

Original article

Influence of early and current environmental exposure factors on sensitization and outcome of asthma in pre-school children

Background: Exposure to furred pets in early life has been considered to increase the risk of allergic sensitization and consequent development of asthma later in children. However, recently, it has been suggested that early exposure to pets prevents sensitization. The aim of this study was to evaluate the importance of early exposure to pets and other environmental risk factors in asthmatic children.

Methods: This is a follow-up study after 2 years of a previously investigated group of 193 asthmatic children, aged 1–4 years. The study was completed by 181 children, who were clinically examined; serum IgE antibodies were also measured and a questionnaire was answered.

Results: Children with reported exposure to cats during the first 2 years of life were more likely to have developed sensitization to cat by 4 years of age than unexposed children. High levels of cat allergen (Fel d 1 ≥ 8 $\mu\text{g/g}$ dust) were associated with an increased risk of sensitization to cat and, in combination with tobacco smoke, also with the development of more severe asthma.

Conclusions: In young asthmatic children, early exposure to cat and tobacco smoke increased the risk of allergic sensitization and further development of more severe asthma later in childhood.

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Is early exposure to furred pets a risk factor for development of asthma and sensitization to these animals later in childhood? A recent review on the issue proposed that all exposure to pets in childhood involves a risk of sensitization and recommended that families with atopic members should postpone keeping of pets until the child is at least 2 years old (1). There are, however, entirely discordant views on the issue, since it has been claimed that early exposure to pets is associated neither with an increased risk of childhood asthma nor with development of IgE antibodies to pets; instead, a protective effect has been proposed (2–5). Several studies have clearly shown that atopic sensitization is a risk factor for asthmatic disease, but few have investigated the possibility of a stepwise development of sensitization due to allergen exposure and consequent disease (6–11).

Abbreviations. CI: confidence interval; ETS: environmental tobacco smoke; OR: odds ratio; RAST: radioallergosorbent test; SPT: skin prick test; WPC: windowpane condensation.

In order to evaluate the importance of exposure to various indoor environmental risk factors in early childhood for the development of bronchial asthma, we performed a case-control study in 1990–2, including 193 children with asthma and 318 controls (12). Heredity for asthma, parental smoking, and signs of dampness at home were strongly associated with development of asthma, whereas exposure to cat and/or dog was not. However, the subgroup of asthmatics who were sensitized to cat and/or dog were overexposed to these animals relative to a population-based control group. In an extension of that study, sensitization to both cat and dog was found to be related to exposure to cat in a dose-dependent way. Furthermore, high levels of cat allergen in the home (≥ 8 $\mu\text{g/g}$ dust), exposure to environmental tobacco smoke (ETS), and signs of home dampness were shown to increase independently the risk of sensitization to both cat and dog (13). Synergistic interaction of the risk factors was indicated in that the risk of sensitization to cat increased 40-fold when all three were present.

This is a 2-year follow-up study of the asthma cases. The aim was to evaluate the importance of early exposure to risk factors for continuous sensitization, mainly to cat and dog, and of disease characteristics, especially severity of asthma.

Material and methods

Study design

This is a follow-up study of a previous investigation of 193 children, aged 1–4 years, referred to the pediatric allergy clinics in Stockholm (Sweden) for evaluation of asthma between May 1990 and May 1992 (13). The children were referred either after hospital admission, as a consequence of repeated visits to the emergency department, or by general pediatricians. Asthma was defined as three or more episodes of wheezing regardless of cause. Questionnaire data on family history of atopic disease and indoor environmental conditions were obtained. A clinical examination of the child was performed and serum IgE antibodies to cat and dog measured. Asthma severity was scored at a structured interview with a parent. Floor dust was collected from the patient's home and analyzed for concentrations both of Fel d 1 and Can f 1. The previous study will be referred to as study I.

The present study, study II, was performed 2 years after study I, the investigations being repeated except that a slightly adjusted version of the questionnaire from study I was used. The new questionnaire dealt with exposures of interest in the patient's home environment during the preceding 2 years. Emphasis was put on exposure to animals, especially furred pets. New dust samples were not collected from the children's homes in the present study.

A total of 183 of the original 193 children participated in study II. Another two children were excluded from study II, because crucial initial data were missing. Due to a freezer breakdown, 37 serum samples from one of the hospitals were lost, a fact which meant that the number of children's sera analyzed for serum IgE antibodies was reduced from 181 to 144. Allergic heredity was defined as reported asthma, rhinoconjunctivitis, or eczema in one or both parents.

Definitions of reported exposure to furred animals

Detailed questions on both direct and indirect exposure to furred pets, cat and dog in particular, were included in the questionnaire. Exposure was graded into three categories:

- 1) *No exposure*; i.e., neither obvious direct contact nor any regular indirect contact with cat or dog for any family member.
- 2) *Low exposure*; i.e., direct contact less than 4 days a month and/or regular indirect exposure of the child to cat or dog, as in the homes of friends or neighbors, or in the summer house or other locations regularly visited by family members.
- 3) *High exposure*; i.e., cat or dog in the current or previous home, day-care center, or any other home where the child had spent more than 3 days a month.

Thus, both the questions concerning exposure to furred pets and the subsequent grading of exposure were the same as in study I, but dealt with such exposures during the last 2 years.

Dust sampling and allergen quantification

Methods used in study I only, i.e., dust sampling and allergen quantification, are described in detail in previous works (12, 13).

Determination of IgE antibodies

Capillary blood samples were drawn, and specific IgE measurements were performed for cat, dog, birch, *Dermatophagoides pteronyssinus*

(*Dpt*), timothy, and rabbit with the Pharmacia CAP System (RAST FEIA, Pharmacia and Upjohn Diagnostics AB, Uppsala Sweden), as recommended by the manufacturer. A positive RAST was defined as a value ≥ 0.35 kU/l. (RAST class 1: 0.35–0.69 kU/l; RAST class ≥ 2 : ≥ 0.70 kU/l).

Skin prick tests (SPT)

The SPT were performed with aqueous extracts of egg white, *Dpt*, cat, dog, rabbit, horse, birch, and timothy (Soluprick 10 HEP, ALK, Hørsholm, Denmark). Histamine hydrochloride 10 mg/ml and saline were used as positive and negative controls, respectively. A test was considered positive if the mean wheal diameter was at least 3 mm.

Classification of asthma severity

The basis for the classification was a structured interview about symptoms and treatment the preceding year performed by a pediatric allergologist in one of the pediatric hospitals. The children were grouped into three categories of asthma severity. The classification was based on current asthma symptoms (judged as number of days a month with inhibited daily activity or disturbed sleep at night due to the asthma) and level of inhalant steroid use (none, intermittent, or daily for more than 3 months during the past year, and daily during the past year). Thus, the classification was based on the following criteria:

- 1) *mild asthma*: no or intermittent steroid treatment and less than 6 days a month with inhibited daily activity
- 2) *moderate asthma*: intermittent or regular daily steroid treatment more than 3 months a year and less than 6 days a month with inhibited daily activity
- 3) *severe asthma*: daily regular steroid treatment more than 3 months a year and more than 6 days a month with inhibited daily activity.

Statistics

All statistical calculations were performed with the statistical package STATA[®]. Crude odds ratios (OR) with 95% confidence interval (CI) were calculated to assess the respective risk estimates for sensitization to cat or dog of exposure to various environmental factors. Logistic regression was used to calculate multivariate models, including a number of potential confounders. The results presented in this paper are based on 181 children's data from studies I and II. In some cases, the amount of serum was sufficient only for limited analyses of IgE antibodies, and the numbers differ in some of the analyses that include IgE antibody measurements.

Ethics

The study was approved by the ethics committee of the Karolinska Institute. Informed parental consent was obtained in writing.

Results

The study comprised 138 boys and 43 girls. The mean age at follow-up was 49 months (34–71) (Table 1), or approximately 4 years. Twenty-three percent of the children had IgE antibodies to cat and 27% to dog, as compared to 23% to both cat and dog in study I. During the 2-year period between studies I and II, asthma symptoms had decreased. Thus, the proportion of children with few symptoms (i.e., symptoms of short duration only after allergen exposure or heavy exercise) had increased from 11% in study I to 42% in study II,

Table 1. Background data on 181 asthmatic children from study I and study II, including data on reported exposure to pets and environmental tobacco smoke and IgE levels to cat and dog

	Age 0–2 years (study I)			Age 2–4 years (study II)		
	<i>n</i>	<i>N</i>	%	<i>n</i>	<i>N</i>	%
Sex (boys)	138	181	76	138	181	76
Age (months)	12–47			34–71		
Age (months) mean	24			49		
Allergic heredity*	132	178	74	132	178	74
Cat at home	26	181	14	12	181	7
Cat high (other than at home)	13	181	7	13	181	7
Cat low	58	181	32	81	181	45
Dog at home	14	181	8	7	181	4
Dog high (other than at home)	9	181	5	8	181	4
Dog low	73	181	40	87	181	48
Tobacco smoking at home	102	181	56	89	181	49
Mother smoking	75	181	41	65	180	36
Father smoking	62	176	35	51	181	28
IgE cat, RAST: <0.35 kU/l	124	162	77	110	143	77
IgE cat, RAST: 0.35–0.69 kU/l	15	162	9	4	143	3
IgE cat, RAST: ≥0.70 kU/l	23	162	14	29	143	20
IgE dog, RAST: <0.35 kU/l	120	156	77	101	138	73
IgE dog, RAST: 0.35–0.69 kU/l	14	156	9	6	138	4
IgE dog, RAST: ≥0.70 kU/l	22	156	14	31	138	23

* Allergic heredity was defined as reported asthma, rhinoconjunctivitis, or eczema in one or both parents.

while the proportion of children with inhaled steroid treatment had increased during the period (data not shown). High-dose exposure to furred pets had decreased; e.g., the keeping of cats fell from 14% to 7%, and the keeping of dogs from 8% to 4%. On the other hand, the reported low-dose exposure to pets, i.e., direct exposure outside the home, had increased. Fifty-six percent of the children were exposed to ETS at home in study I compared to 49% in study II.

Risk factors for sensitization (RAST ≥0.35 kU/l) to cat and dog at the age of 4 years

The exposures for the risk factors under study from studies I and II were related to sensitization to cat and dog at the age of 4 years. As shown in Table 2, the exposure time period was split into two parts, period I – exposure from birth to the time for study I (approximately 0–2 years of age) – and period II – exposure during the time between study I and study II (approximately 2–4 years of age).

Among children sensitized to cat, more were boys (OR = 3.12, CI 95% 0.78–12.4), and more had heredity for allergy and/or asthma (OR = 2.93, 0.85–10.1). Exposure to cat was associated with an increased risk of sensitization to cat. This was true for exposure during period I, but not period II (OR = 5.56, 1.06–29.0), and for exposure during both time periods (OR = 6.21, 1.55–24.8). The pattern of exposure to ETS showed little change between the time periods. The risk of sensitization to cat was increased when there was exposure to ETS during both time periods compared to when there was none (OR = 3.18, 1.11–9.10) (Table 2). Signs of poor ventilation, as indicated by windowpane condensation (WPC) during either of the two periods, were not

significantly associated with sensitization to cat (Table 2). An association was found between both degrees of exposure to cat during period I and sensitization to cat at the age of 4 years; OR = 3.18, 1.02–9.90 and 3.37, 1.09–10.4 for low- and high-dose exposure to cat, respectively (Table 3). High dust levels of cat allergen (≥ 8 µg/g Fel d 1 in home floor dust) were associated with a pronounced increased risk of sensitization to cat (OR = 5.92, 1.38–25.3). When all the three potential risk factors (high-dose exposure to cat, exposure to ETS, and WPC) had been present during period I, there was an 11-fold increased risk of sensitization to cat (OR = 10.8, 1.97–59.6), indicative of a synergistic effect (Table 3).

Exposure to ETS during both periods was significantly associated with an increased risk of sensitization

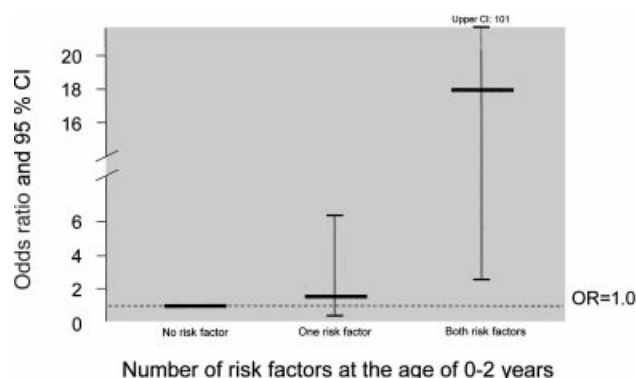


Figure 1. Risk of having current severe asthma (at 4 years of age) in relation to number of risk factors (exposure to Fel d 1 > 8 µg/g dust and parental smoking) during period I (approximately 0–2 years of age). OR (odds ratio) values are adjusted for age, heredity, and exposure to cat, dog, parental smoking, and windowpane condensation.

Table 2. Risk of being sensitized to cat at age of 4 years in relation to exposure to cats, ETS, and WPC from 0 to 4 years of age. Exposure time period was split into two parts: period I – exposure from birth to time for study I (approximately 0–2 years of age) – and period II – exposure during time between study I and study II (approximately 2–4 years of age)

Exposure	Period I	Period II	Sens.	Not sens.	OR _{crude}	CI 95%	OR _{adjust}	CI 95%
			<i>n</i> =32*	<i>n</i> =106*				
Cat	—	—	5	36	1.00		1.00	
	—	+	4	24	1.20	0.29–4.93	1.77	0.36–8.57
	+	—	7	11	4.58	1.21–17.4	5.56	1.06–29.0
	+	+	16	35	3.29	1.09–9.95	6.21	1.55–24.8
ETS	—	—	7	51	1.00		1.00	
	—	+	0	5	—	—		
	+	—	3	9	2.67	0.58–12.2	2.42	0.42–13.8
	+	+	22	41	4.29	1.68–11.0	3.18	1.11–9.10
WPC	—	—	16	69	1.00		1.00	
	—	+	3	11	1.18	0.29–4.71	1.21	0.22–6.55
	+	—	7	9	3.35	1.09–10.4	2.2	0.48–10.0
	+	+	6	17	1.52	0.52–4.47	1.9	0.56–6.44

Sens: sensitized to cat at 4 years of age.

+ indicates exposure during each respective time period; – indicates no exposure during each respective time period.

OR values are adjusted for age, sex, heredity, and exposure to cat, dog, ETS, and WPC.

Cat exposure was defined as reported high- or low-dose exposure during each respective time period.

ETS: environmental tobacco smoke, WPC: windowpane condensation.

*Smaller number of children included due to missing questions about WPC.

to dog (OR=2.91, 1.06–8.00), and this was true for reported WPC during both periods as well (OR = 3.52, 1.11–11.2). High- or low-dose exposure to dog during period I, but not during period II, tended only to increase the risk of sensitization to dog (OR = 3.03, 0.63–14.5). Other combinations of exposure to dog were not associated with an increased risk of sensitization (data not shown).

Early risk factors for current severe asthma

Twelve children fulfilled the criteria for severe asthma (all boys, mean age 45 months), and 162 children those for mild/moderate asthma (124 boys, mean age 49 months) (Table 4). Heredity for asthma and allergy did

not differ between the groups. During the first 2 years of life, the children in the group with severe asthma had been exposed more to several of the environmental risk factors studied than the children in the mild/moderate asthma group. Thus, high levels of Fel d 1 in the children's homes tended to increase the risk of severe asthma (OR = 3.39, 0.77–14.9), and this was also true for parental smoking (OR = 3.01, 0.74–12.2). A combination of the two risk factors resulted in an 18-fold increase of risk (OR = 18.0, 3.20–101) (Fig. 1). A greater proportion of children in the group with severe asthma exhibited also a RAST level of ≥ 2 (≥ 0.70 kU/l) to cat, compared with children in the group with mild/moderate asthma (RAST level ≥ 2 , 33% vs 13%, OR = 3.29, 0.86–12.5). Sensitization to dog did not

Table 3. Risk of being sensitized to cat at age of 4 years in relation to exposure to cats, levels of cat allergen, and combination of risk factors (exposure to cats, ETS, and WPC) during period I (approximately 0–2 years of age)

	Sens.	Not sens.	OR _{crude}	CI 95%	OR _{adjust}	CI 95%
	<i>n</i> =33	<i>n</i> =108				
Exposure						
Cat none	10	62	1.00		1.00*	
Cat low	12	27	2.76	1.06–7.15	3.18*	1.02–9.90
Cat high	11	19	3.59	1.32–9.75	3.37*	1.09–10.4
Allergen level (Fel d 1)	(<i>n</i> =26)	(<i>n</i> =96)				
<0.2 µg/g dust	8	58	1.00		1.00*	
0.2–8 µg/g dust	11	31	2.57	0.94–7.06	2.02*	0.64–6.35
>8 µg/g dust	7	7	7.25	2.01–26.1	5.92*	1.38–25.3
Cat exposure, ETS and WPC						
No risk factor present	3	24	1.00		1.00**	
One risk factor present	7	48	1.17	0.28–4.91	1.11**	0.25–4.92
Two risk factors present	15	31	3.87	1.00–14.9	4.38**	1.03–18.6
Three risk factors present	8	5	12.8	2.48–66.0	10.8**	1.97–59.6

* Adjusted for age, sex, heredity, ETS, WPC, and exposure to dog.

** Adjusted for age, sex, heredity, and exposure to dog.

Sens.: sensitized to cat at 4 years of age; ETS: environmental tobacco smoke; WPC: windowpane condensation.

Table 4. Risk of having current severe asthma (4 years of age) in relation to risk factors during period I (approximately 0–2 years of age)

	Mild/moderate asthma			Severe asthma			OR	95% CI	OR _{adjust}	95% CI
	N	n	%	N	n	%				
IgE cat, RAST ≥ 0.70 kU/l	145	19	13	12	4	33	3.34	0.98–11.6	3.29†	0.86–12.5
IgE dog, RAST ≥ 0.70 kU/l	139	20	14	12	2	17	1.20	0.0–5.31	1.37†	0.27–7.10
SPT positive*: 0	160	113	71	12	5	42	1.00		1.00	
SPT positive*: > 2	160	19	12	12	4	33	4.84	1.19–19.7	6.99†	1.58–31.0
Fel d 1 < 0.2 μ g/g dust	135	67	50	12	6	50	1.00		1.00	
Fel d 1 0.2 – 8 μ g/g dust	135	56	41	12	1	8	0.20	0.02–1.67	0.15**	0.02–1.39
Fel d 1 > 8 μ g/g dust	135	12	9	12	5	42	4.72	1.24–18.0	3.39**	0.77–14.9
ETS	158	85	54	12	9	75	2.59	0.73–9.14	3.01**	0.74–12.2
WPC	158	45	28	12	3	25	0.83	0.23–2.97	0.74**	0.17–3.17

* Number of positive skin prick tests with following extracts: egg white, *Dpt*, cat, dog, rabbit, horse, birch, and timothy.

ETS: environmental tobacco smoke; WPC: windowpane condensation.

† Adjusted for age and heredity.

** Adjusted for age, heredity, and exposure to cat, dog, ETS, and WPC.

differ between the groups. However, multiple sensitization (more than two positive SPT to allergen extracts) significantly increased the risk of severe asthma (OR = 6.99, 1.58–31.0). No significant association was seen of reported exposure to cat or dog with severity of asthma (data not shown)

Current risk factors for current severe asthma

At the mean age of 4 years (study II), severe asthma was still associated with pronounced atopy, i.e., more than two positive SPT (OR = 11.8, 2.3–60), RAST of ≥ 2 (≥ 0.70 kU/l) to cat (OR = 2.8, 0.6–9.9), and now also RAST of ≥ 2 to dog (OR = 2.5, 0.6–10.7). The children in the group with severe asthma were at the time of study II more exposed to cat (reported exposure) and tobacco smoke than children with moderate/mild asthma, although the difference was not statistically significant. No such tendency was observed for exposure to dog (data not shown).

Discussion

In this paper, we have focused on early exposure to different environmental factors up to 2 years of age, and on sensitization later in childhood, i.e., at approximately 4 years of age. In addition, the relationship between current exposure factors and current sensitization was investigated. We also investigated the impact of exposure to cat and dog in the process leading to severe asthma. Synergistic associations between early exposure to cat, parental smoking, signs of poor ventilation, and sensitization to cat and dog were found. Exposure to high levels of cat allergen in the home (≥ 8 μ g/g of floor dust), in combination with parental smoking at 2 years of age, was found to be associated both with the development of severe asthma and continued sensitization to cat.

Exposure and sensitization

Early exposure to cat, as indicated by both reported exposure and levels of cat allergen at home, has been shown to increase the risk of sensitization to both cat and dog later in childhood (13–15). In accordance with results from our previous study, we did not find any significant association between early exposure to dog or exposure to levels of dog allergen and sensitization to dog (13). A significant association was found both between early reported exposure to cat and high measured levels of cat allergen at home and current sensitization to cat. In study I, 26 of the 181 children's parents were reported to keep a cat at home compared to 12 in study II. Among the children sensitized to cat ($n = 33$), 11 were exposed at high dose to cat in study I, but only five in study II. This change of exposure to cat may probably be explained by removal of the cat from the home of symptomatic sensitized children and active avoidance of cats outside the home. Similar results were reported by Kuehr et al. in 1992 (16). The same year, Brunekreef et al. (17) reported that the highest prevalence of current allergy and respiratory symptoms among Dutch children aged 6–12 years was found among children from homes where pets were kept in the past but no longer. Active avoidance of allergen, both as a consequence of disease and as a primary preventive effort, complicates interpretation of sensitization during childhood and may very well explain different results in recent studies.

Wahn et al. showed significantly higher concentrations of cat allergen in the homes of sensitized children (up to 3 years of age) compared to those in homes of unsensitized children (14). This is consistent with our previous findings, while several other studies have failed to show any association between exposure to pets (cat included) and sensitization (18–21). In two recent studies, it has been proposed that childhood exposure to cats is associated with a decreased risk of sensitiza-

tion to cats later in life (2, 5). Such cross-sectional retrospective studies may be liable to recall bias, which may, at least in part, explain the results. In this study, more than half of the families got rid of the cat between study I and study II, when the children were approximately 2–4 years of age, and our data are in good agreement with those of Brunekreef et al. Different results may partly be explained by exposure outside home, e.g., exposure to cat and dog allergen at schools, at day-care centers, and in the homes of friends and relatives. Furthermore, such exposures may also lead to the contamination of homes and consequent hidden exposure.

The association between WPC and sensitization to dog and cat (although not statistically significant) might be explained by the fact that reduced air exchange may lead to indoor trapping of allergens and consequent enhancement of the actual allergen exposure. Furthermore, a synergistic effect was found between exposure to cat, parental smoking, and signs of poor ventilation, thus increasing the risk of sensitization. The presence of WPC and indoor vapor contribution ($>3 \text{ g/m}^3$) has been associated with poor ventilation, although these indicators may not always reflect the true indoor climate (22). Development of atopic disease has also been found to be associated with WPC and poor indoor climate (23), although the mechanism behind these observations may still not be fully understood.

Recently, several studies of domestic allergens in public places have shown that allergens from cat and dog are ubiquitous, even in environments without such animals, and may be present in levels sufficient to induce sensitization and/or worsen symptoms in sensitized individuals (15, 24–27). This contribution to the allergen load must be considered in estimations of an individual's exposure at home and at other places. In this study, we have tried to estimate the children's exposures to pets by detailed questionnaire and allergen measurements. Most importantly, we found that indirect exposure and low to moderate levels of cat allergen in the homes were associated with a considerably increased risk of sensitization to cat. Such a degree of exposure may be an important confounder in the previously discussed studies (2, 5). However, this study was not population based. There is a possibility of a selection bias, and the results need not be applicable to all children. Misclassification of questionnaire data cannot be ruled out but must be expected to be evenly distributed in the group. The time period between the occurrence of the exposures and the collection of data was short, below years; thus, there should be little risk of recall bias. However, since this is a case study in which the children and parents were given an asthma diagnosis, there is a risk of misclassification of data due to influence of the development of the child's asthmatic disease. For instance, a recall bias for the associations

of atopic family history and atopy in children must be considered, and this has been shown to be indeed relevant (28).

Development of asthma requiring continuous treatment

Severe asthma at the age 4 years was in this study associated with exposure to high levels of cat allergen at home, parental smoking, and early sensitization, as indicated by either more than two positive SPT or RAST of $\geq 0.70 \text{ kU/l}$ to cat at the age of 2 years. The link between early sensitization and severity of asthma is of great importance, indicating that atopy in early life is a negative prognostic factor in wheezing children. In this respect, our data are in close agreement with those of others (4, 8).

A number of studies have demonstrated that current atopic status, assessed as either positive SPT or positive RAST, is an important factor for current asthma status. Zimmerman et al. found the number of positive SPT to be associated with increasing severity of asthma (29). Two other recent studies by Sarpong & Karrison have shown that sensitivity to cat increased the risk of having more severe asthma, and this was probably an important determinant for asthma hospitalization in children (6, 7). Furthermore, increased bronchial hyperresponsiveness among children with asthma has been associated with sensitization to dog or cat dander (30). Thus, there are convincing data on a positive association between sensitization to various allergens and asthma severity. This is an important background in the context of our findings of an association between early allergen exposure and sensitization.

A recent meta-analysis study on the health effects of passive smoking concluded that among children with established asthma, parental smoking was associated with more severe disease, a finding which is consistent with our findings (31). Parental smoking in early life among children with wheezing bronchitis has also been shown to be a significant risk factor for asthma at 10 years of age (4).

This follow-up study brings additional information about sensitization and asthma outcome to the current discussion of pet exposure in early life and the development of asthma. Our data clearly indicate that wheezy children should not live in homes where pets are kept. Furthermore they should preferably not have lived in such a home during their first few years, particularly not if the pet was a cat and a parent a smoker.

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