

REGULAR ARTICLE

Patterns of food and aeroallergen sensitization in childhood eczema

Kam-Lun Ellis Hon (ehon@cuhk.edu.hk)¹, Ting-fan Leung¹, Gary Ching¹, Chung-mo Chow¹, Vivianne Luk², Wai-san Fanny Ko², Pak-Cheung Ng¹

1.Department of Paediatrics, The Chinese University of Hong Kong, Prince of Wales Hospital, Shatin, Hong Kong SAR, China

2.Department of Medicine and Therapeutics, The Chinese University of Hong Kong, Prince of Wales Hospital, Shatin, Hong Kong SAR, China

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Correspondence

Dr. Kam-Lun Ellis Hon, Department of Paediatrics, The Chinese University of Hong Kong, 6/F, Clinical Sciences Building, Prince of Wales Hospital, Shatin, Hong Kong SAR, China.

Tel: +852-2632-2859 |

Fax: +852-2636-0020 |

Email: ehon@cuhk.edu.hk

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Abstract

Aim: To compare the patterns of Type 1 sensitization of common food and aeroallergens among infants and older patients with atopic dermatitis (AD).

Methods: All skin prick tests (SPTs) performed over a 6-month period were examined, and patients with urticaria were used for comparison.

Results: Dust mite was the most common aeroallergen and dog dander the least common. Egg white was the most common food allergen and beef the least common. Dust mite and peanut sensitization was more prevalent in AD than in urticaria. Dust mite sensitization was more prevalent in older children than infants with AD. Cow's milk sensitization only occurred in one-tenth of these patients. Prevalence of sensitization to common aeroallergens, but not food allergens, was generally higher in children beyond 5 years of age.

Conclusion: Milk sensitization is far less prevalent than egg white, and the prevalence does not change beyond infancy. There is no significant change in prevalence in many of the common food allergens beyond infancy. Many infants with AD develop eczema before they show atopy to the common food and aeroallergens. The SPT information is useful in reassuring parents of the unlikelihood of severe Type 1 immediate IgE reaction to some of the common food and aeroallergens, so that empirical and multiple food avoidance/restriction can be avoided.

INTRODUCTION

Atopic dermatitis (AD) is a common chronic relapsing disease in children associated with atopy. As there is no definite cure, alternative therapies are practised extensively by parents (1,2). Food has been implicated (2–6), and many parents of children with eczema in our clinic would make a lot of efforts in avoidance strategies, namely, dietary restriction and avoidance. Seafood and beef are the most common foods restricted by Chinese parents (2). This study compared the extent and pattern of atopic sensitization to common food (especially cow's milk) and aeroallergens (especially dust mite) between infants with AD and their older counterparts.

METHODS

All skin prick tests (SPTs), performed consecutively between January 2008 and June 2008, on patients <18 years of age, managed in the paediatric clinics of a university teaching hospital, were reviewed. AD is diagnosed according to Hanifin and Rajka's criteria (7). Children with urticaria and without AD, seen during the same period, were used for comparison.

SPTs were performed using diluent (negative control) and histamine solution (10 mg/mL; positive control) and standardized food and aeroallergen extracts, including dust mites, cockroach, cat and dog danders, beef, egg white, egg yolk, milk, soybean, peanut, almond, crab, shrimp, lobster, shellfish, mixed crustacean, tomato, orange and mixed fish (ALK Abelló, Round Rock, Texas). This panel of common

food and aeroallergen extracts was determined and regularly reviewed by the medical and paediatric services to be relevant to the local setting. Reactions were considered positive if the wheal was at least 3 mm greater than that of diluent and was further classified as 1 + (3–5 mm), 2 + (6–8 mm), 3 + or more (≥ 9 mm). Patients discontinued all pharmacotherapy (antihistamines and/or steroids) at least 3 days before SPT.

Patients were excluded if they suffered a non-specific dermatitis. The Clinical Research Ethics Committee of the Chinese University of Hong Kong approved this study. A χ^2 test with Yates correction was used to compare categorical data. Odds ratios and 95% confidence intervals were calculated when indicated. All comparisons were made two-tailed and p-values less than 0.05 were considered to be statistically significant.

RESULTS

SPT results of 90 patients <18 years of age with AD, performed during the study period, were analysed. During the same period, SPTs were performed on 29 patients without eczema (15 urticaria and 14 miscellaneous conditions such as vitiligo, scabies, warts, contact dermatitis etc.). All patients referred to the paediatric dermatology clinic with urticaria were tested during this period. The 15 patients with urticaria were compared with the AD patients (Table 1). With respect to the five common aeroallergens, dust mite sensitization was more prevalent in AD patients than urticaria patients. The incidence of cockroach, cat and dog fur

Table 1 Skin prick testing in patients with and without AD

	Urticaria without eczema (n = 15)	Eczema (n = 90)	<i>p</i> *
Mean (SD) age (years)	8.3 (5.0)	6.7 (5.4)	0.251
Male gender	10 (67%)	57 (63%)	0.967
SPT positivity for aeroallergens			
<i>D. pteronyssinus</i>	7 (47%)	68 (76%)	0.047†
<i>D. farinae</i>	7 (47%)	67 (74%)	0.060
Cockroach	2 (13%)	20 (22%)	0.660
Cat fur	2 (13%)	22 (24%)	0.537
Dog hair	1 (7%)	15 (17%)	0.542
SPT positivity for food allergens			
Egg white	3 (20%)	37 (41%)	0.204
Egg yolk	2 (13%)	26 (29%)	0.344
Cow's milk	0 (0%)	11 (12%)	0.329
Peanut	1 (7%)	33 (37%)	0.045‡
Fish	5 (33%)	32 (36%)	0.900
Shellfish/shrimp/crab/lobster	2 (13%)	20 (22%)	0.660
Beef	0	4 (4%)	0.917

SD = standard deviation; SPT = skin prick test.

*Yates-corrected *p*-values analysed by χ^2 .†Odds ratio [OR] (95% confidence interval [CI]) of *D. pteronyssinus* atopy for AD was 3.53 (1.01–12.49).

‡OR (95% CI) of positive peanut SPT for AD was 8.11 (1.03–172.53).

sensitization was lower than dust mite sensitization in both groups of patients. With respect to common food allergens, peanut sensitization was more prevalent in AD patients. Interestingly, dog fur as an aeroallergen and milk and beef as food allergens were relatively uncommon among all the studied subjects.

Comparing with older AD patients, dust mite sensitization was not prevalent in infants (Table 2). Only one 7-month-old infant showed a 1+ reaction to cow's milk. All 10 infants with AD had negative SPT to soybean, almond, crustaceans, shellfish, fish, tomato and orange. Seven of these had been breastfed for variable periods. According to SPT, sensitization to milk and many of the food allergens among these infants appeared to be uncommon.

Beyond 5 years of age, prevalence of sensitization to all the common aeroallergens was increased (in Appendix). As for food allergens, prevalence of fish sensitization was increased but egg yolk sensitization was lower. The majority of children was not sensitized to cow's milk, crustaceans or beef.

DISCUSSION

Findings of the present study confirm our previously observed pattern of allergen sensitization in children with AD (6,8). Furthermore, the present study compares and contrasts the two allergic skin diseases (urticaria vs. AD) and investigates Type 1 allergen sensitization in infants with AD.

Aeroallergens

AD patients are more likely to be sensitized to *Der-matophagoides pteronyssinus* than patients with urticaria

Table 2 Skin prick testing in patients with AD

	≤1 year (n = 10)	>1 year (n = 80)	<i>p</i>
Mean (SD) age (years)	0.7 (0.2)	7.4 (5.2)	<0.001
Male gender	8 (80%)	49 (61%)	0.417
SPT positivity for aeroallergens			
<i>D. pteronyssinus</i>	0	68 (85%)	<0.001
<i>D. farinae</i>	1 (10%)	66 (83%)	<0.001
Cockroach	0	20 (25%)	0.165
Cat fur	0	22 (28%)	0.129
Dog hair	0	15 (19%)	0.294
SPT positivity for food allergens			
Egg white			
All SPT positive	7 (70%)	30 (38%)	0.103
SPT ≥ 2+	0 (0%)	4 (5%)	1.000
Egg yolk			
All SPT positive	5 (50%)	21 (26%)	0.233
SPT ≥ 2+	1 (10%)	1 (1%)	0.211
Cow's milk			
All SPT positive	1 (10%)	10 (13%)	0.776
SPT ≥ 2+	0 (0%)	1 (13%)	1.000
Peanut			
All SPT positive	2 (20%)	31 (39%)	0.417
SPT ≥ 2+	1 (10%)	9 (11%)	1.000
Fish	1 (10%)	31 (39%)	0.150
Shellfish/shrimp/crab/lobster	0	20 (25%)	0.165
Beef	0	4 (5%)	0.928

SD = standard deviation; SPT = skin prick test.

(Table 1). Dust mite appears to be the single most important aeroallergen in children with AD beyond infancy (Table 2). The majority of families did not own pets in Hong Kong (8). SPT positivity beyond infancy suggests that aeroallergen sensitization occurs after the onset of AD. We previously found that dust mite sensitization was also associated with AD severity (8). Taking together, AD onset appears to be independent of aeroallergen sensitization but disease severity is associated with dust mite sensitization. Beyond 5 years of age, sensitization to many of the common aeroallergens was increased (in Appendix) and many patients may develop symptoms of airway allergies.

Food allergens

Food allergy is often presumed by parents. Dietary practices were usually empirical and advice was not sought from a doctor or a Chinese medicine practitioner (2,6,9). The most commonly sensitized foods were egg and fish. Surprisingly, peanut sensitization was significantly higher among patients with AD than patients with urticaria without AD. Our findings were generally in agreement with other reports for AD (10,11). In particular, this study showed that egg white sensitization occurred in 70% of infants. On the other hand, the leading causes of parent-reported food allergy were shellfish (15.8%), egg (9.1%), peanut (8.1%), beef (6.4%) and cow's milk (5.7%) among preschool children in Hong Kong (9). Besides, nearly one-third of the patients had avoided

shrimp, crab or beef empirically, despite a negative history of AD aggravation and subsequently found to have no sensitization to the foods concerned (6). Furthermore, our previous study confirmed that multiple food avoidance was a common practice and more than 60% of the parents who avoided beef had also avoided shrimp or crab. As paediatricians, we generally discourage the practice of empirical food avoidance especially in children with mild AD and no specific history of disease aggravation with common foods.

Beef allergy is worth mentioning in the Chinese population as many parents consider beef as the culprits of various skin diseases and allergies (2,6). It has been estimated to be between 3% and 6.5% among children with AD, and its incidence is about 0.3% in the general population (12). In our recent kindergarten survey, 0.5% of Chinese preschoolers were reported to have adverse food reactions to beef (9). Although, we previously documented that there were a significant proportion of AD patients with moderate-to-severe disease whose parents would avoid giving beef to their children, beef sensitization (as documented with SPT) was indeed uncommon in patients with urticaria or AD (6). We previously observed that the majority of patients with SPT positivity for beef were without prior history of AD aggravation by beef. It is generally believed that SPT carries a high false positivity, low positive predictive value but a high negative predictive accuracy (4,13,14). A negative SPT may be useful in reassuring anxious food-avoiding Chinese parents to attempt introducing suspicious food to their children. Interestingly, milk sensitization, empirical milk avoidance or eczema aggravation were all relatively uncommon among the Chinese beyond infancy (2,6). In this study, only one in ten patients with AD was sensitized to either cow's milk or soya. Although not recommended as a direct substitute for cow's milk in sensitized individuals, soy sensitization is relatively uncommon. Our published clinical trial also showed that an amino acid-based milk formula was not useful in treating AD in young children (15). In the previous study, (6) disease severity did not bear any relationship with the prevalence of sensitization to common food.

The present study was a cross-sectional analysis and patterns of dietary changes were not evaluated. We also used urticaria for comparison as a common condition often believed to be associated with food. Despite the small number of infants, this study helps better understand the differences between food and aeroallergen sensitization among infants and older children. It is generally believed that genuine food allergy affects only a minority of AD patients beyond infancy (16). Dietary practices are cultural and may vary from country to country (11). Instead of giving nonspecific dietary advice or adopting guidelines from another culture, it is important to tailor instructions to individuals for optimal compliance. It is also important to evaluate whether some of these food items are genuinely allergic or harmful for our patients with AD. Management is suboptimal if children with food allergy and severe disease continue to consume the culprit food. On the other hand, avoidance of common food materials in children without food allergy could result in food faddism or malnutrition.

The findings in the 10 infants with AD are interesting and suggest that infants with AD develop eczema before they become 'atopic' to the some of the common food and aeroallergens. Other investigators have also found that eczema severity did not differ between sensitized and nonsensitized children (17). In recent years, the atopy patch test (APT) employed in conjunction with specific IgE assays or SPT has been found to be helpful in the diagnosis and treatment of patients with food allergy (18). APT for each food allergy has to be validated with double blind food challenge. Furthermore, parents have to bring their children back for an extra visit 48–72 h later for test reading. There is a need for larger studies to investigate what the best formulations might be for APTs. The interpretation of the APT to many foods has not been standardized. As many of the local Chinese parents of children with AD are already practising empirical and multiple food avoidance/restriction without improvement of AD, combination of additional or new tests is not so much for the diagnosing of more food allergy but rather for the assistance of parents to avoid unnecessary food restriction (2).

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Appendix

Skin prick testing in patients with AD: <5 years versus ≥5 years

	≥5 year (n = 46)	<5 year (n = 44)	OR (95% CI)*	p
Mean (SD) age (years)	10.9 (4.1)	2.2 (1.4)	NA	<0.0001
Male gender	26 (57%)	31 (70%)	0.55 (0.21–1.42)	0.249
SPT positivity for aeroallergens				
<i>D. pteronyssinus</i>	43 (93%)	25 (57%)	10.89 (2.65–51.76)	<0.001
<i>D. farinae</i>	43 (93%)	24 (55%)	11.94 (2.92–56.69)	<0.001
Cockroach	16 (35%)	4 (9.1%)	5.33 (1.46–21.22)	0.007
Cat fur	18 (39%)	4 (9.1)	6.43 (1.78–25.39)	0.002
Dog hair	14 (30%)	1 (2%)	18.81 (2.36–403.05)	<0.001
SPT positivity for food allergens				
Egg white	15 (33%)	22 (50%)	0.48 (0.19–1.24)	0.144
Egg yolk	8 (17%)	18 (41%)	0.30 (0.10–0.88)	0.026
Cow's milk	3 (7%)	8 (18%)	0.31 (0.06–1.44)	0.172
Peanut	16 (35%)	17 (39%)	0.85 (0.33–2.18)	0.873
Fish	24 (52%)	8 (18%)	4.91 (1.72–14.45)	0.002
Shellfish/shrimp/ crab/lobster	11 (24%)	9 (20%)	1.22 (0.40–3.71)	0.888
Beef	2 (4%)	2 (5%)	0.95 (0.09–10.06)	1.000

CI = confidence interval; OR = odds ratio; NA = not applicable; SD = standard deviation; SPT = skin prick test.

*Represent the respective odds ratios of ≥5 years old for allergen sensitizations.