

LETTER

Sensitization profiles of aeroallergens among allergic rhinitis patients in China: A 13-year multicenter retrospective study

To the Editor,

During the past two decades, the incidence of allergic rhinitis (AR) has gradually increased and caused heavy economic burden in China.¹ Due to the differences of climate and temperature in different countries and regions, it is of great significance to establish allergen-screening panels for the AR patients based on the spectrum of local epidemic aeroallergens. Meanwhile, the observation that allergen sensitization patterns change over time as a result of environmental changes highlights the importance of regularly monitoring allergen panels in different regions.²

We conducted an observational, cross-sectional retrospective study to investigate the changes of sensitization profiles to aeroallergens among Chinese AR patients from 2009 to 2021. The AR patients were enrolled from Henan Provincial People's Hospital (Zhengzhou-Center 1, north), Chongqing People's Hospital (Chongqing-Center 2, west), and Tongji Hospital (Wuhan-Center 3, central). For each center, the first 50 patients with recurrent nasal symptoms (sneezing, nose itching, rhinorrhea, nasal obstruction) and suspected diagnosis of AR were included every month in the study. The diagnosis of suspected AR was based on symptoms and signs according to Allergic Rhinitis and its Impact on Asthma (ARIA).³ All the included patients had received skin prick test (SPT) with a panel of 19 aeroallergens (Macro-Union Pharmaceutical).⁴ (Table 1). A step-by-step conditional approach was used to identify the minimal allergen set.⁵ This study was approved by the Independent Ethical Committees of Tongji Hospital (Ethics NO.TJ-C20210304).

A total of 16,664 patients were included in this study, 2529 (15.2%) had AR with asthma, 6200 (37.2%) were children under 18 years old. 13,253 (79.6%) patients had positive SPT results to at least one allergen. The most common aeroallergens were *Dermatophagoides farinae* (66.9%), *Dermatophagoides pteronyssinus* (64.1%), *Blatella germanica* (18.5%), *Brassica campestris* (17.4%), and *Platanus acerifolia* (16.2%). The sensitization rate was significantly higher in children (age below 18 years old) than in adults (85.8% vs 75.8%, $p < .001$). AR patients with asthma had a higher sensitization rate than AR patients (88.7% vs 77.9%, $p < .001$). The sensitization rates of the 19 aeroallergens had changed significantly from 2009 to 2021, with different trends in the three centers (Figure 1). For HDM,

the sensitization rates remained stable. The sensitization rates to *Artemisia*, *Ambrosia*, and *Humulus* gradually increased in all centers. For molds, the sensitization rates to *Alternaria* and *Cladosporium* increased in all centers in recent 5 years. There was a significant increase of the sensitization rates to animal dander in all centers. The overall positive rates of cat and dog hair increased from 1.3% to 15.5% and 0.8% to 10.5%, respectively, from 2016 to 2021. Center 1, in the last couple of years, has a higher sensitization rate than the other centers to most allergens (such as pollens) except HDM. (Figure 1).

Our finding shows HDM was the most common aeroallergen in all centers. The sensitization rates to HDM were relatively stable in the three cities in the past 13 years. However, the sensitization rates to cat and dog increased significantly in all centers, which probably correlated with the surge of pet ownership over the last decade in China.⁶ Still another noteworthy similarity is that the sensitization rates to weed pollens (especially *Humulus*) and molds (*Alternaria* and *Cladosporium*) also gradually increased in the past 5 years, which may be a reflection of the changes of vegetation and climate in China. We also found that Center 1 has a higher sensitization rate to pollens than the other centers, which may be attributed to the quick growth of local vegetation and relatively less precipitation in this area. Indeed, airborne pollens are the most frequent and seasonal allergens in western and northern China.⁷ HDM concentration in house dust was 50-fold lower in family homes in Northern China compared to Southern China,⁸ which may be the reason for the difference in sensitization characteristics of HDM. We also proposed a panel of 5 aeroallergens (*Dermatophagoides farinae*, *Dermatophagoides pteronyssinus*, *Artemisia sieversiana*, *Platanus acerifolia*, *Blatella germanica*) for the diagnosis of AR in the three centers, which provided a sensitization rate >95% among the AR patients (Table 2). This panel found out 94.0% (3725/3964), 96.0% (2774/2888), and 97.4% (6237/6401) of the AR patients in the three centers, respectively. Compared to 18 allergens needed to appropriately assess sensitization across Europe, our SPT panels require fewer allergens.⁵ It was interesting to find that although some allergens such as cat, dog and *Humulus* had an increasing prevalence among the AR patients, they were not included in the minimal allergen panel. We hypothesized these

TABLE 1 Demographic characteristics and sensitization rate of aeroallergens in three centers.

	Whole group (n = 16,664)	Center 1 (n = 5055)	Center 2 (n = 3976)	Center 3 (n = 7633)	p Value
Gender, N (%)					
Male	8855 (53.1%)	2552 (50.5%)	1927 (48.5%)	4376 (57.3%)	<.001
Female	7809 (46.9%)	2503 (49.5%)	2049 (51.5%)	3257 (42.7%)	
Age (years)	26.62 ± 16.96	34.40 ± 15.25	28.64 ± 16.20	20.41 ± 16.01	<.001
Disease, N (%)					
AR with asthma	2529 (15.2%)	888 (17.6%)	171 (4.3%)	1470 (19.3%)	<.001
AR	14,135 (84.8%)	4167 (82.4%)	3805 (95.7%)	6163 (80.7%)	
Allergen, N (%)					
<i>Dermatophagoides farina</i>	11,123 (66.9%)	2946 (58.3%)	2584 (65.0%)	5593 (73.3%)	<.001
<i>Dermatophagoides pteronyssinus</i>	10,676 (64.1%)	2578 (51.0%)	2431 (61.2%)	5667 (74.2%)	<.001
<i>Artemisia sieversiana</i>	2440 (14.7%)	1294 (25.6%)	453 (11.4%)	693 (9.1%)	<.001
<i>Blatella germanica</i>	2401 (18.5%)	343 (24.1%)	1103 (27.8%)	955 (12.5%)	<.001
<i>Humulus scandens</i>	2321 (14.1%)	1143 (22.6%)	596 (15.0%)	582 (7.8%)	<.001
<i>Platanus acerifolia</i>	2089 (16.2%)	1394 (27.6%)	14 (5.7%)	681 (8.9%)	<.001
<i>Brassica campestris</i>	1854 (17.4%)	1179 (23.3%)	534 (17.1%)	141 (5.6%)	<.001
<i>Ambrosia artemisiifolia</i>	1598 (10.3%)	995 (19.7%)	206 (6.9%)	397 (5.3%)	<.001
Cat hair	1506 (9.0%)	526 (10.4%)	488 (12.3%)	492 (6.5%)	<.001
<i>Polulus cathayana</i>	946 (8.2%)	516 (22.7%)	141 (7.9%)	289 (3.9%)	<.001
<i>Alternaria alternata</i>	919 (6.3%)	257 (5.1%)	44 (2.4%)	618 (8.1%)	<.001
Dog hair	847 (5.1%)	436 (8.6%)	301 (7.6%)	110 (1.4%)	<.001
<i>Sabina chinensis</i>	497 (5.7%)	200 (23.1%)	110 (5.6%)	187 (3.2%)	<.001
<i>Salix matsudana</i>	468 (12.7%)	0 (0%)	326 (16.9%)	142 (8.0%)	<.001
<i>Cladosporium cladosporioides</i>	456 (3.5%)	241 (4.8%)	17 (6.5%)	198 (2.6%)	<.001
Mulberry silk	402 (3.4%)	248 (5.9%)	6 (3.1%)	148 (2.0%)	<.001
<i>Aspergillus fumigatus</i>	402 (3.1%)	336 (6.7%)	3 (0.9%)	63 (0.8%)	<.001
<i>Cryptomeria fortunei</i>	245 (3.3%)	0 (0%)	25 (5.3%)	220 (3.1%)	<.01
<i>Paecilomyces varioti</i>	97 (1.1%)	0 (0%)	28 (2.3%)	69 (0.9%)	<.001

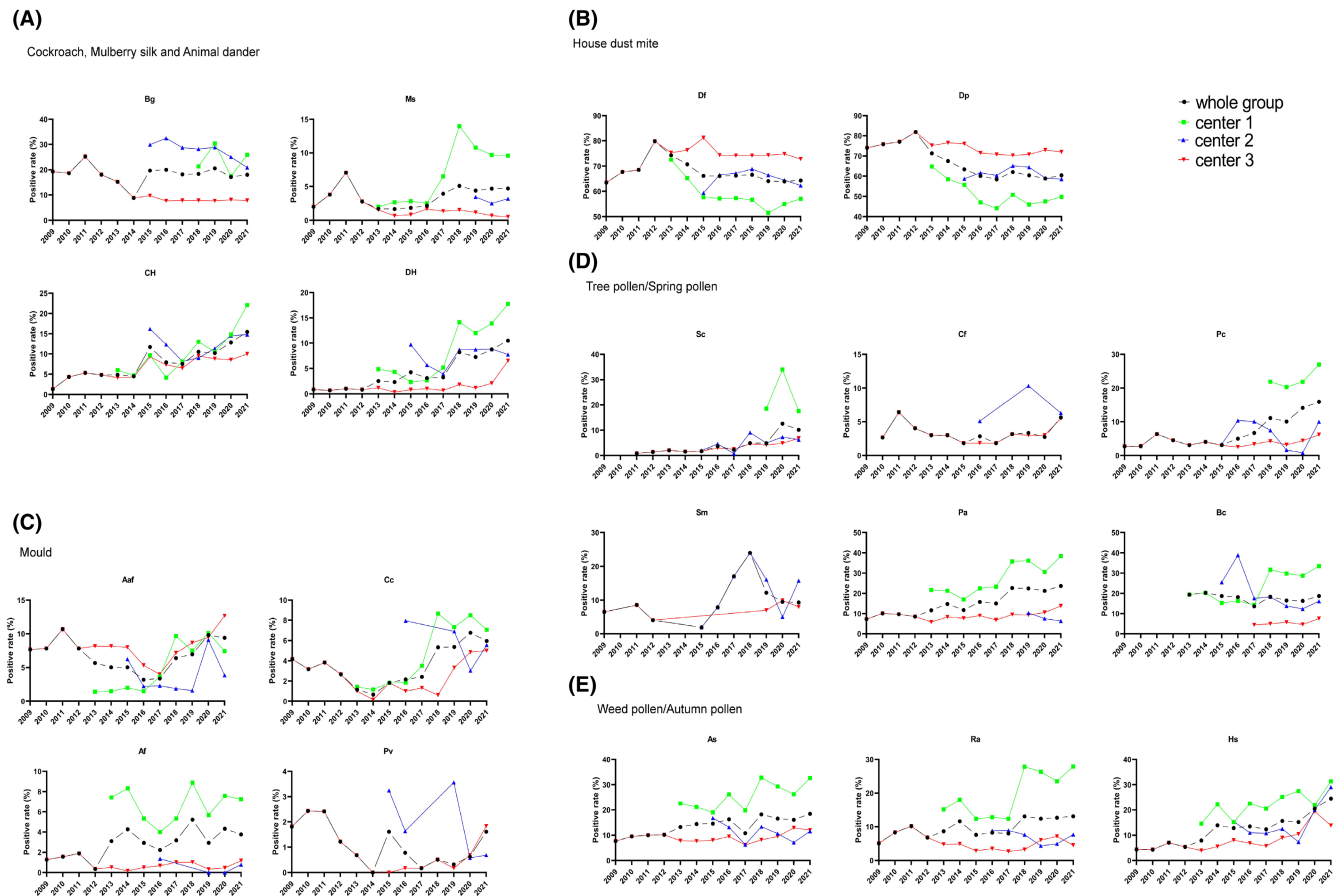


FIGURE 1 Trend chart of positive rate of each allergen positive rate varies with time. Aaf, *Alternaria alternata*; Af, *Aspergillus fumigatus*; As, *Artemisia sieversiana*; Bc, *Brassica campestris*; Bg, *Blatella germanica*; Cc, *Cladosporium cladosporioides*; Cf, *Cryptomeria fortunei*; CH, *Cat hair*; Df, *Dermatophagoides farinae*; DH, *Dog hair*; Dp, *Dermatophagoides pteronyssinus*; Hs, *Humulus scandens*; Ms, *Mulberry silk*; Pa, *Platanus acerifolia*; Pc, *Polulus cathayana*; Pv, *Paecilomyces varioti*; Ra, *Ambrosia artemisifolia*; Sc, *Sabina chinensis*; Sm, *Salix matsudana*.

TABLE 2 The offered test panel for different aeroallergens.

Whole group	N (%)	Cumulative (%)	Center 1	Cumulative (%)	Center 2	Cumulative (%)	Center 3	Cumulative (%)
<i>Dermatophagoides farinae</i> (Df)	11,123 (83.9)	83.9	Df	74.3	Df	89.5	Dp	88.5
<i>Artemisia sieversiana</i> (As)	687 (5.2)	89.1	Pa	87.1	Bg	93.2	Df	93.2
<i>Dermatophagoides pteronyssinus</i> (Dp)	417 (3.2)	92.3	As	91.9	Hs	95.6	As	95.2
<i>Platanus acerifolia</i> (Pa)	331 (2.5)	94.8	Bc	94.2	CH	96.7	Pa	96.5
<i>Blatella germanica</i> (Bg)	178 (1.3)	96.1	CH	96.0	Dp	97.6	Bg	97.4
<i>Humulus scandens</i> (Hs)	127 (1.0)	97.1	Hs	97.2	As	98.3	Aaf	98.3
<i>Cat hair</i> (CH)	93 (0.7)	97.8	Af	97.9	Bc	98.7	Cf	98.8
<i>Brassica campestris</i> (Bc)	80 (0.6)	98.4	Dp	98.4	Sm	99.0	Hs	99.1
<i>Alternaria alternata</i> (Aaf)	70 (0.5)	98.9	Bg	98.7	Aaf	99.3	CH	99.4
<i>Sabina chinensis</i> (Sc)	30 (0.2)	99.1	Aaf	99.1	Sc	99.5	Cc	99.6
<i>Aspergillus fumigatus</i> (Af)	24 (0.2)	99.3	Ra	99.4	DH	99.7	Ra	99.7
<i>Ambrosia artemisifolia</i> (Ra)	22 (0.2)	99.5	Ms	99.7	Ra	99.8	Sc	99.8
<i>Mulberry silk</i> (Ms)	15 (0.1)	99.6	DH	99.8	Pv	99.9	Ms	99.8
<i>Dog hair</i> (DH)	12 (0.1)	99.7	Cc	99.9	Cc	100.0	DH	99.9
<i>Cladosporium cladosporioides</i> (Cc)	12 (0.1)	99.8	Pc	100.0	–	–	Bc	99.9
<i>Cryptomeria fortunei</i> (Cf)	11 (0.1)	99.8	Sc	100.0	–	–	Pc	99.9
<i>Salix matsudana</i> (Sm)	10 (0.1)	99.9	–	–	–	–	Sm	100.0
<i>Paecilomyces varioti</i> (Pv)	6 (0.1)	100.0	–	–	–	–	Pv	100.0
<i>Polulus cathayana</i> (Pc)	5 (0.0)	100.0						

Note: Allergens provided a positive sensitization rate >95% were labeled with red rectangle.

allergens might be co-sensitized to other prevalent allergens such as HDM, which restrained their contribution in increasing positive rate when we used the step-by-step conditional method to determine the minimal allergen pane.⁵

We are aware of the limitations of our study such as not including specific IgE tests and some clinically relevant allergens (e.g., *Morus*, *Broussonetia*). However, we still provide a comprehensive knowledge of prevalent aeroallergens that is required for the diagnosis of AR in China. Although the prevalent allergens were different in those centers, HDMs are still the major allergens in Chinese AR patients, and the sensitization rates to cat, dog and *Humulus* pollen showed quickly increasing trends in the last decade.

AUTHOR CONTRIBUTIONS

ZR and CH conceived and designed the project. WY, ZX, and DW acquired the data. WY and CH did the statistical analysis. YL and CH wrote the first draft of the manuscript and ZR revised it. YX, JQ, HN, LW, YY, and MD contributed to the patients' general information. All authors collaborated in interpreting the data and revising the manuscript and approved of the submitted manuscript.

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CONFLICT OF INTEREST STATEMENT

The authors declared that they have no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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