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ORIGINAL ARTICLE

Questionnaire-based Study on the Relationship between Pet-keeping and Allergic Diseases in Young Children in Japan

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ABSTRACT

Background: It is still unclear how early exposure to pets is related to the risk of developing atopy-related diseases in children. There are few reports on this pet-allergy relationship in Japan although much controversial data have been reported in Europe and the USA.

Methods: A questionnaire on pet-keeping and allergic diseases was distributed to parents of children 3–6 years of age who belonged to 4 kindergarten and 2 nursery schools in Gifu city and surrounding areas. A total of 1185 questionnaires were analyzed statistically.

Results: Bronchial asthma (11.6%), atopic dermatitis (16.5%), and allergic rhinitis (16.5%) were reported. Dogs, cats, hamsters, rabbits, and birds were kept by 21.6%, 5.5%, 10%, 1.5%, and 2.6% of all families, respectively. Indoor pets with fur resulted in a significantly higher prevalence of atopic dermatitis (OR = 1.82, 95% CI 1.26–2.63) using univariate analysis and also in multivariate logistic regression analysis. We also found a significantly higher prevalence of atopic dermatitis in subjects who started keeping dogs and/or cats indoors after 1 year of age, compared to subjects who kept neither dogs nor cats, using both univariate analysis (OR = 2.26, 95%CI 1.13–4.54) and multivariate logistic regression analysis (OR = 2.17, 95%CI 1.09–4.32).

Conclusions: We found no evidence that pet-keeping protects people from developing various allergies. Conversely, indoor pets with fur have a slightly increased prevalence of atopic dermatitis.

KEY WORDS

allergy, asthma, atopic dermatitis, cats, dogs, Japan, pet-keeping

INTRODUCTION

It is still unclear how early exposure to pets is related to the risk of developing atopy-related diseases in children. Controversial data have been published during the last several years regarding the potential harmful or favorable effects of pet exposure in households,[1-4] but to our knowledge, there are few reports on this pet-allergy relationship in Japan. Environmental risk factors for allergy in Japan might be different to some extent from those in the USA and Europe since some Japanese customs are different from those in Europe and the USA. For example, the Japanese usually take off their shoes before entering the house and use "tatami" mats on the floors. Another example is that mite allergen levels tend to be low and cat ownership rates are very high in Scandinavia where much of the work on pet allergen exposure has been done.[5] Hence the results of studies conducted in other countries, where the customs and the climate are quite different, may not apply to Japan. Recently, however, pet-keeping, especially dogs in the house, has become more common in Japan. We herein report a questionnaire-based cross-sectional study on pet-keeping and children's allergies.

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Table 1 Relationship of variables to prevalence of allergy, BA, and AD

Variables			Allergy*1	BA*2	AD*3
SEX					
	Female	(n = 566)	32.5%	7.8%	13.6%
	Male	(n = 608)	42.3%	15.1%	18.8%
FAMILIAL HISTORY OF ALLERGY					
	paternal allergic	No (n = 601)	30.3%	9.8%	13.8%
	history	Yes (n = 584)	45.0%	13.4%	19.2%
	maternal allergic	No (n = 550)	26.0%	8.5%	11.6%
	history	Yes (n = 635)	47.6%	14.2%	20.6%
	parental allergic	No (n = 331)	22.4%	8.5%	9.7%
	history	Yes (n = 854)	43.4%	12.8%	19.1%
	BA or AD	No (n = 903)	31.5%	8.9%	12.3%
	in a parent	Yes (n = 282)	57.1%	20.2%	29.8%
SMOKING ≧ 1 cigarette per day					
	any family	No (n = 481)	35.8%	8.5%	15.8%
	member	Yes (n = 667)	39.1%	13.8%	16.9%
KEEPING F-PETS					
	no pets	(n = 788)	36.1%	11.2%	14.3%
	indoor	(n = 228)	40.4%	12.3%	23.2%
	outdoor	(n = 140)	37.9%	11.4%	16.4%
DOGS					
	no dog	(n = 928)	37.0%	11.0%	15.9%
	one dog	(n = 241)	39.8%	14.1%	17.8%
	two or more dogs	(n = 16)	37.5%	6.3%	25.0%
	indoor	(n = 99)	41.4%	17.2%	21.2%
	outdoor	(n = 158)	38.6%	11.4%	16.5%
	in the 1st	No (n = 1017)	37.6%	11.3%	16.5%
	year of age	Yes (n = 165)	38.2%	13.3%	16.4%
CATS					
	no cat	(n = 1118)	37.1%	11.2%	16.2%
	indoor	(n = 53)	47.2%	17.0%	24.5%
	outdoor	(n = 14)	35.7%	21.4%	7.1%
	in the 1st	No (n = 1136)	37.4%	11.5%	16.2%
	year of age	Yes (n = 47)	40.4%	12.8%	21.3%
HAMSTERS					
	no hamster	(n = 1067)	36.8%	11.4%	15.5%
	indoor	(n = 115)	42.6%	12.2%	25.2%
	in the 1st	No (n = 1182)	37.4%	11.5%	16.4%
	year of age	Yes (n = 14)	42.9%	7.1%	42.9%

*1Allergy includes bronchial asthma, atopic dermatitis, allergic rhinitis, food allergy, and/or urticaria
*2BA, bronchial asthma; *3AD, atopic dermatitis

METHODS

STUDY DESIGN AND SUBJECTS

This was a cross-sectional population-based study. A questionnaire on pets and allergic diseases was distributed to parents of children 3–6 years of age who belonged to 4 kindergarten and 2 nursery schools in Gifu city and surrounding areas in July 2003. The questionnaires were sent to 1405 persons and 1185 of them were returned for analysis. Pets were analyzed as to whether they were kept outdoors or indoors.

Statistical Analysis

We used the odds ratio (OR) to quantify exposure re-

Table 2 Association between variables and allergic diseases, BA and AD

Variables			Allergy*1		BA*2		AD*3	
			OR (95%CI)	*p* value	OR (95%CI)	*p* value	OR (95%CI)	*p* value
SEX								
	Female		1		1		1	
	Male		**1.52 (1.20－1.93)**	**＜0.001**	**2.12 (1.45－3.09)**	**＜0.001**	**1.47 (1.07－2.01)**	**0.02**
FAMILIAL HISTORY OF ALLERGY								
	paternal allergic history	No	1		1		1	
		Yes	**1.89 (1.49－2.39)**	**＜0.001**	1.42 (0.99－2.03)	0.06	**1.48 (1.09－2.02)**	**0.01**
	maternal allergic history	No	1		1		1	
		Yes	**2.58 (2.02－3.30)**	**＜0.001**	**1.77 (1.22－2.57)**	**＜0.005**	**1.97 (1.43－2.73)**	**＜0.001**
	parental allergic history	No	1		1		1	
		Yes	**2.67 (1.99－3.57)**	**＜0.001**	**1.58 (1.02－2.45)**	**0.04**	**2.20 (1.47－3.30)**	**＜0.001**
	BA or AD in a parent	No	1		1		1	
		Yes	**2.90 (2.22－3.82)**	**＜0.001**	**2.61 (1.80－3.77)**	**＜0.001**	**3.03 (2.19－4.18)**	**＜0.001**
SMOKING ≧ 1 cigarette per day								
	any family member	No	1				1	
		Yes	1.15 (0.91－1.47)	0.24	**1.72 (1.16－2.53)**	**0.01**	1.09 (0.79－1.49)	0.61
KEEPING F-PETS								
	no pets		1		1		1	
	indoor		1.20 (0.88－1.62)	0.24	1.11 (0.71－1.75)	0.65	**1.82 (1.26－2.63)**	**＜0.005**
	outdoor		1.08 (0.74－1.56)	0.69	1.02 (0.58－1.81)	0.93	1.18 (0.72－1.93)	0.51
DOGS								
	no dog		1		1		1	
	one dog		1.13 (0.84－1.51)	0.41	1.33 (0.88－2.02)	0.18	1.14 (0.79－1.66)	0.48
	two or more dogs		1.02 (0.37－2.84)	0.96	0.54 (0.07－4.13)	0.55	1.76 (0.56－5.52)	0.33
	indoor		1.13 (0.84－1.51)	0.38	1.68 (0.96－2.94)	0.07	1.42 (0.85－2.37)	0.18
	outdoor		1.07 (0.76－1.52)	0.69	1.04 (0.61－1.77)	0.88	1.04 (0.66－1.64)	0.87
	in the 1st year of age	No	1		1			
		Yes	1.03 (0.73－1.44)	0.88	1.21 (0.74－1.97)	0.45	0.99 (0.63－1.54)	0.96
CATS								
	no cat		1		1		1	
	indoor		1.51 (0.87－2.63)	0.14	1.62 (0.77－3.41)	0.20	1.68 (0.88－3.21)	0.11
	outdoor		0.94 (0.31－2.83)	0.91	2.17 (0.60－7.87)	0.24	0.40 (0.05－3.06)	0.38
	in the 1st year of age	No	1		1		1	
		Yes	1.14 (0.63－2.06)	0.68	1.12 (0.47－2.70)	0.80	1.40 (0.68－2.86)	0.36
HAMSTERS								
	no hamster		1		1		1	
	indoor		1.27 (0.86－1.88)	0.22	1.07 (0.60－1.94)	0.81	**1.84 (1.17－2.90)**	**0.01**
	in the 1st year of age	No						
		Yes	1.25 (0.43－3.68)	0.68	0.59 (0.08－4.54)	0.61	3.89 (1.33－11.34)	0.01

*1Allergy includes bronchial asthma, atopic dermatitis, allergic rhinitis, food allergy, and/or urticaria
*2BA, bronchial asthma; *3AD, atopic dermatitis

lated to pets and the risk of allergic diseases. We also estimated adjusted OR in multivariate logistic regression analysis. Sex, age, parental allergic histories, and the presence of smokers at home were employed as possible risk factors. We studied the relation of each allergic disease to parental history of allergic diseases and to the histories of exposure to any pet which had hair, fur, or feathers.

Table 3 Relationship of dogs and/or cats to prevalence of allergic diseases, BA and AD

Subjects				Allergy*1 OR (95%CI)	BA*2 OR (95%CI)	AD*3 OR (95%CI)
Dogs and/ or cats	indoor	outdoor	In the first year of age			
No				1	1	1
Yes	Yes	Yes	Yes	1.50 (0.54 – 4.18)	2.03 (0.56 – 7.32)	0.84 (0.19 – 3.76)
Yes	Yes	No	Yes	1.22 (0.78 – 1.90)	1.52 (0.83 – 2.79)	1.48 (0.87 – 2.54)
Yes	Yes	No	No	1.10 (0.58 – 2.09)	1.13 (0.43 – 2.94)	**2.26 (1.13 – 4.54)**
Yes	No	Yes	Yes	1.28 (0.84 – 1.80)	1.18 (0.66 – 2.12)	0.98 (0.58 – 1.68)
Yes	No	Yes	No	0.71 (0.34 – 1.51)	0.79 (0.24 – 2.62)	1.42 (0.60 – 3.32)

*1Allergy includes bronchial asthma, atopic dermatitis, allergic rhinitis, food allergy, and/or urticaria
*2BA, bronchial asthma; *3AD, atopic dermatitis

RESULTS

PREVALENCE OF ALLERGIC DISEASES IN CHILDREN

In this study, the prevalence of allergies included both past and present illness. Parents were asked whether their child had or has bronchial asthma, atopic dermatitis, allergic rhinitis, food allergy or urticaria and if so, how long the child had or has had a history of these disorders. Out of 1185 children studied, 37% had more than one allergy (including those we are focusing on here)·11.6% had bronchial asthma, 16.5% had atopic dermatitis and 16.5% had allergic rhinitis.

PREVALENCE OF ALLERGIC DISEASES IN THE PARENTS

The prevalence of past and current bronchial asthma, atopic dermatitis, and allergic rhinitis was 6.0%, 6.2%, and 39.2%, respectively in the fathers, and 6.2%, 10.3% and 41.0%, respectively in the mothers. If the father/mother had or has one of either bronchial asthma, atopic dermatitis, allergic rhinitis, food allergy or urticaria, he/she was defined as a case of paternal/maternal allergy as shown in Table 1. A history of allergic diseases in parents was defined as a positive paternal and/or maternal allergic history. Since the prevalence of allergic rhinitis was the predominant disease in the mother or father and 72% of all families resulted in having a positive parental allergic history (Table 1), we, hence, also used the occurrence of bronchial asthma and/or atopic dermatitis in at least one of them (Table 1, BA or AD in a parent) as one parameter for the evaluation of parental allergic history.

PET-KEEPING IN THE FAMILIES

We focused on pets with fur or feathers, such as dogs, cats, hamsters, rabbits, and birds. We defined these pets as F-pets. Dogs, cats, hamsters, rabbits, and birds were kept in 21.6%, 5.5%, 10%, 1.5%, and 2.6% of all families, respectively. Thirty nine percent of dogs, 82% of cats, 98% of hamsters, 56% of rabbits, and 90% of birds were kept indoors. Most dogs and cats were kept even when the children were less than 1 year of age.

We thought that families with a parental history of allergic diseases would tend to avoid pet ownership, however, there was no significant difference in the percentages of F-pet ownership between families with (33%) and without (38%) a parental history of allergic diseases. This was also true even if pet ownership was restricted to cats or dogs or even if we used a parental allergic history other than allergic rhinitis.

THE RELATIONSHIP AMONG THE PREVALENCE OF ALLERGIC DISEASES IN CHILDREN WITH FAMILY HISTORIES OF ALLERGIC DISEASES AND PETS IN THE HOUSEHOLD

Tables 1 and 2 show the results of this questionnaire-based study in which allergic diseases include bronchial asthma, atopic dermatitis, allergic rhinitis, food allergy, and urticaria. A significant gender difference was seen in the prevalence of total allergic diseases, bronchial asthma and atopic dermatitis. Boys had an approximately two-fold higher prevalence of bronchial asthma than girls (OR = 2.12, 95%CI 1.45–3.09). The familial histories of allergic diseases were analyzed on the basis of 4 determinants: paternal allergic history, maternal allergic history, parental allergic history, and bronchial asthma or atopic dermatitis in at least one of the parents (termed as BA or AD in a parent), as described above. All these determinants were significant in the prevalence of total allergic diseases, bronchial asthma and atopic dermatitis, except for the combination of bronchial asthma and paternal allergic history (OR = 1.42, 95%CI 0.99–2.03). These results indicate that parental allergic history is an important determinant in the occurrence of a child's allergic disease. The presence of smokers in households resulted in an OR = 1.72 (95%CI 1.16–2.53) for bronchial asthma.

Keeping F-pets indoors resulted in a significantly higher prevalence of atopic dermatitis (OR = 1.82,

95%CI 1.26–2.63). However, there was no increase or decrease in the prevalence of bronchial asthma. Neither dog- nor cat-keeping affected the prevalence of asthma or atopic dermatitis, even for the first year of age. Hamster-keeping resulted in a significantly high prevalence of atopic dermatitis (OR = 1.84, 95%CI 1.17–2.90). Multivariate logistic regression analysis showed that positive determinants were sex (male) and parental allergic history in total allergic diseases, BA and AD. In addition, multivariate logistic regression analysis revealed that keeping F-pets indoors increased the prevalence of atopic dermatitis significantly (OR = 1.82, 95%CI 1.26–2.63).

As shown in Table 1, the prevalence of bronchial asthma and atopic dermatitis in children keeping dogs indoors (17.2 and 21.2%, respectively) was higher than those without dogs (11.0% and 15.9%, respectively), but there was no statistical significance (Table 2). A similar relationship was seen in cat-keeping indoors. We, hence, analyzed whether dog- and/or cat-keeping indoors increased the prevalence of total allergic diseases, bronchial asthma, and atopic dermatitis. We found a significantly higher prevalence of atopic dermatitis in subjects who started to keep dogs and/or cats indoors after 1 year of age, compared to subjects who kept neither dogs nor cats, in both univariate analysis (OR = 2.26, 95%CI 1.13–4.54) and multivariate logistic regression analysis (OR = 2.17, 95%CI 1.09–4.32) (Table 3).

DISCUSSION

Since there are few reports on the relationship between pets and allergies in the Japanese population, we aimed to study the relationship between allergic diseases and pets in Japan. Although many similar studies have been reported in Europe and North America, we could not apply these results directly to the Japanese population. Japanese customs have been westernizing but there are still many differences from those in the USA/Europe. Moreover, the effects of pets on the risk of developing allergic disorders in children are still controversial, even in the USA and Europe.[1-4]

Our study focused on the prevalence of keeping dogs, cats, hamsters, rabbits, and birds in Japanese families with preschool children. In this study pets were reported by 21.6%, 5.5%, 10%, 1.5%, and 2.6% of the families, respectively. These prevalences include current pet-keeping and previous pet-keeping after the birth of their children. According to a report from the Pet Food Manufactures Association, Japan, the prevalence of dog- and cat-keeping in Japan was 18.3% and 12.4%, respectively, in 2003 (http//www.jppfma.org/shiryo/tyosa00.html). The prevalence of cat-keeping in our study was about one half of that report. Households without children may keep cats more than those with children or cat-keeping may be less common in the Gifu region compared to other regions in Japan. The striking difference between Japan and Europe was seen in the prevalence of cat-keeping. In Europe, the prevalence of cat-keeping was reported to be 20–80%.[6] Most cats were kept indoors in Europe and about 40% of cats were kept indoors in our study. Most dogs were previously kept outside of the houses in Japan but now indoor dog-keeping is more common in Japan. Hamsters became popular in Japan recently, the prevalence of which is thought to be around 5% of the households, but in our study it was 10%. This is because hamster-keeping has been very popular among preschool and school children in Japan. More than 30% of households with preschool children had F-pets in the Gifu region.

Recent studies have suggested that exposure to dogs and cats during infancy is associated with a reduced risk of allergic diseases.[7-10] In this study, however, we found no such evidence that pet-keeping protects people from developing various allergies. The same result was obtained even when data from subjects who started to keep pets within 1 year of age were analyzed. Conversely, indoor pets with fur increased the prevalence of atopic dermatitis to some extent in our study. This effect was also observed when pets were restricted to dogs and cats.

Ownby *et al.*[11] reported that keeping two or more cats or dogs prevented sensitization to major allergens, including Fel d1 and Can f1, but that this effect was not seen when one dog or cat was kept. However, in the present study, we could not evaluate such a dose effect since only a few families keep two or more dogs or cats.

Hamster-keeping resulted in a significantly higher prevalence of atopic dermatitis (OR = 1.84, 95%CI 1.17–2.90) in our study. However, in most cases, hamster-keeping was started when children were more than 1 year of age. Hence, it is possible that hamster-keeping was started after children suffered from atopic dermatitis. Some parents might think that hamster-keeping is better for their children than cat- or dog-keeping in regard to atopic dermatitis. From our data, we could not conclude that hamster-keeping is a risk factor for allergy so further investigation may be necessary.

There are several weak points in this study, one of which is that the results depended completely on a questionnaire and did not evaluate sensitization to pets and other allergens. Secondly, most subjects were 3–5 years of age, so we could not evaluate the long-term effects of pets. Thirdly, there was no information as to whether grandparents keep pets in their houses. Newborns, especially the first children, often stay at the maternal grandparents' house for 1 month or longer in the case of most Japanese nuclear families after discharge from hospital. In such cases, the first exposure to pets may occur at the grandparents' house. However, as noted above, this is one of the first reports concerning pet-keeping in childhood and

allergic diseases from Japan. We are planning to perform a more detailed study in the near future.

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