

Exposure and sensitization to cat dander: Asthma and asthma-like symptoms among adults

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Background: Several pets, such as cats, dogs, and rodents, are known to produce allergens. Despite the clinical and laboratory evidence that exposure to pets can cause bronchoconstriction in sensitized subjects, the results of population studies have been contradictory.

Objectives: The purpose of this study was to investigate the relationship between cat ownership and the prevalence of asthma, asthma-like symptoms, and bronchitic symptoms among subjects 20 to 44 years of age in Vancouver, Canada and to determine whether sensitization is responsible for such an association.

Methods: Two thousand nine hundred ninety-nine (88%) randomly selected subjects responded to a mail questionnaire. Of these, 504 participated in laboratory examination, including allergy skin testing.

Results: One thousand nineteen study responders (34%) were pet owners at the time of the study (current owners). Current pet owners were found to have a higher prevalence of current asthma, asthma-like symptoms, and bronchitic symptoms compared with those without pets. Cat owners had significantly higher risk of having current asthma and asthma-like symptoms. In the subset who had allergic skin tests, we found that those who were allergic to cat dander had a significantly higher risk of current asthma than those not allergic to cat dander and not owning a cat.

Conclusion: This study provides evidence that sensitization to cat dander is a more important risk factor for current asthma and asthma-like symptoms than cat ownership itself. (*J Allergy Clin Immunol* 1999;103:60-5.)

Key words: Pets, cat, adults, asthma, respiratory symptoms, sensitization

Several pets, such as cats, dogs, and rodents, are known to produce allergens, which may cause or aggravate respiratory symptoms. These domestic animals are popular among families with children. Cats or dogs are frequently found in over 50% of homes in many countries.^{1,2}

Despite the clinical^{3,4} and laboratory⁵ evidence that exposure to pets can cause bronchoconstriction in sensitized subjects, the results of population studies linking respiratory symptoms to pet ownership were contradictory.⁶⁻²⁶ These studies were carried out mostly in children; however, 2 studies conducted among adults showed a negative association.^{8,14} So far, there has not been any study exploring the interrelationship between cat ownership, sensitization, and the presence of asthma and asthma-like symptoms.

The purpose of this study is to investigate the relationship between cat ownership and the prevalence of asthma and asthma-like and bronchitic symptoms among subjects 20 to 44 years of age in Vancouver, Canada and to determine whether sensitization to cat dander is responsible for the association if such an association exists.

METHODS

Study population

The study was carried out in Vancouver on subjects 20 to 44 years of age as part of a multicenter prevalence study of asthma and asthma-like symptoms in 6 communities in Canada. The design of this study has been described in detail elsewhere.²⁷ In Vancouver, a random sample of 18,000 telephone numbers was generated for each center. Interviewers systematically called the telephone numbers. The eligibility criteria were that the telephone number was a residential number and that only 1 individual aged 20 to 44 years residing in the household was eligible. If more than 1 household member was eligible to participate, the interviewer identified the resident to be included in the survey by using a predetermined sampling scheme. Three thousand three hundred ninety-three individuals were found to be eligible (100%) for the study in Vancouver. A short mail questionnaire was sent to these selected individuals. A second questionnaire was sent to nonresponders. Those who did not respond to 2 mailings were invited to complete the questionnaire over the telephone. Two thousand nine hundred ninety-nine individuals (88%) completed the mail questionnaire; 2076 (69%) by mail and 923 (31%) by phone. Of those who completed the mail questionnaire, 1267 (42%) were randomly chosen to attend the laboratory for further testing. Five hundred four (40%) took part in the laboratory examination, which included a more detailed questionnaire and allergy skin testing.

This study was approved by the Ethic Committee on Human Studies of the University of British Columbia.

Questionnaire

The mail questionnaire was a modified version of the one used in the European Community Respiratory Health Survey²⁸ and the Canadian survey.²⁷ Questions on smoking habits, past and present pet ownership, type of pet, parental history of asthma and allergy, and work exposure were included in the mail questionnaire in the survey conducted in Vancouver.

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TABLE I. Characteristics of study population

	Without pets (n = 1980)	With pets (n = 1019)
Age (y) (mean ± SD)	31.9 ± 6.6	31.9 ± 7.0
Gender: female, n (%)	972 (49.1)	608 (59.7)*
Foreign born: n (%)	699 (35.9)	228 (22.6)*
Smoking status: n (%)		
Nonsmokers	1116 (56.6)	433 (42.5)*
Exsmokers	451 (22.9)	272 (26.7)
Current smokers	404 (20.5)	314 (30.8)
Exposure to dust at work: n (%)	775 (39.1)	419 (41.1)
Exposure to gas at work: n (%)	521 (26.3)	301 (29.5)
Parental history of asthma: n (%)	189 (9.5)	106 (10.4)
Parental history of other allergic disease: n (%)	464 (23.4)	236 (23.2)
Childhood respiratory infection: n (%)	97 (4.9)	57 (5.6)
Pet ownership at childhood: n (%)	1963 (99.1)	1018 (99.9)*
Type of pets owned at time of study: n (%)		
Cat and other animals	—	625 (61.3)
Dog and other animals except cat	—	204 (20.0)
Other animals	—	190 (18.6)

* $P < .01$ for differences between those with pets and those without pets.

Allergy skin tests

Allergy skin tests were done by the prick method with 14 allergens, including cat dander, cockroach, house dust mites, and local pollens and molds (HollisterStier Laboratory, Spokane, Wash). A positive (histamine 1 mg/mL, Bencard Laboratory) and a negative control (normal saline) were also used.

The results were read at 15 minutes after testing. The largest diameter of the wheal and its perpendicular were measured and averaged. The length of the diameter of the negative control was subtracted from the diameters of wheals caused by allergens. The reaction was considered positive if the average diameter was 3 mm or greater than that produced by the negative control. Allergy to cat dander was defined as a positive skin reaction to cat dander.

Data analysis

The outcome (dependent) variables were 3 mutually exclusive groups: current asthma, asthma-like symptoms, and bronchitic symptoms. *Current asthma* was defined as a positive answer to "Have you had an attack of asthma in the last 12 months?" or "Are you currently taking any medication for asthma?" *Asthma-like symptoms* was defined as a positive answer to any 1 of the following: "Have you been at all breathless when the wheezing noise is present in the last 12 months?"; "Have you had this wheezing or whistling when you did not have a cold in the last 12 months?"; "Have you woken up with a feeling of tightness in your chest at any time in the last 12 months?"; "Have you ever woken by an attack of shortness of breath at any time in the last 12 months?"; or "Have you been woken by an attack of coughing any time in the last 12 months?" *Bronchitic symptom* was defined as a positive answer to "Do you usually cough?" and/or "Do you usually bring up phlegm from chest?"

The 2 primary explanatory (independent) variables were (1) the type of current pet ownership and (2) cat ownership and allergic status to cat dander. The type of current pet ownership was grouped as follows: cats and other pets, including dogs; dogs and other pets (no cat); other types of pets, including rodents, birds, horses, and reptiles; and no pets. Cat ownership and allergy to cat dander were grouped into the following categories: not a cat owner and not allergic to cat dander (on skin testing); own a cat and not allergic to cat dander; not a cat owner but allergic to cat dander; own a cat and allergic to cat dander.

Other independent variables included in the analyses were age, gender (male vs female), country of birth (Canadian vs foreign born), smoking status (current smoker vs nonsmoker and exsmoker vs nonsmoker), exposure to dust or gas at work, parental history of allergy, and a history of childhood respiratory infection (yes vs no for each of the previous 3 variables).

Chi-squared statistics, independent sample *t* tests, and 1-way ANOVA were used to examine the bivariate relationship between dependent and independent variables. The relationships between outcome and independent variables were examined by using the multinomial logit model (polytomous regression).²⁹ Statistical significance was defined as a 2-tailed *P* value less than .05. Stata statistical software version 5.0 for Windows 95²⁹ (Stata Corp) was used for analyses.

RESULTS

Characteristics of the study population

Table I shows the characteristics of the study population according to current pet ownership. One thousand nineteen (34%) responders were pet owners at the time of the study, and the rest did not have pets. More females, Canadian-born subjects, and current smokers were pet owners. There were no differences in workplace exposure to dusts and gases, parental history of asthma and other allergic diseases, and history of childhood respiratory infection between those with and without pets. Cats (20.8%) were the most common pet followed by dogs (10.3%), birds (2.5%), rodents (2.0%), reptiles (1.9%), and horses (0.1%). Almost all subjects had 1 or more types of pet in childhood (99.4%).

Pet ownership and respiratory symptoms

Current pet owners, compared with those without pets, had higher prevalence of current asthma (8.2% vs 5.8%), asthma-like symptoms (34.4% vs 30.4%), and bronchitic symptoms (15.5% vs 11.6%). Table II shows that those who owned a cat (with or without other pets) had signif-

TABLE II. Adjusted odds ratios of respiratory symptoms and current asthma for pet ownership

	Current asthma			Asthma-like symptoms			Bronchitic symptoms		
	Prevalence, n (%)	OR	95% CI	Prevalence, n (%)	OR	95% CI	Prevalence, n (%)	OR	95% CI
No pets	115 (5.8)	1.0	—	602 (30.4)	1.0	—	230 (11.6)	1.0	—
Other pets only	16 (8.4)	1.7	0.9-3.1	70 (36.8)	1.5	1.1-2.2	28 (14.7)	1.6	0.9-2.6
Dogs and others except cats	18 (8.8)	1.6	0.9-2.9	65 (31.9)	1.1	0.8-1.6	27 (13.2)	1.1	0.7-1.8
Cats and others	50 (8.0)	1.6	1.1-2.4	216 (34.6)	1.3	1.1-1.6	103 (16.5)	1.3	0.9-1.8

Other independent variables in the model: age (years), smoking status, parental history of asthma, childhood respiratory infection, and exposure to dust or gas at work.

TABLE III. Adjusted risk for respiratory symptoms and current asthma

	n (%)	Current asthma		Asthma-like symptoms		Bronchitic symptoms	
		OR	95% CI	OR	95% CI	OR	95% CI
Cat−, allergy−	338 (67.1)	1.0	—	1.0	—	1.0	—
Cat+, allergy−	102 (20.2)	2.7	1.1-7.3	1.2	0.7-2.1	1.4	0.7-2.8
Cat−, allergy +	51 (10.1)	18.9	6.8-53.0	2.3	1.1-4.9	0.4	0.1-2.0
Cat+, allergy+	13 (2.6)	14.1	2.9-67.8	0.4	0.1-3.3	1.7	0.3-10.1

Cat−, Did not own cat; cat+, owned cat at the time of study; allergy−, not allergic to cat dander; allergy+, allergic to cat dander.

Other independent variables in the model: age (years), smoking status, parental history of asthma, childhood respiratory infection, exposure to dust or gas at work, country of birth, and gender.

icantly higher prevalence of current asthma (OR 1.6, 95% CI, 1.1-2.4) and asthma-like symptoms (OR 1.3, 95% CI 1.1-1.6) compared with those without pets. Owners of other pets (no cat or dog) had a significantly higher prevalence of asthma-like symptoms (OR 1.5, 95% CI 1.1-2.2).

Ownership of pets in childhood was not associated with an increased risk of current asthma and other respiratory symptoms (data not shown).

Allergy to cat dander, cat ownership, and respiratory symptoms and asthma

Five hundred four responders took part in the laboratory examination. Laboratory attendees were older compared with those who took part only in the questionnaire survey (32.7 ± 6.8 vs 31.7 ± 6.7 years, respectively), and a higher proportion of them were nonsmokers (53.6% vs 51.4%, respectively). They also had a significantly higher prevalence of current asthma (14% vs 9.8%, respectively).

Of the laboratory attendees, 64 (12.7%) had a positive skin test reaction to cat dander (with 3 mm as the cut-off point). Of these, 13 were cat owners (cat+, allergy+), and 51 were not (cat−, allergy+). Of the 440 subjects who had negative skin test reactions to cat dander, 102 were cat owners (cat+, allergy−), and the remaining 338 did not have cats (cat−, allergy−). By using 2 mm as the cut-off point, there were 87 subjects (17.3%) who had a positive skin test reaction to cat dander. Of these, 16 were cat owners (cat+, allergy+), and 71 were not (cat−, allergy+). Of the 417 subjects who had negative skin test reactions to cat dander, 99 were cat owners (cat+, allergy−), and the remaining 318 did not have cats (cat−, and allergy−).

Fig 1 shows the prevalence of positive skin test reac-

tions to cat dander and cat ownership. There was no relationship between cat ownership and the prevalence of sensitization to cat dander; the prevalence of sensitization to cat dander in those who never owned a cat was similar to those who owned a cat in childhood or at the time of the study.

Fig 2 shows that those who did not own a cat and were not allergic to cat dander had the lowest prevalence of current asthma. Those who were allergic to cat dander, whether they were cat owners or not, and cat owners not allergic to cat dander had a significantly higher prevalence of current asthma than those not allergic to cat dander and not owning a cat (OR 14.1, 95% CI 2.9-67.8; OR 18.9, 95% CI 6.8-53.0; and OR 2.7, 95% CI 1.1-7.3, respectively) (Table III). Those allergic to cat dander who did not own a cat also had significantly higher prevalence of asthma-like symptoms compared with the other groups. Interestingly, cat owners with allergy to cat dander had the lowest prevalence of asthma-like symptoms. No relationship was found between cat ownership and cat sensitization and bronchitic symptoms. The same analysis, with 2 mm as the cut-off point for cat allergy, showed the same relationship (data not shown).

DISCUSSION

In this study we found that current pet owners had a higher prevalence of current asthma and other respiratory symptoms. Of the pets, cat ownership was found to be associated with the highest prevalence of current asthma. Further analysis in a subset of subjects with positive allergy skin test reactions showed that sensitivity to cat dander and cat ownership was associated with the high-

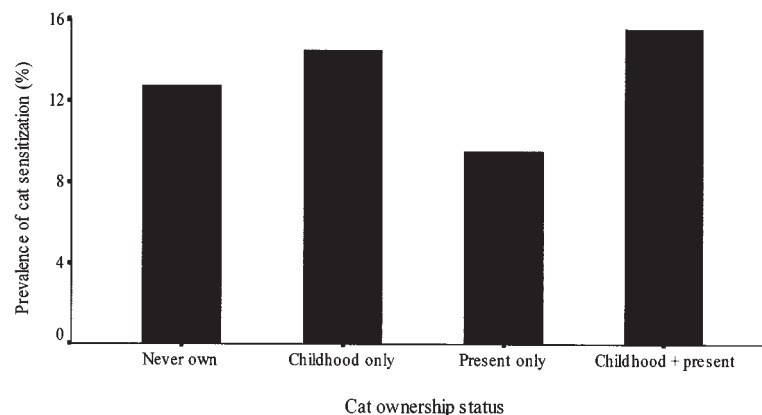


FIG 1. Prevalence of sensitization to cat dander and cat ownership.

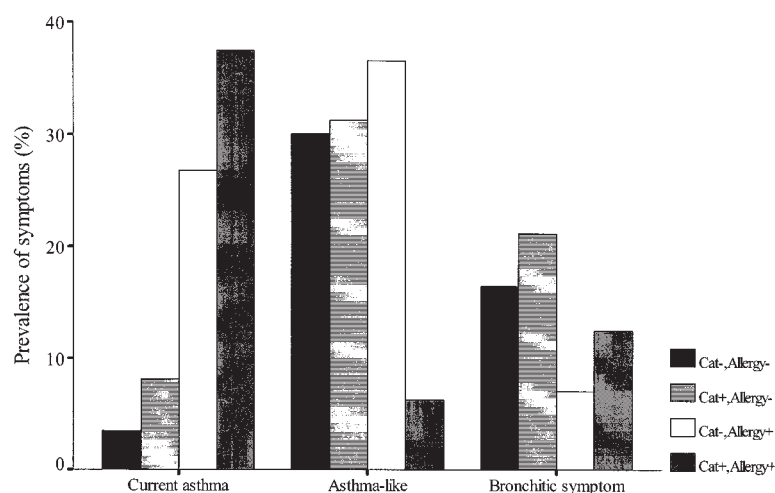


FIG 2. Cat ownership and allergy to cat dander and respiratory symptoms. Differences between groups were significant for current asthma and respiratory symptoms by chi-square test.

est prevalence of current asthma. However, these subjects had the lowest prevalence of asthma-like symptoms. The most likely explanation for this observation is that these individuals were all diagnosed as having current asthma or were taking medications for treatment of asthma because of the severity of their symptoms. Those who were allergic to cat dander but did not possess a cat not only had the second highest prevalence of current asthma but also the highest prevalence of asthma-like symptoms. These findings suggest that allergy to cat dander is a more important risk factor for current asthma and asthma-like symptoms than cat ownership itself.

We also found that cat owners not sensitized to cat dander also had a slightly higher prevalence of current asthma than those without cats who were not sensitized. The reason for this finding is not clear. It is possible that cat ownership is associated with a higher dust level, which encourages the growth of house dust mites. Previous studies have shown an inconsistent relationship between pet ownership and respiratory symptoms and, in particular,

asthma. Some studies have shown a positive association,²⁰⁻²⁶ whereas others have failed to do so.⁶⁻¹⁵ Some studies have even shown an inverse relationship.¹⁶⁻¹⁹ These contradictory findings could be due to several factors. The most obvious one is development of sensitization and asthma to cat dander in cat owners and the removal of pets because of symptoms, thus leading to a negative association. Brunekreef et al¹⁶ reported that 12% of families had removed pets from the house and 2% had avoided household pets because of allergy. The lowest prevalence of pet-related allergy and respiratory symptoms was found in children who currently (but not previously) had a pet in the home, whereas the highest prevalence of respiratory symptoms was found in families without pets at present but with pets in the past. This inverse relationship was also found in 2 other studies conducted in Scandinavian countries, one in Eastern Finland¹⁹ and the other in Sweden.¹⁸ It is therefore important to consider sensitization to cat dander in studying the relationship between cat ownership and asthma.

The development of allergic symptoms from exposure to pets may not always result in the removal of the pet as shown in our study and others.²⁰⁻²⁶ In some situations, removal is not possible because the domestic animals may be important for the livelihood of the family, particularly in the rural area. For example, a positive association between pet ownership and respiratory symptoms were found in children living in desert countries, such as the United Arab Emirates^{24,26} and Saudi Arabia, even after adjustment for confounders.²⁵ In these countries goats and poultry are common domestic animals reared for dairy products and meat. Birds, cats, camels, rabbits, and dogs are also common.²⁶ Sensitization to cats and goats is responsible for both asthma and eczema in these countries.²⁶

Sensitization to cats appears to be more common than to dogs. Murray et al,⁴ in a study of 1238 children 1 to 17 years of age, found significantly more frequent skin test reactions to cat dander than to dog hair extract. The higher frequency of sensitivity to cats was not caused by exposure to cats in more homes because dogs outnumbered cats as household pets in their study. They suggested that the greater intimacy of exposure to cats than dogs might be a factor because cats were inside the house and the child's bedroom.

Another possible reason for the discrepancy in findings is the differences in the prevalence of the types of pet ownership in different countries. In a comparative survey of childhood asthma in 4 countries (New Zealand, Wales, South Africa and Sweden), the prevalence of asthma was 16.8%, 12%, 11.5%, and 4%, respectively.¹⁸ The prevalence of pet ownership was highest in New Zealand and lowest in Sweden, with cats being present in 63% of family homes in New Zealand and in only 22.7% in Sweden. In Sweden wheezing was negatively associated with pet ownership, and elsewhere there was a positive association, although a nonsignificant one.

The cat allergen Fel d 1 has been most extensively studied.³⁰ In our previous study we found that cat allergen was highest in homes with cats but was also present in homes without cats.³¹ We did not observe any relationship between the prevalence of skin test reactions to cat dander and cat ownership in our current study or in the previous study. Cat allergen is present in small particles and is carried on the clothing of cat owners to public places such as schools where cats are absent.³² The amount of cat allergen in schools had been found to be high enough to induce asthmatic attacks in allergic subjects.³² Thus cat allergen is a community allergen. This explains the finding in this study of the high prevalence of current asthma in subjects who were allergic to cats even though they were not cat owners.

Dog allergens (Can f 1 and Can f 2) have also been identified recently.³³ So far, relatively few studies have been carried out to assess the levels in homes and the impact of dog ownership on respiratory symptoms and asthma. In this study dog dander was not included as one of the allergens in skin testing to assess the significance of sensitivity to dog allergen in a similar manner.

The main strength of our study is the randomization procedure that was used in participant selection and the

high response rate to the mail questionnaire. As such, our study has a high degree of generalizability. A standardized questionnaire was also used and will enable us to compare our results with other studies using the same questionnaire. We have also adjusted for a number of important potential confounders when we investigated the relationship between pet ownership and asthma and other respiratory symptoms.

The weaknesses of our study are the low response rate of laboratory attendees and the fact that laboratory participants had more symptoms than those who took part in the questionnaire survey alone. It is unlikely that selection bias could have influenced the observation relating to sensitization to cat dander and asthma.

In conclusion, this study provides evidence that current pet ownership is associated with an increase in the prevalence of current asthma and other respiratory symptoms among adults. Among the various types of pets, cat ownership is associated with the highest prevalence for current asthma. Sensitization to cat dander is a more important factor for current asthma and asthma-like symptoms than cat ownership itself.

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