

# Sensitization to Common Allergens Among Children with Asthma and Allergic Rhinitis in Qatar

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Khalid Zahraldin<sup>1</sup>  
Prem Chandra<sup>2</sup>  
Amjad Tuffaha<sup>3,4</sup>  
Mohammad Ehlayel<sup>4,5</sup>

<sup>1</sup>Section of Pediatric Pulmonology, Department of Pediatrics, Hamad Medical Corporation, Doha, Qatar; <sup>2</sup>Department of Statistics, Medical Research Center, Hamad Medical Corporation, Doha, Qatar; <sup>3</sup>Division of Pediatric Pulmonology, Sidra Medicine, Doha, Qatar; <sup>4</sup>Department of Pediatrics, Weill-Cornell-Medical College- Qatar, Ar-Rayyan, Qatar; <sup>5</sup>Section of Pediatric Allergy-Immunology, Department of Pediatrics, Hamad Medical Corporation, Doha, Qatar

**Background:** Childhood asthma (A) and allergic rhinitis (AR) are common in Qatar. Aeroallergens sensitization is integral in disease pathogenesis and clinical presentation. Determining sensitization patterns assists clinicians in tailoring an efficient medical management.

**Objective:** To determine the aeroallergen sensitization pattern and relationship to clinical parameters.

**Methods:** A retrospective review of children (2–14-years) files with i) Pediatric Allergist/or Pulmonologist confirmed-diagnosis of A, and AR, and ii) positive skin prick test (SPT).

**Results:** Among 473 patients (69.1% males; 30.9% females), aged 7.6 years, family history was positive in 66.3%: 59.4% in A, 64.2% AR, and 78.2% A-AR. The number of allergens/patients was  $2.1 \pm 1.7$ . Median eosinophil count was 400 cells/ul and IgE 287 KU/L. Rates of A, AR, and A-AR varied significantly in children  $\leq 5$  years compared to  $>10$  years: A was 43.2% vs 17.8%, and AR 34.5% vs 16.4%. Two hundred and four children (43.1%) were mono-sensitized, 215 (45.5%) oligosensitized (2–3 allergens), and 54 (11.4%) polysensitized ( $\geq 4$  allergens). A-AR ranked the top number of positive allergens. The commonest aeroallergen was Der p1 (38.1%), followed by Der f (29.0%), cat (22.6%), alternaria (18.8%), American cockroach (18.4%), and dog (14.0%). House dust mite (HDM) and American cockroach were commoner in  $\leq 5$  years than older  $>10$ -year children (52.5%, 24.1%), while cat and dog allergens were commoner in older ones (37.1%, 21.6%).

**Conclusion:** Family history is quite positive in patients with A and AR. Common aeroallergens include HDM, cats, and alternaria in the young children, while animal allergens were commoner in the older children.

**Keywords:** asthma, allergic rhinitis, skin prick test, children

## Introduction

The prevalence of respiratory allergic disorders has increased in the last few decades and has become a major medical concern, and the impact of these diseases is huge on patients, families, and societies.<sup>1,2</sup>

Despite decades of research, little is known about which factors are the main determinants of the high and of the large global variation in asthma and other respiratory allergic disease prevalence.<sup>3</sup> By the time children reach middle school (10–13 years of age), asthma is very strongly associated with common inhalant allergens.<sup>4</sup> At this age, the odds ratio for wheezing among sensitized compared to non-sensitized individuals is often 6 folds or higher.<sup>5,6</sup>

Correspondence: Mohammad Ehlayel  
Section of Pediatric Allergy-Immunology,  
Department of Pediatrics, Hamad Medical  
Corporation, PO Box 3050, Doha, Qatar  
Tel +974 4439 2834  
Fax +974 4443 9571  
Email mehlayel@gmail.com

SPT with the standardized allergen panels is highly recommended for epidemiological studies, clinical use, and research.<sup>7</sup> It is essential to determine the patterns of aeroallergen sensitization for purposes of disease management in a particular region (eg, Gulf area) where aeroallergen monitoring systems have not been well established. Although respiratory allergies are common in Qatar, both in children and adults,<sup>8–12</sup> the medical research is sparse on the pattern of aeroallergens, particularly in allergic children.<sup>10</sup>

The aim of this study is to determine the prevalence of aeroallergen sensitization, rate of specific aeroallergen sensitization, and pattern change in this sensitization over a 6-year period in children with respiratory allergic disorders in Qatar.

## Methods

### Study Design and Subjects

In this retrospective chart review of children who were evaluated at the pediatric allergy and pediatric pulmonology clinics, Hamad General Hospital, a tertiary care hospital and affiliated with Weill-Cornell Medical College-Qatar in Doha, Qatar between September 2008 and October 2014. Using the clinic logbook, we collected data on i) children 2–14-years old with ii) physician-confirmed-diagnosis of A, and AR, and ii) and positive SPT to at least one aeroallergen.

The study population comprised all patients, between 2 and 14 years, that underwent skin prick testing for aeroallergens during the study period. We excluded patients who had i) severe debilitating chronic illnesses (eg, chronic renal failure, hepatic failure, malignancy, etc.), ii) dermatographism as per physical examination prior to SPT, iii) patients on immunotherapy (subcutaneous or sublingual immunotherapy), or patients on iv) chronic systemic steroids at the time of SPT or immune-modulator therapy (eg, omalizumab or similar). The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Institutional Review Board (IRB) at Hamad Medical Corporation. As this was a retrospective study, informed consent from patients is not required by the Institutional Review Board (IRB) of Hamad Medical Corporation. The privacy of all participants was protected, we confirmed the data were anonymized and maintained with confidentiality.

### SPT Technique and Extract

We utilized a standardized panel of SPT at our clinics for all patients suspected of sensitization to aeroallergens and it included 12 common aeroallergens: *A. alternata*, *A. fumigatus*, *C. herbarum*, feather mix, grass mix, penicillium, rhizopus, cat

dander, dog hair, *D. pteronyssinus* (Der p1), *D. farinae* (Der f), and cockroaches. SPTs to other aeroallergens were performed, when indicated by medical history, including alfalfa, palm date, mesquite, *B. tropicalis*, acacia, birch, and mugwort. SPTs were performed by a well-trained allergy/pulmonary function laboratory technician under the supervision of the clinic allergists/pulmonologists using a standardized technique. A drop of each aeroallergen extracts along with a drop from the positive (histamine) and negative (normal saline) controls was applied to the anterior forearm skin and then skin prick through the drop using Stallerpoint<sup>®</sup> plastic lancets. The test was read by the technician and the clinic allergists/pulmonologists 10 to 15 minutes after the application of the allergen. A positive test was defined as a wheal of at least 3 mm larger than the negative control. Mono-sensitization was defined as sensitization to one aeroallergen of the SPT panel, oligo-sensitization as sensitization to 2–3, and poly-sensitization as sensitization to  $\geq 4$  aeroallergens.

### Data Collection

Basic demographic data (age, sex), type of respiratory allergic disease, family history of allergies, and SPT results were collected and entered into an MS Excel spreadsheet and analyzed in all patients. Whenever available, CBC with differential counts and total serum IgE were collected; too.

### Statistical Analysis

All collected data were analyzed using statistical packages SPSS 24.0 (SPSS Inc. Chicago, IL) and Epi-info (Center for Disease Control and Prevention, Atlanta, GA) software. The normally distributed data and results were presented with mean and standard deviation (SD) with corresponding 95% confidence interval (CI); the remaining results were reported with median and inter-quartile range (IQR). Categorical data were summarized using frequencies and percentages. Associations between two or more qualitative variables were assessed using Pearson Chi-square test ( $\chi^2$ ) or Fisher exact Chi-square or Yates corrected Chi-square tests as appropriate. All P values presented were two-tailed, and P values  $<0.05$  were considered as statistically significant.

## Results

A total of 473 children ( $\leq 14$  years) with at least one respiratory tract allergic disease and SPT showing sensitivity to at least one allergen were enrolled in the study. Mean age ( $\pm$ SD) of the study cohort was  $7.6 \pm 3.3$  years and 69.1% were males (Table 1).

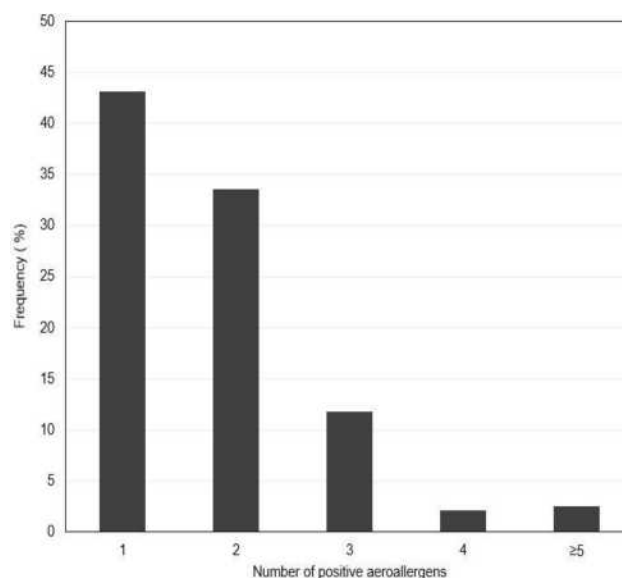
**Table 1** Clinical Characteristics of 473 Children with Respiratory Allergic Diseases

Variable	
Total number (n=473 patients)	
Age (years $\pm$ SD)	7.6 $\pm$ 3.3
Sex	
Male	327 (69.1%)
Female	146 (30.9%)
M/F ratio	2.2/1.0
Allergy Type (n=473 patients)	
Asthma	175(37%)
Allergic rhinitis	57(12%)
Both	209 (44.2%)
Others**	32(0.8%)
Family history of allergies*, (n=406 patients)	
Positive	269 (66.3%)
Negative	137 (33.7%)
No of positive SPT (mean $\pm$ SD)	2.1 $\pm$ 1.7

**Notes:** \*Data available on 406 patients. \*\*Others: A or AR coexistent with other non-respiratory allergic diseases: drug allergy, eosinophilic esophagitis, etc.

The rates of A, AR, or A-AR, in addition to family history of these diagnoses, were significantly different between different age groups, [Table 2](#).

The number of allergen sensitization per patient was 2.1 $\pm$ 1.7 (95% CI: 1.93–2.24) allergens. Two hundred and four children (43.1%) were mono-sensitized, 215 (45.5%) oligosensitized and 54 (11.4%) polysensitized. Almost 90% were positive for  $\leq 3$  allergens, 75% for  $\leq 2$  allergens, and around 40% for one allergen as in [Figure 1](#).

**Figure 1** Frequency of positive skin tests among children with respiratory allergy.

The number of polysensitized children (n=271, 57.3%) was more than monosensitized (n=202, 42.7%) ones. However, rates of monosensitization were comparable to those of polysensitization for children  $\leq 5$  years (30.7 vs 30.3%), children 6–10 years' age (48% vs 49.8%), and those 10> years (21.3% vs 19.9%).

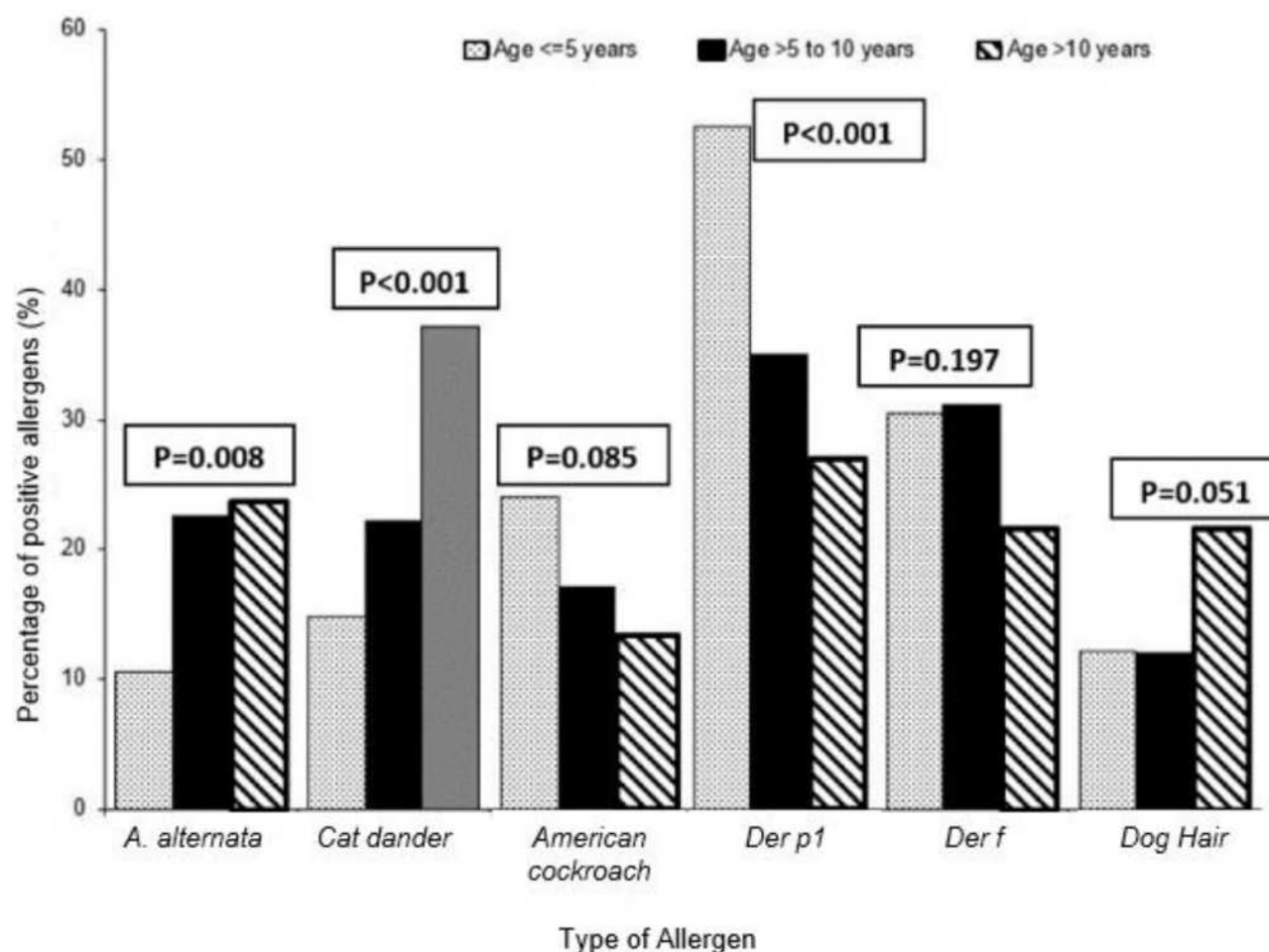
Compared to A alone, AR alone, or other disease combinations, A-AR ranked the highest rates of positive SPT regardless of number of positive allergens, data not shown.

The frequency of specific allergens across all age groups: Der p1 observed in 180 subjects (38.1%), Der f 137 (29.0%), cat allergen 107 (22.6%), *A. alternata* 89 (18.8%), American

**Table 2** Rates of Different Types of Respiratory Allergic Disease According to Sex, Age, and Family History of Allergic Diseases

Characteristics	Number of Subjects (n=473 Patients)				P value
	Asthma	(A) Rhinitis	Both (A-AR)	Others**	
Sex					0.032
Male	114 (28.7%)	35 (10.7%)	158 (38.3%)	20 (6.3%)	
Female	61 (41.8%)	24 (16.4%)	50 (34.2%)	11 (7.5%)	
Age					<0.0001
2–5yr	76 (43.4%)	20 (35.1%)	39 (18.8%)	9 (29.0%)	
>5yr–10yr	68 (38.9%)	28 (49.1%)	121 (57.9%)	17 (51.6%)	
>10yr–14yr	31 (17.7%)	9 (16.4%)	49 (23.3%)	6 (19.4%)	
Family history of allergy*					<0.0001
Positive	85 (59.4%)	34 (64.2%)	147 (78.2%)	3 (13.6%)	
Negative	58 (40.6%)	19 (35.8%)	41 (21.8%)	19 (86.4%)	

**Notes:** Yates corrected Chi-square test was applied in case of small cell frequencies (50% or more cells have expected frequencies  $< 5$ ) to compute respective statistical P-value. \*Data available on 406 patients. \*\*Others: A or AR coexistent with other non-respiratory allergic diseases: drug allergy, eosinophilic esophagitis, etc.



**Figure 2** Rates of different types of allergens according to age groups of children with respiratory allergic diseases.

cockroach 87 (18.4%), dog allergen 66 (14.0%), *C. herbarum* 40 (8.5%), grass mix 40 (8.5%), *A. fumigatus* 25 (5.3%), and feather mix 13 (2.7%). HDM tended to be the most common allergen for all age groups. It was noticed that HDM and American cockroach sensitization rates were highest among children less than 5 years and tended to be less frequent in the older age groups. Rates of cat and dog allergens were higher in children >10 years. However, rates of alternaria were higher to older children (6–14 years) than those in young (<5 years) children, as in Figure 2. Median (25th–75th percentiles) absolute eosinophil count of 400 cells/ul (180–738), and serum IgE 287 KU/L (112–852).

## Discussion

Sensitization to aeroallergens is commonly associated with AR and asthma, yet numerous studies have shown that the distribution and pattern of allergy differ significantly from one country to another. Identifying

common allergens in local populations is imperative for diagnosis and targeted specific therapy.<sup>13</sup> Our study was conducted with the aim of specifically targeting the pediatric population and as far as we know, it might be the first study to solely include children under the age of 14 in Qatar. This discussion will include further elaboration in regards to the most common aeroallergens in patients with A, AR, or A-AR and comparison with other studies in the region.

Bronchial asthma and AR tended to be more common in females than males with the percentages of 41.8% and 16.4%, respectively. However, the results were not statistically significant. One similar study on 1106 asthmatic adult patients in Doha, State of Qatar was established in 2003 and showed similar results, where asthma was more prevalent in females 32.7% than males 29.8%.<sup>8</sup>

In this study, the rate of AR alone, asthma alone, or A-AR and asthma were significantly more common in the

young age groups (less than 10 years) compared to older counterparts (those above 10 years).

Asthma is a multifactorial disease that can be influenced by environmental and genetic factors. Family history plays an important role in the pathogenesis of the disease. Therefore, identifying people with a family history may promote their earlier diagnosis and treatment.<sup>14</sup> In our study, there was significant difference in rates of positive family history compare to negative family history children with A (1.5 folds), AR (1.8 folds), but highest rates among those with A-AR (3.6x folds). The rates of positive family history were significantly different in the 3 allergic respiratory diseases: for A 59.4%, AR 64.2%, and A-AR 78.2%. Similarly, these findings were comparatively approximate to the previous study conducted in Qatar which showed that 44% of asthmatic patient had a strong positive family history.<sup>8</sup>

In this study, the most common aeroallergen was Der p1 (38.1%), followed by Der f (29.0%), cat (22.6%), *A. alternata* (18.8%), American cockroach (18.4%), dog (14.0%), *C. herbarum* (8.5%), grasses (8.5%), *A. fumigatus* (5.3%), and feathers (2.7%). Similar results were observed in previous studies done in Qatar and Saudi Arabia.<sup>8,15–17</sup> On the other hand, a study in UAE that involved 180 pediatric patients with allergies, showed that the most common aeroallergens were Der f (38.3%) followed by Der p1 (37.2%) and Cat dander (17.2%).<sup>13</sup> Moreover, there was a study in Jordan and two previous studies directed in Iran (one of them was a meta-analysis study) revealed that the most common aeroallergens were pollens followed by HDM and cockroach.<sup>18–20</sup> The differences between the results from Gulf states, including ours, with those from Jordan and Iran might be related to genetic, environmental, or geographical/meteorological factor or even lifestyles.

HDM and American cockroach sensitization rates were commoner in children <5 years (52.5%, 24.1%) than older children, while rates for cat and dog allergen sensitization (37.1%, 21.6%) were highest in children older than 10 years. These results can be explained by the assumption that younger children stay more indoor and therefore are more exposed to HDM and cockroaches than older children who play outside baring themselves to animal allergens. Similar conceptual results were found in the following studies: Riyadh (HDM and aspergillus sensitization rates were more common in adults whereas *Salsola kali* and date palm sanitization were more common in children),<sup>16</sup> Iran (cockroaches sanitization is more prevalent in children <16 years, whereas

HDM, pollens, cat dander, and molds were more common in adults >16 years),<sup>20</sup> Jordan (cats and HDM are more common in younger age group)<sup>18</sup> and Saudi Arabia (where HDM is the most prevalent allergen in younger age group).<sup>17</sup>

## Conclusions

It has come to our conclusion that asthma and allergic rhinitis are strongly correlated with a positive family history. Moreover, in comparison to the older age group, the younger age groups had a higher rate of allergic diseases with HDM, cats, and alternaria being the most common amongst this group and animal allergens the most common amongst the older age group. The majority of children tested positive to 4 inhalant allergens.

This study presents evidence that family history still remains of great help when clinically diagnosing asthma and allergic rhinitis, and in addition to other factors, child's age should be considered when selecting the aeroallergens panel for skin testing.

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## Disclosure

The authors declare no conflicts of interest for this work.

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