

Early, current and past pet ownership: associations with sensitization, bronchial responsiveness and allergic symptoms in school children

G. Anyo, B. Brunekreef, G. de Meer, F. Aarts, N. A. H. Janssen and P. van Vliet

Institute for Risk Assessment Sciences (IRAS), Division of Environmental and Occupational Health, Utrecht University, Utrecht, the Netherlands

Summary

Background Studies have suggested that early contact with pets may prevent the development of allergy and asthma.

Objective To study the association between early, current and past pet ownership and sensitization, bronchial responsiveness and allergic symptoms in school children.

Methods A population of almost 3000 primary school children was investigated using protocols of the International Study on Asthma and Allergies in Childhood (ISAAC). Allergic symptoms were measured using the parent-completed ISAAC questionnaire. Sensitization to common allergens was measured using skin prick tests (SPT)s and/or serum immunoglobulin (Ig)E determinations. Bronchial responsiveness was tested using a hypertonic saline challenge. Pet ownership was investigated by questionnaire. Current, past and early exposure to pets was documented separately for cats, dogs, rodents and birds. The data on current, past and early pet exposure were then related to allergic symptoms, sensitization and bronchial responsiveness.

Results Among children currently exposed to pets, there was significantly less sensitization to cat (odds ratio (OR)=0.69) and dog (OR=0.63) allergens, indoor allergens in general (OR=0.64), and outdoor allergens (OR=0.60) compared to children who never had pets in the home. There was also less hayfever (OR=0.66) and rhinitis (OR=0.76). In contrast, wheeze, asthma and bronchial responsiveness were not associated with current pet ownership. Odds ratios associated with past pet ownership were generally above unity, and significant for asthma in the adjusted analysis (OR=1.85), suggesting selective avoidance in families with sensitized and/or symptomatic children. Pet ownership in the first two years of life only showed an inverse association with sensitization to pollen: OR=0.71 for having had furry or feathery pets in general in the first two years of life, and OR=0.73 for having had cats and/or dogs in the first two years of life, compared to not having had pets in the first two years of life.

Conclusion These results suggest that the inverse association between current pet ownership and sensitization and hayfever symptoms was partly due to the removal of pets in families with sensitized and/or symptomatic children. Pet ownership in the first two years of life only seemed to offer some protection against sensitization to pollen.

Keywords pets, cats, dogs, sensitization, bronchial responsiveness, asthma

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Introduction

The association between exposure to pets early in life and subsequent development of sensitization and allergic disease remains controversial. A review published in 1998 [1] concluded that exposure to pets in the first years of life increases the chance of developing sensitization and allergic disease, and that pets best be avoided in the first two years of life, especially in families with atopic individuals. A German birth cohort study seemed to support this, in showing a positive association between cat allergen exposure and sensitization in the first three years of life [2]. In the same cohort, however, there was no significant

association between early cat allergen exposure and asthma at age 7 years [3]. A number of recent papers have suggested that exposure to pets and possibly farm animals early in life may actually reduce the incidence of sensitization and allergic disease in children. A questionnaire study from Sweden found that exposure to pets in the first year of life was associated with less allergic rhinitis in 7–9 year-old children, and less asthma in 12–13 years olds. Moreover, early exposure to cats was associated with less cat sensitization at age 12–13 years [4]. Data from the European Respiratory Health Survey suggested that childhood exposure to a dog in the household was associated with less atopy [5], and childhood exposure to pets including cats was associated with less sensitization to cats in adulthood [6]. The latter study also showed, however, that there was a positive, ecological association between the prevalence of cats in the community and the prevalence of sensitization to cat. Other

Correspondence: B. Brunekreef, IRAS, PO Box 80176, 3508 TD, Utrecht, the Netherlands. E-mail: B.Brunekreef@iras.uu.nl

studies have found that growing up on a farm was associated with less hayfever, asthma and wheeze in Germany [7], less hayfever and atopic sensitization but not less wheeze in Switzerland [8], less wheeze, asthma and atopy in Canada [9], less hayfever, asthma and atopic sensitization in Austria [10], less hayfever and asthma (but not atopic dermatitis) in Finland [11]. A retrospective study from Italy suggested that exposure to food-borne and orofecal microbes, the latter of which may be more frequent on farms and in families with pets, was associated with less atopy in army recruits [12]. Higher levels of bacterial endotoxin have recently been found in farm homes than in non-farm homes [13], and a small study from the USA recently found an inverse association between house dust endotoxin levels and allergic sensitization to common inhalant and food allergens in 9–24 months-old infants [14].

We measured allergic symptoms, sensitization against common inhalant allergens, and bronchial responsiveness in a large population of Dutch primary school children. We collected data on early and current pet ownership, and this paper describes the association between current, past and early life exposure to pets, and sensitization, bronchial responsiveness and allergic symptoms in this population.

Methods

Populations

Two populations of children were investigated. One population lived close to freeways with varying traffic densities. The other population lived in the area surrounding the Schiphol Airport. Primary schools in these areas were invited to participate. All children in classes 4–8 of these schools were invited to participate. Children are generally between 7 and 12-years-old in these classes. Parents of all children were asked to complete a questionnaire (see below). In the 'freeway' study, children in the four highest classes were also invited to participate in tests of bronchial hyper-responsiveness and of sensitization to common allergens. In the 'airport' study, children in these classes were invited to participate in tests of sensitization to common allergens (in addition to the questionnaire) only. The reason for the differences in approach was lack of funding to offer all tests to all children.

Questionnaire

The International Study on Asthma and Allergies in Childhood (ISAAC) questionnaire was used to measure symptoms of asthma and allergic disease in the children [15]. We used the questions on wheeze in the past year, nasal symptoms in the past year, asthma, hayfever and eczema as end-points. In addition, we used a question of whether a doctor had ever diagnosed allergy against a pet. From the questionnaire, we also extracted information on potential confounders such as age, gender, being of foreign descent, maternal and paternal asthma and hayfever, parental educational status, number of older siblings, smoking in the home, having visited a daycare centre as a child.

Exposure to pets

We first asked whether the participating families owned a furred or feathery pet (defined as cat, dog, bird or rodent), and classified pet ownership in three categories: never owned a pet during the life of the index child, current pet owners, and past pet

owners. We then asked for defined age periods of the index child during pet ownership: first two years of life, age 2–4 years, and after age 4 years, for each of the four categories of pets. We defined 'early pet ownership' as having had one or more of these pets in the first two years of life. In addition, we defined early cat and/or dog ownership as having had a cat and/or dog in the first two years of life.

Bronchial responsiveness

We tested for bronchial responsiveness using the ISAAC protocol, with a hypertonic saline challenge [16]. Children inhaled a hypertonic saline mist for 15.5 min, starting with an inhalation time of 0.5 min and then 1, 2, 4 and 8 min, until a fall in FEV₁ of more than 15% compared to baseline was observed. Bronchial hyper-responsiveness was defined as having a fall in FEV₁ of 15% or more at or before completion of the challenge protocol.

Sensitization to common allergens

In the 'freeway' study, children were tested with skin prick tests (SPTs) as well as serum immunoglobulin (Ig)E determinations. SPTs were performed according to the standardized ISAAC phase II protocol [17]. The ISAAC panel of six aeroallergens was used: *Dermatophagoides farinae*, *Dermatophagoides pteronyssinus*, cat, *Alternaria tenuis*, mixed tree pollen (*Betula verrucosa*, *Alnus glutinosa*, *Corylus avellana*) and mixed grass pollen (*Dactylis glomerata*, *Lolium perenne*, *Festuca pratensis*, *Poa pratensis*, *Phleum pratense*, *Avena eliator*). In addition, dog allergen was added. Standardized allergen extracts (all but *alternaria*) and controls (negative control and histamine 10 mg/mL as the positive control) were provided by ALK (Hørsholm, Denmark). The test was performed on the volar side of the left forearm using ALK lancets. After 15 min the outside contour of the weal was measured and the mean of the longest diameter and the length of the perpendicular line through its middle was calculated. Data from children who had a reaction of > 0 mm to the negative control, or who did not react to histamine (i.e. the positive control), were not further analysed. A mean weal diameter of 3 mm or more is regarded as a positive reaction according to the position paper on skin tests of the European Academy of Allergy and Clinical Immunology [18]. After centrifugation serum specimens were frozen and stored at –20°C until further analysis. IgE tests were performed by Pharmacia, Woerden, the Netherlands, using the PHADIATOP test for common inhalant allergens as a screening instrument [19], with further testing of all sera that were positive in the PHADIATOP for common allergens *D. pteronyssinus*, cat, moulds (*Alternaria tenuis*, *Penicillium notatum*, *Cladosporium herbarum*), mixed trees (*Betula verrucosa*, *Corylus avellana*, *Alnus incana*, *Quercus alba*, *Salix caprea*), mixed grasses (*Phleum pratense*, *Lolium perenne*, *Anthoxanthum odouratum*, *Secale cereale*, *Holcus lanatus*) and dog. Specific IgE is considered elevated if its value was 0.35 kU/L or more.

Data analysis

For the purpose of this study, we confined ourselves to analysing data from children who had data on sensitization and/or bronchial responsiveness ($n=2729$). The total population that was studied was 5666 children. The distribution of all questionnaire variables we used in this paper was closely similar in the

population that was analysed compared to the population that was not analysed.

In the analysis, we focused on three main exposure variables:

- pet ownership in three mutually exclusive categories (never, current, past); 'current' and 'past' pet owners were compared to the 'never' owners as a reference category;
- ownership of cat, dog, bird and/or rodent in the first two years of life; children who were exposed to these pets in the first two years of life were compared to children who did not have these pets in the first two years of life (but who may have been exposed later on);
- ownership of cat and/or dog in the first two years of life; children who were exposed to cats and/or dogs in the first two years of life were compared to children who did not have cats and/or dogs in the first two years of life (but who may have been exposed later on).

The data on sensitization obtained from SPT and IgE testing were combined, so that sensitization to (respectively) cat allergen, dog allergen, 'indoor' allergens (pets, mites) and 'outdoor' allergens (grasses and trees) was defined as having a positive test on either of the two.

We analysed the association between these exposure variables and the health end-points by cross tabulation and calculation of simple odds ratios. Multivariate analyses, adjusting for age, gender, being of foreign descent, maternal and paternal asthma and hayfever, parental educational status, number of older siblings, smoking in the home, having visited a daycare centre as a child, and study area were conducted with logistic regres-

sion. All analyses were conducted using the SAS system for Windows release 6.12.

Ethical issues

The study protocol was approved by the medical ethical committee of the Wageningen University. Parents gave written informed consent for each of the separate parts of the study.

Results

24 (71%) of the 34 schools asked to participate in the 'traffic-study' gave their consent and 25 (93%) out of 27 approached schools in the 'airport-study' agreed to participate. Reasons for non-participation in both studies were not having time for research, not interested in research and the burden of the study for the children.

The response rates were respectively, 65% for the questionnaire, 49% for the SPT and 43% for the blood sampling. Response rates were about the same for both studies. Of respectively, 85% and 54% of the study population we have IgE and SPT data (of 39% we have both IgE and SPT data). The higher prevalence of IgE data despite the lower response compared to the SPT is explained by the different population size asked for, respectively, blood sampling and skin prick testing.

Table 1 shows the distribution of some major variables for the 2729 children whose data were analysed for the purpose of this paper. Current pet ownership was reported by over half of the population, 14% had pets in the past but not anymore, and 26% reported they had never had a pet during the life of the index child. In the first two years of life, 41% of the families had pets, and 36% had cats and/or dogs.

Table 2 shows the prevalence of sensitization, symptoms and bronchial hyper-responsiveness in six groups: those who were never exposed to pets in the home ($n=705$); those who currently had a pet in the home ($n=1617$), those who had a pet in the past but not anymore ($n=387$), those who had ever had pets in the home (i.e. the combination of the last two groups, $n=2004$); those who had furry and/or feathery pets in the first two years of life ($n=1113$) and those who had cats and/or dogs in the first two years of life ($n=963$). The results show that the highest prevalence of sensitization and symptoms was found in the group of past pet owners. The lowest prevalence

Table 1. Description of the study population ($n=2729$)

Variable	%	Variable	%
Gender (% boys)	50.4	Older siblings	53.6
Current pet ownership	59.7	Past pet ownership	14.3
Never owned a pet	26.0	Pets in first two years of life	41.4
Cat or dog in first two years of life	35.7	Exposed to tobacco smoke in the home	42.6
Maternal asthma	6.6	Paternal asthma	6.4
Maternal hayfever	26.9	Paternal hayfever	24.1

Table 2. Prevalence of sensitization and symptoms in relation to current, past and early pet ownership, in school children living in the Netherlands

	Pet ownership					
	Never ($n=705$)	Current ($n=1617$)	Past ($n=387$)	Ever ($n=2004$)	Pets first 2 yrs ($n=1113$)	Cat/dog first 2 yrs ($n=963$)
Cat sensitization ($n=2532$)	10.3	7.3	12.6	8.3	8.1	8.5
Dog sensitization ($n=2531$)	13.1	8.7	15.5	10.0	9.7	10.1
Sensitization indoor allergens ($n=2531$)	29.4	21.0	28.9	22.5	22.8	23.1
Sensitization outdoor allergens ($n=2534$)	24.6	16.5	22.6	17.6	16.4	16.3
Asthma ($n=2700$)	8.3	6.5	10.7	7.3	8.1	7.6
Hayfever ($n=2667$)	10.2	7.0	10.1	7.6	7.2	7.3
Eczema ($n=2690$)	30.1	29.2	33.8	30.1	29.6	30.1
Wheeze in last 12 months ($n=2719$)	9.7	8.1	10.4	8.5	8.9	8.7
Rhinitis in last 12 months ($n=2703$)	30.4	24.8	28.3	25.5	25.9	25.5
Doctor-diagnosed pet allergy ($n=2670$)	9.7	4.9	11.1	6.1	6.1	5.9
Bronchial hyper-responsiveness ($n=1153$)	24.0	21.5	19.9	21.1	20.6	20.3

Table 3. Unadjusted association between current, past and early pet ownership, sensitization and respiratory symptoms in school children living in the Netherlands

	Pet ownership			
	Current*	Past*	Pets in first 2 yrs†	Cat/dog in first 2 yrs‡
Cat sensitization (<i>n</i> =2516)	0.69 (0.50–0.94)	1.26 (0.84–1.88)	0.86 (0.65–1.15)	0.95 (0.71–1.26)
Dog sensitization (<i>n</i> =2515)	0.63 (0.47–0.84)	1.20 (0.83–1.74)	0.83 (0.64–1.08)	0.89 (0.68–1.16)
Sensitization indoor allergens (<i>n</i> =2515)	0.64 (0.55–0.77)	1.33 (1.01–1.15)	0.87 (0.72–1.05)	0.92 (0.76–1.11)
Sensitization outdoor allergens (<i>n</i> =2518)	0.60 (0.48–0.76)	0.89 (0.66–1.21)	0.71 (0.58–0.88)	0.73 (0.59–0.91)
Asthma (<i>n</i> =2681)	0.77 (0.55–1.08)	1.33 (0.87–2.03)	1.12 (0.84–1.50)	1.01 (0.75–1.36)
Hayfever (<i>n</i> =2648)	0.66 (0.48–0.90)	0.99 (0.65–1.50)	0.78 (0.58–1.04)	0.83 (0.62–1.12)
Eczema (<i>n</i> =2672)	0.96 (0.79–1.16)	1.18 (0.91–1.55)	0.96 (0.81–1.14)	1.01 (0.85–1.20)
Wheeze in last 12 months (<i>n</i> =2700)	0.82 (0.61–1.12)	1.08 (0.72–1.64)	1.01 (0.77–1.32)	0.98 (0.74–1.30)
Rhinitis in last 12 months (<i>n</i> =2684)	0.76 (0.62–0.92)	0.91 (0.69–1.19)	0.93 (0.78–1.10)	0.91 (0.76–1.09)
Doctor-diagnosed pet allergy (<i>n</i> =2652)	0.48 (0.34–0.68)	1.17 (0.78–1.77)	0.80 (0.59–1.10)	0.77 (0.56–1.07)
Bronchial hyper-responsiveness (<i>n</i> =1144)	0.86 (0.62–1.20)	0.79 (0.49–1.25)	0.88 (0.66–1.18)	0.87 (0.65–1.18)

Odds ratios and 95% confidence limits.

*Reference category is families that never owned pets during the life of the child.

†Reference category is families that did not own pets in the first two years of the life of the child.

‡Reference category is families that did not own cats/dogs in the first two years of the life of the child.

Table 4. Adjusted association between current, past and early pet ownership, sensitization and respiratory symptoms in school children living in the Netherlands

	Pet ownership			
	Current*	Past*	Pets in first 2 yrs†	Cat/dog in first 2 yrs‡
Cat sensitization (<i>n</i> =2126)	0.65 (0.45–0.93)	1.14 (0.72–1.81)	0.85 (0.62–1.17)	0.94 (0.68–1.30)
Dog sensitization (<i>n</i> =2125)	0.61 (0.44–0.85)	1.26 (0.83–1.90)	0.84 (0.63–1.14)	0.89 (0.66–1.21)
Sensitization indoor allergens (<i>n</i> =2125)	0.64 (0.51–0.82)	1.03 (0.51–1.43)	0.91 (0.74–1.13)	0.93 (0.74–1.15)
Sensitization outdoor allergens (<i>n</i> =2128)	0.60 (0.46–0.77)	0.94 (0.66–1.33)	0.70 (0.55–0.88)	0.73 (0.57–0.92)
Asthma (<i>n</i> =2273)	0.78 (0.52–1.16)	1.84 (1.15–2.95)	1.34 (0.96–1.88)	1.13 (0.80–1.60)
Hayfever (<i>n</i> =2247)	0.69 (0.48–1.00)	1.09 (0.68–1.75)	0.77 (0.55–1.07)	0.82 (0.58–1.15)
Eczema (<i>n</i> =2266)	0.96 (0.77–1.19)	1.16 (0.86–1.56)	0.95 (0.79–1.15)	1.01 (0.83–1.22)
Wheeze in last 12 months (<i>n</i> =2287)	0.84 (0.59–1.21)	1.20 (0.76–1.90)	0.92 (0.68–1.26)	0.87 (0.63–1.20)
Rhinitis in last 12 months (<i>n</i> =2277)	0.81 (0.64–1.01)	0.92 (0.67–1.26)	0.91 (0.74–1.11)	0.88 (0.72–1.08)
Doctor-diagnosed pet allergy (<i>n</i> =2256)	0.53 (0.35–0.79)	1.37 (0.85–2.20)	0.80 (0.55–1.14)	0.73 (0.50–1.07)
Bronchial hyper-responsiveness (<i>n</i> =966)	0.88 (0.60–1.29)	0.73 (0.43–1.23)	0.87 (0.62–1.21)	0.85 (0.60–1.20)

Odds ratios and 95% confidence limits.

Adjusted for age, gender, being of foreign descent, maternal and paternal asthma and hay fever, parental educational status, number of older siblings, smoking in the home, having visited a day care centre as a child and area of residence.

*Reference category is families that never owned pets during the life of the child.

†Reference category is families that did not own pets in the first two years of the life of the child.

‡Reference category is families that did not own cats/dogs in the first two years of the life of the child.

was found in the current pet owners, and the 'never' owners were in between. There was little difference between groups for bronchial hyper-responsiveness. Children who were exposed to pets in the first two years of life overlapped considerably with current pet owners; the prevalence of sensitization and symptoms was somewhat higher in those groups than in those children who were still exposed to pets in the home at the time of questioning.

Table 3 shows the unadjusted associations between current, past and early pet ownership and a range of health variables. It is clear that current pet ownership was associated with reduced prevalence of sensitization and several symptoms, but that past pet ownership was not associated with a difference in health status (compared to never having owned a pet). With the exception of being sensitized to outdoor allergens, early pet

ownership (total or just cats/dogs) was not associated with any health endpoint.

Adjustment for potential confounding (Table 4) changed these associations only marginally; only the association between past pet ownership and asthma now became strongly positive.

As 'selective avoidance' may be insufficiently analysed by adjusting for parental symptoms and allergy, we performed a stratified analysis also, by parental allergy and symptoms. This stratification did not result in major changes of the odds ratios. Notably, the negative association between early pet contact and pollen sensitization was even somewhat stronger in the 'no parental symptoms and allergy' group than in the 'parental symptoms and allergy' group (odds ratios of 0.63 and 0.73, respectively).

When we restricted the analysis to families in which cats (or dogs, etc.) had been kept as the only pet, the results did not change (results not shown).

Discussion

The results of our study show that current pet ownership was associated with a reduced prevalence of sensitization and hayfever symptoms, but not asthma and bronchial hyper-responsiveness, compared to children who were never exposed to pets in the family. In contrast, the prevalence of sensitization, symptoms and hyper-responsiveness was not reduced in children who had been exposed to pets in the house in the past. In these children, the prevalence of asthma was actually increased. Exposure to pets in the first two years of life was associated only with a moderately reduced prevalence of sensitization against pollen.

Assessment of current and past exposure to pets by questionnaire may be biased by the presence or absence of family members with allergic symptoms. Most studies on the topic of early pet exposure have been of a retrospective nature, without possibility for direct validation of questions about the past. This study is no exception. The interpretation therefore needs to be cautious. The few prospective studies have not directly assessed this question either. The German MAS study has, interestingly, documented that parents 'remember' their own allergic past more readily once their children develop symptoms [20]. Whether allergic symptoms in children would lead to biased reporting of previous pet ownership remains speculative.

In the analysis which was stratified for parental allergy and symptoms, the results were not markedly different between the two groups. When we assume that avoidance does not take place in families in which none of the parents report respiratory symptoms and/or allergy, this suggests that the negative association we found between early pet contact and sensitization to pollen cannot be explained by selective avoidance.

Allergic symptoms in family members may lead to avoidance of pets, either to prevent development of allergy in children who have no disease yet, or to reduce symptoms once the children have been exposed to pets for a while, and sensitization has occurred. In an earlier study, we found that a fairly large proportion of a population we studied in the late 1980s admitted to having avoided pets because of allergy in the family, and the prevalence of allergic symptoms and asthma was highest in children from such families [21]. The current study again shows that allergic symptoms were least reported in children living in homes with pets, whereas past pet ownership was associated with a higher asthma prevalence. The second mode of avoidance (to reduce symptoms in already sensitized children) therefore seems to be present in this more recently studied population as well. We did not, in this study, specifically ask for reasons why families never had pets, or no longer had pets. There was some tendency for families that never owned pets to have more fathers and/or mothers with asthma and/or hayfever, but none of these associations reached statistical significance (results not shown). Moreover, adjustment for parental asthma and hayfever did not change the associations we report in this paper. In an ongoing birth cohort study, we did

find that families in which both parents are allergic to inhalant allergens less often have cats than families with one or no allergic parent [22]. A similar suggestion of avoidance was not found for dogs. The data in the current study do not suggest that pets were more often being avoided continuously in families with parents suffering from hayfever and/or asthma, compared with families with parents who did not have these afflictions.

Pet ownership in the first two years of life was only associated with reduced sensitization to pollen, but not with any other type of sensitization or allergic symptoms. Adjustment for parental asthma and hayfever did not change this result. This suggests that our result was not sensitive to selective avoidance of pets in families where parents have asthma and/or hayfever. Our results do not support that pets should be avoided at early age, nor do they suggest that early life exposure to pets confers protection against the development of allergic disease. It should be stressed that in our analysis, we have compared children who did not have pets in the home in the first two years of life with children who had, regardless of pet ownership later in life. If pet contact that starts later in life offers protection also, it would be more appropriate to compare children who never had pets in the home with children who ever had pets in the home. The crude prevalences reported in Table 2 show that, over all, children who had ever had pets in the home had a lower prevalence of sensitization and symptoms than children who had never had pets, and that the prevalence of sensitization and symptoms in 'ever' pet owners was very similar to the prevalence in children who had pets in the home in the first two years of life. Does this mean that one could, after all, recommend that families expose their children to pets in the home? Two reasons preclude that such a conclusion be drawn from our data: one is that the questionnaire data do not allow a very precise comparison of the groups in the study. It remains possible that the 'never' and 'ever' pet owners were different in important, unmeasured variables (such as parental sensitization) which may be more predictive of allergic disease in their children. The second is that exposure to pet allergens is not completely avoided by not owning a pet. Cat allergen especially, is found in relatively high quantities in places where cats have never been; transport through the air, and on clothes of cat owners is a likely explanation. Both of these issues require further study.

There are many studies on the relationship between asthma, hayfever and other allergic diseases and exposure early in life to older siblings, daycare and a farming environment. Few of these have included data on sensitization to common allergens, and even fewer have analysed sensitization to indoor and outdoor allergens separately. In the study by Riedler et al. [10], children living on farms had less sensitization to birch and timothy grass pollen, but not to dust mites, cat fur and moulds. This pattern of protection is similar to what we found in this study. Studies on older siblings and early respiratory infections have found some protection against atopic sensitization [23–26] but sensitization to indoor and outdoor allergens was not analysed separately in these studies so that, as in the Riedler et al. [10] study, it remains possible that the protection was mainly for sensitization against pollen allergens.

In conclusion, we found that current pet ownership was negatively associated to sensitization to indoor and outdoor allergens, and to the prevalence of hayfever. There was no

relationship with wheeze, asthma and bronchial responsiveness. Past pet ownership was positively associated with asthma, and unrelated to any of the other end-points, suggesting that selective removal of pets took place in this population. Exposure to pets in the first two years of life was associated with a reduced prevalence of sensitization to outdoor allergens only, irrespective of parental allergy. It was unrelated to the prevalence sensitization to indoor allergens, bronchial responsiveness and symptoms of allergic disease, suggesting that early exposure to pets is neither protective nor harmful. Prospective studies are needed to shed further light on this issue.

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