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To the Editor,

Recent epidemiological studies revealed that the prevalence of allergic rhinitis and asthma dramatically increased in China[1, 2] . In 2008, to better represent sensitization rates in rhinitis and asthma, the China Alliance of Research on Respiratory Allergic Disease (CARRAD) conducted a national cross-sectional study on allergen sensitization in outpatients with asthma and rhinitis. The study demonstrated that house dust mites were the most prevalent allergens in China. The allergen sensitization rates varied by geographic location[3] . One decade has passed since our last national multi-center epidemiologic survey in 2008. Tremendous transformations have been taken place in economy status, e.g. people's living and working styles, urbanizations and the environment variations in China. Especially in the northern part, the regional governments have made great efforts to plant a large scale of *Artemisia desertorum* in order to control the impact of sandstorms on the big cities. Little is known about the impact of social and environmental changes on temperature and humidity as well as sensitizations in the general population or in patients with rhinitis and/or asthmas. Given the needs in providing important evidences for the national developmental strategies and clinical managements to reduce the burden and morbidity of allergic airway diseases, CARRAD decided to conduct the second national survey in 2018 with the same study protocol used in 2008 to understand the trends of sensitizations of patients with rhinitis and asthma in the past 10 years.

The 2008 survey was conducted from January 2008 to December 2008 in 17 cities with 24 participating centers. Expanding on this, the 2018 study was conducted from January 2018 to December 2018 in 26 cities with 36 centers from the northern, eastern, central, and southern coastal regions of China. A total of 6304 patients and 5532 patients, aged 5–65 years, in outpatient clinics at the study sites were enrolled in 2008 and 2018, respectively. After finishing the questionnaire, participants underwent serum specific IgE measurement. A total of 2322 and 2798 patients were enrolled in 2008 and 2018, respectively. The study protocol was approved by the ethics review board of each study center. Details about the methods were in the Appendix S1.

As shown in Table 1, the general sensitization rates to mites were significantly higher in 2018 than in 2008 (*Dermatophagoides pteronyssinus, Dermatophagoides farinae, Blomia tropicalis* : 52.1% vs 45.4%, 51.7% vs 44.5%, 30.7% vs 24.1%, respectively; all P<0.01). Likewise, sensitization rates to pollens (*Populus nigra* , *Ambrosia artemisifolia* , and*Artemisia vulgaris*) (4.2% vs 2.9%, 5.2% vs 1.7%, 10.5% vs 7.4%, respectively; all P <0.05) and dog fur (5.9% vs 3.7%, P<0.01) was increased in 2018 compared with 2008. No significant differences in sensitization rates to cat dander, timothy grass, and *Alternaria alternata* were observed between the 2018 and 2008 cohorts. Adults showed a greater increase in sensitization rate to mites (all P<0.01), while children had a greater increase in sensitization rates to dog dander, *Populus nigra* , *Ambrosia artemisifolia* , and *Artemisia vulgaris* (all P<0.01). Sensitivity to *Alternaria alternata* was significantly higher in children than in adults in both cohorts (both P<0.01). Among four regions, individuals from the southern coast showed the highest and the north the lowest prevalence of sensitization to*Dermatophagoides pteronyssinus* in 2008 and 2018. Except for the east region, the other three regions showed a significant increase in sensitization rates to *Dermatophagoides pteronyssinus* and*Dermatophagoides farinae* in 2018. Sensitization to cat and*Alternaria alternata* was higher in children than in adults in both cohorts. The northern region showed a dramatic increase in sensitization rates to *Ambrosia artemisifolia* and *Artemisia vulgaris* in 2018 compared with those in 2008, and it showed the highest sensitization rate among the four regions in both surveys.

Compared to 2008 data, results from 2018 found that in northern China, high-degree pollen sensitization (IgE

grade 4-6) and low-degree sensitization to dog dander increased in both children and adults, whereas high-degree mite sensitization increased only in adults (all P<0.05). In eastern China, grade 6 sIgE levels to mites (*Dermatophagoides pteronyssinus* and *Dermatophagoides farinae*) sIgE were observed in greater numbers of children (both P<0.05). High-level sIgE sensitization to dog dander declined in adults (P<0.001). In central China, mites (*Dermatophagoides pteronyssinus* and *Dermatophagoides farinae*) sIgE levels (grades 4–6) were increased in adults (both P<0.05). In the southern coast, high-degree sensitization to mites increased, whearas to Art v decreased in both children and adults (all P<0.05). All degrees of sensitization to *Alternaria alternata* significantly decreased in children (P<0.01) (Figure S1).

As in 2008, mites were still the most important allergen in 2018, especially for the youngest group. Sensitization to mite increased in nearly all age groups among individuals with rhinitis alone as well as in those with rhinitis and asthma (all P<0.05) (Figure 1A) . Patients with rhinitis had significantly higher positive rates of pollen sensitization in 2018, peaking between 25 and 44 years (P<0.05) (Figure 1C) . In 2018, the positive rate of animal sensitization was twofold higher in the 15–24-year-old rhinitis group (P<0.05). In addition, the fungus sensitization was increased in children with rhinitis and asthma (P<0.05) (Figure 1B and 1D) .

Using nationwide epidemiological study data, we found that the prevalence of sensitization to house dust mites (*Dermatophagoides pteronyssinus* , *Dermatophagoides farinae and Blomia tropicalis*), pollens (*Populus nigra, Ambrosia artemisifolia* , and*Artemisia vulgaris*), and animals (dog dander) in individuals with asthma and/or rhinitis significantly increased in China over the last decade. We noted that sensitization to pollens, especially those of*Artemisia vulgaris* , showed the greatest increase in the north, with sIgE grades 4–6. This may attributed to the allergenic properties of the pollen changing with climate across the northern hemisphere and sand dust control planting with *Artemisia desertorum* in our country[4,5] . These findings suggest that policies need to be adjusted to mitigate human-induced climate change and conduct further studies on the allergen testing for *Artemisia desertorum.*

Figure S1. Comparison of allergen sensitization grades in children and adults in four geographic regions of China. Allergen abbreviations: Der p=*Dermatophagoides pteronyssinus* , Der f=*Dermatophagoides farinae* , Blo t=*Blomia tropicalis* , Phl p=*Phleum pretense* , Pop n=*Populus nigra* , Amb a=*Ambrosia artemisifolia* , Art v=*Artemisia vulgaris* , Alt a=*Alternaria alternata* . *P<0·05, **P<0·01, ***P<0·001.

Figure 1. Distribution of sensitizations to different groups of allergens in patients with rhinitis, asthma, and asthma with rhinitis by stratification to age groups between 2008 and 2018. *P<0·05, **P<0·01.

Conflicts of interest

The authors declare that they have no conflicts of interest.

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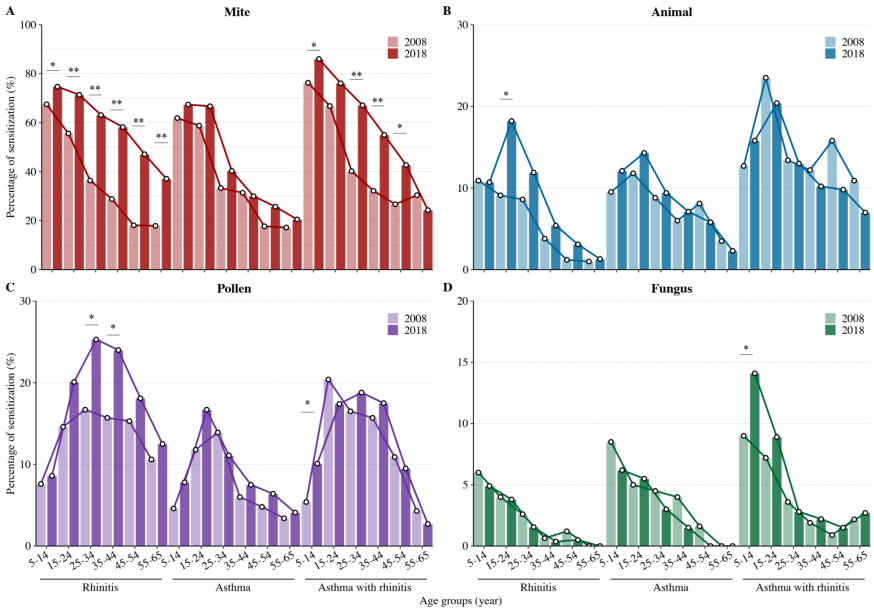

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`Table 1. Overall.pdf` available at https://authorea.com/users/436222/articles/538708-changes-in-sensitization-rates-in-patients-with-asthma-and-or-rhinitis-in-china-between-2008-and-2018-a-national-cross-sectional-study