

Original article

Childhood asthma and continuous exposure to cats since the first year of life with cats allowed in the child's bedroom

Background: There are controversial data as to interdependencies of exposure to furred pets in infancy and the prevalence of asthma and hay fever in children. Does the timing, intensity and type of pet exposure matter?

Methods: Cross-sectional questionnaire data on 8216 German schoolchildren aged 5–7 years not living on a farm in ten rural districts in Bavaria in 1997 were analysed. The diagnosis of asthma and hay fever was ascertained with the International Study of Asthma and Allergies in Childhood (ISAAC) core questions. Wheeze and asthma were classified as 'atopic' in children who also had hay fever or atopic dermatitis. Prevalence and intensity of exposure to pets in the first year of life and at present were assessed via questionnaire.

Results: Although the study was of considerable size we found no convincing association between atopic disease and pet exposure in general. Exposure to cats from the first year of life to school entry, however, was associated with a reduced prevalence of atopic asthma, if cats were allowed to be in the child's bedroom: no case of atopic asthma in 296 children exposed and an aOR 0.11 (95% CI: 0.01–0.52) for atopic wheeze in the last 12 months.

Conclusions: Allowing cats to be in the child's bedroom from the first year of life onwards may be an indicator of intensive exposure to cats and appears to prevent the development of childhood asthma.

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Key words: asthma; cats; children; hay fever.

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Accepted for publication 30 April 2003

'Growing up on a farm' has been identified as a strong protective factor against atopic disease by several authors (1–7). Early exposure to farm animals in the first year of life appears to account for this association (3, 6) and exposure to endotoxin may in part explain the findings (6).

Exposure to endotoxin may also be conferred by pets and the presence of cats and dogs in the home has been shown to increase the indoor endotoxin exposure (8), although the endotoxin concentrations associated with keeping cats or dogs are much lower than those found in farmers' houses (9, 10). Factors other than endotoxin may explain the 'cat effect'.

Several recent studies have shown protective effects of early life pet exposure (11–13), although the findings remain controversial. In fact, other studies indicated that exposure to pets in childhood might even be associated with an increased risk for atopic disease (14–17).

Additional factors may be crucial. Is the effect related to the time of the exposure? Is the effect dependent on the intensity of the exposure? These questions were addressed in a cross-sectional study on risk factors for atopic disease

at school entry providing data on the time of exposure to furred pets in infancy and on the intensity of the exposure to cats in 8216 children living in rural regions of Bavaria but not on farms (3).

Material and methods

Cross-sectional data on 10 163 children had been collected within the scope of the 1997 school entry health examinations in southern Bavaria (Germany) (3). The analyses in this study were restricted to 8216 subjects of German nationality aged 5–7 years whose families did not live on a farm – because farming was found to be a strong protective factor for atopic disease. Children from families who had given up a cat because of respiratory diseases or allergies ($n = 82$) were excluded.

The questionnaire administered to the parents included questions on doctor-diagnosed asthma, hay fever and eczema, and the International Study of Asthma and Allergies in Childhood (ISAAC) core questions on symptoms of asthma, allergic rhinitis and atopic eczema (18). Children whose parents reported either a doctor's diagnosis of asthma or recurrent 'asthmatic', 'spastic' or 'obstructive' bronchitis were defined as being diagnosed with asthma (19). Wheeze and asthma were classified as 'atopic' if the children also had hay fever or atopic dermatitis diagnosed.

Pet keeping was ascertained by the questions: 'Which of the following pets do or did you keep in your apartment (house): dogs, cats, hamsters, guinea pigs, rabbits, birds and fishes?'. For

Abbreviations: aOR: adjusted odds ratio; CI: confidence interval; Ig: immunoglobulin; ISAAC: International Study of Asthma and Allergies in Childhood; SAS: statistical analysis system.

each species the time of keeping the animal was requested: 'in the child's 1st year of life? now?' The analyses were confined to exposure to furred animals (dogs, cats, hamsters, guinea pigs, rabbits).

Exposure to pets was classified as either:

- (1) 'pet keeping in the first year only': pet keeping in the first year of life but not at age 5–7 years;
- (2) 'continuous pet keeping': pet keeping at age 5–7 years and in the first year of life;
- (3) 'current pet keeping only': pet keeping at age 5–7 years but not in the first year of life.

Regarding exposure to cats there was an additional question 'Is the cat allowed to be in the child's bedroom?' The answer 'yes' defined intensive exposure to cats.

Information on established or potential risk and protective factors for atopic disease as age, gender, parental education, family history of atopic disease, number of older siblings, smoking in the dwelling was collected in order to allow to adjust for potential confounding.

Cross tabulation was applied in order to assess differences in prevalence of atopic disease. We defined confounding factors by a change of at least 10% of the odds ratio for exposure to furred pets and doctor-diagnosed asthma and/or hay fever. Confounding was controlled by a multivariate logistic regression model in which variables were introduced by forward selection. Logistic regression analysis was used to estimate crude and adjusted odds ratios and 95%-confidence intervals. All statistical analyses were performed using the software package SAS, release 6.12 (SAS Institute, Cary, NC, USA).

Results

A total of 368 (4.5% of the study population) families kept furred pets in the child's first year of life only, 1198 families (14.6%) did so continuously from first year of life to school entry, 1620 families (19.7%) at interview only and 5030 (61.2%) families did not keep furred pets at any time. The most common furred pets were cats and dogs: 1126 families (94.0%) of the families keeping furred pets continuously, had a cat or a dog compared with only 237 families (19.8%) with guinea pigs, rabbits or hamsters in the first year of life and at interview (some families kept more than one furred animal).

The effects of furred pet keeping varied by time of exposure as shown in Table 1. While keeping of furred pets in the first year of life only was related to an increased prevalence of hay fever and hay fever symptoms – reaching significance for hay fever symptoms, aOR 1.63 (95%-CI: 1.06–2.42) – current pet keeping was associated with a lower prevalence of all six outcomes, albeit not significantly. For continuous exposure the prevalence of doctor-diagnosed asthma, doctor-diagnosed hay fever and atopic wheeze in the last 12 months was lower than in the reference group, although a significant association was only found for atopic asthma, aOR 0.58 (95%-CI: 0.33–0.96). When these analyses were run by strata of children with and without a family history of atopic disease the results were almost identical (data not shown).

In order to assess the impact of exposure to specific furred animals the analyses were repeated with stratification by type of animal. Significant associations were only found between continuous exposure to cats and asthma (doctor's diagnosis), aOR 0.57 (95%-CI: 0.35–0.87), atopic asthma, aOR 0.33 (95%-CI: 0.12–0.56) and hay fever (doctor's diagnosis), aOR 0.55 (95%-CI: 0.32–0.90), whereas exposure to dogs was unrelated to the prevalence of asthma and hay fever (data not shown).

Further stratification by the intensity of exposure to cats showed that most of the protective effect conferred by exposure to cats was related to intensive exposure to cats from the first year of life to school entry (Table 2). Interestingly this effect of intensive exposure to cats was not seen if the cats came into the household after the child's first year of life (Table 3).

Discussion

In this study population of considerable size there was no clear association between exposure to furred animals in infancy and the prevalence of asthma and hay fever at school entry. Children intensively exposed to cats since the first year of life, however, had a significantly reduced

Table 1. Prevalence, aOR* + 95%-CI for doctor-diagnosed asthma and hay fever and disease-specific symptoms by keeping of furred pets (cat and/or dog and/or hamster and/or guinea pig and/or rabbit)

<i>n</i> = 8216	Keeping of furred pets in the first year of life only (<i>n</i> = 368)	Keeping of furred pets in the first year of life and at interview (<i>n</i> = 1198)	Current keeping of furred pets only (<i>n</i> = 1620)	Neither keeping of furred pets in the first year of life nor at interview (<i>n</i> = 5030)
Doctor's diagnosis of asthma	5.6% aOR 0.84 (0.50–1.33)	5.1% aOR 0.84 (0.62–1.12)	5.9% aOR 0.95 (0.73–1.22)	6.8% Reference
Doctor's diagnosis of asthma; atopic asthma	2.6% aOR 0.96 (0.44–1.81)	1.5% aOR 0.58 (0.33–0.96)	2.3% aOR 0.88 (0.58–1.29)	2.8% Reference
Any wheeze in the last 12 months	7.8% aOR 0.83 (0.51–1.27)	8.0% aOR 1.03 (0.79–1.33)	7.7% aOR 1.04 (0.83–1.30)	7.9% Reference
Atopic wheeze in the last 12 months	3.1% aOR 0.99 (0.48–1.84)	2.4% aOR 0.86 (0.54–1.31)	2.6% aOR 0.97 (0.66–1.39)	3.0% Reference
Doctor's diagnosis of hay fever	6.0% aOR 1.13 (0.69–1.77)	4.1% aOR 0.85 (0.60–1.18)	3.9% aOR 0.84 (0.62–1.12)	5.3% Reference
Runny nose and itchy eyes in the last 12 months	8.5% aOR 1.63 (1.06–2.42)	5.4% aOR 1.10 (0.80–1.48)	4.2% aOR 0.83 (0.61–1.11)	5.3% Reference

* Adjusted for gender, parental education, family history of atopic disease, number of older siblings, smoking in the dwelling.

Table 2. Prevalence, aOR* + 95%-CI for doctor-diagnosed asthma and hay fever and disease specific symptoms by cat keeping in the first year of life and current keeping

	Cat keeping in the first year of life and current keeping + cat allowed to be in the child's bedroom (n = 296)	Cat keeping in the first year of life and current keeping + cat not allowed to be in the child's bedroom (n = 335)	Neither keeping of furred pets in the first year of life nor current keeping of furred pets (n = 5,030)
n = 5661			
Doctor's diagnosis of asthma	1.7% aOR 0.28 (0.10–0.62)	4.9% aOR 0.84 (0.48–1.38)	6.8% Reference
Doctor's diagnosis of asthma; atopic asthma	0.0% –	1.6% aOR 0.65 (0.23–1.46)	2.8% Reference
Any wheeze in the last 12 months	5.8% aOR 0.68 (0.37–1.14)	9.6% aOR 1.25 (0.81–1.85)	7.9% Reference
Atopic wheeze in the last 12 months	0.4% aOR 0.11 (0.01–0.52)	3.4% aOR 1.38 (0.69–2.49)	3.0% Reference
Doctor's diagnosis of hay fever	3.1% aOR 0.58 (0.26–1.13)	3.1% aOR 0.54 (0.24–1.04)	5.3% Reference
Runny nose and itchy eyes in the last 12 months	5.5% aOR 1.04 (0.57–1.76)	4.8% aOR 0.94 (0.51–1.58)	5.3% Reference

* Adjusted for gender, parental education, family history of atopic disease, number of older siblings, smoking in the dwelling.

Table 3. Prevalence, aOR* + 95%-CI for doctor-diagnosed asthma and hay fever and disease-specific symptoms by current cat keeping

	Current cat keeping only + cat allowed to be in the child's bedroom (n = 422)	Current cat keeping only + cat not allowed to be in the child's bedroom (n = 521)	Neither keeping of furred pets in the first year of life nor current keeping of furred pets (n = 5030)
n = 5973			
Doctor's diagnosis of asthma	5.9% aOR 0.86 (0.52–1.34)	6.5% aOR 1.07 (0.71–1.55)	6.8% Reference
Doctor's diagnosis of asthma; atopic asthma	2.5% aOR 0.96 (0.45–1.82)	2.4% aOR 0.93 (0.47–1.68)	2.8% Reference
Any wheeze in the last 12 months	7.0% aOR 0.93 (0.60–1.39)	7.1% aOR 1.04 (0.71–1.48)	7.9% Reference
Atopic wheeze in the last 12 months	2.3% aOR 0.90 (0.42–1.70)	1.8% aOR 0.71 (0.33–1.34)	3.0% Reference
Doctor's diagnosis of hay fever	3.8% aOR 0.86 (0.49–1.41)	3.5% aOR 0.72 (0.42–1.16)	5.3% Reference
Runny nose and itchy eyes in the last 12 months	4.5% aOR 0.89 (0.51–1.43)	5.4% aOR 1.02 (0.64–1.54)	5.3% Reference

* Adjusted for gender, parental education, family history of atopic disease, number of older siblings, smoking in the dwelling.

risk for asthma and atopic wheeze compared with children in families with no furred pets.

A recent paper has pointed to the importance of taking the time of exposure into account in assessing the interdependencies between pet contact in infancy and childhood asthma or hay fever (20). Assessment of current exposure only may result in spurious protective effects because of reverse causation if mainly children without a history of allergies are allowed to have pets. Likewise families keeping pets in the child's first year of life only may have decided to give up a pet after the child had shown symptoms of atopic disease. Pet avoidance may be the explanation for the increased odds for hay fever symptoms – aOR 1.63 (95%-CI: 1.06–2.42) – in children exposed to pets in the first year of life only. This contrasts with an aOR 0.83 (95%-CI: 0.61–1.11) for current exposure only. Such bias can be avoided if continuous exposure from the first year of life to interview is used to assess the impact of exposure to furred pets.

High endotoxin exposure has recently been shown to be inversely related to atopic asthma, atopic wheeze, hay fever and atopic sensitization, but not to nonatopic wheeze (21). Keeping of cats was in turn was found to be associated with higher concentrations of endotoxin in the dust in living rooms (9). If cats are allowed in the child's bedroom a more intense exposure to endotoxins may occur, since children come into close contact with their

microbial environment during the 8–10 h of sleep each day. Factors other than endotoxin may, however, be associated with cat exposure such as other microbial exposures or characteristics of cat allergens explaining the inverse associations found in a number of studies (12, 22–24).

There are some limitations related to the study design: unfortunately we had no opportunity to measure serum IgE levels or to perform skin prick tests. Our definition of atopic asthma/wheeze therefore had to be based on the presence of other symptoms of atopic disease. This definition may lack sensitivity, but is likely to be specific, because in other studies the majority of children who had been diagnosed with hay fever were found to have increased IgE levels (25) or positive skin prick tests (2, 26).

One might argue that families decide to live without pets from the very beginning because of a family history of respiratory diseases or allergies. This source of bias could be excluded in the analyses: the effects of pet keeping were identical when stratified by family history of atopic disease (data not shown). We furthermore excluded subjects where families had given up a cat because of atopic disease in the child from the analyses. Asthmatic children may finally not be allowed to have the cat in their bedroom. Such reverse causation would mainly be expected among children with current exposure to cats only. The protective effect in relation to current intensive exposure only was not observed, however. The marked

effect of intensive exposure to cats from the first year of life to interview therefore is unlikely to be attributable to reverse causation.

We hypothesize that allowing cats in the child's bedroom from the first year of life onwards might be an

indicator of early and intensive exposure to cats which appears to protect against the development of atopic asthma. Further research on the interdependencies of exposure to pets and atopic disease should focus on early and intensive exposure.

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