

# Exposure to Pets and the Risk of Allergic Symptoms During the First 2 Years of Life

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## ■ Abstract

*Background:* Currently, there is a lack of consensus regarding the influence of household pets on the development of allergic diseases in childhood.

*Objective:* The aim of this birth cohort study was to analyze the relationship between pet ownership at time of birth and the prevalence of atopic diseases approximately 2 years later.

*Methods:* A few days after the delivery of their babies, we asked 3132 mothers of German nationality whether they kept household pets like dogs, cats, or birds. Two years later, we asked whether their children had developed bronchial asthma, eczema, or hay fever. We then used logistic regression models to analyze whether there was an association between the development of allergic reactions among the children and pet ownership at the time of birth.

*Results:* In families without a history of atopic disease, the prevalence of asthma and eczema among 2-year-old children was significantly lower in those families that owned a dog at the time the children were born (odds ratio [OR], 0.52; 95% confidence interval [CI], 0.33-0.83). In contrast, in families with a history of atopic disease, early dog exposure was associated with a higher prevalence of asthma and eczema in 2-year-old children (OR, 1.43; 95% CI, 0.95-2.15). Comparable analyses assessing the influence of cats and birds in the home showed no effect on the development of atopic diseases in early childhood.

*Conclusions:* This study confirms the findings of several earlier studies suggesting a negative association between dog ownership and the development of atopic diseases in early childhood, although the effect was only observed in families without a history of atopic disorders.

**Key words:** Allergies. Children. Epidemiology. Pets.

## ■ Resumen

*Antecedentes:* Actualmente no existe consenso en cuanto a la influencia de los animales domésticos en la aparición de enfermedades alérgicas en la infancia.

*Objetivo:* El objetivo de este estudio de cohortes de recién nacidos fue analizar la relación entre la convivencia con animales domésticos desde el nacimiento y la prevalencia de enfermedades atópicas aproximadamente dos años más tarde.

*Métodos:* Unos días después del nacimiento de sus hijos, preguntamos a 3.132 madres alemanas si tenían en casa animales como perros, gatos o pájaros. Dos años más tarde les preguntamos si sus hijos habían presentado asma bronquial, eccema o rinitis alérgica. A continuación, usamos modelos de regresión logística para analizar si había una relación entre la aparición de reacciones alérgicas en los niños y la presencia de animales domésticos en casa desde recién nacidos.

*Resultados:* En las familias sin historial de enfermedad atópica, la prevalencia de asma y eccema entre los niños de dos años de edad fue muy inferior en las familias que tenían un perro al nacer el niño (oportunidad relativa [OR], 0,52; intervalo de confianza [IC] del 95%, 0,33-0,83). Por el contrario, en el caso de las familias con un historial de enfermedad atópica, la exposición al perro en la etapa posterior al nacimiento se asoció con una prevalencia superior de asma y eccema en los niños de dos años (OR, 1,43; IC del 95%, 0,95-2,15). Análisis parecidos que valoraron la influencia de gatos y pájaros en el hogar revelaron que no tenían ningún efecto sobre la aparición de enfermedades atópicas en la primera infancia.

*Conclusiones:* Este estudio confirma los resultados de varios estudios anteriores que sugerían la existencia de una asociación negativa entre tener perros y el desarrollo de enfermedades atópicas en la primera infancia, aunque el efecto se observó solamente en familias sin un historial de enfermedades atópicas.

**Palabras clave:** Alergias. Niños. Epidemiología. Animales domésticos.

## Introduction

In recent years, various epidemiological studies have shown an increasing prevalence of asthma and allergic diseases in children from several countries, including Germany [1]. Besides genetic influences, a variety of environmental and lifestyle factors, such as exposure to air pollution, environmental tobacco smoke, or childhood infections, may be responsible for the observed trend. However, the possible influence of household pets has been extensively debated in recent years. Depending on the age of the children, the type of study, and the definition of exposure and outcome, several studies have suggested that exposure to household pets increases the risk of allergic diseases in childhood. In contrast, several recently published studies found no association or even protective effects of exposure to pets. The main objective of the present study was to investigate the relationship between the presence of household pets at the time of birth and the prevalence of atopic diseases 2 years later.

## Patients and Methods

### *Study Population and Questionnaire Data*

The study included 3132 children born to mothers of German nationality between 1999 and 2000 in 5 participating hospitals in 3 cities (Delmenhorst, Wilhelmshaven, and Leer) in the northwest of Germany. Delmenhorst and Wilhelmshaven are small cities with approximately 76 000 and 85 000 inhabitants, respectively; Leer is a small town with approximately 34 000 inhabitants and its hospital has a wide rural catchment area. Before the mothers were discharged from hospital they completed a questionnaire containing detailed questions on family history of allergic diseases, parental education (social class), and several lifestyle conditions such as pet ownership [2]. Two years later, it was possible to contact 1881 (60%) parents of those children again as part of the routine preventive medical checkup “well baby visits” for children. They completed a questionnaire that included a set of standardized questions from the International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire [3] in order to assess whether their children suffered from symptoms of allergic disease.

### *Variables*

Based on information obtained from completed questionnaires in the baseline survey (a few days after birth), several variables were established. Social class was defined by the highest school grade completed by either mother or father [4]. Families in which the parents received less than 10 years of formal education were defined as social class I, 10 years of parental education as social class II, and more than 10 years of formal parental education as social class III. Family history of allergic diseases was defined by a reported history of asthma, eczema, or hay fever among the newborns’ first-degree relatives (mother, father, or siblings). The presence of household pets at the time of birth was also defined based on information from the questionnaire provided in the baseline

survey by means of the question “Does your household include furred or feathered pets? – If yes, which ones (dogs, cats, birds, other).” Finally, in order to define the disease status for the 2-year-old children, we considered the following questionnaire information: a) “Has the child ever had physician-diagnosed eczema or an itchy rash for more than 6 months or cracking of the earlobes (symptoms of eczema)?”, b) “Has the child ever had physician-diagnosed asthma or chronic obstructive bronchitis (symptoms of asthma)?”, and c) “Has the child ever had physician-diagnosed hay fever?”

If at least one of those conditions was met, the child was considered as suffering from symptoms of allergic disease.

### *Statistical Analysis*

Logistic regression was used to analyze the impact of household pets on the development of symptoms of allergic diseases in childhood. Adjusted odds ratios (OR) and 95% confidence intervals (CI) were calculated for keeping a cat, a dog, or a bird at the time of birth. Family history, as one of the most important risk factors and confounders, was considered by separate analyses for children with and without first-degree relatives with a history of atopic disease. All analyses were routinely adjusted for parental education to mimic socioeconomic status. Further adjustment for sex, location, or parental smoking did not influence the OR compared with the results adjusted for parental education alone. Stratified analyses were carried out to assess the results according to level of parental education. All statistical analyses were performed using the software package SAS, release 8.2 (SAS Institute, Cary, North Carolina, USA).

## Results

Among the 1881 2-year-old children, 432 (23%) showed symptoms of allergic disease (boys, 24.8%; girls, 21.2%). The majority of them showed symptoms of eczema (69.4%), 34.3% had physician-diagnosed asthma or chronic obstructive bronchitis, and only 2 children had physician-diagnosed hay fever.

Table 1 shows the distribution of children with and without symptoms of allergic disease by sex, parental education, location, and family history of atopic disease. The role of family history in the development of allergic diseases during early childhood was confirmed—a significantly higher prevalence of allergy symptoms was observed in children with at least one first degree relative suffering from asthma, eczema, or hay fever.

Forty-eight percent of the families without history of allergic disease kept domestic pets compared to 41% of the families with a history of allergic disease ( $P = .006$ ). Moreover, keeping of pets was also dependent on parental education: in class I and class II, approximately 50% of the families kept a pet, whereas in class III only 36% owned a pet. No differences in pet ownership were found according to geographic location. In children without family history of allergic disease the presence of a pet in the home at the time of birth was associated with a nonsignificant trend towards less allergic symptoms. Only dog ownership displayed a significant association with

Table 1. Two-year-old Children With and Without Symptoms of Allergic Disease According to Sex, Parental Education, Study Center, and Family History of Atopic Disease

	No.	Symptoms of Allergic Disease*		P†
		No	Yes	
Overall group	1881	1449 (77.0%)	432 (23.0%)	
Sex				
Boy	918	690 (75.2%)	228 (24.8%)	.06
Girl	963	759 (78.8%)	204 (21.2%)	
Parental education (social class)				
<10 years (class I)	377	295 (78.2%)	82 (21.8%)	.09
10 years (class II)	842	663 (78.7%)	179 (21.3%)	
>10 years (class III)	662	491 (74.2%)	171 (25.8%)	
Study center				
Delmenhorst	799	617 (77.2%)	182 (22.8%)	.87
Wilhelmshaven	539	411 (76.3%)	128 (23.7%)	
Leer	543	421 (77.5%)	122 (22.5%)	
Family history of allergic disease ‡				
No	1071	867 (81.0%)	204 (19.0%)	<.0001
Yes	810	582 (71.9%)	228 (28.1%)	
Maternal history of allergic disease ‡				
No	1441	1135 (78.8%)	306 (21.2%)	.001
Yes	440	314 (71.4%)	126 (28.6%)	
Paternal history of allergic disease ‡				
No	1509	1178 (78.1%)	331 (21.9%)	.03
Yes	372	271 (72.8%)	101 (27.2%)	
Sibling history of allergic disease ‡				
No	1682	1316 (78.2%)	366 (21.8%)	.0003
Yes	199	133 (66.8%)	66 (33.2%)	

\*Physician-diagnosed asthma or asthma-like bronchitis, hay fever, or eczema, itchy rash for more than 6 months, or cracking of the earlobes

†  $\chi^2$  test

‡ History of asthma, eczema, or hay fever among the newborns' first degree relatives (mother, father, or siblings)

a lower risk of allergic symptoms in children with no family history of atopic disease. In children with a family history of allergic disease there was a trend towards increased risk among those exposed to dogs in the home at the time of birth.

To analyze the extent to which socioeconomic status could explain our findings, dog ownership was also stratified

according to social class (Table 3). Interestingly, in families without a dog the prevalence of allergic disease in 2-year-old children varied between 16.8% in the lower social class and 25% in the upper social class. In families who kept a dog, the prevalence varied between 9.1% (lower social class) and 15.5% (upper social class), whereas the OR was almost identical in

Table 2. Pet Ownership at Time of Birth and Symptoms of Allergic Diseases 2 years Later According to Family History of Allergic Disease\*

	Families Without History of Allergic Disease (n = 1071)†		Families With History of Allergic Disease (n = 810)‡	
	Symptoms of Allergic Disease‡		Symptoms of Allergic Disease‡	
	No	Yes	No	Yes
Overall group	867 (81.0%)	204 (19.0%)	582 (71.9%)	228 (28.1%)
	OR (95% CI)§		OR (95% CI)§	
Keeping pets at time of birth				
No	441 (79.0%)	117 (21.0%)	341 (71.9%)	133 (28.1%)
Yes	426 (83.0%)	87 (17.0%)	241 (71.7%)	95 (28.3%)
		0.80 (0.59-1.09)		1.00 (0.73-1.37)
Keeping a dog at time of birth				
No	688 (79.3%)	180 (20.7%)	500 (73.1%)	184 (26.9%)
Yes	179 (88.2%)	24 (11.8%)	82 (65.1%)	44 (34.9%)
		0.52 (0.33-0.83)		1.43 (0.95-2.15)
Keeping a cat at time of birth				
No	676 (81.4%)	154 (18.6%)	466 (71.6%)	185 (28.4%)
Yes	191 (79.3%)	50 (20.7%)	116 (73.0%)	43 (27.0%)
		1.17 (0.82-1.68)		0.94 (0.64-1.40)
Keeping a bird at time of birth				
No	748 (80.9%)	177 (19.1%)	526 (71.4%)	211 (28.6%)
Yes	119 (81.5%)	27 (18.5%)	56 (76.7%)	17 (23.3%)
		1.01 (0.64-1.59)		0.74 (0.64-1.40)

\* OR indicates odds ratio; CI, confidence interval.

†History of asthma, eczema, or hay fever among the newborns' first degree relatives (mother, father, or siblings)

‡Physician-diagnosed asthma or asthma-like bronchitis, hay fever, or eczema, itchy rash for more than 6 months or cracking of the earlobes

§Adjusted for parental education

Table 3. Dog Ownership at Time of Birth and Symptoms of Allergic Diseases 2 Years Later According to Family History of Allergic Disease and Social Class\*

	Families Without History of Allergic Disease (n = 1071)†		Families With a History of Allergic Disease (n = 810)‡		OR (95% CI)
	Symptoms of Allergic Disease‡		Symptoms of Allergic Disease‡		
	No	Yes	No	Yes	
Overall group	867 (81.0%)	204 (19.0%)	582 (71.9%)	228 (28.1%)	
Dog Ownership at Time of Birth					
Class I					
No	153 (83.2%)	31 (16.8%)	71 (68.3%)	33 (31.7%)	1
Yes	50 (90.9%)	5 (9.1%)	21 (61.8%)	13 (38.2%)	1.33 (0.60-2.99)
Class II					
No	324 (81.2%)	75 (18.8%)	217 (74.1%)	76 (25.9%)	1
Yes	80 (88.9%)	10 (11.1%)	42 (70.0%)	18 (30.0%)	1.22 (0.66-2.25)
Class III					
No	211 (74.0%)	74 (25.0%)	212 (73.9%)	75 (26.1%)	1
Yes	49 (84.5%)	9 (15.5%)	19 (59.4%)	13 (40.6%)	1.94 (0.91-4.11)

\*OR indicates odds ratio; CI, confidence interval.

†History of asthma, eczema, or hay fever among the newborns' first degree relatives (mother, father, or siblings)

‡Physician-diagnosed asthma or asthma-like bronchitis, hay fever, or eczema, itchy rash for more than 6 months or cracking of the earlobes

the different classes. Among children with a family history of atopic disease, the OR associated with dog ownership varied from 1.22 in the middle social class to 1.94 in the higher social class.

## Discussion

In this birth cohort study we found that newborns without a family history of allergic disease had a lower prevalence of asthma and eczema at the age of 2 years when their families kept a dog, an effect that could be observed in all social classes. In contrast, dog ownership was associated with a higher prevalence of allergy symptoms in children with a family history of allergic diseases. No such associations were found for ownership of cats, birds, or other furred or feathered pets. Our findings confirm several recent studies that also reported protective effects, especially with regard to dog ownership. The study design used here is most similar to that of Zirngibl et al [5]. Those authors also recruited children at birth and performed follow-up to the age of 2 years. They found a significant negative association between keeping dogs in the first years of life and the development of atopic eczema. However, in contrast to our findings, they found a protective effect in children both with and without a family history of atopic disease. Another birth cohort study initiated in the early 1980s in Tucson, Arizona, USA, found that cat exposure was not associated with wheezing or allergic sensitization [6]. Moreover, the study showed that dog exposure during childhood (at least 1 dog) might prevent the development of asthma-like symptoms, at least in children with no family history of asthma—no such protective effect was found in children with parental history of asthma. Another comparable population-based study was the cohort study published by Nafstad et al [7]. In that study, which included 2531 children from Norway, a decreased risk of atopic eczema at 0-6 months of age was found when the families kept a dog at the time of birth. In contrast to our findings in children aged 2 years, this protective effect was found in children of both nonatopic and atopic parents. Since our study also included information from questionnaires obtained when the children were aged 6 months (collected as part of the well baby visit after 6 months), we repeated our analysis restricted to the first half year of life and considered only symptoms of atopic eczema as an outcome measure (to compare our results directly with those from the Norwegian study). Keeping a dog at the time of birth was associated with an OR of 0.60 (95% CI, 0.34-1.05) for the subset of children without a family history of atopic disease. Interestingly, at this point in time (after 6 months), we also found a decreased OR of 0.75 (95% CI, 0.45-1.23) for the subset of children with a family history of allergy.

One of the most widely discussed explanations for the occasionally conflicting results regarding the relationship between pet exposure and allergic diseases in children is based on the hygiene hypothesis [8]. This hypothesis essentially suggests that early exposure to microbial substances (as measured by the endotoxin levels in the environment) is associated with the suppression of immunoglobulin (Ig) E antibody production, resulting in a decreased risk for allergic diseases. According to that hypothesis, as a result

of increasing hygiene, our immune system is not exposed to microbes to a sufficient degree early in life and, as a result, it starts to overreact to harmless exposures. This possibility is supported by the results of several studies showing that the presence of animals and especially the presence of dogs in households is associated with increased levels of airborne endotoxin and higher endotoxin concentrations in settled house dust [9-12]. Furthermore, some studies have reported an association between higher levels of house-dust endotoxin and reduced risk of atopic diseases in early childhood [13,14]. However, a recently published study showed that the inverse relationship between exposure to dogs and asthma or hay fever in schoolchildren aged 9 to 10 years was not greatly affected by adding indoor endotoxin levels as a potential explanatory variable in the multivariate regression model [15].

It must be stressed that there are also several studies suggesting both a lack of effect and harmful effects of pet exposure in households. For example, Arshad et al [16] conducted a birth cohort study in which they found no association between concurrent pet ownership and positive skin prick tests to cats or dogs in 4-year-old children. In a recent meta-analysis of 32 published articles, Apelberg et al [17] found that early pet exposure (during the first 2 years of life) was associated with a slightly elevated risk of wheezing in older children (>6 years). Some evidence was also found for a protective effect in younger children; however, the authors stressed that this effect could be explained by selection bias.

There is an almost unlimited number of possible conditions that may explain the different and sometimes contradictory findings of the studies published to date. These include the design of the study (cross-sectional, case-control, cohort), geographic differences, outcome measures (eczema, asthma, wheeze, hay fever, atopic sensitization, etc), the definition of exposure (pets, dogs, cats, farming, endotoxin, etc), the time of exposure (at birth, early childhood, current), the age of children (newborns up to adults), and not least of all, family history. These many variables make it difficult to compare different studies directly. Interestingly, however, differentiation between symptoms of eczema and symptoms of asthma (used as the outcome in this study) did not change the interpretation of our results.

In some studies, avoidance behavior towards pets has been suggested to explain the protective effect of pet exposure during childhood against development of atopic diseases [18-20]. Families with a positive history of atopy may try to avoid keeping pets. Therefore, higher prevalences of atopic diseases among children in those families (without pets) would suggest a protective effect of pet ownership since more families without a history of atopy own pets. The observed protective effect would then be caused by the stronger genetic influence in families who decided to live without pets. In our study such a bias seems unlikely to explain the results. We found an inverse relationship only in the subgroup of families without a positive history of atopy—ie, in the absence of the most important reason for pet avoidance.

It should nevertheless be stressed that our findings must be interpreted with caution, since we do not know whether the observed effect is really due to the presence of a dog in the household or whether keeping a dog is a surrogate variable for some other factor, such as a different lifestyle, that protects

against the development of allergic diseases, at least in children without a family history of atopic disease.

The main strength of the present study is its prospective design. We asked parents from a population-based cohort about pet ownership when their children were born and asked about symptoms of allergic diseases after 6 months, 1 year, and 2 years. Therefore, undesirable effects like recall bias or bias due to misclassification of exposure are not very likely to appear. The same is true for the most important confounders, social class and family history, which were also assessed at the beginning of the study. However, there are also limitations related to this study. In particular, exposure to pets and especially disease status were only based on parental information without assessment of objective outcomes such as serum IgE levels or skin prick tests.

Perhaps our study is one more piece in the still unfinished puzzle of the influence of pets on the development of allergy in children. A further survey will be performed in this cohort when the children sit the school entrance examination at approximately 6 years old.

## Acknowledgments

We are especially grateful to all the families for their participation in the study. Part of the study was presented, and published as an abstract, at the annual meeting of the German Association of Epidemiology in Heidelberg, Germany. The study was funded by the Bundesministerium für Bildung, Wissenschaft, Forschung und Technologie (BMBF), 53170 Bonn, Germany (No: 01 EG 9812 / 9). The authors declare no conflicts of interest.

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■ *Manuscript received February 13, 2007; accepted for publication March 6, 2007.*

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