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ORIGINAL RESEARCH

Allergen Sensitization in Patients with Skin Diseases in Shanghai, China

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Introduction: Allergen distribution has obvious geographical characteristics. Understanding local epidemiological data may provide evidence-based strategies for the prevention and management of disease. We investigated the distribution of allergen sensitization in patients with skin diseases in Shanghai, China.

Methods: Data from tests for serum-specific immunoglobulin E were collected from 714 patients with three skin diseases who visited the Shanghai Skin Disease Hospital from January 2020 to February 2022. The prevalence of 16 allergen species, as well as age, sex, and disease-group differences in allergen sensitization, were investigated.

Results: *Dermatophagoides farinae* and *Dermatophagoides pteronyssinus* were the most common aeroallergen species to cause allergic sensitization in patients with skin diseases, whereas shrimp and crab were the most common food-allergen species. Children were more susceptible to various allergen species. With regard to sex differences, males were sensitized to more allergen species than females. Patients suffering from atopic dermatitis were sensitized to more allergenic species than patients with non-atopic eczema or urticaria.

Conclusion: Allergen sensitization in patients with skin diseases in Shanghai differed by age, sex, and disease type. Knowing the prevalence of allergen sensitization across age, sex, and disease type may help facilitate diagnostic and intervention efforts, and guide the treatment and management of skin diseases in Shanghai.

Keywords: atopic dermatitis, non-atopic eczema, urticaria, specific immunoglobulin E, sensitization

Introduction

Over recent decades, the incidence of allergic diseases has been increasing worldwide, and allergic diseases have become a considerable public-health problem.[1–3] This increase is closely related to changes in the environmental climate, lifestyle, and health awareness. The prognosis and reduced recurrence of most allergic diseases are closely related to the identification of allergens. Detection of serum-specific immunoglobulin E (sIgE) is convenient and fast, and it has been used widely in clinical practice to identify different sensitization profiles.[4] The distribution of allergens varies by region, environment, weather, and pollution. In addition, sensitization to different allergen species varies in different populations according to age and sex.[5–9] These observations suggest that understanding local epidemiological evidence-based data on allergens will be beneficial for preventing and managing allergic diseases.

Several studies have focused on the prevalence of allergen sensitization in different regions of China.[6,10–13] However, few local epidemiological studies investigating different age groups (children, adolescent and adult, elderly) with skin diseases have been carried out in Shanghai (a large city on the southeastern coast of China).

Here, we investigated the prevalence of allergen sensitization in patients with three common skin diseases in Shanghai to provide evidence-based support for the prevention and management of skin diseases.

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Materials and Methods

Study Population

Data were obtained from 714 patients who visited Shanghai Skin Disease Hospital between January 2020 and February 2022. Patients diagnosed with atopic dermatitis (AD), non-atopic eczema (NAE), and urticaria were included.

Dermatologists diagnosed AD based on the Williams' criteria.[14] Traditionally, in China, eczema and AD are considered to be different diseases.[15,16] Usually, eczema refers to a milder phenotype or phenotype with atypical morphology and distribution of lesions.[16] However, many dermatologists in China do not realize that clinically diagnosed "eczema" corresponds to a milder phenotype or phenotype with atypical morphology and distribution of AD lesions.[16] Here, we defined patients diagnosed with eczema as having NAE to distinguish eczema from AD.[16,17] 'Urticaria' was defined as the occurrence of wheals and/or angioedema.[18] Patients diagnosed with other types of skin disease or with missing test results were excluded from this study.

Detection Methods

Eight aeroallergen species and eight species of food allergen were tested in patients. According to the type of disease and economic situation of patients, initially dermatologists selected the more suitable allergen species. Therefore, not all patients were tested with all 16 allergen species. Aeroallergen species were *Dermatophagoides farinae, Dermatophagoides pteronyssinus, Blattella germanica*, dog dander, cat dander, mixed molds (*Penicillium chrysogenum, Cladosporium herbarum, Aspergillus fumigatus, Candida albicans, Alternaria* species, *Helminthosporium* species), mixed grasses (ragweed, mugwort, French chrysanthemum, dandelion, autumn unicorn grass), and mixed trees (*Alnus incana, Corylus avellane, Fagales, Ulmus americana, Salix caprea, Populus deltoides*). Food-allergen species were shrimp, crab, egg white, milk, soybean, peanut, wheat, and mixed food (egg white, milk, peanut, wheat, cod, soybean).

sIgE levels were assessed using ImmunoCAP™ (Phadia, Uppsala, Sweden) with uniform and standardized procedures according to the manufacturer's manual. Detection limit of ImmunoCAP is 0.10–100 kU/L. According to the method recommendation, results were divided into seven classes (Table 1). The results of sIgE were considered sensitization positive for values of 0.35 kU/L or more.

Statistical Analyses

Data were analyzed using SPSS 20.0 (IBM, Armonk, NY, USA). Demographic variables were defined as categorical variables. The chi-square test was used to compare differences among groups. $P < 0.05$ was considered significant.

Table 1 Recommendation of Classes for ImmunoCAP™

Class	Concentration Range (kU/L)
0	<0.35
1	0.35 to <0.7
2	0.70 to <3.50
3	3.50 to <17.5
4	17.5 to <50
5	50 to <100
6	≥100

Results

Patients

A total of 714 patients (316 males, 398 females) were enrolled. The mean age of the study was 36.57±20.70 (range, 3–91; interquartile range, 21.00–54.25) yrs. Patients were divided into three age groups: "children" (3–12 yrs; 102 cases), "adolescent and adult" (13–60 yrs; 482), and "elderly" (61–100 yrs; 130). The diagnoses were AD (187 cases), NAE (268), and urticaria (259) (Table 2).

Profiles of Allergen Sensitization

Sensitization to various allergen species is listed in Table 3. The mites *D. farinae* (40.62%) and *D. pteronyssinus* (39.78%) were the allergens which most participants were sensitized to, followed by mixed molds (15.85%) and

Table 2 Characteristics of Patients

	N	3–12 yrs	13–60 yrs	61–100 yrs
N	714	102	482	130
Male/Female	316/398	52/50	187/295	77/53
Diagnose				
Atopic dermatitis	187	63	107	17
Non-atopic eczema	268	14	168	86
Urticaria	259	25	207	27

Table 3 Sensitization Positive Rates and sIgE Levels in Allergen Species

Allergen Species	N	Sensitization	sIgE Level, *n* (% of the Sensitization)					
		n(%)	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6
Aeroallergen species								
Mites								
Der.f	714	290(40.62)	39(13.45)	52(17.93)	67(23.10)	52(17.93)	37(12.76)	43(14.83)
Der.p	714	284(39.78)	35(12.32)	63(22.18)	71(25.00)	45(15.85)	28(9.85)	42(14.79)
B.g.	554	84(15.16)	28(33.33)	46(54.76)	10(11.90)	0(0.00)	0(0.00)	0(0.00)
Animal dander								
Dog dander	554	65(11.73)	16(24.62)	33(50.77)	9(13.85)	2(3.08)	5(7.69)	0(0.00)
Cat dander	552	64(11.59)	6(9.38)	16(25.00)	28(43.75)	6(9.38)	5(7.81)	3(4.69)
Mixed molds	714	113(15.83)	28(24.78)	46(40.71)	29(25.66)	7(6.19)	2(1.77)	1(0.88)
Pollens								
Mixed grasses	713	40(5.61)	23(57.50)	12(30.00)	3(7.50)	2(5.00)	0(0.00)	0(0.00)
Mixed trees	712	33(4.63)	45.45	42.42	12.12	0(0.00)	0(0.00)	0(0.00)
Food-allergen species								
Shrimp	713	127(17.81)	41(32.28)	71(55.91)	14(11.02)	0(0.00)	1(0.79)	0(0.00)
Crab	712	92(12.92)	33(35.87)	47(51.09)	11(11.96)	1(1.09)	0(0.00)	0(0.00)
Egg white	312	37(11.86)	23(62.16)	12(32.43)	1(2.70)	1(2.70)	0(0.00)	0(0.00)
Milk	312	32(10.26)	24(75.00)	8(25.00)	0(0.00)	0(0.00)	0(0.00)	0(0.00)
Wheat	312	30(9.62)	11(36.67)	15(50.00)	3(10.00)	1(3.33)	0(0.00)	0(0.00)
Peanut	312	27(8.65)	11(40.74)	12(44.44)	3(11.11)	1(3.70)	0(0.00)	0(0.00)
Soybean	310	20(6.45)	13(65.00)	5(25.00)	2(10.00)	0(0.00)	0(0.00)	0(0.00)
Mixed food	401	25(6.23)	10(40.00)	13(52.00)	2(8.00)	0(0.00)	0(0.00)	0(0.00)

Notes: *D. farinae* (40.62%) and *D. pteronyssinus* frequently elicited strong positive reactions (classes 4–6), while most other allergen species caused weaker positive reactions (classes 1–3). Class 1 (0.35 to < 0.70 kU/L), class 2 (0.70 to < 3.50 kU/L), class 3 (3.50 to <17.5 kU/L), class 4 (17.5 to <50 kU/L), class 5 (50 to <100 kU/L), and class 6 (≥100 kU/L).

Abbreviations: *Der.f, Dermatophagoides farinae; Der.p, Dermatophagoides pteronyssinus; B.g., Blattella germanica.*

B. germanica (15.16%). The food-allergen species that most participants were sensitized to were shrimp (19.92%), crab (19.92%), egg white (11.86%), and milk (10.26%). Approximately 99% of patients were co-sensitized to *D. farinae* and *D. pteronyssinus*. Less common allergen species that participants were sensitized to were grass and tree pollens (aeroallergen species), peanut and soybean (food allergen), and mixed food.

More positive results belonged to classes 1–3 than to higher classes. *D. farinae, D. pteronyssinus*, cat dander, and dog dander elicited a reaction in classes 4–6 of 45.52%, 40.49%, 21.88% and 10.77%, respectively, which indicated a strong positive reaction.

Sensitization Profiles and Age

We compared the difference in sensitization among the three age groups. The overall prevalence of positivity (aeroallergen and food-allergen species) was higher in the children group. The prevalence of positivity to *D. farinae, D. pteronyssinus*, dog dander, cat dander, mixed molds, mixed grasses, mixed trees, egg white, milk, wheat, soybean, and mixed food decreased with increasing age (all $p < 0.05$, and some $p < 0.01$). A significant difference in the prevalence of sensitization for *B. germanica*, shrimp, crab, and peanut was not found among groups (Figure 1).

Sensitization Profiles and Sex

The prevalence of sensitization of most aeroallergen and food-allergen species was higher in males than in females. More males than females were sensitized to *D. farinae* (46.84% vs 35.68%), *D. pteronyssinus* (45.25% vs 35.43%), *B. germanica* (21.70% vs 10.34%), mixed molds (18.99% vs 13.32%), and pollens (mixed grasses 7.94% vs 3.77%, mixed trees 6.98% vs 2.77%, respectively) in aeroallergen species. When comparing with the females, males showed higher sensitization rate to shrimp (23.17% vs 13.57%), crab (16.24% vs 10.30%), wheat (13.13% vs 5.92%), and peanut (11.88% vs 5.26%) in food-allergen species. However, a sex-associated difference was not observed for the prevalence of sensitization to allergen species such as dog dander, cat dander, egg white, milk, or mixed food (Table 4).

We further explored the sex-based difference in the prevalence of allergen sensitization in the three age groups. A sex-based difference in sensitization to *D. farinae, D. pteronyssinus, B. germanica*, mixed molds, mixed grasses, mixed trees, shrimp, crab, wheat, and peanut was found mainly in patients aged 13–60 years (all $p < 0.05$, some $p < 0.01$) (Table 5). However, a sex-based difference in sensitization to all allergen species was not found in patients aged 3–12 yrs or 61–100 yrs.

Sensitization Profiles and Disease Type

Many patients suffering from AD were sensitized to most allergen species (Table 6). Among aeroallergen species, the prevalence of sensitization positivity to *D. farinae, D. pteronyssinus*, dog dander, cat dander, mixed grasses, and mixed

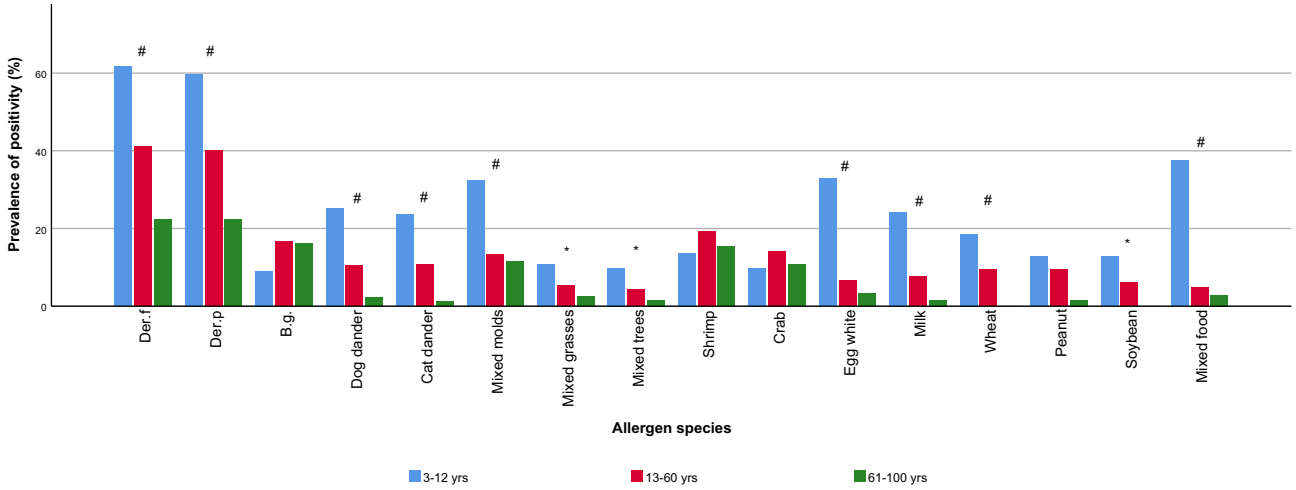

Figure 1 Difference in sensitization among the three age groups. Chi-square test: #p <0.01,*p <0.05.
Abbreviations: *Der.f, Dermatophagoides farinae; Der.p, Dermatophagoides pteronyssinus; B.g., Blattella germanica.*

Table 4 Prevalence of Sensitization to Allergen Species in Sex

Allergen Species	Male	Female	χ2	*P* value
	n (%)	*n* (%)		
Aeroallergen species				
Mites				
Der.f	148 (46.84)	142 (35.68)	9.091	0.003#
Der.p	143 (45.25)	141 (35.43)	7.100	0.008#
B.g.	51 (21.70)	33 (10.34)	13.569	<0.001#
Animal dander				
Dog dander	31 (13.19)	34 (10.66)	0.838	0.360
Cat dander	30 (12.82)	34 (10.69)	0.032	0.858
Mixed molds	60 (18.99)	53 (13.32)	4.252	0.039*
Pollens				
Mixed grasses	25 (7.94)	15 (3.77)	5.768	0.016*
Mixed trees	22 (6.98)	11 (2.77)	7.054	0.008#
Food-allergen species				
Shrimp	73 (23.17)	54 (13.57)	11.085	0.001#
Crab	51 (16.24)	41 (10.30)	5.505	0.019*
Egg white	18 (11.25)	19 (12.50)	0.117	0.733
Milk	16 (10.00)	16 (10.53)	0.023	0.878
Wheat	21 (13.13)	9 (5.92)	4.655	0.031*
Peanut	19 (11.88)	8 (5.26)	4.311	0.038*
Soybean	14 (8.81)	6 (3.97)	2.996	0.083
Mixed food	7(4.52)	18(7.32)	1.276	0.259

Note: Chi-square test: #p <0.01,*p <0.05.
Abbreviations: *Der.f, Dermatophagoides farinae; Der.p, Dermatophagoides pteronyssinus; B.g., Blattella germanica.*

Table 5 Sex-Based Difference in the Prevalence of Allergen Sensitization in the Three Age Groups

Allergen Species	3–12 yrs, *n*(%)				13–60 yrs, *n*(%)				61–100 yrs, *n*(%)			
	M	F	χ2	*P* value	M	F	χ2	P value	M	F	χ2	*P* value
Aeroallergen species												
Mites												
Der.f	33 (63.46)	30 (60.00)	0.129	0.719	97 (51.87)	101 (34.24)	14.704	<0.001#	18 (23.38)	11 (20.75)	0.125	0.724
Der.p	32 (61.54)	29 (58.00)	0.133	0.716	94 (50.27)	100 (33.90)	12.752	<0.001#	17 (22.08)	12 (22.64)	0.006	0.940
B.g.	3 (6.98)	5 (11.11)	0.455	0.500	39 (28.47)	23 (9.79)	21.743	<0.001#	9 (17.65)	5 (13.89)	0.221	0.638
Animal dander												
Dog dander	14 (29.79)	10 (20.83)	1.008	0.315	17 (12.41)	22 (9.36)	0.856	0.355	0 (0.00)	2 (5.56)		0.168
Cat dander	12 (25.53)	10 (21.74)	0.185	0.667	17 (12.50)	23 (9.79)	0.659	0.417	0 (0.00)	1 (2.86)		0.407
Mixed molds	13 (25.00)	20 (40.00)	2.621	0.105	37 (19.79)	28 (9.49)	10.396	0.001#	10 (12.99)	5 (9.43)	0.388	0.533
Pollens												
Mixed grasses	5 (9.62)	6 (12.00)	1.151	0.698	20 (10.75)	6 (2.02)	17.124	<0.001#	0 (0.00)	3 (6.52)		0.054
Mixed trees	5 (9.62)	5 (10.00)	0.004	0.948	16 (8.60)	5 (1.69)	13.035	<0.001#	1 (1.30)	1 (1.92)	0.079	0.778
Food-allergen species												
Shrimp	7 (13.46)	7 (14.00)	0.006	0.937	52 (27.96)	41 (13.90)	14.456	<0.001#	14 (18.18)	6 (11.32)	1.135	0.287
Crab	5 (9.62)	5 (10.00)	0.004	0.948	37 (20.00)	31 (10.51)	8.424	0.004#	9 (11.69)	5 (9.43)	0.166	0.684
Egg white	10 (25.64)	13 (41.94)	2.079	0.149	6 (7.41)	6 (6.00)	0.143	0.705	2 (5.00)	0 (0.00)		0.541
Milk	7 (17.95)	10 (32.26)	1.923	0.165	9 (9.89)	6 (5.61)	1.288	0.256	0 (0.00)	1 (4.76)		0.344
Wheat	8 (20.51)	5 (16.13)	0.219	0.639	13 (16.05)	4 (4.00)	6.285	0.012*	0 (0.00)	0 (0.00)		NA
Peanut	6 (15.38)	3 (9.68)	0.122	0.727	13 (16.05)	4 (4.00)	6.285	0.012*	0 (0.00)	1 (4.76)		0.344
Soybean	6 (15.38)	3 (9.68)	0.122	0.727	8 (10.00)	3 (3.03)	2.616	0.106	0 (0.00)	0 (0.00)		NA
Mixed food	7(53.85)	5(26.32)	2.496	0.114	4(3.81)	11(5.64)	0.174	0.677	0 (0.00)	2(6.25)		0.211

Note: Chi-square test: #p <0.01,*p <0.05.
Abbreviations: M, Males; F, Females; *Der.f, Dermatophagoides farinae; Der.p, Dermatophagoides pteronyssinus; B.g., Blattella germanica*; NA, not available: the sample size is too small to meet the applicable conditions of χ2.

Table 6 Disease Type Difference in Sensitization Positivity

Allergen Species	Atopic Dermatitis		Non-Atopic Eczema		Urticaria		χ2	*P* value
	N	*n*(%)	N	*n*(%)	N	*n*(%)		
Aeroallergen species								
Mites								
Der.f	187	117 (62.57)[a]	268	80 (29.85)[b]	259	93 (35.91)[b]	52.615	<0.001[#]
Der.p	187	113 (60.43)[a]	268	80 (29.85)[b]	259	91 (35.14)[b]	46.644	<0.001[#]
B.g.	179	35 (19.55)	122	17 (13.93)	253	32 (12.65)	4.069	0.131
Animal dander								
Dog dander	179	47 (26.26)[a]	122	8 (6.56)[b]	253	10 (3.95)[b]	54.405	<0.001[#]
Cat dander	179	41 (22.91)[a]	122	6 (4.92)[b]	251	17 (6.77)[b]	33.339	<0.001[#]
Mixed molds	187	60 (32.09)[a]	268	28 (10.45)[b]	259	25 (9.65)[b]	50.340	<0.001[#]
Pollens								
Mixed grasses	187	25 (13.37)[a]	267	7 (2.62)[b]	259	8 (3.09)[b]	28.871	<0.001[#]
Mixed trees	187	21 (11.23)[a]	268	6 (2.24)[b]	257	6 (2.33)[b]	24.959	<0.001[#]
Food-allergen species								
Shrimp	187	47 (25.13)[a]	267	42 (15.73)[b]	259	38 (14.67)[b]	9.383	0.009[#]
Crab	187	31 (16.58)	267	34 (12.73)	258	27 (10.47)	0.658	0.720
Egg white	178	30 (16.85)[a]	111	5 (4.50)[b]	23	2 (8.70)[a,b]	10.213	0.006[#]
Milk	178	25 (14.04)[a]	111	4 (3.60)[b]	23	3 (13.04)[a,b]	8.307	0.016*
Wheat	178	25 (14.04)[a]	111	3 (2.70)[b]	23	2 (8.70)[a,b]	10.144	0.006[#]
Peanut	178	24 (13.48)[a]	111	1 (0.90)[b]	23	2 (8.70)[a,b]	13.692	0.001[#]
Soybean	178	15 (8.43)	110	3 (2.73)	22	2 (9.09)	3.933	0.140
Mixed food	9	2(22.22)	156	7(4.49)	236	25(6.78)	4.870	0.088

Notes: For comparison of each allergen specie significant differences (p <0.05) between two disease groups are indicated with different letters. [a,b]Chi-square test: [#]p <0.01,*p <0.05.

Abbreviations: *Der.f, Dermatophagoides farinae; Der.p, Dermatophagoides pteronyssinus; B.g., Blattella germanica.*

trees in the AD group was higher than that of the other two disease groups (all p < 0 0.01) but there was no significant difference between the NAE group and urticaria group. Among food-allergen species, the prevalence of sensitization positivity to shrimp in the AD group was higher than that in the other two disease groups (p < 0.01). Besides, the prevalence of sensitization to egg white, milk, wheat, and peanut was higher in patients with AD than in patients suffering from NAE (all p < 0.05, some p < 0.01). However, the prevalence of sensitization to these different allergenic species did not show a significant difference between patients with urticaria and patients with the other two diseases. The prevalence of sensitization to *B. germanica*, crab, soybean and mixed food was not significantly different among the three disease groups.

Discussion

The incidence of allergic diseases has increased considerably worldwide over recent decades. Detection of sIgE may help avoidance of the triggering factors and aid implementation of allergen-specific immunotherapy.

The situation of allergen sensitization in different regions and countries is not identical. In the USA, mites, grass pollen, and cockroaches are the most common allergen species to which the population are sensitized to.[19,20] In Northern and Eastern Europe, the most common sensitizing allergen species the population are sensitized to are cat dander, dog dander, and tree pollens, whereas Western European residents are allergic to mites, cockroaches, and tree pollen.[21] We found that the major sensitizing allergen species in a study cohort from Shanghai were mites, mixed molds, and cockroaches (*B. germanica*). We discovered that *D. farinae* and *D. pteronyssinus* very possibly caused strong positive reactions, whereas most other allergen species caused weaker positive reactions, data which are consistent with the findings of adults[11] and children[10] living in Shanghai. Otero et al reported that the intensity of the response may correlate significantly with disease severity.[22] Moreover, ~99% of patients were co-sensitized to *D. farinae* and *D. pteronyssinus*,

which is consistent with data from other studies.[11,23–25] Some research has shown that co-sensitization might be closely related to the homology of amino-acid sequences in allergen species.[26,27]

As the main aeroallergen species, mixed molds might be related to the subtropical monsoon climate that features abundant precipitation and sunshine. In contrast, pollens are important allergen species in northwestern China.[28–30] Cockroaches (*B. germanica*) were also common sensitizing aeroallergen species in our study cohort from Shanghai. A survey from Zhang et al found that allergens from cockroaches were detected in 93% of households, and that allergen levels in the living room were higher than those in bedding.[31] Therefore, frequent ventilation and cleaning of the indoor environment are essential for patients to reduce environmental exposure to aeroallergens. Shrimp and crab were the most common sensitizing food-allergen species in our study cohort from Shanghai, which might be related to the geographical environment of Shanghai, a coastal city in which many people eat crustaceans such as shrimps and crabs. We found a low prevalence of sensitization to mixed grasses and mixed trees in Shanghai.

Furthermore, we searched for differences in sensitization for several allergen species with regard to sex, age, and disease group. With regard to age, children showed greater susceptibility to developing sensitization. Their immature digestive system and underdeveloped immune system may explain this phenomenon.[13] Therefore, allergens could induce sensitization more readily (sometimes causing allergic symptoms) in children. With regard to sex, males showed greater susceptibility to becoming sensitized to the vast majority of allergen species than females. Studies have shown males to be more susceptible to allergen sensitization and more likely to develop allergic diseases.[10,32,33] Possible causes include genetics, environment, differences in exposure to allergens, differences in immune function, and the effects of sex hormones.[33–35] With respect to a difference in disease groups, patients with AD were, in general, susceptible to almost all allergen species tested, which is similar to the findings of other studies.[36,37] One can postulate that the atopic constitution of patients with AD is more susceptible to various allergen species than that of healthy people.

Mixed food was tested in most patients with NAE or urticaria, but in only a small number of patients with AD. All allergen species test need to spend a lot of money, mixed food detection may to a certain extent, reduce the economic burden of patients. Moreover, food allergy may play an important part in the aggravation of AD. Our program for testing of allergen species for different diseases is in accordance with that of the Chinese government.

The results of this study may provide data support for improvement in the programs for testing of allergen species for patients with skin diseases attending Shanghai Hospitals. Sensitization patterns differed significantly among patients in different age groups, so age-specific strategies to prevent allergen exposure should be employed. In children (and even younger patients), early testing for sIgE may help identify allergen species to avoid. Due to the complex clinical signs of allergic diseases, allergen-species testing may help avoid misdiagnoses. Furthermore, our results may help clinicians (and even public-health administrators) in Shanghai to identify efficacious interventions for specific patient groups, and guide researchers to further study the epidemiology of skin diseases.

Our study had three main limitations. First, the study cohort was small. Second, only 16 allergen species were evaluated. Third, the study cohort was from a single center.

Conclusions

The prevalence and distribution of sensitization to different allergen species among patients with skin diseases in Shanghai exhibited differences in terms of sex, age, and disease type. We demonstrated the prevalence of specific sensitization and risk groups for skin disease. This information could guide treatment planning and reduce disease burden for affected individuals in Shanghai.

Data Sharing Statement

The data that support the findings of our study are not publicly available because they contain information that could compromise the privacy of its participants, but are available from the corresponding author upon reasonable request.

Statement of Ethics

The study protocol complies with the Declaration of Helsinki 1964 and its later amendments. The study protocol was approved (2021-121) by the ethics committee of Shanghai Skin Disease Hospital. Written informed consent was obtained from all participants, including children under the age of 18 years (obtained from the legal guardian).

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Disclosure

The authors have no conflicts of interest to declare for this work.

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