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Allergic Sensitization Pattern in the Korean Dermatologic Patients

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Background: Avoiding causative allergens is important for controlling the clinical course of allergic diseases. Allergen sensitization is influenced by many factors including the environment and lifestyle. The socioeconomic development, climate, and lifestyle changes have increased the prevalence of allergic diseases worldwide. However, there is little information about changes in the trend of the common allergens over time.
Objective: This study was aimed at identifying the trends of the common allergens in Korea over a 10-year period based on the results of the multiple allergosorbent test chemiluminescent assay (MAST-CLA).
Methods: We retrospectively reviewed the medical records of 5,760 patients aged ≥18 years who visited the Dermatology Department at a tertiary hospital over a period of 10 years. The serum total immunoglobulin (Ig) E and specific IgE levels to 41 allergens were determined using MAST-CLA, along with the clinical diagnosis, duration of illness, white blood cell count and eosinophil percentage.
Results: *Dermatophagoides farinae*, *Dermatophagoides pteronyssinus*, and house dust were the most prevalent allergens during the 10 years period, but the percentage of higher class responses has decreased in recent years. The number of patients sensitized to house dust (p<0.001), dogs (p=0.005), and cats (p<0.001) increased while that of patients sensitized to cockroaches (p<0.001) and storage mites (p<0.001) decreased over time. There were no significant changes in the total number of sensitizing allergens over time.
Conclusion: The common allergens have changed over time. Based on the findings of this study, physicians and patients should consider changing their strategies for disease prevention and management.

Keywords: Allergens, Allergy, Atopic dermatitis, Immunoglobulin E, Multiple allergosorbent test chemiluminescent assay, Time trend

INTRODUCTION

The prevalence of allergic diseases such as atopic dermatitis is on the rise worldwide[1,2]. Although the exact etiology of allergic diseases is not known, it is thought that genetic and environmental factors, along with immunological dysfunction play an important role. In particular, allergens are involved in the onset and exacerbation of symptoms, thus, avoiding causative allergens is important in controlling the disease's clinical course and maintaining a good quality of life[3].

Allergen sensitization is influenced by many factors including genetics, age, and environmental factors. As there are significant changes in the environment and lifestyle, common allergens may also have changed over time. Therefore, identifying the trends of common allergens and taking appropriate preventive measures is essential for disease management.

Multiple allergosorbent test chemiluminescent assay (MAST-CLA) is a quick and simple method that detects multiple allergen-specific immunoglobulin (Ig) Es quantitatively with a rela-

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tively small amount of serum. In addition to the skin prick test and immunoCAP assays, the reliability and accuracy of MAST-CLA in detecting IgE have also been validated in many studies[4,5].

Several studies on allergen sensitization in allergic disease patients have shown that house dust mites are the most prevalent allergens[6,7]. However, to the best of our knowledge, data on the time and distribution trends, and severities of the common allergens are limited. Thus, the purpose of this study was to investigate the pattern of the common allergens over time based on the MAST-CLA results.

MATERIALS AND METHODS

Study subject

We retrospectively reviewed the medical records of patients aged ≥18 years who underwent MAST-CLA in the Department of Dermatology at Incheon St. Mary's Hospital, Incheon, Korea, from January 2011 to April 2020. The Advansure Alloscreen® (LG Life Science, Seoul, Korea) was used to detect allergen-specific IgEs in the serum. A total of 41 allergens on the Korean inhalant and food panel were examined from January 2011 to February 2017, and 62 allergens on the Korean standard and food panel were examined from March 2017 to April 2020 because of the change in panels. Overall, we analyzed 41 allergens over the study period as follows: alder and birch mix, *Alternaria alternata*, *Aspergillus fumigatus,* baker's yeast, barley meal, beef, buck-wheat, *Candida albicans,* cat, cheddar cheese, chicken, citrus mix, *Cladosporium herbarum*, cockroach, codfish, crab, *Dermatophagoides farinae, Dermatophagoides pteronyssinus*, dog, egg white, garlic, house dust, Japanese hop, mackerel, milk, mugwort, oak white, onion, peach, peanut, pork, rice, rye pollens, salmon, short ragweed, shrimp, soy bean, storage mite, tomato, tuna, and wheat flour.

The specific IgE levels were categorized into seven classes where Class 0 represents a specific IgE level of 0.00~0.34 IU/ml (negative findings), Class 1 0.35~0.69 IU/ml (low threshold response), Class 2 0.70~3.49 IU/ml (increased response), Class 3 3.50~17.49 (significantly increased response), Class 4 17.50~49.99 IU/ml (high response), Class 5 50.00~99.99 IU/ml (very high response), and Class 6 >100.00 IU/ml (extremely high response). Class 2 or greater was considered positive to sensitization to the specific allergen.

In addition to the MAST-CLA results, we obtained the following data: the patient's age, sex, dermatologic diagnosis, duration of illness, serum total IgE level, white blood cell (WBC) count and eosinophils as a percentage of WBC. The total serum IgE was measured by enzyme immunoassay (EIA), and it was considered to have increased if the level was higher than 165.30 IU/ml. If the value exceeded 3,000 IU/ml, it was considered as 3,000 IU/ml. This study was approved by the Institutional Review Board of the Catholic University of Korea, Incheon St. Mary's Hospital (IRB no. OC21RASI0058). The informed consent was waived.

Statistical analyses

The clinical characteristics are presented as number (%) and mean±standard deviation (SD) and the prevalence is expressed in percentage. The values of IgE, WBC, eosinophil and the number of MAST-CLA responses were expressed as mean±SD. For allergens with high incidence rate, the number and rate of positive responses and their ranks were analyzed by year and also over the entire period.

One way analysis of variance (ANOVA) test was performed to analyze the annual trends of IgE, WBC, eosinophil and positive MAST-CLA responses. To investigate whether there are statistically significant changes in the clinical characteristics of subjects and their results including MAST-CLA over time, we divided the entire study period into two: the first five years and the latter five years. Chi-squared tests and independent t-tests were performed to analyze the differences of the above values between the first five and the latter five years. Independent t-tests were performed to evaluate the changes (increase or decrease) in an individual's allergen sensitization. A p-value <0.05 was considered statistically significant. All statistical analyses were performed using SPSS version 21.0 (IBM Corp., Armonk, NY, USA).

RESULTS

In total, 5, 760 patients who underwent MAST-CLA from January 2011 to April 2020 were enrolled. Among them, 2,236 cases were male (38.8%, 43.2±17.3 years old) and 3,524 were female (61.2%, 43.4±15.6 years old). The most common dermatological diagnosis was acute urticaria (28.3%), followed by chronic urticaria (21.3%), allergic contact dermatitis (9.9%), atopic dermatitis (8.8%) and others (31.6%) including infectious skin disorders, and drug eruptions. The duration of illness ranged from one day to 40 years with an average of 11.0 months and an SD of 31.0 months overall; 32.1±57.7 months in atopic dermatitis, 16.5±30.8 months in chronic urticaria, 0.5±0.4 months in acute urticaria, and 8.1±21.9 months in contact dermatitis.

Annual trends of the subjects' clinical characteristics are shown in Table 1. There was no clear annual trend for sex, age,

Table 1. Clinical characteristics of subjects with the total IgE, WBC, eosinophil serum levels, and MAST results

Variable	2011 (n=402)	2012 (n=512)	2013 (n=707)	2014 (n=759)	2015 (n=637)	2016 (n=687)	2017 (n=660)	2018 (n=587)	2019 (n=660)	2020 (n=149)	Overall (n=5,760)	*p*-value
Sex												0.705
Male	154 (38.3)	181 (35.4)	277 (39.2)	286 (37.7)	246 (38.6)	270 (39.3)	258 (39.1)	238 (40.5)	259 (39.2)	67 (45.0)	2,236 (38.8)	
Female	248 (61.7)	331 (64.6)	430 (60.8)	473 (62.3)	391 (61.4)	417 (60.7)	402 (60.9)	349 (59.5)	401 (60.8)	82 (55.0)	3,524 (61.2)	
Age (yr)	42.6±15.8	41.1±15.1	43.0±15.1	42.8±15.7	43.6±16.4	43.5±16.2	43.1±16.8	44.5±17.3	45.2±17.6	44.3±16.7	43.4±16.3	0.004*
Diagnosis												
AD	28 (7.0)	35 (6.8)	45 (6.4)	63 (8.3)	49 (7.7)	61 (8.9)	70 (10.6)	65 (11.1)	70 (10.6)	19 (12.8)	505 (8.8)	<0.001*
CU	100 (24.9)	144 (28.1)	140 (19.8)	170 (22.4)	125 (19.6)	159 (23.1)	130 (19.7)	103 (17.5)	135 (20.5)	23 (15.4)	1,229 (21.3)	
AU	81 (20.1)	137 (26.8)	231 (32.7)	230 (30.3)	240 (37.7)	167 (24.3)	166 (25.2)	202 (34.4)	155 (23.5)	23 (15.4)	1,632 (28.3)	
ACD	37 (9.2)	50 (9.8)	61 (8.6)	51 (6.7)	73 (11.5)	51 (7.4)	71 (10.8)	75 (12.8)	86 (13.0)	18 (12.1)	573 (9.9)	
Others	156 (38.8)	146 (28.5)	230 (32.5)	245 (32.3)	150 (23.5)	249 (36.2)	223 (33.8)	142 (24.2)	214 (32.4)	66 (44.3)	1,821 (31.6)	
Duration of illness (mo)	12.9±41.1	8.22±4.3	7.8±20.0	12.3±35.7	8.5±18.9	14.2±37.7	8.8±21.9	15.3±38.2	11.4±34.3	9.3±22.0	11.0±31.0	0.017*
Total IgE (IU/ml)	334.3±598.5	324.4±598.1	333.8±625.6	320.1±615.0	313.2±573.6	336.3±617.5	353.0±639.4	316.5±577.7	366.2±662.7	376.0±690.7	334.5±616.3	0.848
WBC (/μl)	7,354±2,755	7,544±2,959	7,571±2,785	7,478±2,582	7,613±2,877	7,741±2,839	7,729±3,006	7,757±2,901	7,596±2,920	8,012±3,005	7,615±2,849	0.258
Eosinophil (%)	2.9±3.0	3.0±3.8	3.2±3.5	3.0±2.8	3.0±2.8	3.1±3.9	3.2±3.8	3.4±4.5	3.3±5.1	3.4±4.0	3.1±3.6	0.455
The number of sensitizing allergens identified by MAST												
≥Class 2	1.68±3.17	2.48±4.50	2.33±3.87	2.17±3.68	2.17±3.04	2.23±3.40	2.04±3.28	2.33±3.58	1.97±2.92	2.15±3.54	2.17±3.52	0.037*
≥Class 3	1.07±2.32	1.54±3.28	1.46±2.83	1.42±2.70	1.35±2.15	1.40±2.68	1.07±2.11	1.20±2.37	0.97±1.82	1.11±2.42	1.28±2.51	<0.001*
≥Class 4	0.61±1.53	0.92±2.37	0.86±1.97	0.91±1.86	0.80±1.46	0.86±2.04	0.42±1.11	0.43±1.07	0.36±0.86	0.48±1.41	0.69±1.66	<0.001*
≥Class 5	0.39±1.05	0.62±1.66	0.60±1.53	0.63±1.35	0.54±1.13	0.59±1.50	0.18±0.62	0.15±0.50	0.13±0.46	0.15±0.47	0.42±1.21	<0.001*

Values are presented as number (%) or mean±standard deviation. IgE: immunoglobulin E, WBC: white blood cell, MAST: multiple allergen simultaneous test, AD: atopic dermatitis, CU: chronic urticaria, AU: acute urticaria, ACD: allergic contact dermatitis. Annual rates were compared by one way analysis of variance test, showing significant difference between each year *$p<0.05$.

and illness duration. The number of patients diagnosed with atopic dermatitis increased gradually from the year 2011 to 2020 compared with the other diagnoses.

The annual and overall serum levels of the total IgE, WBC, eosinophil and the number of MAST-CLA positive panels are also shown in Table 1. Overall, the mean value of IgE was 334.5±616.3 IU/ml, WBC was 7,615±2,849 (/μl), and eosinophil was 3.1±3.6 (%). The number of positive allergen per patient over the entire study period was 2.17±3.52, for Class 3 was 1.28±2.51, for Class 4 was 0.69±1.66, for Class 5 was 0.42±1.21. According to the one-way ANOVA test, there was a significant difference in the number of responses for classes 2, 3, 4, and 5 between the years. On the other hand, there was no significant difference between the years with regards to IgE, WBC count, and eosinophil percentages.

Each year's 10 most common allergens are in Table 2. The 10 most common allergens during the entire study period were *D. farinae, D. pteronyssinus*, house dust, storage mite, rye pollen, cat, garlic, cockroach, dog, and short ragweed in decreasing order (Supplementary Table 1). The positive responses of these 10 allergens changed (increased or decreased) over time, which led to changes in their ranking (Fig. 1). The three most common allergens were *D. farinae, D. pteronyssinus*, and house dust, and were constant over the years. The cat, dog, shrimp, peach, alder-birch mix allergens ranked higher while storage mite, rye pollen, garlic, onion, crab, and cockroach ranked lower over time.

The positive response rates of the 10 most common allergens according to intensity were compared each year to evaluate the trends of sensitization in detail (Fig. 2). Over time, specific IgE responses to cat, dog, egg white, shrimp, peach, alder-birch mix, and oak white allergens were shown to increase. On the other hand, responses to the storage mite, rye pollen, garlic, cockroach, short ragweed, crab, onion, milk, pork, beef, wheat flour, and peanut allergens decreased. The positive rates of specific IgE to cat allergen increased for all the classes, while those of the dog allergen increased only for classes 2, 3, and 4 and decreased for class 5. The degree of sensitization for the three most common allergens, *D. farinae, D. pteronyssinus* and house dust, was high all through the study period, but the percentage of severe responses of classes 4, 5 or higher, decreased.

To investigate whether there are statistically significant changes in the clinical characteristics of subjects and their

Table 2. The 10 most common allergens

Rank	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Overall
1	*D. farinae*	*D. farinae*	*D. farinae*	*D. farinae*	*D. pteronyssinus*	*D. farinae*	*D. farinae*	*D. farinae*	*D. farinae*	*D. farinae*	*D. farinae*
2	*D. pteronyssinus*	*D. pteronyssinus*	*D. pteronyssinus*	*D. pteronyssinus*	*D. farinae*	*D. pteronyssinus*	*D. pteronyssinus*	*D. pteronyssinus*	*D. pteronyssinus*	*D. pteronyssinus*	*D. pteronyssinus*
3	Storage mite	Storage mite	Storage mite	House dust	House dust	House dust	House dust	House dust	House dust	House dust	House dust
4	House dust	House dust	House dust	Storage mite	Storage mite	Storage mite	Storage mite	Cat	Cat	Cat	Storage mite
5	Cockroach	Cockroach	Cockroach	Garlic	Rye pollens	Rye pollens	Rye pollens	Rye pollens	Storage mite	Peach	Rye pollens
6	Rye pollens	Garlic	Garlic	Rye pollens	Garlic	Garlic	Cat	Storage mite	Shrimp	Shrimp Alder-birch mix Storage mite*	Cat
7	Garlic	Rye pollens	Rye pollens	Cockroach	Short ragweed	Dog	Dog	Oak white	Dog		Garlic
8	Mugwort	Short ragweed	Onion	*Candida albicans*	*C. albicans*	Cat	*Aspergillus fumigatus*	Dog	Rye pollens		Cockroach
9	Dog	Onion	Dog	Cat	Milk	*C. albicans*	*Cladosporium herbarum*	Mugwort	Peach	*C. albicans*	Dog
10	Onion Short ragweed *C. albicans**	Peach	Short ragweed	Crab	Crab	Cockroach	Oak white	Alder-birch mix	Alder-birch mix	Dog	Short ragweed

D. farinae: *Dermatophagoides farinae, D. pteronyssinus: Dermatophagoides pteronyssinus.* *Having multiple allergens in a cell means they occupy the same rank.

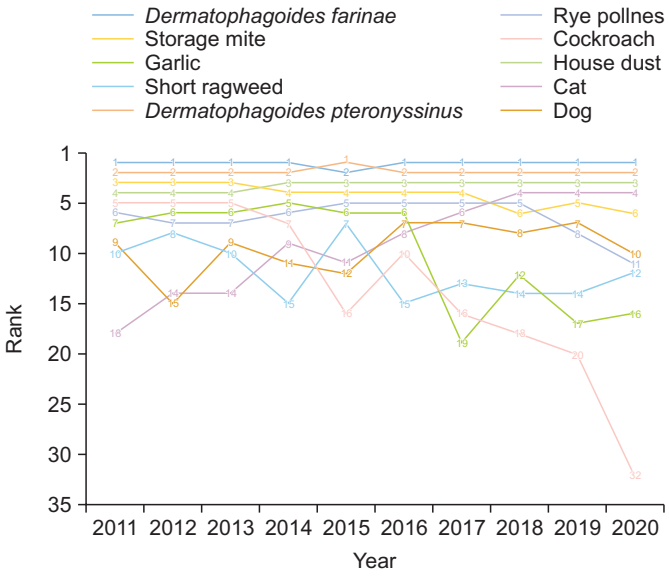

Fig. 1. Annual change in rank of the 10 most common allergens.

results including MAST-CLA over time, we divided the entire study period into two: the first five years and the latter five years (Table 3). There was a significant difference in the patients' age, diagnosis, and WBC count between the two periods (age, p=0.001; diagnosis, p<0.001; WBC, p=0.012). Atopic dermatitis and allergic contact dermatitis were more common in patients enrolled from 2016 to 2020 than in those enrolled in the first five years. The number of positive MAST-CLA responses did not differ between the two time periods while those of higher intensity decreased (Class 3, p=0.001; Class 4, p<0.001; Class 5, p<0.001).

The positive response rates, which are defined as specific IgE level of class 2 or higher, of each of the 41 allergens for the two periods were compared (Table 4). A number of the allergens showed a significant difference suggesting a change in sensitization to that particular allergen over time. The following allergens carried an increased risk of sensitization: house dust (p<0.001), dog (p=0.005), cat (p<0.001), peach (p=0.002), alder-birch mix (p=0.001), oak white (p<0.001), *C. herbarum* (p=0.001), *A. fumigatus* (p<0.001), shrimp (p<0.001), and egg white (p<0.001). On the other hand, the followings were shown with a decreased risk of sensitization: storage mite (p<0.001), garlic (p<0.001), cockroach (p<0.001), short ragweed (p=0.012), *C. albicans* (p=0.005), crab (p=0.002), barley meal (p=0.044), pork (p=0.027), milk (p=0.001), rice (p<0.001), beef (p<0.001), citrus mix (p=0.029), salmon (p=0.019), and chicken (p=0.007).

DISCUSSION

Allergic diseases are on the rise worldwide and this trend is expected to continue. This is attributed to the changes in the environment, climate, and lifestyle[8-10]. Accordingly, common allergens are likely to have changed over time. Considering the importance of avoiding causative allergens in the control of allergic diseases, it is important to investigate the trends of common allergens. In this study, this was evaluated using the MAST-CLA result.

This study showed a change in the trend of the common allergens in the Korean population over the past 10 years. *D. farinae, D. pteronyssinus*, and house dust, which are the best-known allergens[6,11,12], still remain in the top ranks. However, it is noteworthy that the proportion of people who are sensitized to these allergens remain high, but the percentage of patients showing high intensity has decreased. The decrease could be attributed to the patients' increased awareness of allergens and environmental control through the education provided by clinicians, the media, and the internet. Since the specific IgE level is reduced with allergen avoidance[13], the efforts to maintain clean environment keeping concentration of house dust and dust mites low may have reduced the severe responses. In the recent decades, there has been a rapid growth in the media and an increased interest in health matters; according to Google searches, between 2001 and 2010, there were only 19 online medical news in Korean on house dust mites, between 2011 and 2015 the searched news increased to 200 and latter to 240 between 2016 and 2020[14-16]. In addition, according to the user's search statistics from Google trends, the average search rate for house dust mites and allergies has increased[17], and the popularity of related products such as bedding vacuum cleaners and allergen-proof bedding has also increased. To sum up, the information on allergens and environmental management are becoming widely known through the Internet, and this may have led to the changes in the behavior of patients, resulting in decreased rate of severe allergic response to *D. farinae, D. pteronyssinus*, and house dust.

Several allergens including cats and dogs allergens have been shown to play a significant role in Koreans. The sensitization to cats and dogs has increased significantly, which is consistent with the results of a recent publication[18]; cats allergen was ranked the fourth, and dogs allergen was ranked the seventh most common allergen in 2020, which is a noticeable

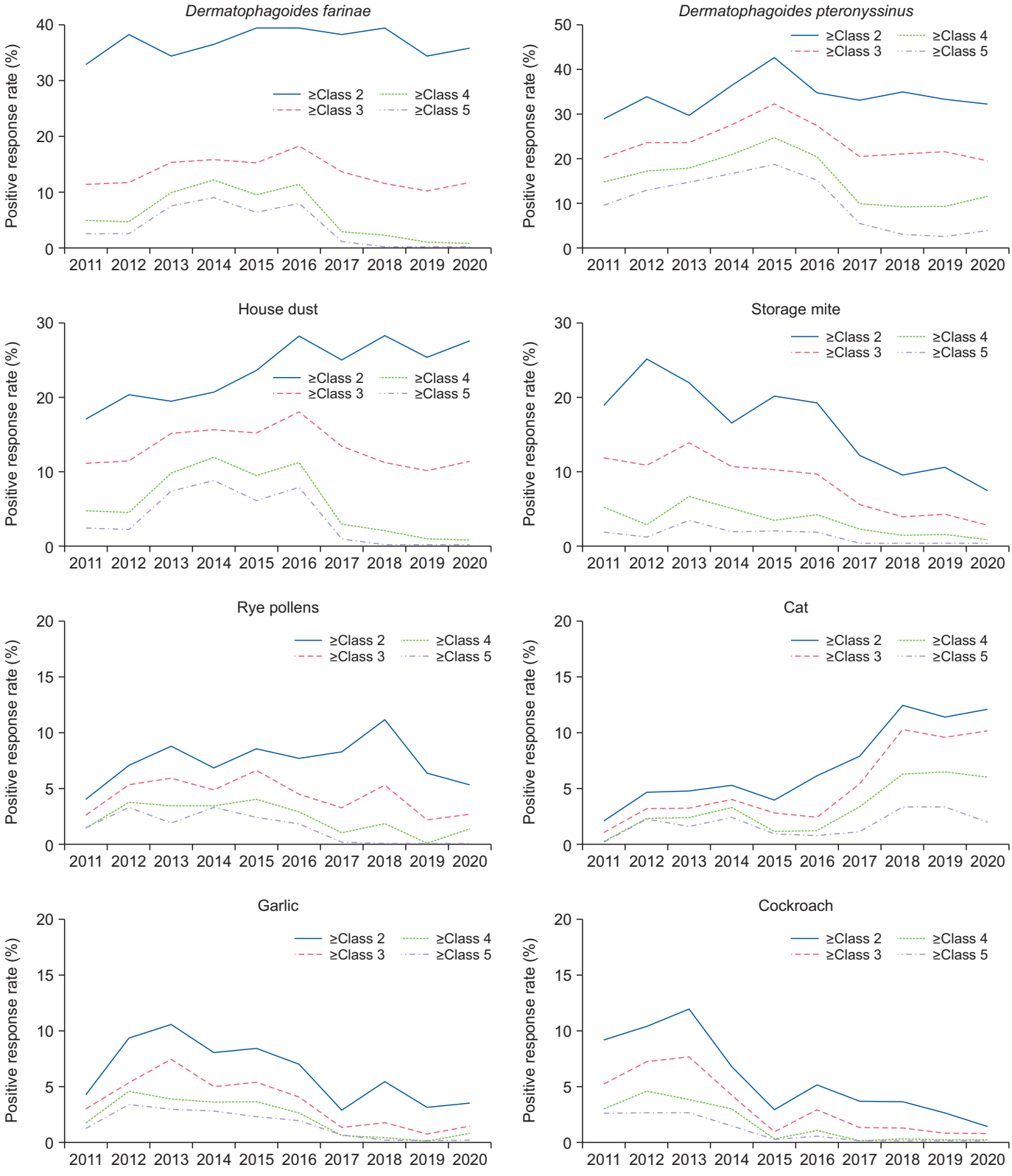

Fig. 2. Annual change in the positive response rates of the 10 most common allergens.

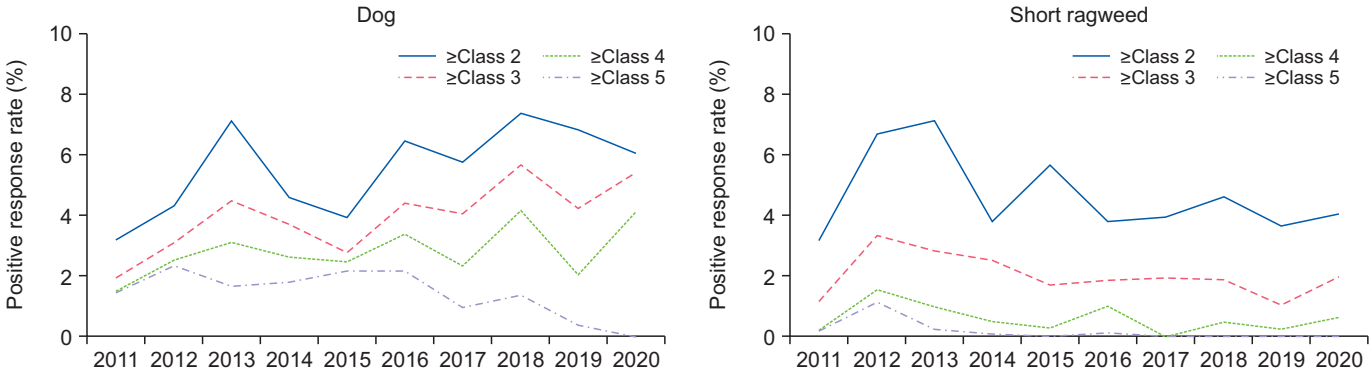

Fig. 2. Continued

Table 3. Comparison of subjects' clinical characteristics and responses between the first five years and latter five years

Variable	2011~2015 (n=3,017)	2016~2020 (n=2,743)	*p*-value
Sex			
Male	1,144 (37.9)	1,092 (39.8)	0.141
Female	1,873 (62.1)	1,651 (60.2)	
Age (yr)	42.7±15.6	44.1±17.0	0.001*
Diagnosis			
AD	220 (7.3)	285 (10.4)	<0.001*
CU	679 (22.5)	550 (20.1)	
AU	919 (30.5)	713 (26.0)	
ACD	272 (9.0)	301 (11.0)	
Others	927 (30.7)	894 (32.6)	
Duration of illness (mo)	9.8±28.7	12.0±32.9	0.05
IgE (IU/ml)	324.5±603.6	345.4±629.8	0.198
WBC (/μl)	7,523±2,781	7,725±2,924	0.012*
Eosinophil (%)	3.04±3.18	3.23±4.04	0.061
The number of sensitizing allergens identified by MAST			
≥Class 2	2.20±3.70	2.14±3.31	0.517
≥Class 3	1.39±2.70	1.16±2.28	0.001*
≥Class 4	0.84±1.87	0.52±1.38	<0.001*
≥Class 5	0.57±1.43	0.26±0.90	<0.001*

Values are presented as number (%) or mean±standard deviation. AD: atopic dermatitis, CU: chronic urticaria, AU: acute urticaria, ACD: allergic contact dermatitis, IgE: immunoglobulin E, WBC: white blood cell, MAST: multiple allergen simultaneous test. Discrete variables and continuous variables are compared by chi-square test and independent t-test, respectively, showing significant difference between each year *$p<0.05$.

increase compared to the rankings in 2010. Cats and dogs allergens were the third and fourth most common allergens, respectively, with strong intensity and therefore became the most important allergic diseases causative allergens among the Koreans. This could be attributed to the increased popularity of cats and dogs as domestic pets and therefore increased exposure[19]. The increased sensitization could also be as a result of indirect exposure to cats and dogs through Fel d 1 cat antigen from the pet owners' clothing in pet-free environments[20,21].

The positive response rate of house dust, peach, alder-birch mix, oak white, *C. herbarum*, *A. fumigatus*, shrimp and egg white also increased. The increased sensitization to peach, alder-birch mix, and oak white could be explained by their cross-reactivity with profilins and lipid transfer proteins[22,23]. Profilin is a structural protein and lipid transfer protein is a plant defense protein. They are found in many pollens and fruits, cause cross-reactivity among allergens, and may influence each other to increase sensitization. The sensitization rate to tree pollens has also increased over the recent years in patients with allergic rhinitis[24,25]. An increase in pollen concentration from 2012 to 2016 has been reported as the reason for the increased number of patients with allergic diseases in Korea[26]. The increased sensitization to shrimp could be attributed to the increased exposures; according to the National Statistical Office in Korea, consumption of shrimp has increased from approximately 50,000 tons in 2014 to 80,000 tons in 2019. In addition, this could be as a result of tropomyosin, a major shrimp allergen, cross-reacting with dust mites[27,28].

The importance of some allergens including storage mites and cockroaches in their contribution to allergic diseases has decreased. Their positive response and intensity have been decreased in this study. Storage mites do not belong to the Pyroglyphidae family represented by the species such as *D. farinae* and *D. pteronyssinus*, major sources of mite allergens in house dust. Since storage mites are common causative al-

Table 4. Comparison of the 41 allergens positive response rates between the first five years and latter five years

Allergen	2011~2015 (n=3,017)	2016~2020 (n=2,743)	*p*-value
Dermatophagoides farinae	36.3±48.1	37.5±48.4	0.339
Dermatophagoides pteronyssinus	34.5±47.6	33.7±47.3	0.515
House dust	20.5±40.4	26.8±44.3	<0.001*
Storage mite	20.2±40.2	12.7±33.3	<0.001*
Garlic	8.4±27.7	4.5±20.8	<0.001*
Cockroach	8.1±27.2	3.6±18.7	<0.001*
Rye pollens	7.3±26.1	8.2±27.4	0.234
Short ragweed	5.4±22.5	4.0±19.5	0.012*
Onion	5.0±21.9	2.7±16.1	<0.001*
Candida albicans	4.9±21.5	3.4±18.1	0.005*
Dog	4.8±21.4	6.5±24.7	0.005*
Crab	4.7±21.3	3.1±17.4	0.002*
Cat	4.4±20.5	9.6±29.4	<0.001*
Mugwort	4.1±19.9	4.0±19.6	0.799
Tomato	4.1±19.8	4.0±19.5	0.842
Barley meal	3.1±17.4	2.3±14.9	0.044*
Peach	3.0±17.2	4.7±21.1	0.002*
Pork	2.9±16.9	2.0±14.1	0.027*
Milk	2.9±16.6	1.6±12.4	0.001*
Rice	2.9±16.6	1.4±11.8	<0.001*
Wheat flour	2.8±16.5	2.2±14.7	0.150
Alder-birch mix	2.8±16.5	4.4±20.5	0.001*
Beef	2.8±16.4	0.1±3.8	<0.001*
Peanut	2.5±15.6	1.8±13.4	0.082
Alternaria alternata	2.4±15.4	3.0±17.0	0.184
Citrus mix	2.3±15.1	1.5±12.3	0.029*
Oak white	2.2±14.6	4.3±20.3	<0.001*
Cladosporium herbarum	2.2±14.6	3.7±18.9	0.001*
Aspergillus fumigatus	2.0±14.0	3.8±19.0	<0.001*
Japanese hop	1.9±13.7	2.3±15.1	0.282
Buck-wheat	1.8±13.4	1.4±11.8	0.227
Soy bean	1.5±12.0	0.9±9.7	0.074
Shrimp	1.2±11.0	4.6±20.9	<0.001*
Yeast, bakers	1.2±10.7	0.8±8.7	0.124
Salmon	0.7±8.5	0.3±5.4	0.019*
Chicken	0.6±7.5	0.1±3.8	0.007*
Tuna	0.4±6.3	0.3±5.4	0.494
Codfish	0.3±5.7	0.4±6.3	0.662
Mackerel	0.3±5.1	0.1±3.3	0.168
Egg white	0.2±4.8	1.2±11.1	<0.001*
Cheddar cheese	0.1±3.2	0.1±3.3	0.907

Values are presented as mean±standard deviation. Positive response refers to the response of Class 2 or higher. Rates are compared by independent t-test, showing significant difference between each year *$p<0.05$.

lergens in the agricultural environment[29], these findings could be attributed to the gradual change of the Korean lifestyle from rural to urban in the past few decades. The cockroach is an important indoor allergen in homes along with dust mites and domesticated pets, and low socioeconomic status is a risk factor for exposure and sensitization[30]. In this present study, the decrease in cockroach sensitization could be a result of improved hygiene in Korea over the past decades.

The average number of positive allergens has not changed over time although the prevalence of allergic diseases has increased. These findings are different from those of the previous study that reported an increase in the rate of multiple allergen sensitizations in Korean children[31]. As the subjects in this study are adults, they are already exposed and accustomed to the external environment changes and inhaled allergens, resulting in little additional sensitization to the allergens compared to children.

The allergen sensitization trends differ by country because they are influenced by various factors, including race, socioeconomic, and environmental factors. In a study analyzing food-specific IgE changes using data from the National Health and Nutrition Examination Survey in the United States, unlike this study, the sensitization rate to shrimp decreased and the rate to egg white did not change[32]. This may be due to different food habits and environments that affect allergen exposures. Another study in the United States found racial and ethnic differences in the allergic disease prevalence and allergen sensitization trends[33]. An analysis of Finnish and Russian Karelia, which are geographically adjacent but have different socioeconomic and cultural environments, showed that the sensitization rates to birch pollen and cats increased in Finnish, but did not in Russian Karelia over the past decade[34]. Putting these findings together, it would be worth investigating whether there are such differences among patients with various socioeconomic or cultural backgrounds in Korea as well.

In conclusion, the trend of common allergens in the Korean population has changed over the past decade. House dust and dust mites are still the most prevalent allergens, but the percentage of those with severe responses has decreased in recent years. There was increased sensitization to house dust, cats, and dogs and a decreased in cockroaches and storage mites. While the prevalence of allergic diseases has increased, there was no significant difference in the number of sensitizing allergens identified by MAST-CLA in the adult population over time. We believe that the findings of this study will provide guidance to the physicians and patients in planning for allergic disease prevention and management.

SUPPLEMENTARY MATERIALS

Supplementary data can be found via http://anndermatol.org/src/sm/ad-21-260-s001.pdf.

CONFLICTS OF INTEREST

The authors have nothing to disclose.

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DATA SHARING STATEMENT

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

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