

# Airway allergy and skin reactivity to aeroallergens in Riyadh

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## ABSTRACT

**الأهداف:** لرصد نمط التفاعل الجلدي لاختبار الحساسية لمجموعة من مسببات الهوائية في المرضى الذين يعانون من حساسية الأنف والربو الشعبي في منطقة الرياض.

**الطريقة:** شملت الدراسة 139 سعودي (53% إناث - 47% ذكور)، بمتوسط عمر (27±12 عاماً)، من المراجعين بمستشفى الملك خالد الجامعي - الرياض - المملكة العربية السعودية، خلال الفترة ما بين يناير 2003م وحتى مارس 2004م. وقد تم تشخيصهم سريريا وتبين أنهم يعانون من حساسية بالجهاز التنفسي. تم إجراء اختبار الحساسية الجلدية لجميع المرضى باستخدام مجموعة من مسببات الحساسية الهوائية (مسببات داخل وخارج المنزل) بالإضافة إلى مجموعة من مسببات الفطرية.

**النتائج:** أوضحت الدراسة أن (75%) (105) من المرضى لديهم تفاعل لاختبار الحساسية لواحد أو أكثر من المسببات. كانت درجة التحسس لمسببات الحساسية المنزلية عالية لعثة الغبار المنزلي (77.8%)، يليها التحسس لوبر الققط (33.6%)، الصراصير (19.2%). أما مسببات الحساسية خارج المنزل فكانت عالية لحبوب لقاح شجرة البرسوس (72.1%)، تليها حبوب لقاح حشائش الثيل (53.8%)، حبوب لقاح الزربيع (47.1%)، حبوب لقاح حشائش الهيبان (36.5%) وحبوب لقاح حشائش الروث (36.5%). وقد وجد أن عدد كبير من المرضى لديه تفاعل للمسببات الفطرية (18.2%) وعلى الأخص فطر الرشاشية الدخلاء (18.2%).

**خاتمة:** تبين أن عدد كبير من المرضى الذين لديهم قابلية التحسس يعانون من حساسية الأنف أو الربو الشعبي، كما إن لديهم تفاعل لاختبار الحساسية الجلدية لواحد أو أكثر من المسببات الهوائية بمنطقة الرياض.

**Objectives:** To determine the pattern of skin prick test reactivity to aeroallergens in patients with asthma and rhinitis (airway allergy) residing in Riyadh region.

**Methods:** This is a retrospective cross sectional study based on data analysis of skin prick test results of individuals with clinical diagnosis of airway allergy. Allergy skin prick test result data of 139 Saudi nationals from Riyadh region tested at King Khalid University

Hospital between January 2003 and March 2004 was analyzed retrospectively. This group comprised of 53% females and 47% males, with a mean age of 27 ± 12 years. A set of aeroallergens extracts for both indoor and outdoor allergens including fungal spores was used to test the patients.

**Results:** Seventy-five percent (105) of patients reacted to one or more allergen extracts. The most frequently reacting indoor allergen was house dust mite (77.8%) followed by the cat (33.6%) and cockroach (19.2%). Among the outdoor allergens *Prosopis juliflora* was tested positive in 72.1%, Bermuda grass in 53.8%, *Chenopodium album* in 47.1%, Rye grass in 36.5% and *Salsola kali* in 36.5%. A significant proportion of patients were also found reacting to Moulds (18.2%) and *Aspergillus fumigatus* (18.2%) extracts.

**Conclusion:** Sensitivity to one or more aeroallergens was common in patients, indicating high level of aeroallergen sensitization in patients with airway allergy residing in Riyadh region.

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Exposure to aeroallergens has long been associated with airway allergic disorders. In recent decades a number of authors have argued that allergen exposure is the major primary cause of asthma,<sup>1-4</sup> and that the global increases in asthma prevalence could be the result of increases in exposure to aeroallergens.<sup>3</sup> The hypothesized mechanism is that allergen exposure produces sensitization and continued exposure leads to the development of bronchial hyperactivity and

inflammation resulting in clinical asthma.<sup>1</sup> In a sensitized individual, bronchial provocation with a relevant allergen is a well-established method for recruiting eosinophils in the lungs and producing increase in bronchial hyperactivity.<sup>5,6</sup> Asthma associated allergens are primarily perennial indoor allergens such as house dust mite (HDM), animal dander, and cockroaches.<sup>7-11</sup> Removing asthmatics from their homes not only decreases the symptoms but a marked reduction in bronchial hyper-reactivity has also been observed among these patients.<sup>12</sup> In addition, education of parents and a simple preventive measure (mattress encasement) to reduce mite allergen exposure has been shown to reduce sensitization to mite allergens in toddlers and preschoolers.<sup>13</sup>

Skin prick test (SPT) is a major tool in the diagnosis of IgE mediated-allergy. Skin tests are easily carried out, without absolute contraindications and may also be applied to assess predisposition to asthma.<sup>14</sup> Increased exposure to both indoor and outdoor aeroallergens has been implicated in the sharp rise in the prevalence of allergic diseases such as asthma and rhinitis observed in the Kingdom of Saudi Arabia (KSA) between 1986 and 1995.<sup>15</sup> This is further supported by the fact that a previous report from Riyadh region has shown that 63.3% children with asthma react to both indoor and outdoor aeroallergen extracts.<sup>16</sup> Based on the SPT reactivity, this study retrospectively examines the status of aeroallergen sensitization in Saudi adults and children with clinical diagnosis of airway allergy in Riyadh region of KSA.

**Methods.** A total of 139 Saudi patients from Riyadh region were assessed in this study. On the basis of history and clinical presentation, 84 adults (mean age 29 ± 12 years) and 55 children (mean age 9 ± 4 years) were diagnosed as having airway allergy (asthma, rhinitis or both). Forty-nine (59%) of adults recruited were females and 35 (41%) were males, whereas 29 children (52%) out of 55 were females and 26 (48%) were males. These patients were referred for aeroallergen SPT to the allergy clinic at King Khalid University Hospital, Riyadh, KSA between January 2003 and March 2004. Patients who are taking anti-histamine medications or on long term steroids were excluded as well as pregnant women. The informed consent was obtained from each subject or subject's guardian, after approval of the experimental protocol by the local human ethics committee. A combination of allergen extracts from tree, weed, grass pollens, HDM, cockroach, cat and fungal spores was used for SPT. Table 1 shows the details of the set of allergen extracts used in the study. A positive (histamine dihydrogen phosphate 1 mg/ml) and a negative control (saline) were included for each assessment. A drop of

each allergen extract was placed on the skin of forearm and the underlying skin was nicked using a fine lancet. The results were recorded after 15 minutes and a test was considered positive if the wheal diameter was equal to or more than 3 millimeters in diameter.

Comparison of the proportions was performed using Medical software version 7. Student t test was used for comparison of means and a  $p \leq 0.05$  was considered significant.

**Results.** Out of the total 139 patients, 105 (75.5%) reacted to either one or more allergens. This group included, 64 (61%) adults and 41 (39%) children. Table 2 shows the details of the number of SPT reactions in children and adults. Five (7.8%) adult patients and 7 (17%) children reacted to single allergen whereas the rest of the patients in both groups reacted to multiple allergens. The majority of adults (17.5%) reacted to 5 and children (19.5%) reacted to 6 allergens. The maximum number of positive tests per patient was 14 compared to 8 in children. Skin prick test results of adults and children with airway allergy to indoor and outdoor aeroallergen were compared (Table 3). Comparison of the data revealed that a significantly higher proportion of adults were reacting to HDM ( $p=0.008$ ), *Aspergillus* ( $p=0.02$ ), Bermuda grass ( $p=0.004$ ) and ragweed allergens, whereas children were reacting to *Salsola kali* ( $p=0.02$ ) and date palm ( $p=0.009$ ) more often than the adults. Skin prick test reactivity for *Aspergillus niger* and ragweed allergens was observed only in adults and none of the children tested positive to these allergens.

**Table 1** - Allergen extracts used for skin prick testing (Nelco Labs. USA).

Concentration	Allergen
1:20w/v	Date palm, <i>Phoenix dactylifera</i>
1:10w/v	Atriplex
1:20w/v	<i>Salsola kali</i> , Russian thistle
1:20w/v	<i>Prosopis juliflora</i> , Mesquite tree
1:20w/v	<i>Chenopodium album</i> , Lamb's quarters
1:10w/v	Rye grass, <i>Lolium perenne</i>
1:20w/v	Ragweed mix
1:10w/v	Bermuda grass, <i>Cynodon dactylon</i>
1:20w/v	Cladosporium
1:20w/v	<i>Alternaria tenuis</i>
1:20w/v	<i>Aspergillus niger</i>
1:20w/v	<i>Aspergillus fumigatus</i>
1:20w/v	Moulds
1:10w/v	Cat
1:100w/v	Cockroach mix American/German
10,000 IU/ml	House dust mite, <i>Dermatophagoides pteronyssinus</i>
10,000 IU/ml	House dust mite, <i>Dermatophagoides farinae</i>

**Discussion.** This study shows the spectrum of aeroallergen sensitization in patients with airway allergy in Riyadh region. The most common indoor allergen was HDM whereas the out-door allergen was *Prosopis juliflora* in children and adults with airway allergy. It was shown that 75.5% patients reacted to one or more allergens. Results of other studies have varied from 24.9-81.6%.<sup>17-19</sup> A recent study examining the aeroallergen spectrum in Chinese population reports HDM allergen to be the most common among patients with airway allergy.<sup>20</sup> Similarly, a separate study of approximately 1100 patients with allergic rhinitis has shown that the most commonly reacting allergens detected using SPT were grasses, mountain cedar, and dust mites.<sup>17</sup> The varying rates of allergen sensitization and the diversity of reacting allergens could be due to different populations and regional variations. The skin reactivity to allergen extract is mediated by allergen specific IgE. Elevated serum IgE specific to indoor allergens has been associated with asthma in several cross sectional studies of children,<sup>9,10,21,22</sup> and young adults.<sup>23</sup> Both genetic and environmental factors are believed to contribute to this relationship between the presence of specific IgE to aeroallergens and manifestations of airway allergy.<sup>24-27</sup> In genetically predisposed individuals, environmental factors appear to play an important role in sensitization to allergens. The amount of domestic allergen exposure necessary for sensitization to occur and the amount necessary to result in symptoms in sensitized individuals is however not clearly defined although provisional values have been suggested.<sup>28,29</sup> The level of sensitization to aeroallergens observed in this study may therefore reflect the degree of exposure to allergens in

the environment of these patients were residing in. This possibility appears to be real since the concentration of mite allergen in the environment has been shown to be a predictor of future mite sensitization.<sup>1,30</sup> Aerobiological survey is probably the best method of estimating the aeroallergen load that the atopic individuals are exposed to. A survey conducted in Al-Khobar, KSA provides some insight to the aeroallergen composition of the region.<sup>31</sup> Extensive aerobiological survey of the Kingdom and simultaneous assessment of aeroallergen sensitization by SPT and detection of specific IgE in the respective atopic population would help to assess the impact of environmental aeroallergen load on airway allergy. Several reports regarding aeroallergen sensitization in Riyadh and other regions of the Kingdom published in the past have focused on children with asthma.<sup>16,32,33</sup> We compare this study to the status of aeroallergen sensitization in adults and children with airway allergy in Riyadh. In the Eastern province of the Kingdom a similar population of Saudi nationals with airway allergy was investigated in 1996.<sup>34</sup> The set of allergens used in that study was different from the one used in the present study; however, consistent with findings of the present study, pollen hypersensitivity was found to be very common in Saudi patients with airway allergy. Whereas *Prosopis juliflora* was the most frequently reacting allergen in the present study. *Chenopodium album* allergen was found to react in majority of the patients about 8 years back. Reactivity to Bermuda grass

**Table 2** - Number of positive skin prick test reactions in adults and children with airway allergy.

Allergens no.	No. of positive reactions in adults (%) n=64	No. of positive reactions in children n=41 (%)
1	5 (7.8)	7 (17)
2	5 (7.8)	6 (14.6)
3	9 (14)	6 (14.6)
4	9 (14)	4 (9.7)
5	11 (17.1)	5 (12.1)
6	9 (14)	8 (19.5)
7	8 (12.5)	2 (4.8)
8	1 (1.5)	3 (7.3)
9	2 (3.1)	-
10	1 (1.5)	-
11	1 (1.5)	-
12	1 (1.5)	-
13	1 (1.5)	-
14	1 (1.5)	-

**Table 3** - Comparison of skin test reactivity to aeroallergens between adults and children with airway allergy.

Allergen	No. of adults (n=64) (%)	No. of children (n=41) (%)	P-value
Total <i>D. pteronyssinus</i> & <i>D. farinae</i>	46 (71.8)	18 (43.9)	0.008
<i>D. pteronyssinus</i> & <i>D. farinae</i>	27 (58.8)	9 (50.0)	ns
<i>D. pteronyssinus</i>	10 (21.7)	7 (38.9)	ns
<i>D. farinae</i>	9 (19.5)	2 (11.1)	ns
Cockroach	11 (17.1)	6 (14.6)	ns
Cat	20 (31.2)	18 (43.9)	ns
Moulds	12 (18.7)	3 (7.3)	ns
<i>Aspergillus fumigatus</i>	12 (18.7)	1 (2.4)	0.02
<i>Aspergillus niger</i>	4 (6.2)	0 (0)	
Alternaria	6 (9.3)	2 (4.8)	ns
Cladosporium	8 (12.5)	2 (2.4)	ns
Bermuda grass	38 (59.3)	12 (29.2)	0.004
Ragweed	17 (26.5)	0 (0)	
Rye grass	24 (37.5)	9 (21.9)	ns
<i>Chenopodium album</i>	33 (51.5)	14 (34.1)	ns
<i>Prosopis juliflora</i>	41 (64.0)	25 (60.9)	ns
<i>Salsola kali</i>	20 (31.2)	23 (56)	0.02
Atriplex	13 (20.3)	13 (31.7)	ns
Date palm	13 (20.3)	19 (46.3)	0.009

ns - not significant, *D. pteronyssinus* - *Dermatophagoides pteronyssinus*, *D. farinae* - *D. farinae*

allergen remained unchanged when compared with the children; however, adult reactivity to Bermuda grass was remarkably high in the present study. With regards to the indoor allergens comparison of the data shows that sensitization to both HDM and cat allergen has increased whereas reactivity to cockroach allergen has decreased. It is though difficult to draw conclusions on the basis of comparison of the 2 studies since they were carried out in different regions and environmental conditions, but it may reflect regional variation in the environmental flora of the aeroallergens. While residing in an area where both the adults and children were exposed to a similar aeroallergen load some interesting observations were made when allergen reactivity was compared. Cross reactivity between *D. pteronyssinus* and *D. farinae* was common in adults compared to children. Pollen reactivity was high for both the groups however children appeared to be more sensitive compared to adults generally and in particular when reactivity to *Salsola kali* and *Date palm* was compared. A higher number of children reacted to cat allergen compared to the adult patients. On the contrary, adult patients were reacting to moulds more often than the children. Sensitization to moulds has also been suggested as a risk factor for life threatening asthma.<sup>35</sup> Similarly, ragweed reactivity was only noted in adults indicating a differential pattern of aeroallergen sensitization between the children and adults. Moreover, a higher percentage of children (17%) in this study were found to react to single allergen compared to the adults. There are insufficient data comparing mono-allergen sensitization between the adults and children, however in agreement with the findings of this study a previous study conducted on children found 19% of children reacting to a single allergen.<sup>36</sup> It is difficult to explain this discrepancy on the basis of existing data but these findings suggest that the maturation of airways with advancing age may influence the aeroallergens sensitization status of the atopic individuals and may have a bearing on the manifestations of the allergic diseases in children and adults. Since this was a cross sectional study, it falls short of drawing firm conclusions based on the available data. A longitudinal study over a longer period of time is required to address the queries.

In conclusion, the magnitude of sensitization to aeroallergens in patients with airway allergy reported in this study is far greater than reported in the previous studies<sup>16,33,34</sup> in Riyadh region or elsewhere in the KSA. There is no consistency with previous reports with regards to selection of study population, set of aeroallergen extracts used and geographical and environmental conditions, thus limiting interpretation of the results of this study based on the findings of the past. It is recommended that further studies be

conducted in different regions of the Kingdom to assess the aeroallergen sensitization in patients with airway allergy. Simultaneous aerobiological surveys would not only help to study the impact of aeroallergen load in the environment on sensitization of atopic individuals but would go a long way to guide future environmental control measures.

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## Ethical Consent

All manuscripts reporting the results of experimental investigations involving human subjects should include a statement confirming that informed consent was obtained from each subject or subject's guardian, after receiving approval of the experimental protocol by a local human ethics committee, or institutional review board. When reporting experiments on animals, authors should indicate whether the institutional and national guide for the care and use of laboratory animals was followed.