Dog and Cat Allergies and Allergen Avoidance Measures in Korean Adult Pet Owners Who Participated in a Pet Exhibition

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INTRODUCTION

Pet allergens are aeroallergens whose size is small enough to be inhaled and to induce asthma as well as other allergic diseases.1 As early as 1975, it was suggested that contact with certain pets, such as dogs, cats, rabbits, guinea pigs, budgerigars, and hamsters, could lead to sensitization to those pets and to elevated reactions on skin prick tests (SPTs).2 Thereafter, keeping a pet has also been reported to increase the risk of sensitization to pet allergens in Westernized countries, including Turkey, Kuwait, Japan, and Korea.3-6 In addition to sensitization to pet allergens, pet exposure is associated with allergic diseases, such as asthma, allergic rhinitis, atopic dermatitis, and other respiratory and skin allergy-related conditions.7,12-14 Indeed, many studies have suggested that exposure to pets is associated with exacerbation of asthma, poor lung function, increased airway inflammation, airway hyper-responsiveness (AHR), and increased inhaled corticosteroid (ICS) dose.5,7-9,11-13

However, many other studies have yielded conflicting results. Many reports focusing on the early life of birth cohorts or children, when allergies have not fully developed, have suggested that keeping pets is not associated with development of an allergic disease or a protective effect against an allergy.2-4,11-20 However, relatively few such studies have been performed in adults.5,7,12,14 In 2000, it was reported that asthmatics with pets suffered from allergy symptoms related to animal exposure more frequently than diabetics, and that higher doses of ICS were required in pet-owning asthmatics than non-pet-owning asthmatics.7 It has also been reported that the prevalence of rhinitis, skin allergy, and asthma was significantly more common in adults with animals than in those without.14 In contrast, cat ownership is associated with a lower prevalence of sensitiza-
tion to cats and dogs among English adults, and current exposure to pets is not related to sensitization to pets in adult French asthma sufferers. Furthermore, few studies have been conducted regarding pet ownership and pet allergy in regions other than Europe and the US, especially Korea.

Thus, this study was performed to evaluate dog and cat allergies and their association with allergen avoidance measures in Korean adult pet owners who participated in a pet exhibition, under the hypothesis that pet owners with dog or cat allergies try to minimize contact with their pets and reduce environmental indoor allergens.

**MATERIALS AND METHODS**

**Study population**

The study population consisted of current pet owners aged ≥ 19 years who attended a pet exhibition entitled the “Korea Pet (KOPET) Show” during November 25-27, 2015. Subjects who owned pets other than a dog or cat and those who kept both dogs and cats were excluded to rule out the influence of allergy to other pets and the interaction between dog and cat allergy.

**Questionnaires regarding demographics, pet ownership, and pet allergy**

After providing informed consent, subjects were asked to complete questionnaires regarding their age, gender, current allergic diseases, family history of allergic diseases, duration of pet ownership, duration of space sharing with pets, frequency of direct or facial contact with pets, pet residence, pet defecation site, pet species, and pet breed.

We defined allergic diseases as follows: allergic rhinitis, if the subjects suffered from one or more of watery rhinorrhea, sneezing, nasal congestion, postnasal drip, and itchy nose, perennially or seasonally when they did not have a cold or the flu; allergic conjunctivitis, if the subjects suffered from itchy eyes with or without tears perennially or seasonally; urticaria, if the subjects suffered from one or more itchy hives on their skin; atopic dermatitis, if the subjects suffered from itchy eczema that fluctuated with remission and relapse, with affected sites including the folds of the elbows, behind the knees, in front of the ankles, under the buttocks, or around the neck, ears, and eyes; asthma, if the subjects suffered from dyspnea accompanied by wheezing that fluctuated with nocturnal aggravation; food allergy, if the subjects suffered from one or more of oropharyngeal itching, angioedema, whole body itching, hives, skin rash, dyspnea, wheezing, and hypotension after ingestion of certain foods; and drug allergy, if the subjects suffered from one or more of angioedema, whole body itching, hives, skin rash, dyspnea, wheezing, and hypotension after the administration of certain drugs. We also considered subjects to have allergic diseases if their conditions were diagnosed by a doctor.

Subjects were also asked how often they cleaned their homes (per month) and beds (per month), removed pet hair from their clothes (per week), and had their pets shaved (per year).

Subjects were asked whether they suffered from any allergy symptoms, including eye itching, conjunctival engorgement, tears, eye burning, conjunctival edema, sneezing, rhinorrhea, nasal obstruction, nasal itching, postnasal drip, ear itching, palpating itching, cough, sputum, dyspnea, chest discomfort, wheezing, chest pain, skin itching, urticaria, skin rash, and angioedema during contact with their pets. They were considered to have a dog or cat allergy if they suffered from one or more of those allergy symptoms during contact with their dog or cat.

**SPTs for animal and other indoor inhalant allergens**

Subjects who agreed to participate, did not have dermatographism, and were not taking medications, including leukotriene modifiers, systemic glucocorticosteroids, and H1 or H2 antagonists within 3 days were asked to undergo SPTs for animal allergens (dog and cat) and other indoor inhalant allergens, including *Dermatophagoides farinae* (Df), *Dermatophagoides pteronyssinus* (Dp), American cockroach, German cockroach, and a mold mixture using the Lofarma Diagnostics Allergen (Lofarma, Milan, Italy). If the mean diameters of the wheals provoked by allergens in SPT were ≥ 3 mm, the results were considered positive for those allergens.

**Statistical analysis**

The statistical analysis was performed using PASW 20.0 software (SPSS Inc., Chicago, IL, USA). We hypothesized that subjects with a dog or cat allergy tend to contact with their pet less frequently than those without allergies. We further hypothesized that subjects with a dog or cat allergy have facial contact with their pets less frequently than those without (10 vs 20 times/day), based on the results of our pilot survey. The target sample size was calculated to be 107 in a 2-sided test with 95% confidence intervals ($\alpha/2 = 0.025$, $\beta = 0.2$, and $\sigma = 23.5$). Continuous variables were analyzed by Student’s t test, whereas categorical variables were analyzed by the $\chi^2$ test for parametric variables or Fisher’s exact test for non-parametric variables. A $P$ value < 0.05 was considered significant.

**Ethics**

The study was performed in accordance with the International Conference on Harmonization Good Clinical Practice and applicable legal requirements and was registered at ClinicalTrials.gov (NCT03101618). The study protocols and informed consent forms were reviewed and approved by the Institutional Review Board (GBIRB2016-155).

**RESULTS**

**Demographic and clinical characteristics**

In total, 654 of 19,956 participants in the KOPET Show visited...
Subjects who visited our survey booth in “Korea Pet (KOPET) Show” (n = 654)

Subjects keeping other pets (n = 44)
- 18 kept rabbits,
- 5 kept parrots,
- 2 kept turtles,
- 1 kept a rat,
- 1 kept a snail,
- 1 kept a snake,
- 1 kept a bearded dragon

Subjects keeping both dogs and cats (n = 54)
- 8 kept hamsters,
- 3 kept fish,
- 1 kept a hedgehog,
- 1 kept a mouse

Questionnaires and SPT for dog, cat, and other indoor inhalant allergens (n = 556)

Dermographism (n = 19)

Analysis (n = 537)

Fig. 1. Participant flowchart. Informed consent was obtained from 654 subjects who visited our survey booth. Among them, 44 dropped out because they owned pets other than a dog or cat, and 54 because they owned both dogs and cats. A total of 556 subjects were asked to respond to questionnaires regarding their dog or cat ownership and dog or cat allergy. Nineteen subjects dropped out due to dermographism following the SPT. Thus, the final analysis was performed on a total of 537 subjects. SPT, skin prick test.

Most of the subjects were female (80.1%), aged about 30 years. Among them, the most prevalent allergic disease was allergic rhinitis (39.1%), followed by allergic conjunctivitis (11.4%), atopic dermatitis (8.9%), urticaria (7.1%), food allergy (4.3%), drug allergy (3.4%), and asthma (1.3%). A total of 295 subjects (54.9%) had a family history of allergic diseases. Totals of 43 (8.0%), 44 (8.2%), 173 (32.2%), 160 (29.8%), 28 (5.2%), 10 (1.9%), and 23 (4.3%) had positive responses to dog, cat, Df, Dp, American cockroach, German cockroach, and a mold mixture allergen on the SPT, respectively.

Female predominance was significantly higher in dog owners with a dog allergy than in those without (88.3% vs 78.9%), but gender did not differ between cat owners with and without. No difference in age was observed between the dog owners with and without a dog allergy or between cat owners with and without a cat allergy.

Allergic rhinitis, allergic conjunctivitis, atopic dermatitis, urticaria, and food allergy, but not drug allergy or asthma, were more prevalent in dog owners with a dog allergy than in those without (63.1%, 22.3%, 15.5%, 12.6%, and 8.7% vs 32.2%, 7.6%, 7.6%, 5.3%, and 3.3%; respectively). Only allergic rhinitis was more prevalent in cat owners with a cat allergy than in those without (51.1% vs 28.2%). Dog owners with a dog allergy and cat owners with a cat allergy had a family history of allergic diseases more frequently than those without (67.0% vs 51.0%), but no difference was found between cat owners with and without a cat allergy (51.1% vs 56.6%).

Dog owners with a dog allergy were positive to dog, cat, Df, and Dp allergens more frequently than those without (38.8%, 29.1%, 57.3%, and 57.3% vs 8.2%, 6.9%, 30.6%, and 27.6%; respectively). Cat owners with a cat allergy were positive to dog, cat, and Df allergens more frequently than those without (28.9%, 31.1%, and 64.4% vs 5.9%, 10.6%, and 32.9%; respectively).

Pet ownership
No difference was observed in the number of dogs kept currently between dog owners with and without a dog allergy, which was similar in cat owners (Table 2). The cumulative numbers of dogs and cats kept throughout life did not differ be-
Table 1. Demographic and clinical characteristics of the subjects

| Variables                        | All subjects (n=537) | Dog allergy+ (n=103) | Dog allergy- (n=304) | Total (n=407) | Cat allergy+ (n=45) | Cat allergy- (n=85) | Total (n=130) |
|----------------------------------|----------------------|----------------------|----------------------|----------------|----------------------|----------------------|--------------|
| Female                           | 430 (80.1)           | 91 (88.3)*           | 240 (78.9)           | 331 (81.3)     | 36 (80.0)            | 63 (74.1)            | 99 (76.2)    |
| Age (year)                       | 30.6 ± 8.7           | 30.6 ± 8.0           | 31.1 ± 9.6           | 31.0 ± 9.3     | 28.5 ± 4.9           | 29.3 ± 4.9           | 29.0 ± 4.9   |
| Comorbid allergic diseases       |                      |                      |                      |                |                      |                      |              |
| Allergic rhinitis                | 210 (39.1)           | 65 (63.1)*           | 88 (32.2)            | 163 (40.0)     | 23 (51.1)*           | 24 (28.2)            | 47 (36.2)    |
| Allergic conjunctivitis          | 61 (11.4)            | 23 (22.3)*           | 23 (7.6)             | 46 (11.3)      | 6 (13.3)             | 9 (10.6)             | 15 (11.5)    |
| Atopic dermatitis                | 48 (8.9)             | 16 (15.5)*           | 23 (7.6)             | 39 (9.6)       | 3 (6.7)              | 6 (7.1)              | 9 (6.9)      |
| Urticaria                        | 38 (7.1)             | 13 (12.5)*           | 16 (5.3)             | 29 (7.1)       | 1 (2.2)              | 8 (9.4)              | 9 (6.9)      |
| Food allergy                     | 23 (4.3)             | 9 (8.7)*             | 10 (3.3)             | 19 (4.7)       | 0 (0.0)              | 4 (4.7)              | 4 (3.1)      |
| Drug allergy                     | 18 (3.4)             | 5 (4.9)              | 8 (2.6)              | 13 (3.2)       | 0 (0.0)              | 5 (5.9)              | 5 (3.8)      |
| Asthma                           | 7 (1.3)              | 2 (1.9)              | 3 (1.0)              | 5 (1.2)        | 2 (4.4)              | 0 (0.0)              | 2 (1.5)      |
| Family history of allergic diseases | 295 (54.9)         | 69 (67.0)*           | 155 (51.0)           | 224 (55.0)     | 23 (51.1)            | 48 (56.5)            | 71 (54.6)    |

Sensitization to dog and cat allergens

|                          | Dog                       | Cat                      |
|--------------------------|---------------------------|--------------------------|
| Total                    | 171 (32.3)                | 86 (25.3)                |
| Dog allergy+             | 6 (18.2)                  | 13 (25.5)                |
| Dog allergy-             | 20 (66.7)                 | 14 (26.9)                |
| Cat allergy+             | 24 (68.6)                 | 4 (8.1)                  |
| Cat allergy-             | 12 (34.3)                 | 23 (45.3)                |

Sensitization to other indoor inhalant allergens

|                 | Allergy Asthma Immunol Res. 2018 March;10(2):155-164. https://doi.org/10.4168/aair.2018.10.2.155 |
|-----------------|---------------------------------------------------------------------------------------------------|
| Variables       | All subjects (n=537)                                                                            |
|                 | Dog allergy+ (n=103)                                                                            |
|                 | Dog allergy- (n=304)                                                                            |
|                 | Total (n=407)                                                                                   |
|                 | Cat allergy+ (n=45)                                                                            |
| Family history of allergic diseases | 295 (54.9)                                      | 69 (67.0)*                               |
|                | 155 (51.0)                                                                                      |
|                | 224 (55.0)                                                                                      |
|                | 23 (51.1)                                                                                       |
|                | 48 (56.5)                                                                                       |
|                | 71 (54.6)                                                                                       |
| Sensitization to dog and cat allergens | Dog ownership                                                                                     |
|                 | 83 (15.5)                                                                                       |
|                 | 40 (38.8)*                                                                                      |
|                 | 25 (8.2)                                                                                         |
|                 | 65 (16.0)                                                                                       |
|                 | 13 (28.9)*                                                                                      |
|                 | 5 (5.9)                                                                                          |
|                 | 18 (13.8)                                                                                       |
| Sensitization to other indoor inhalant allergens | Dog allergy                                                                                       |
|                 | 209 (38.9)                                                                                      |
|                 | 59 (57.3)*                                                                                      |
|                 | 93 (30.6)                                                                                       |
|                 | 152 (37.3)                                                                                      |
|                 | 29 (64.4)*                                                                                      |
|                 | 28 (32.9)                                                                                       |
|                 | 57 (43.8)                                                                                       |
| Sensitization to other indoor inhalant allergens | Cat allergy                                                                                       |
|                 | 197 (37.6)                                                                                      |
|                 | 59 (57.3)*                                                                                      |
|                 | 84 (27.6)                                                                                       |
|                 | 143 (35.1)                                                                                      |
|                 | 25 (55.6)                                                                                       |
|                 | 29 (34.1)                                                                                       |
|                 | 54 (41.5)                                                                                       |
| Sensitization to other indoor inhalant allergens | Dog allergy                                                                                       |
|                 | 51 (9.5)                                                                                         |
|                 | 11 (10.7)                                                                                       |
|                 | 26 (8.6)                                                                                         |
|                 | 37 (9.1)                                                                                         |
|                 | 4 (8.9)                                                                                          |
|                 | 10 (11.8)                                                                                        |
|                 | 14 (10.8)                                                                                        |
| Sensitization to other indoor inhalant allergens | Cat allergy                                                                                       |
|                 | 38 (7.1)                                                                                         |
|                 | 7 (6.8)                                                                                          |
|                 | 17 (5.6)                                                                                         |
|                 | 24 (5.9)                                                                                         |
|                 | 5 (11.1)                                                                                         |
|                 | 9 (10.6)                                                                                         |
|                 | 14 (10.8)                                                                                        |
| Sensitization to other indoor inhalant allergens | Dog allergy                                                                                       |
|                 | 23 (4.3)                                                                                         |
|                 | 15 (14.6)*                                                                                      |
|                 | 19 (6.3)                                                                                         |
|                 | 34 (8.4)                                                                                         |
|                 | 1 (2.2)                                                                                          |
|                 | 4 (4.7)                                                                                          |
|                 | 5 (3.8)                                                                                          |

Data are means ± standard deviation or frequencies (%).

*P<0.05 compared with dog owners without a dog allergy or cat owners without a cat allergy; †P<0.01 compared with dog owners without a dog allergy or cat owners without a cat allergy; ‡P<0.001 compared with dog owners without a dog allergy or cat owners without a cat allergy.

There was no difference in the frequencies of shaving, cleaning beds, pet hair removal from the clothes, or home cleaning between dog owners with and without a dog allergy or between cat owners with and without a cat allergy. Dog owners with a dog allergy had kept their dogs longer than those without (88.0 ± 72.0 vs 67.5 ± 72.7 months). No differences were observed in duration of space sharing or frequency of direct and facial contact. Cat owners with a cat allergy had facial contact less frequently than those without (8.6 ± 11.9 vs 18.3 ± 27.0 times/day), whereas the other above-mentioned variables did not differ between the 2 groups.

No difference in dogs’ residence or defecation site was observed between dog owners with and without a dog allergy. In contrast, the number of cats that slept with their owners was lower in cat owners with a cat allergy than in those without (71.1% vs 81.2%), while the number of cats that must leave the bedroom during sleep was higher in cat owners with a cat allergy than in those without (13.3% vs 9.4%). No difference in cats’ defecation site was observed between cat owners with and without a cat allergy.

Allergen avoidance measures

There was no difference in the frequencies of shaving, cleaning beds, pet hair removal from the clothes, or home cleaning between dog owners with and without a dog allergy (Table 3). By contrast, cat owners with a cat allergy had their cats shaved less frequently than those without (1.8 ± 3.3 vs 3.2 ± 4.4 times/year), and cleaned their beds less frequently (1.5 ± 1.5 vs 3.9 ± 6.0 times/month). No difference in the frequency of pet hair removal from the clothes or home cleaning was observed between cat owners with and without cat allergy.

Prevalence of dog and cat allergies according to breed

A dog allergy was most prevalent in dog owners who kept Chihuahua (40.0%), followed by Yorkshire terrier (38.3%), Maltese (30.1%), Poodle (22.8%), Spitz (20.8%), and Shih Tzu (24.5%) (Fig. 2). The prevalence of dog allergy among all dog owners was 25.3%, and it did not differ significantly according to breed. Cat allergy was the most prevalent in cat owners who kept Persian (47.8%), followed by Turkish Angora (41.7%), Korean Shorthair (38.3%), and Scottish Fold (26.7%) cats. The prevalence of cat allergy among all cat owners was 34.6%, and did not differ significantly according to breed.

Allergy symptoms during contact with pets

The most frequent allergy symptoms during contact with their
Table 2. Pet ownership

| Variables                                      | All subjects (n = 537) | Dog owners (n = 103) | Cat owners (n = 45) |
|-----------------------------------------------|------------------------|----------------------|--------------------|
|                                               | Dog allergy+ (n = 53)  | Dog allergy- (n = 48) | Cat allergy+ (n = 13) |
|                                               | 1.6 ± 1.0              | 1.6 ± 1.8            | 0.8 ± 0.6          |
| Number of pets kept currently                 | 1.3 ± 1.5              | 1.6 ± 1.6            | 3.0 ± 3.5          |
| Dogs                                          | 0.6 ± 1.9              | 0 ± 0.0              | 3 ± 3.1           |
| Cats                                          |                        | 0.7 ± 1.0            | 1.0 ± 0.0          |
|                                               |                        | 0.8 ± 2.6            | 0.8 ± 2.3          |
| Cumulative number of pets kept ever in life   |                        | 3.9 ± 7.0            | 5.3 ± 19.3         |
| Dogs                                          | 3.6 ± 6.6              | 4.0 ± 3.0            | 5.3 ± 19.3         |
| Cats                                          | 1.3 ± 3.0              | 0.7 ± 1.0            | 3.1 ± 3.0          |
| Exposure time                                 |                        | 0.8 ± 2.6            | 4.2 ± 5.5          |
| Duration of pet keeping (month)               | 68.3 ± 69.8            | 88.0 ± 72.0*         | 60.9 ± 56.3        |
| Dogs                                          | 11.6 ± 8.0             | 13.8 ± 12.5          | 11.4 ± 7.3         |
| Cats                                          | 11.3 ± 6.2             | 11.9 ± 8.3           | 12.8 ± 13.2        |
| Frequency of direct contact (times/day)       | 30.3 ± 37.3            | 31.0 ± 33.0          | 33.5 ± 58.5        |
| Frequency of facial contact (times/day)       | 16.7 ± 25.9            | 19.2 ± 25.8          | 18.6 ± 11.9*       |
| Pet residence                                 |                        | 17.4 ± 27.2          | 13.2 ± 10.8        |
| Pet sleeps in bedroom with owner              | 420 (78.2)             | 84 (81.6)            | 69 (81.2)          |
| Pet can come into bedroom but must leave when sleeping | 63 (11.7)         | 8 (7.8)              | 8 (9.4)            |
| Pet lives inside but cannot come into bedroom | 36 (6.7)               | 7 (6.9)              | 7 (8.2)            |
| Pet lives outside only                        | 7 (1.3)                | 2 (2.0)              | 1 (2.4)            |
| Pet lives outside but can come in            | 3 (0.6)                | 1 (1.0)              | 0 (0.0)            |
| Defecation site                               |                        | 1 (0.3)              | 1 (1.2)            |
| Inside, predetermined place                  | 471 (87.7)             | 86 (83.5)            | 40 (88.9)          |
| Inside, anywhere                             | 30 (5.6)               | 7 (6.8)              | 3 (6.7)            |
| Outside                                      | 30 (5.6)               | 7 (6.8)              | 2 (4.4)            |

Data are means ± standard deviation or frequencies (%).

Table 3. Allergen avoidance measures

| Variables                              | All subjects (n = 537) | Dog owners (n = 103) | Cat owners (n = 45) |
|----------------------------------------|------------------------|----------------------|--------------------|
|                                        | Dog allergy+ (n = 53)  | Dog allergy- (n = 48) | Cat allergy+ (n = 13) |
| Shaving (times/year)                   | 4.8 ± 17.2             | 4.9 ± 3.9            | 1.8 ± 3.3*         |
| Cleaning beds (times/month)            | 2.4 ± 3.5              | 2.5 ± 2.8            | 1.5 ± 1.5†         |
| Pet hair removal from clothes (times/week) | 4.7 ± 8.0             | 5.2 ± 8.8            | 3.9 ± 3.8          |
| Home cleaning (times/month)            | 17.5 ± 15.4            | 19.3 ± 20.4          | 15.4 ± 13.1        |

Data are means ± standard deviation.

Table 4. Symptoms of pet allergy

| Variables                              | All subjects (n = 537) | Dog owners (n = 103) | Cat owners (n = 45) |
|----------------------------------------|------------------------|----------------------|--------------------|
|                                        | Dog allergy+ (n = 53)  | Dog allergy- (n = 48) | Cat allergy+ (n = 13) |
| rhinitis                               | 80.0%                  | 80.0%                | 80.0%              |
| conjunctivitis                         | 73.3%                  | 73.3%                | 73.3%              |
| cutaneous symptoms                     | 55.3%                  | 55.3%                | 55.3%              |
| lower respiratory symptoms             | 33.0%                  | 33.0%                | 33.0%              |

The most frequent allergy symptoms of cat owners with a cat allergy during contact with their cats were rhinitis (80.0%), followed by conjunctivitis (73.3%), cutaneous symptoms (55.3%), and lower respiratory symptoms (33.0%) (Table 4).

Use of medical services for pet allergy and recognition of allergy immunotherapy (AIT)

Only 35.3% of dog owners with a dog allergy consulted doc-
tors due to their dog allergy and 19.6% received prescription medications. Although 17.6% of them recognized AIT, merely 2.9% received it (Fig. 3).

Only 24.4% of cat owners with a cat allergy consulted doctors due to their cat allergy and 11.1% received prescription medications. While 28.9% recognized AIT, only 2.2% received it.

The use of medical services for a pet allergy, and recognition of AIT, did not differ between dog owners with a dog allergy and cat owners with a cat allergy.
Table 4. Allergy symptoms during contact with pets

| Symptoms                     | Dog owners with dog allergies (n=103) | Cat owners with cat allergies (n=45) | Pvalue |
|------------------------------|--------------------------------------|-------------------------------------|--------|
| Conjunctivitis symptoms      | 67 (65.0)                            | 33 (73.3)                           | 0.322  |
| Eye itching                  | 45 (43.7)                            | 23 (51.1)                           | 0.405  |
| Conjunctival engorgement      | 38 (36.9)                            | 16 (35.6)                           | 0.876  |
| Tears                        | 34 (33.0)                            | 13 (28.9)                           | 0.620  |
| Eye burning                  | 35 (34.0)                            | 12 (26.7)                           | 0.379  |
| Conjunctival edema            | 22 (21.4)                            | 13 (28.9)                           | 0.321  |
| Rhinitis symptoms            | 76 (73.8)                            | 36 (80.0)                           | 0.418  |
| Sneezing                     | 67 (65.0)                            | 29 (64.4)                           | 0.944  |
| Rhinorrhea                   | 60 (58.3)                            | 22 (48.9)                           | 0.292  |
| Nasal obstruction            | 44 (42.7)                            | 13 (28.9)                           | 0.112  |
| Nasal itching                | 27 (26.2)                            | 9 (20.0)                            | 0.418  |
| Postnasal drip               | 15 (14.6)                            | 4 (8.9)                             | 0.342  |
| Ear itching                  | 10 (9.7)                             | 3 (6.7)                             | 0.548  |
| Palatine itching             | 8 (7.8)                              | 4 (8.9)                             | 0.818  |
| Cutaneous symptoms           | 57 (55.3)                            | 15 (33.3)                           | 0.014  |
| Skin itching                 | 37 (35.9)                            | 12 (26.7)                           | 0.271  |
| Urticaria                    | 37 (35.9)                            | 7 (15.6)                            | 0.013  |
| Skin rash                    | 20 (19.4)                            | 11 (24.4)                           | 0.489  |
| Angioedema                   | 10 (9.7)                             | 2 (4.4)                             | 0.280  |
| Lower respiratory tract symptoms | 32 (33.0) | 6 (13.3) | 0.013 |
| Cough                        | 24 (23.3)                            | 3 (6.7)                             | 0.016  |
| Sputum                       | 12 (11.7)                            | 2 (4.4)                             | 0.168  |
| Dyspnea                      | 9 (8.7)                              | 1 (2.2)                             | 0.146  |
| Chest discomfort             | 7 (6.8)                              | 1 (2.2)                             | 0.258  |
| Wheezing                     | 2 (1.9)                              | 3 (6.7)                             | 0.143  |
| Chest pain                   | 2 (1.9)                              | 1 (2.2)                             | 0.911  |

Variables are shown as frequencies (%). Allergy symptoms for which the frequency significantly differs between dog owners with dog allergies and cat owners with cat allergies (P<0.05) are shown as bold font.

DISCUSSION

Most subjects in this study were female, aged about 30 years, as most participants in the KOPET Show were women of that age. As the gender and age of subjects in this study were skewed, they may not accurately represent Korean pet owners. In addition, there were more female dog owners with a dog allergy than those without; however, we could not exclude the possibility that male subjects were included less as dog owners with a dog allergy than those without due to the female predominance in this study. Other studies that considered pet allergies did not find a female predominance in pet owners, nor did they find an association between female gender and pet allergy.1,5-13

In this study, dog owners with a dog allergy suffered from allergic rhinitis, allergic conjunctivitis, atopic dermatitis, urticaria, and food allergy, and had a family history of allergic diseases more frequently than those without. In addition, cat owners with a cat allergy also suffered from allergic rhinitis more frequently than those without. Furthermore, subjects with a dog or cat allergy in this study were positive for Df and/or Dp, which are the most common indoor inhalant allergens, more frequently than those without. These results are consistent with those of previous reports, suggesting an association between pet allergy, comorbid allergic diseases, and atopic inheritance.1,5-13 Regarding allergen sensitization, the sensitization rates of dog, cat, Df, and Dp allergens in the subjects of this study (15.5%, 13.8%, 38.9%, and 36.7%, respectively) were much or less similar to those in subjects of a previous hospital-based Korean study (20.4%, 15.0%, 47.4%, and 47.1%, respectively).5 The prevalence of allergic rhinitis, allergic conjunctivitis, atopic dermatitis, or asthma did not differ between dog or cat owners in another study of the Korean population.25 However, in this study, dog owners with a dog allergy suffered from cutaneous and lower respiratory symptoms more frequently than did cat owners with a cat allergy, while rhinitis or conjunctivitis symptoms did not differ between the 2 groups. One possible explanation for this is that cat owners with a cat allergy tried to minimize direct and facial contact with their cats, which may have reduced cutaneous and respiratory symptoms, which are generally provoked by close contact with allergens.

In this study, dog owners with a dog allergy had kept their dogs for a longer time than those without. The risk of becoming sensitized to pet allergens and subsequent pet allergy has been suggested to be higher when people are exposed to intermediate levels of pet allergens for a certain period.26 By contrast, patients with established pet allergen-induced allergic diseases can experience improvements in their disease symptoms, such as alleviation of AHR, and reduction of ICS dose in asthma patients after removal of their pets.27-29 Alleviation of allergic disease morbidity by removal of pets from the homes of all persons with a pet allergy would reduce healthcare costs.30 In fact, patients with a pet allergy or those with family members with a pet allergy tended to keep pets less frequently, and the levels of pet allergens in their households were lower.31-33 Whether pet owners allow their pets to enter their bedroom or a baby’s room, and whether individuals regularly visit places where pets are kept or where pet allergens are pooled by pet allergen carriers (e.g., pet owners’ clothes), such as schools or other public places, is also critical.34,35-38 Note that allergen avoidance measures at schools, involving school clothing or pet ownership bans, are equally effective in controlling the levels of airborne pet allergens.37 Other measures for reducing pet allergens, such as the use of air filters, vacuum cleaners, or washing and drying systems, have also been considered.38 However, one Cochrane review concluded that there was no significant difference between the effects of an active intervention using an air filter and those of control interventions.39 In this study, entire or partial
removal of pets was extremely rare (data not shown). Instead, cat owners with a cat allergy had less frequent facial contact and slept with their cats less frequently than those without; this phenomenon was not observed in dog owners. Because dog or cat hairs are well-known reservoirs of pet allergens, we thought that shaving pets and removing pet hairs from clothes may have reduced indoor pet hair, and thus served as potential allergen avoidance measures in addition to cleaning the house and bed. Therefore, we asked the subjects how often they took these measures. Cats are frequently observed to swallow their hair when they groom themselves, and these swallowed hair are frequently observed to be mixed in their feces. Therefore, we considered pet feces as potential reservoirs of pet allergen, and asked the subjects about where their pets defecated. This showed that cat owners with a cat allergy had their cats shaved and cleaned their beds less frequently than those without, while other allergen avoidance measures did not differ between the 2 groups. In dog owners, allergen avoidance measures did not differ according to whether they had dog allergies.

In this study, dog or cat allergies tended to be more prevalent in subjects who kept certain breeds, such as Chihuahua and Yorkshire terrier dogs and Persian and Turkish Angora cats, although this difference was not significant. It has been suggested that dog or cat allergies do not differ by breed, and that so-called hypoallergenic pets have higher allergen levels in hair and environmental samples. Instead, gender, age, and spay/neuter status, as suggested previously, influence glandular secretion and resulting allergenicity. Major pet allergens, such as Can f 1 (from dogs) and Fel d 1 (from cats), generally originate from salivary, sebaceous, or perianal glands, with the skin and hair serving as reservoirs, and their production may be influenced by sexual hormones, such as testosterone. Pets’ gender, age, and spay/neuter status may affect hormonal and excretory status to a greater extent than whether a specific breed sheds more or less; therefore, these may be more important contributors to allergenicity. Note that one company in the US has produced and marketed “hypoallergenic” pets that are deficient in Can f 1 or Fel d 1.

The most frequent allergy symptoms in subjects with a dog or cat allergy during contact with their pets were rhinitis symptoms, followed by conjunctivitis symptoms, cutaneous symptoms, and lower respiratory symptoms, which is consistent with those of previous studies.

As patients who are allergic to their pets are rarely willing to give up their pets, pharmacotherapy and AIT may become the main methods of controlling pet allergy. Pharmacotherapy for pet-allergic asthmatics requires a stepwise approach according to established asthma management guidelines. In addition to short-acting beta-agonists and ICSs, prophylactic anti-histamines before anticipated pet exposure, the use of intranasal steroids, and the use of leukotriene antagonists may also be considered as adjunctive therapy for pet-allergic patients with asthma and/or allergic rhinitis. Allergen-specific high-dose subcutaneous immunotherapy has been shown to be beneficial in cat-allergic patients with asthma and rhinoconjunctivitis, whereas the data for dog-allergic patients are less convincing. Alternative immunotherapeutic approaches, including sublingual, subcutaneous, and intralymphatic routes, and allergen-derived peptide-based immunotherapy, have been tried recently. In particular, intralymphatic immunotherapy has rapid onset and a long-duration therapeutic effect after only 3 injections in patients with a dog or cat allergy. However, in this study, only a small portion of subjects with a dog or cat allergy consulted doctors, and received prescription medication or AIT, indicating unmet medical needs in this population.

This study had several limitations. First, most subjects were adult females aged about 30 years, whereas there were relatively few male subjects or subjects in other age groups. Therefore, as mentioned previously, our study population was not representative of all pet owners in Korea. Second, we did not investigate the status of pets with regard to gender, age, or spay/neuter status, which would influence glandular secretions and resulting allergenicity. Instead, we focused on breeds of dogs and cats and found that pet owners keeping some breeds were prone to have a pet allergy more frequently. Further studies with a larger number of subjects are required to determine whether some breeds are more allergenic than others. Third, we performed SPTs with extracts from pets’ dander to determine sensitization to pet allergens. However, major pet allergens are now thought to be derived from salivary, sebaceous, or perianal glands, and the serum-specific IgE for these allergens is generally measured to determine sensitization. Unfortunately, we could not measure serum-specific IgE for major pet allergens because of budget and personnel constraints. Note that less than half of the subjects with a dog or cat allergy (31.1%-38.8%) showed skin reactivity to the relevant pet.

Despite these limitations, our study also has some merits. First, we carried out SPTs with indoor inhalant allergens other than pet dander and found that subjects with a dog or cat allergy were more frequently sensitized to Djf and Dpf. Second, we thoroughly evaluated each allergy symptom and found that subjects with a dog or cat allergy frequently experienced some allergy symptoms, such as sneezing, rhinorrhea, eye itching, nasal obstruction, and conjunctival engorgement. Third, we investigated subjects’ use of medical services for a dog or cat allergy and found that only a small portion of subjects with a dog or cat allergy consulted doctors, and even fewer received prescription medications and/or AIT. Finally, we surveyed subjects’ pet ownership and allergen avoidance measures. The results indicated that cat owners with a cat allergy had less facial contact and slept with their cats less frequently than those without a cat allergy, while they had their cats shaved and cleaned their beds less frequently than those without, which may increase exposure to cat allergens.

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In conclusion, cat owners with a cat allergy, but not dog owners with a dog allergy, tried to minimize contact with their cats, but their efforts to avoid cat allergens were lower than those without. Moreover, only a small portion of subjects with a dog or cat allergy used medical services. Further large-scale studies are needed to investigate pet ownership and dog or cat allergies in Korea.

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