Prevalence and severity of sensitization reaction to food and inhalant allergens among allergic patients from Jeddah city: Saudi Arabia

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ABSTRACT

Background: The identification of local common allergens could facilitate the diagnosis and treatment of allergic diseases. The aim of this study was to assess the prevalence of common inhalant and food allergens among patients with allergic symptoms in Jeddah city.

Methods: This is a cross sectional study which recruited 209 consecutive patients who showed allergic clinical presentation and referred to Alborg Laboratory in Jeddah City, Saudi Arabia. Thirty inhalant and 50 food allergens were assessed using in vitro testing for specific IgE. Blood was drawn to be tested with RIDA Allergy Screen, which provides results within 6 degrees of allergy severity from class I with low reactivity to class VI with very high reactivity.

Results: Out of the total 209 patients, 136 (65.1%) reacted to either one or more allergens. Among Aeroallergens, mites indoor allergens were the most common which followed by American cockroaches, cat dander, pollens and then molds. The most common indoor allergen was Dermatophagoides pteronyssinus followed by Dermatophagoides farina. The most common allergen of pollens was Cynodon dactylon and the most prevalent mold allergen was Alternaria tenuis. The common food allergen was peanut followed by cocoa, egg white, cow milk, chocolate, wheat flour, Pistachio nut, goat milk and then cod fish.

Conclusions: Reactivity to aeroallergens such as house dust mites, grasses, American cockroaches, and cat dander were found to be high. The common food allergens were found to be peanut followed by cocoa, egg white, cow milk, and chocolate among patients testing positive for sIgE.

Keywords: Aeroallergens, Food allergens, Inhalant allergens, Allergy, House dust mites, Pollen, Peanut, Cow milk

INTRODUCTION

Allergen is an antigen which can trigger a hypersensitivity reaction in atopics. The overproduction of IgE targeting this antigen usually occurs in allergy patients.1 The sensitization process is the landing of IgE on the surface of mast cells.

The mast cells might explode when re-exposed to the same allergens and yield the inflammatory mediators which provoke the allergic reaction in allergy patients.2 Both environmental and genetic factors play an important role in the occurrence and severity of allergic conditions. Many inhalants and dietary allergens can initiate allergic response in that patients.3 According to the literature, the common aeroallergens are molds, house dust mites and pollens which have a well-established link with asthma and other respiratory allergic conditions.4

The link between dietary allergens and development of atopic conditions is less prominent but there is a hypothesis that shifting from animal to vegetable fat in the last decades contributed to increase in allergic diseases.5
In children, the top food allergens triggering allergic reactions are milk, egg, wheat, soy, peanuts, tree nuts, and fish. Most of children overcome milk, egg, wheat and soy allergy, but allergy to peanuts, tree nuts and fish continue throughout adulthood. There is an international increase in the prevalence of allergic diseases, and Saudi Arabia is no exception.  

To the best of our knowledge, there is no national registry in Saudi Arabia for allergic conditions which could document the common inhalant and food allergens. Although, there are few studies tried to document the top allergens in different area in Saudi Arabia. In Taif city, Tayeb conducted a study aimed to identify the prevalence of common aeroallergens. They found that, the most common indoor aeroallergens were Dermatophagoides pteronyssinus followed by Dermatophagoides farina and american cockroach. While, the most common pollens allergens were dessert palm pollens followed by timothy grass and rye grass.

In Makkah region, another study conducted by the same author found that, the most common aeroallergens are American cockroach followed by Dermatophagoides pteronyssinus, then cat epithelial/hair, then dessert palm pollens and Dermatophagoides farina. In Riyadh region, the highest reactivity to indigenous pollens was to P. juliflora and reactivity to mites such as D. pteronyssinus and D. farinae where 30% in Jeddah city.

The most prevalent allergen pollen was found to be Cynodon dactylon with prevalence ranging from 31% in Riyadh to 3% in Jeddah. As the aeroallergens differ from one climatic region to another. Thus, it is crucial to study the environment of the area to document the most common allergens for that area, which could facilitate the diagnosis and treatment of allergic diseases. The aim of this study was to assess the prevalence of common inhalant and food allergens among patients with allergic symptoms in Jeddah city.

This is a cross sectional study, which recruited 209 consecutive patients who showed allergic clinical presentation and referred to Alborg Laboratory in Jeddah City, Saudi Arabia. Alborg Laboratory is a central lab in Jeddah City, thus it receives patients referred from different allergy clinics. The included patients in this study were any patients referred to the lab in the period of October 2015 up to December 2016 with wide age range (from 1 month to 70 years old). Both inhalant and food allergens were assessed using in vitro testing for specific IgE (SIgE).

The inhalant panel contained 30 allergens including: Salsola kali, Amaranthus retroflexus, Ambrosia, Amaranthus palmeri, Chenopodium album, Kochia scoparia, Artemisia vulgaris, Plantago lanceolate, Poa pratensis, Cynodon dactylon, Sorghum halepense, Lolium perenne, Phleum pretense, Prosopis juliflora, Acacia longifolia, Fraxinus Americana, Eucalyptus globulus, Samanea saman, Medicago sativa, Phoenix dactylifera, Dermatophagoides farina, Dermatophagoides pteronyssinus, Aspergillus fumigatus, Cephalosporium acremonium, Alternaria tenuis, Penicillium notatum, Candida albicans, Cladosporium herbarum, Felis catus, Canis familiaris, Canis familiaris, Equus caballus, Ovis aries, Periplaneta Americana.

The food panel included 50 applied allergens: nuts mix (hazelnut, peanuts, walnut, almond, pistachio nut and cashew); milk and dairy products like (cow milk, goat milk, cheese mix and casein); fruits (orange, peach, cherry, bananas, strawberry, mango, apple, lemon, kiwi and dates); vegetables (potato, celery, carrot, tomato, onion, garlic, aubergine, green bean and celery); egg (yolk, white), sea food (tuna, cod fish, red fish, crab, salmon, shrimp, and sardine); cereals (rice, wheat flour, rye flour, gluten and soya beans), meat (lamb, chicken); Other food and food additives (honey, cocoa, baker’s yeast, chocolate, sesame and maize).

The testing of SIgE was conducted as follows: Blood was drawn to be tested with RIDA Allergy Screen (R-Biopharm, Darmstadt, Germany).

This screening test is highly efficient and cost-effective for the diagnosis of allergies. It compromises test procedures for the antibody detection using an immunoblot with four panels (panel 1 - 4) with 20 allergens on each panel. The digital pictures in RIDA X-Screen or RIDAmaXi-Screen were evaluated automatically. SIgE provides results within 6 degrees of allergy severity from class I with low reactivity to class VI with very high reactivity.

RESULTS

Out of the total 209 patients, 136 (65.1%) reacted to either one or more allergens (Table 1). Among those reacted patients, 74 (54.4%) were adults and 62 were (45.6%) children. Table 2 shows the distribution of patients according to radio allegro sorbent test (RAST) reactions to aeroallergens.

Table 1: Percentage of positive rast to common inhalant and food allergens.

| RAST | Inhalants/food | Number of patients | Percentage (%) |
|------|---------------|--------------------|----------------|
| Positive | 136 | 65.1 |
| Negative | 73 | 34.9 |
| Total | 209 | 100 |

Indoor allergens were the most common type of aeroallergens followed by pollens and molds. Among 209 allergic patients, the prevalence of sensitization to indoor allergens was high.

The most common indoor allergen was Dermatophagoides pteronyssinus with 22% prevalence.
followed by *Dermatophagoides farina* with 18.6% prevalence. They were followed by *Periplaneta americana*, *Felis catus*, and *Canis familiaris*. The most common allergen of pollens among included patients was *Cynodon dactylon*, followed by *Artemisia vulgaris*, *Phleum pretense*, *Phoenix dactyllifera*, and *Ambrosia*. Among mold allergens, the most prevalent allergens was *Alternaria tenuis* (5.7%), followed by *Cladosporium herbarum* (4.3%) and *Candida albicans* (2.9%).

Aspergillus fumigatus sensitivity found at rate of 2.4% and *Cephalosporium acremonium* was 1.4%. The levels of reactivity of specific IgE were started from low reactivity (class I), moderate reactivity (class II), high reactivity (class III) and very high reactivity (class IV, Class V, Class VI).

Top inhalants allergens with low reactivity were *Periplaneta americana* (7.6%), *Canis familiaris* (5.7%), and *Pollens* (*Phleum pretense*; 5.3%, *Cynodon dactylon*; 4.8%, *Artemisia vulgaris*; 3.8%).

Top allergens with moderate reactivity were mites (8.1% and 5.3%), pollens (4.8% and 4.3%), *Felis catus* (4.3%) and *Periplaneta americana* (4.3%). Top allergens with high reactivity were mites (6.2%), *Felis catus* (6.2%), *Periplaneta americana* (4.8%) and *Artemisia vulgaris* (4.3%). Allergens with very high reactivity of specific IgE were *Cynodon dactylon*, *Felis catus*, *Plantago lanceolate* and mites (Figures 1 A-D).

Table 3 shows the number and rate of positive specific IgE reactions to fifty food allergens among examined patients. In this study, 14.8% of patients were allergic to peanut, 12.9% to cocoa. Egg white reactivity was found at a rate of 11.5%, cow milk reactivity was 10% and chocolate reactivity was 8.1%. 7.6% of patients were reactive to wheat flour and Pistachio nut. Goat milk reactivity was found at a rate of 6.7%, cod fish reactivity was 6.2%. 5.3% of patients were reactive to onion, shrimp and walnut. Strawberry, garlic, rye flour and cashew nut reactivity were found at a low
rate of 4.3% and bananas, tomato, red fish, soya bean, cheese mix and hazel nut reactivity was 3.3%. From food panel 50 allergens were tested and categorized of various levels of reactivity of specific IgE same as done in environmental panel. Top allergens with low reactivity were cocoa (4.3%), cow milk (3.3%), soya bean (2.9%), walnut (2.9%), ray flour (2.4%) and casein (2.4%). Allergens with moderate reactivity were goat milk (3.3%), hazel nut (2.9%), red/cod fish (2.4%), garlic (1.9%), egg white (1.9%), cocoa (1.9%) and chocolate (1.9%). Bananas (1.4%), strawberry (1.4%), onion (1.4%), tuna (1.4%) and wheat flour.

Table 2: Prevalence of positive radio allergo sorbent test (RAST) and severity class to 30 applied Aeroallergens among allergic patients.

| Aeroallergens | Scientific name | Number of positive RAST | % of positive RAST results/total RAST= | Severity class of positive Aeroallergens* |
|---------------|-----------------|--------------------------|--------------------------------------|-----------------------------------------|
| **Weeds**     |                 |                          |                                      | I  II  III  IV  V  VI                     |
| Russian thistle | Salsola kali    | 8                        | 3.8                                  | 3  5  0  0  0  0                         |
| Pigweed       | Amaranthus retroflexus | 14                 | 6.7                                  | 6  4  3  1  0  0                         |
| Ragweed       | Ambrosia         | 28                       | 13.4                                 | 4  9  6  2  4  3                        |
| Carless weed  | Amaranthus palmeri | 11                    | 5.3                                  | 4  3  3  1  0  0                         |
| White goosefoot | Chenopodium album | 19                    | 9.1                                  | 4  3  5  2  3  2                        |
| Burning Bush  | Kochia scoparia  | 13                       | 6.2                                  | 6  4  3  0  0  0                         |
| Mugwort       | Artemisia vulgaris | 32                     | 15.3                                 | 8  6  9  2  5  2                        |
| Plantain      | Plantago lanceolata | 21                    | 10.1                                 | 6  2  7  4  2  0                        |
| **Grasses**   |                 |                          |                                      | I  II  III  IV  V  VI                     |
| Bermuda grass | Cynodon dactylon | 36                      | 17.2                                 | 10 5  5  6  3  3                        |
| Johnson grass | Sorghum halepense | 7                      | 3.3                                  | 4  3  0  0  0  0                         |
| Perennial rye grass | Lolium perenne | 17                    | 8.1                                  | 4  4  4  2  1  2                        |
| Timothy grass | Phleum pretense  | 31                      | 14.8                                 | 11 9  7  2  1  1                        |
| **Trees**     |                 |                          |                                      | I  II  III  IV  V  VI                     |
| Mesquite      | Prosopis juliflora | 22                    | 10.5                                 | 4  9  3  3  2  1                        |
| Acacia        | Acacia longifolia | 23                     | 11                                   | 3  10  6  2  1  1                       |
| White Ash     | Fraxinus americana | 4                      | 1.9                                  | 3  1  0  0  0  0                         |
| Rain tree     | Samanea saman    | 16                       | 7.7                                  | 3  7  3  2  1  0                        |
| Alfalfa       | Medicago sativa  | 23                       | 11                                   | 4  9  4  2  3  1                        |
| Date palm     | Phoenix dactylifera | 29                    | 13.8                                 | 5  9  3  3  6  3                        |
| **Mites**     |                 |                          |                                      | I  II  III  IV  V  VI                     |
| House dust mite | Dermatophagoides farinace | 39                | 18.6                                 | 6  11 13 4 2 3                          |
| House dust mite | Dermatophagoidespteronyssinus | 46              | 22                                   | 4  17 13 3 4 5                          |
| **Molds**     |                 |                          |                                      | I  II  III  IV  V  VI                     |
| Fungus        | Aspergillus fumigatus | 5                   | 2.4                                  | 4  1  0  0  0  0                        |
| Fungus        | Cladosporium herbarum | 9                   | 4.3                                  | 4  3  2  0  0  0                        |
| Fungus        | Alternaria tenuis | 12                       | 5.7                                  | 6  3  3  0  0  0                        |
| Fungus        | Candida albicans  | 6                        | 2.9                                  | 2  3  1  0  0  0                        |
| Fungus        | Cephalosporium acremonium | 3                 | 1.4                                  | 3  0  0  0  0  0                        |
| **Animal**    |                 |                          |                                      | I  II  III  IV  V  VI                     |
| Cat [epithelial/hair] | Felis catus  | 33                       | 15.8                                 | 3  9  13 6 2 0                         |
| Dog [epithelial/hair] | Canis familiaris  | 27                     | 12.9                                 | 12 7  6  2  0  0                        |
| Horse [epithelial/hair] | Equus caballus  | 4                      | 1.9                                  | 3  1  0  0  0  0                        |
| Sheep’s wool  | Ovis aries      | 3                        | 1.4                                  | 3  0  0  0  0  0                        |
| **Insects**   |                 |                          |                                      | I  II  III  IV  V  VI                     |
| American Cockroach | Periplaneta americana | 36                | 17.2                                 | 16 9  10 1 0  0                        |

Class I: Low; Class II: Moderate; Class III: High; Class IV: Very High; Class V: Very High; Class VI: Very High
Table 3: Prevalence of positive radio allergo sorbent test (RAST) and severity class to 50 applied food allergens among allergic patients

| Food allergens       | Number of positive RAST | % of positive RAST results/total RAST= 209 | Severity class of positive Food allergens* |
|----------------------|-------------------------|--------------------------------------------|------------------------------------------|
|                      |                         |                                            | I  | II | III | IV | V  | VI |
| Fruits               |                         |                                            | 23 | 22 | 12  | 4  | 1  | 1  |
| Orange               | 6                       | 2.8                                        | 4  | 2  | 0   | 0  | 0  | 0  |
| Mango                | 5                       | 2.4                                        | 3  | 2  | 0   | 0  | 0  | 0  |
| Apple                | 3                       | 1.4                                        | 3  | 0  | 0   | 0  | 0  | 0  |
| Cherry               | 1                       | 0.5                                        | 1  | 0  | 0   | 0  | 0  | 0  |
| Peach                | 1                       | 0.5                                        | 1  | 0  | 0   | 0  | 0  | 0  |
| Bananas              | 7                       | 3.3                                        | 2  | 3  | 1   | 1  | 0  | 0  |
| Strawberry           | 9                       | 4.3                                        | 2  | 3  | 4   | 1  | 0  | 0  |
| Lemon                | 1                       | 0.5                                        | 1  | 0  | 0   | 0  | 0  | 0  |
| kiwi                 | 2                       | 0.9                                        | 1  | 1  | 0   | 0  | 0  | 0  |
| Dates                | 1                       | 0.5                                        | 1  | 0  | 0   | 0  | 0  | 0  |
| Vegetables           |                         |                                            | 23 | 22 | 12  | 4  | 1  | 1  |
| Onion                | 11                      | 5.3                                        | 4  | 3  | 2   | 2  | 0  | 0  |
| Carrot               | 5                       | 2.4                                        | 1  | 0  | 3   | 1  | 0  | 0  |
| Tomato               | 7                       | 3.3                                        | 4  | 2  | 1   | 0  | 0  | 0  |
| Garlic               | 9                       | 4.3                                        | 2  | 4  | 2   | 1  | 0  | 0  |
| Potato               | 4                       | 1.9                                        | 2  | 2  | 0   | 0  | 0  | 0  |
| Aubergine            | 1                       | 0.5                                        | 1  | 0  | 0   | 0  | 0  | 0  |
| Green bean           | 3                       | 1.4                                        | 1  | 1  | 1   | 0  | 0  | 0  |
| Celery               | 1                       | 0.5                                        | 4  | 0  | 0   | 0  | 0  | 0  |
| Sea food             |                         |                                            | 11 | 10 | 7   | 2  | 2  | 2  |
| Tuna                 | 6                       | 2.8                                        | 1  | 3  | 1   | 1  | 0  | 0  |
| Shrimp               | 11                      | 5.3                                        | 3  | 1  | 4   | 2  | 1  | 0  |
| Salmon               | 3                       | 1.4                                        | 3  | 0  | 0   | 0  | 0  | 0  |
| Crab                 | 3                       | 1.4                                        | 1  | 2  | 0   | 0  | 0  | 0  |
| Sardine              | 4                       | 1.9                                        | 1  | 1  | 2   | 0  | 0  | 0  |
| Red fish             | 7                       | 3.3                                        | 2  | 5  | 0   | 0  | 0  | 0  |
| Cod fish             | 13                      | 6.2                                        | 2  | 5  | 2   | 3  | 1  | 0  |
| Cereals              |                         |                                            | 9  | 8  | 5   | 3  | 3  | 3  |
| Rice                 | 2                       | 0.9                                        | 1  | 1  | 0   | 0  | 0  | 0  |
| Ray flour            | 9                       | 4.3                                        | 5  | 1  | 2   | 1  | 0  | 0  |
| Soya bean            | 7                       | 3.3                                        | 6  | 1  | 0   | 0  | 0  | 0  |
| Wheat flour          | 16                      | 7.6                                        | 4  | 3  | 5   | 2  | 2  | 0  |
| Gluten               | 5                       | 2.4                                        | 3  | 2  | 0   | 0  | 0  | 0  |
| Milk and Derivate    |                         |                                            | 10 | 9  | 6   | 3  | 3  | 3  |
| Cow milk             | 21                      | 10                                         | 7  | 2  | 4   | 6  | 2  | 0  |
| Goat milk            | 14                      | 6.7                                        | 1  | 7  | 2   | 3  | 1  | 0  |
| Cheese mix           | 7                       | 3.3                                        | 2  | 1  | 3   | 1  | 0  | 0  |
| Casein               | 6                       | 2.8                                        | 5  | 1  | 0   | 0  | 0  | 0  |
| Eggs                 |                         |                                            | 11 | 11 | 7   | 3  | 7  | 2  |
| Egg white            | 24                      | 11.5                                       | 3  | 4  | 6   | 7  | 2  | 2  |
| Egg yolk             | 4                       | 1.9                                        | 1  | 1  | 2   | 0  | 0  | 0  |
| Nuts                 |                         |                                            | 14 | 14 | 9   | 3  | 3  | 3  |
| Peanut               | 31                      | 14.8                                       | 4  | 2  | 6   | 11 | 7  | 1  |
| Cashew nut           | 9                       | 4.3                                        | 2  | 1  | 1   | 3  | 2  | 0  |
| Almond               | 4                       | 1.9                                        | 1  | 1  | 2   | 0  | 0  | 0  |
| Hazel nut            | 7                       | 3.3                                        | 0  | 6  | 1   | 0  | 0  | 0  |
| Pistachio nut        | 16                      | 7.6                                        | 2  | 2  | 1   | 7  | 1  | 3  |
| Walnut               | 11                      | 5.3                                        | 6  | 1  | 2   | 2  | 0  | 0  |
| Meat                 |                         |                                            | 9  | 8  | 5   | 3  | 3  | 3  |
| Chicken              | 1                       | 0.5                                        | 1  | 0  | 0   | 0  | 0  | 0  |
| Lamb                 | 2                       | 0.9                                        | 2  | 0  | 0   | 0  | 0  | 0  |
| Other food/food additives |                     |                                            | 23 | 22 | 12   | 9 | 4  | 1  |
| Honey                | 1                       | 0.5                                        | 1  | 0  | 0   | 0  | 0  | 0  |
| Cocoa                | 27                      | 12.9                                       | 9  | 4  | 1   | 6  | 2  | 5  |
| Sesame               | 4                       | 1.9                                        | 1  | 1  | 0   | 0  | 0  | 0  |
| Maize                | 2                       | 0.9                                        | 1  | 1  | 0   | 0  | 0  | 0  |
| Baker’s yeast        | 2                       | 0.9                                        | 0  | 2  | 0   | 0  | 0  | 0  |
| Chocolate            | 17                      | 8.1                                        | 4  | 4  | 7   | 2  | 0  | 0  |

Class I: Low; Class II: Moderate; Class III: High; Class IV: Very High; Class V: Very High; Class VI: Very High.
Allergens with high reactivity were chocolate (3.3%), egg white (2.9%), peanut (2.9%), wheat flour (2.4%), cow milk (1.9%), shrimp (1.9%) and strawberry (1.9%). Allergens with very high reactivity of specific IgE were peanut (5.3%), egg white (3.3%), pistachio nut (3.3%), cow milk (2.9%) and cocoa (2.9%) (Figures 2A-D).

Figures 2A: Food low reactivity (Class 1).

Figures 2B: Food moderate reactivity (Class 2).

Figures 2C: Food high reactivity (Class 3).

Figures 2D: Food very high reactivity (Class 4).

DISCUSSION

Recent studies have found that a high occurrence of respiratory allergy which related to the global warming and increase of CO₂ emersion. Climate changes associated with global warming leads to a rise in the production of pollens by trees, which consequently increase allergic diseases.¹¹

In this study, the prevalence of inhalant and food allergens was assessed using in vitro testing for specific IgE. About 65.1% demonstrated reactivity to either one or more allergens. Migueres et al. found a slightly lower prevalence of sensitization with 50% of patients complaining of respiratory allergies showed reactivity to inhalant allergens.¹²

In the present study, indoor allergens were the most common type of aeroallergens in Jeddah city followed by pollens and molds. The most common indoor allergen was *Dermatophagoides pteronyssinus* with 22% prevalence, followed by *Dermatophagoides farinae* with 18.6% prevalence.

These findings showed prevalence lower than findings of a study conducted in Iran, where prevalence of reactivity to *Dermatophagoides farinae* and *Dermatophagoides pteronyssinus* were 32% and 27% respectively.¹³ Many studies from hot and humid regions reported a high prevalence of mites allergy such as in Singapore, Malaysia and Thailand.¹⁴-¹⁶ Similar conditions are found in Jeddah city with high prevalence of mites reactivity according to the present study.

The studies from different countries found Pollens, molds and pets are the most common allergens.¹⁷,¹⁸ In the present study, the most common allergen of pollens among included patients was *Cynodon dactylon*, followed by *Artemisia vulgaris, Phleum pretense, Phoenix*
Reactivity of house dust mites, some grasses, American cockroaches, and cat dander were found to be high in environmental allergens. The most common food allergens were found to be peanut, cocoa, egg white, cow milk, and chocolate among patients testing positive for sIgE.

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**REFERENCES**

1. Kay A. Allergy and allergic diseases. Eng J Med. 2001;344(1):30-7.  
2. Altman LC. Basic immune mechanisms in immediate hypersensitivity. Med clin Nor Am. 1981;65(5):941.  
3. Sicherer SH, Sampson HA. Food allergy. J All All Immun. 2010;125(2):S116-25.  
4. Ezeamuzie C, Thomson M, Al-Ali S, Dowaisaan A, Khan M, Hijazi Z. Asthma in the desert: spectrum of the sensitizing aeroallergens. Allergy. 2000;55(2):157-62.  
5. Okada H, Kuhn C, Feillette H, Bach JF. The ‘hygiene hypothesis’ for autoimmune and allergic diseases: an update. Clin Exper Immun. 2010;160(1):1-9.  
6. Seaton A, Godden DJ, Brown K. Increase in asthma: a more toxic environment or a more susceptible population? Thorax. 1994;49(2):171.  
7. Pearce N, Ait-Khaled N, Beasley R, Mallol J, Keil U, Mitchell E, et al. Worldwide trends in the prevalence of asthma symptoms: phase III of the International Study of Asthma and Allergies in Childhood (ISAAC). Thorax. 2007;62(9):758-66.  
8. Tayeb MMS. Aeroallergens sensitization pattern at Taif city: Saudi. Int J Comm Med Pub Health. 2016;3(4):973-6.  
9. Goronfolah L. Aeroallergens, atopy and allergic rhinitis in the Middle East. Eur Ann Aller Clin Immun. 2016;48(1):5-21.  
10. Hasanin S, Al-Frayh A, Subiza J, Fernández-Caldas E, Casanovas M, Geith T, et al. Sensitization to indigenous pollen and moulds and other outdoor and indoor allergens in allergic patients from Saudi Arabia, United Arab Emirates, and Sudan. World Allergy Organ J. 2012;5(6):59-65.  
11. Clot B. Trends in airborne pollen: an overview of 21 years of data in Neuchâtel (Switzerland). Aerobiologia. 2003;19(3-4):227-34.
12. Migueres M, Dávila I, Frati F, Azpetitia A, Jeanpetit Y, Lhéritier-Barrand M, et al. Types of sensitization to aeroallergens: definitions, prevalences and impact on the diagnosis and treatment of allergic respiratory disease. Clin Transl Allergy. 2014;4:16.

13. Assarehzadegan M-A, Shakurnia A, Amini A. The most common aeroallergens in a tropical region in Southwestern Iran. World World Allergy Organ J. 2013;6(1):1.

14. Chew F, Lim S, Goh D, Lee B. Sensitization to local dust-mite fauna in Singapore. Allergy. 1999;54(11):1150-9.

15. Liam CK, Loo KL, Wong CMM, Lim KH, Lee TC. Skin prick test reactivity to common aeroallergens in asthmatic patients with and without rhinitis. Respirology. 2002;7(4):345-50.

16. Punhirun P, Towiwat P, Mahakit P. Aeroallergen sensitivity of Thai patients with allergic rhinitis. Asian Pacific J Aller Immunol. 1997;15(4).

17. Singh AB, Kumar P. Aeroallergens in clinical practice of allergy in India. An overview. Annals of Agricultural and Environmental Medicine. 2003;10(2):131-6.

18. Fereidouni M, Hossini RF, Azad FJ, Assarehzadegan MA, Varasteh A. Skin prick test reactivity to common aeroallergens among allergic rhinitis patients in Iran. Allergologia et immunopathologia. 2009;37(2):73-9.

19. Huang H-W, Lue K-H, Wong R-H, SUN H, SHEU J, Lu K-H. Distribution of allergens in children with different atopic disorders in central Taiwan. children. 2006;2:3.

20. Singh M. The burden of asthma in children: an Asian perspective. Paediatric respiratory reviews. 2005;6(1):14-9.

21. Abbas N, Raheem A, Ghani F. Environmental and Food Allergens Reactivity and its Association with Total IgE, Age and Gender in Karachi, Pakistan. J Allergy Therapy. 2015;2015.

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