25
<i>D. farinae</i>	5	8	13	5	1	6	2	-	2	1	-	1	1	-	1	23
<i>C. herbarum</i>	9	9	18	-	2	2	-	-	-	-	-	-	-	-	-	20
Birch	11	7	18	2	-	2	-	-	-	-	-	-	-	-	-	20
Mugwort	5	4	9	3	-	3	1	-	1	-	-	-	-	-	-	13

\*: A total of 143 CCD-positive sera were discarded from the study. A level 6 response was not encountered to any of the allergens. M: Male, F: Female.

#### 4. Discussion

Allergy is encountered in about 20% of individuals, being one of the most frequent diseases of the immune system. Almost half of all people in North America and Europe are allergic to one or more than one environmental antigen(s) (3,4). The prevalence of atopic sensitization is also increasing worldwide. Many studies have shown that food allergy affects more than 1% to 2% but less than 10% of the population. Sensitization patterns change dynamically with age (10,11). According to studies carried out in Turkey, the prevalence of allergic diseases in childhood has rapidly increased, particularly in the last 10 years (12). Many risk factors play a role in the development of sensitization, including genetics, age, exposure time, exposure amount to allergens, and environmental factors (10,11,13).

Sensitization to allergens is an important risk factor for the development of allergic diseases (10). Allergen sensitization tests are important in diagnosing and managing atopic diseases in childhood (14). Currently, the most frequently used in vitro tests used in the diagnosis of allergies are the RAST and enzyme-linked immunosorbent assay (ELISA). The measurement of the serum value of IgE specific for an antigen is also the direct quantitative measurement of the grade of hypersensitivity to that antigen (7,8). The Euroline Pediatric IgE test (EUROIMMUN) test used in this study is an ELISA test measuring specific IgE antibodies in serum or plasma against food- and inhalant-allergens. In the presence of specific IgE, these IgE antibodies bind to allergens and the bound antibodies are determined with the addition of enzyme-linked monoclonal antihuman IgE to the medium. The test strips are coated with bands of CCD and indicator.

The allergens inducing hypersensitivity reactions such as pollens, animal fur, food (nuts, sea crustaceans), and various drugs generally do not cause clinical symptoms in most people. However, some people react against these substances by producing high quantities of IgE and consequently show signs of allergy (5). The most common causes of allergy worldwide are milk, egg, peanut, tree nuts, wheat, soy, fish, and shellfish. These foods are known as the 'big eight' allergens. Eggs and milk are the most prevalent foods in small children (15). Studies have shown that the most common inhalant allergens are *Dermatophagoides farinae*, *D. pteronyssinus*, cats, and dogs (13). *D. pteronyssinus* and *D. farinae* also represent the most common sensitizing strains of house dust mites (16).

In their study on specific IgE values in 25,000 children in Taiwan, Wan et al. (17) determined crab, egg white, milk, and shrimp as the most frequent food allergens and *D. pteronyssinus*, *D. farinae*, *Blomia tropicalis*, dog, cockroach, and cat as the most frequent inhalant allergens. In their study on allergens in cases of atopic dermatitis, Somani et al. (18) determined apple, hazelnut, potato,

and wheat flour as the most frequent food allergens and ryegrass, cat, knotgrass, and *D. pteronyssinus* as the most frequent inhalant allergens. Soares et al. (19) reported that total allergen sensitization among patients with allergic respiratory disease was observed as 73.5%, of which 61.7%, 59.9%, 54.7%, 45.7%, 38.2%, 33.3%, and 9.9% were sensitized to *Dermatophagoides pteronyssinus*, *Dermatophagoides farinae*, *Blomia tropicalis*, *Blattella germanica*, *Canis familiaris*, *Felis domesticus*, and *Alternaria alternata*, respectively. Pastorino et al. (20) evaluated the sensitization to aeroallergens determined by skin prick test in Brazilian adolescents. The positivity of aeroallergens to at least one allergen was observed in 46.8%. Positivity to more than one allergen occurred in 49.8%.

Among studies on allergens in Turkey, Öztürk et al. (21) found specific IgE against one or more allergen(s) in 75% of males and 40% of females, making a total of 58% of all children. As to the general distribution of the allergens, the highest levels of IgE were detected in 12.7% to mites, in 11.5% to house dust mites, in 4.9% to rye, in 4.7% to cockroaches, and in 4.7% to poultry, followed by others (21). Koç et al. (6) found the highest rate of IgE positivity against *D. pteronyssinus*, *D. farinae*, oatmeal, and corn, with an overall positivity in 34.8% of all patients. Çiftçi et al. (22) reported the presence of specific IgE in 29.3% of children studied. In the whole group, allergies to inhalers in 58.6%, to house dust in 51.5%, and to food in 48% was determined by using mixed allergy panels. In atopic children, Perçin (23) found the rate of hypersensitivity to at least one antigen as 52.5% and reported that the most frequent allergen was house dust mites (*D. pteronyssinus*: 45.9%, *D. farinae*: 42.9%) followed by, in order of frequency, grass pollens, tree pollens, cereals, and mold spores. Araz et al. (24) determined hypersensitivity to at least one allergen in 57.1% of children presenting with a chronic cough, and the most frequently determined hypersensitivity was determined to be to grass pollens in 50.4%, to house dust mites in 26.4%, and to wheat pollens in 23.3% of these patients.

In our study on children who had formerly received no diagnosis of allergy, specific IgE positivity was most frequently found against codfish, potato, cow's milk, egg yolk, egg white, and rice among the food allergens and against cat, dog, grass mix, *D. pteronyssinus*, and *A. fumigatus* among the inhalant allergens. The differences in the results as to allergens between this study and other studies in the literature are related to the change of hypersensitivity to allergens with genetic, environmental, and regional factors, as well as to different allergens used in the tests. The differences could also be due to the fact that the studies in the literature had been carried out on patients presenting with an allergy, on patients who had been diagnosed to have an allergic disease, or on patients suspected to have allergy.

In our area, trout (*Salmo trutta*) as well as pearl mullet (*Chalcalburnus tarichi*), which are endemic in Lake Van, are consumed at a high extent. For this reason, the fact that codfish is the most frequent allergen could be related to the high consumption of trout and pearl mullet in the area. Further detailed investigations are required to assess the effect of this situation on the 61% antibody positivity rate against at least one allergen among children who had formerly received no diagnosis of allergy.

In conclusion, allergic sensitization was determined to be high in our region. The fact that the most frequent specific IgE production was found to be that against

codfish necessitates further detailed investigations on trout and pearl mullet, which are of high consumption in the area. This study is the first investigation in the area on allergens and is important for reporting the local allergens in children. The results of this study could contribute to the knowledge of the etiology of allergic diseases. Additionally, regular analysis of changes in allergen sensitization is important for prevention of allergic disease.

#### Acknowledgment

The authors would like to thank EUROIMMUN, Turkey, for supplying test kits and other contributions.

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