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Research Article

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.[6] There is an international increase in the prevalence of allergic diseases, and Saudi Arabia is no exception.[7]

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.[8] 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*.[9] 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.[10]

The most prevalent allergen pollen was found to be *Cynodon dactylon* with prevalence ranging from 31% in Riyadh to 3% in Jeddah.[10] 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 dactyllifera, 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%).

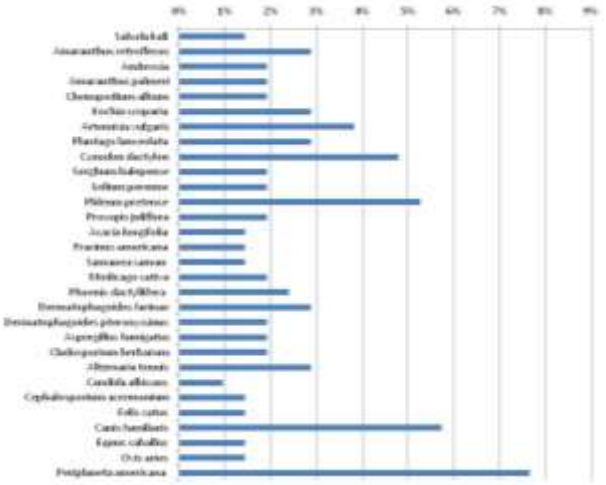


Figure 1A: Aeroallergens low reactivity (Class 1).

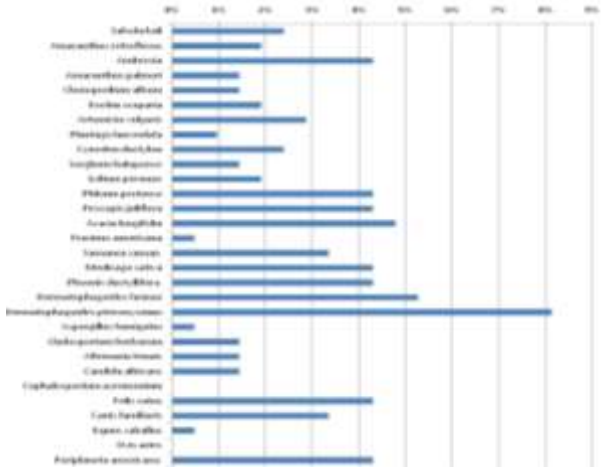


Figure 1 B: Aeroallergens moderate reactivity (Class 2).

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).

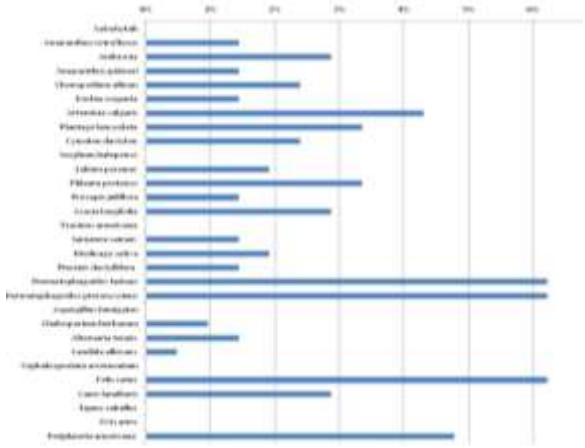


Figure 1C: Aeroallergens high reactivity (Class 3).

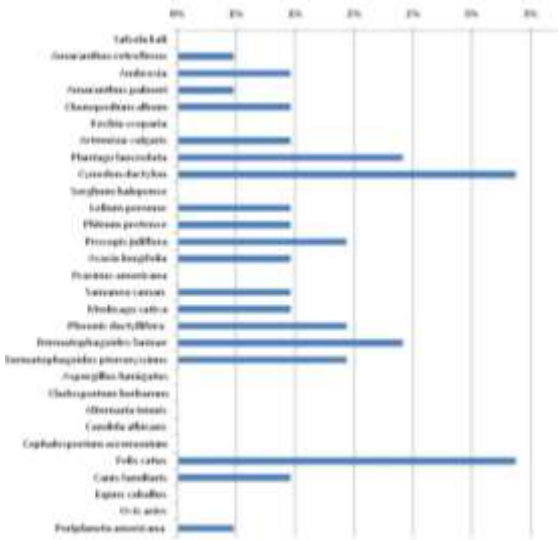


Figure 1D: Aeroallergens very high reactivity (Class 4).

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 allegro sorbent test (RAST) and severity class to 30 applied aeroallergens among allergic patients.

Aeroallergens				Severity class of positive Aeroallergens*					
Common name	**Scientific name**	**Number of positive RAST**	**% of positive RAST results/total RAST= 209**	**I**	**II**	**III**	**IV**	**V**	**VI**
Weeds									
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									
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									
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 dactyllifera*	29	13.8	5	9	3	3	6	3
Mites									
House dust mite	*Dermatophagoides farinae*	39	18.6	6	11	13	4	2	3
House dust mite	*Dermatophagoides pteronyssinus*	46	22	4	17	13	3	4	5
Molds									
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									
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									
American Cockroach	*Periplaneta americana*	36	17.2	16	9	10	1	0	0

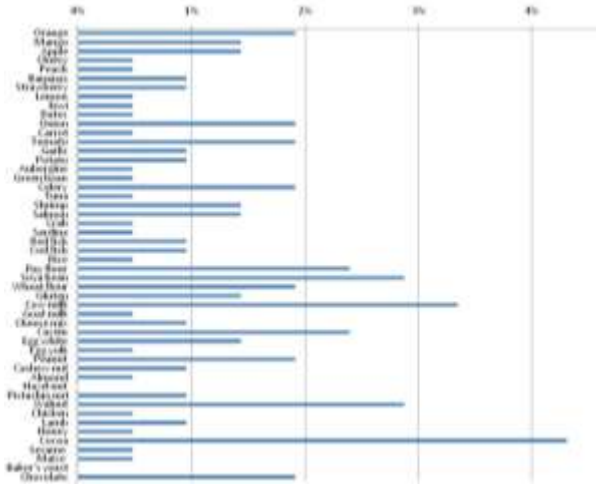
Class I: Low; Class II: Moderate; Class III: High; Class IV: Very High; Class V: Very High; Class VI: Very High

Table 3: Prevalence of positive radio allegro sorbent test (RAST) and severity class to 50 applied food allergens among allergic patients

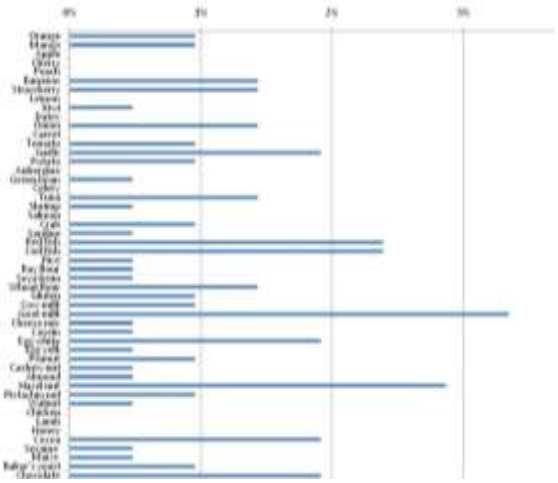
Food allergens				Severity class of positive Food allergens*					
Food type		**Number of positi RAST**	**% of positive RAST results/total RAST= 209**	**I**	**II**	**III**	**IV**	**V**	**VI**
Fruits	Orange	6	2.8	4	2	0	0	0	0
	Mango	5	2.4	3	2	0	0	0	0
	Apple	3	1.4	3	0	0	0	0	0
	Cherry	1	0.5	1	0	0	0	0	0
	Peach	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	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	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	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	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	Egg white	24	11.5	3	4	6	7	2	2
	Egg yolk	4	1.9	1	1	2	0	0	0
Nuts	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	Chicken	1	0.5	1	0	0	0	0	0
	Lamb	2	0.9	2	0	0	0	0	0
Other food/ food additives	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).

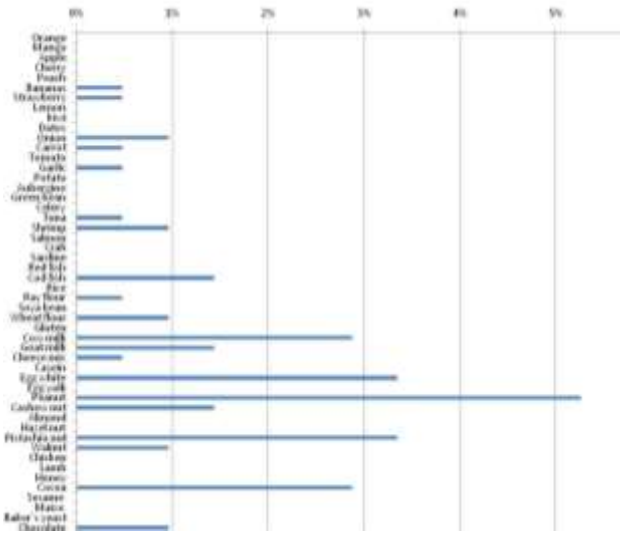


Figures 2A: Food low reactivity (Class 1).



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 CO_2 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 farina* with 18.6% prevalence.

These findings showed prevalence lower than findings of a study conducted in Iran, where prevalence of reactivity to *Dermatophagoides farina* 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*

dactyllifera, and then Ambrosia. In a study conducted in Iran, *Prosopis juliflora* pollen was the most common sensitizing tree pollen followed by pollen of *Fraxinus americana* tree.[13] Type of allergen pollen seemed to be dependent on the geographical and ecological distributions of trees.

In the present study, among mold allergens, the most prevalent allergens was *Alternaria tenuis* with prevalence of 5.7%, followed by *Cladosporium herbarum* with prevalence of 4.3% and then *Candida albicans*. Huang et al. found high prevalence of, environmental allergens such as house dust mites.[19,20]

Abbas et al. found that atopic children are reactive to house dust mites, in addition to other inhaled allergens, such as cockroaches and animal dander.[21] In the present study, prevalence of reactivity for American cockroaches was 17.2% in Jeddah city, while it was 23% in Makkah region and 23% in Taif city.[8]

In this study, in regards with food allergens, 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%. In the literature, three food allergies, including shrimp, crab, and egg white were common in atopic children. Furthermore, compared to older children, younger children (2-6 years) also had higher rates of reactivity to milk, egg white, peanuts, wheat, and soybeans.[19,20]

In the present study, top allergens with low reactivity were cocoa, cow milk, soya bean, walnut, ray flour. While Abbas et al. found the top allergens with low reactivity to be beef, wheat, egg white and then rice.[21]Allergens with moderate reactivity in the present study were goat milk, followed by hazel nut, red/cod fish, garlic, and then egg white.

While Abbas et al. found the top allergens with moderate reactivity to be egg white followed by beef, shrimps, rice, soybean and then wheat.[21] Top allergens with high reactivity in this study were chocolate, egg white, peanut, wheat flour, cow milk, shrimps and strawberry. Abbas et al. found top allergens with high reactivity of specific IgE to be egg white followed by shrimp and peanuts.[21]

In this study, the top allergens with very high reactivity of specific IgE were peanut, egg white, pistachio nut and then cow milk.

This study reported the most common inhalant and food allergens among clinically complaining allergic patients in Jeddah city. However, there are some limitations of the present study. A selection bias could affect the findings of this study since the analysis of samples was done retrospectively. A prospective approach with multi-central samples collection could be a more robust methodology to evaluate the reactivity to allergens among clinically presented patients

CONCLUSION

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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