Effects of pet exposure in the first year of life on respiratory and allergic symptoms in 7-yr-old children. The SIDRIA-2 study

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The effects of pet exposure on the development of respiratory symptoms have recently been the matter of vivid discussion. Our objective was to determine the effects of exposure to cat or dog in the first year of life on subsequent respiratory/allergic symptoms in children in a large Italian multicentre study. As part of the SIDRIA-2 Study (Studi Italiani sui Disturbi Respiratori dell'Infanzia e l'Ambiente 2002), the parents of 20016 children (median age 7 yr) provided information on indoor exposures at different times in life and respiratory/allergic symptoms through questionnaires. Logistic regression analyses were performed taking into account cat or dog exposure at different times in life and adjusting for the presence of the other pet, mould exposure, gender, age, parental education, maternal smoking during the first year of life, current passive smoking, family history of asthma/rhinitis/eczema and other potential confounders. Neither significant effects of dog exposure in the first year of life nor in other periods were found on respiratory/allergic symptoms after adjusting for the other covariates. Cat exposure in the first year of life was significantly and independently associated with current wheezing [OR (95% CI) 1.88 (1.33–2.68), p < 0.001] and current asthma [1.74 (1.10–2.78), p < 0.05] and border-line associated with current rhinoconjunctivitis [1.43 (0.97–2.11), p = 0.07]. No other effects of cat exposure were found on respiratory/allergic symptoms. Cat, but not dog, exposure in the first year of life is an independent risk factor for current wheezing, current asthma and current rhinoconjunctivitis at the age of 7.

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The effects of family pet exposure on the development of respiratory and allergic symptoms have recently been the matter of vivid discussion. Although for several years the presence of dogs and cats at home has been considered a risk factor for the subsequent development of respiratory and allergic symptoms, recent studies have questioned this harmful role of family pets. The studies on this topic have so far given contradicting results. Some studies have shown a higher prevalence of allergic sensitization and respiratory illness in children with dogs or cats at home (1–5) and a systematic review of the literature by Apelberg et al. (6), based on articles published between 1966 and 1999, concluded that pet exposure was a significant risk factor for subsequent asthma and wheezing in children older than 6. Other studies, however, could not find this relationship between pet exposure and subsequent respiratory symptoms, or even found a protective effect of dogs and cats on the subsequent development of respiratory symptoms or allergic sensitization (7–12).

The comparison of such studies is often difficult, because of differences in study design and outcomes. One of the main points is the confusion between allergic sensitization and respiratory/allergic symptoms. Although chronic childhood atopy is associated with the most significant forms of childhood wheezing (13), the relationship between atopic sensitization and clinical allergic disease remains incompletely understood (14). Furthermore, where the atopic sensitization is absent, numerous environmental factors plus genetic predisposition may assume importance for wheezing (13). In the present study, we focused our attention on the respiratory/allergic symptoms rather than allergic sensitization.

Another important issue when interpreting the studies on pet exposure and respiratory/allergic disease is that the protective effect of family pets on allergic disease reported by several prospective birth cohort studies might in part be attributable to the removal of pets in families with sensitized or symptomatic children or in families with a positive history for atopy at the time the child was born (15). To minimize the effect of pet avoidance and focus on an early period of life, we brought our attention into cat or dog exposure in the first year of life, when pet avoidance because of respiratory/allergic problems of the newborn child is less likely and exposure to the determinants of atopic disease may be crucial for the subsequent onset of the disease. Also, family history of respiratory or allergic symptoms was taken into account in the analysis. The purpose of this investigation was to determine the effects of exposure to cat or dog in the first year of life on respiratory and allergic symptoms at the age of 6–7 yr in children enrolled in a large Italian multicentre study.

Methods

This study was part of the SIDRIA-2 Study (Studi Italiani sui Disturbi Respiratori dell'Infanzia e l'Ambiente 2002), a large multicentre survey carried out in Italy in 2002 in the

framework of the International Study of Asthma and Allergies in Childhood (ISAAC) Project (16).

The methods have been already fully described in previous publications by our group (17–19). Briefly, the study involved children in the first and second grade from 235 elementary schools, living in five areas of Northern Italy (Turin, Milan, Mantova, Trento, Emilia-Romagna Region), four areas of Central Italy (Florence, Empoli, Siena, Colleferro) and two areas of Southern Italy (Bari, Palermo). Each area was required to sample at least 1000 subjects. A random sample was extracted from the total number of schools in each area, weighted for the number of children attending the school. If the number of subjects to enroll was equal to or < 25% of the population, or if there was marked urban or geographic heterogeneity in the area under study, stratification was performed before sampling. Approval for this study was obtained from the Bioethics Committee of the Catholic University of Rome.

Respiratory and allergic symptoms

Information on respiratory and allergic symptoms of the children was collected using self-administered questionnaires completed by parents at home. The respiratory and allergic symptoms studied in this investigation were: (i) current wheezing: wheeze or whistles in the chest during the previous 12 months; (ii) current asthma: presence of (1) asthma or hospitalization because of asthma or use of asthma medication during the previous 12 months; or (2) asthma ever in life and presence in the previous 12 months of: wheezing or exercise-induced wheezing or shortness of breath with wheezing or dry cough at night or chest tightness with wheezing; (iii) current rhinoconjunctivitis: frequent sneezes or runny/stuffy nose, out of common cold/flu with itching/watery eyes, in the previous 12 months; (iv) eczema: skin reddening with itching, at least once in life, in one or more of the following sites: elbow folds, back of the knees, ankles, under the gluteus zone, around the neck, around the ears or around the eyes; (v) cough/phlegm: presence of cough and/or phlegm for at least 4 days a week for at least 3 months in the year out of common cold/flu.

Information was also obtained on parental education, as a proxy of socioeconomic status, family history (mother, father, siblings) of asthma or /rhinoconjunctivitis or eczema, breast-feeding (≤ 3 or >3 months), lower respiratory infections (bronchiolitis or bronchitis or pneumonia) during the first 2 yr of life and day-care attendance during the first 3 yr of life.

Pet exposure and indoor confounders

The presence of dogs and cats at home was assessed from the questionnaires using the questions: 'Has your child ever had a dog at home?'; 'Has your child ever had a cat at home?' For each question the possible answers were: 'Never', 'During the first year of life', 'In the past 12 months', 'In other periods'. To focus on pet exposure in the first year of life, children who had a positive answer for the category 'During the first year life' and one or more of the other possible categories were classified as in the category 'During the first year of life' only. For the same purpose, the category 'In the past 12 months' was merged with the category 'In other periods'.

Information on possible indoor confounders or effect modifiers was also collected. Information on mould exposure was obtained using the questions: 'Have you ever seen mould/dampness/fungi on the walls or on the ceiling of your child's bedroom in the first year of your child's life?'; 'Currently?' In children, current passive smoking exposure was assessed through the question 'Are there smokers at home?' Parents were also asked if they had a gas water heater at home. Information was also collected on maternal smoking during the child's first year of life.

Statistical analysis

Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS) (SPSS Inc., Chicago, IL, USA), release 10. The analyses performed were frequency distribution, chi-square test, and logistic regression analysis. Multivariate logistic regression models to assess the relationship between pet exposure and the single respiratory and allergic symptoms were built including in the analysis the confounders that were significantly associated with the outcomes in the bivariate analysis and the risk factors that the literature reported to be potential confounders. The models were further adjusted for the interactions between dog or cat ownership and the risk factors that were significantly associated with pet ownership in the bivariate analysis.

Results

Information was collected on 20,016 children (response rate 89%). Mean (s.d.) age was 6.7 (0.7) yr and the proportion of males was 51.4%.

A total of 52.6% of children were resident in northern Italy, 32.7% in central Italy and 14.8% in southern Italy. Other details of the sample characteristics have been reported elsewhere (17–19).

Table 1 shows the respiratory and allergic symptoms of the children, along with subject history of breastfeeding, early lower respiratory infections and day-care attendance, and family history of respiratory and allergic symptoms. In children current wheeze was 7.9%, current asthma 6.7%, current rhinoconjunctivitis 6.5%, eczema 9.9%, cough/phlegm 2.9%. Asthma was similarly distributed among mothers, fathers, and siblings. The prevalence of eczema was higher in mothers than in the other first-degree relatives, while the prevalence of rhinoconjunctivitis was lower in siblings than in the mothers or fathers (Table 1).

In Table 2 the presence of cats and dogs in the houses of children at different times in life is reported. In general, cats and dogs were present in similar proportions in Italian houses. Considering together the exposed children, a total of 3444 children (17.2%) had ever had a dog and 3484 children (17.4%) had ever had a cat at home, while 1197 children (6.0%) had ever had both pets at home. A total of 252 children (1.3%) had always had a dog and 263 children (1.3%) had always had a cat at home, while those who had had a pet at home only during the first year of life were 805 (4.0%) for dog and 646 (3.2%) for cat. The proportion of children with a dog or

Table 1. Characteristics of the sample: symptoms and history

	n (%)
Current wheeze	1575 (7.9)
Current asthma	1343 (6.7)
Current rhinoconjunctivitis	1307 (6.5)
Eczema	1977 (9.9)
Cough/phlegm	575 (2.9)
Breastfeeding >3 months	9628 (49.3)
Lower respiratory infections first 2 yr	7622 (38.1)
Day-care attendance first 3 yr	5652 (28.9)
Family history of asthma	
Mother	1296 (6.7)
Father	1293 (7.1)
Siblings	1423 (8.2)
Family history of rhinoconjunctivitis	
Mother	3342 (17.4)
Father	3004 (16.4)
Siblings	1665 (9.7)
Family history of eczema	
Mother	2525 (13.2)
Father	1312 (7.2)
Siblings	1735 (10.0)
Parental education ≤ 8 yr	
Mother	7866 (40.4)
Father	8845 (45.6)

Table 2. Characteristics of the sample: exposure to pets, moulds, and indoor pollutants

	n (%)
Dog	
Never	16572 (82.8)
In the 1st year of life	1555 (7.8)
In other periods only	1889 (9.4)
Cat	
Never	16532 (82.6)
In the 1st year of life	1383 (6.9)
In other periods only	2101 (10.5)
Maternal smoking first year	3529 (17.6)
Current passive smoking	6438 (32.2)
Moulds	3876 (20.9)
Gas water heater	4500 (22.5)

a cat at home during the first year of life was not different in those with a positive family history of asthma/rhinitis/eczema with respect to those with a negative family history (7.8% vs. 7.4% for dog, p = 0.270; 7.0% vs. 6.6% for cat, p = 0.298).

The prevalence of possible indoor confounders or effect modifiers, such as moulds in bedrooms, maternal smoking in the first year of life, current passive smoking and gas water heaters, is also shown in Table 2. Children were intensively exposed to current passive smoking (32.2%).

Fig. 1 shows the prevalences of symptoms/diagnoses by cat or dog exposure at different times in life. Dog exposure in the first year of life was not significantly associated with respiratory and allergic symptoms at age 7, while cat exposure in the first year of life was significantly associated with current wheezing and current rhinoconjunctivitis at age 7 (p < 0.05).

Bivariate analyses showing the associations between potential confounders and respiratory/allergic symptoms/diseases are reported in Table 3. To evaluate possible confounding effects in the association between dog or cat exposure and health outcomes, we also assessed the relationships between the considered risk factors and exposure to dog or cat. The prevalence of exposure to dog was significantly higher in children with less (i.e., ≤ 8 yr) rather than more educated mothers or fathers (9% vs. 7% and 12% vs. 8% for dog in the first year and in other periods, respectively, p for trend < 0.001), children exposed rather than unexposed to moulds (9% vs. 7% and 11% vs. 9%, p < 0.001), children with current passive smoking (11% vs. 6% and 14% vs. 8%, p < 0.001) and with maternal smoking in the first year of life (12% vs. 7% and 14% vs. 9%, p < 0.001), children with a cat ever in life (17% vs. 6% and 18% vs. 8%, p < 0.001), children who attended a day-care school rather than those who did not (9% vs. 7%
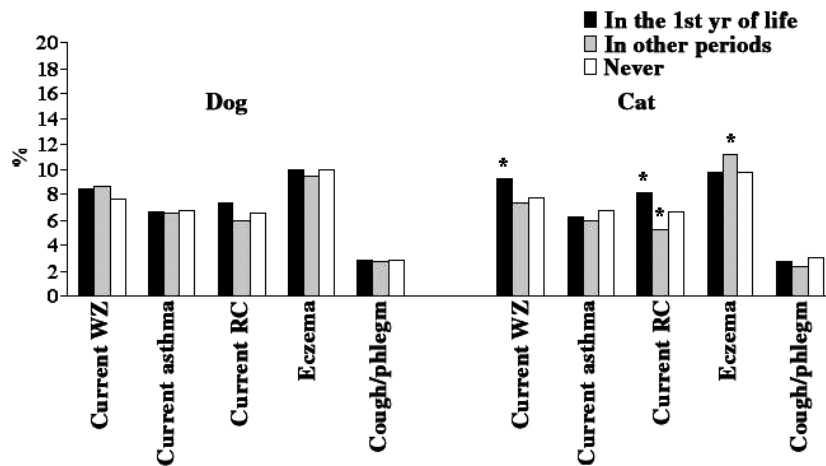
Fig. 1. Prevalence (%) of symptoms/diagnoses by exposure to cat or dog. *p by χ^2 < 0.05 (reference category, never exposed); WZ, wheeze; RC, rhinoconjunctivitis.

Table 3. Associations between potential confounders and respiratory/allergic symptoms/diseases

Factor	Current wheeze	Current asthma	Current rhinoconjunctivitis	Eczema	Cough/phlegm
Female gender	0.70 (0.63–0.78)***	0.65 (0.58–0.73)***	0.72 (0.64–0.81)***	1.10 (1.00–1.20)*	0.79 (0.67–0.94)**
Age	0.95 (0.87–1.03)	1.07 (0.98–1.17)	1.12 (1.03–1.22)**	0.92 (0.85–0.99)*	1.03 (0.91–1.17)
Questionnaire compiler: only mother	1.34 (1.20–1.49)***	1.45 (1.29–1.63)***	1.36 (1.21–1.53)***	1.33 (1.21–1.47)***	1.24 (1.05–1.48)*
Mother education >8 yr	0.92 (0.83–1.03)	1.03 (0.92–1.15)	0.95 (0.84–1.06)	0.86 (0.78–0.95)*	0.99 (0.84–1.18)
Father education >8 yr	1.04 (0.94–1.16)	1.14 (1.02–1.28)**	1.02 (0.91–1.15)	0.97 (0.88–1.10)	1.15 (0.97–1.36)
Season of interview: spring	1.06 (0.94–1.20)	1.13 (1.00–1.29)BL	1.04 (0.91–1.19)	0.98 (0.87–1.10)	1.17 (0.97–1.42)BL
Family history of asthma/rhinitis/eczema	2.27 (2.02–2.57)***	2.83 (2.47–3.25)***	2.61 (2.28–2.99)***	2.27 (2.04–2.53)***	1.78 (1.47–2.15)***
Maternal smoking in the first year of life	1.18 (1.04–1.34)**	1.28 (1.11–1.46)***	0.97 (0.84–1.13)	1.07 (0.95–1.21)	1.53 (1.27–1.86)
Current passive smoking	0.93 (0.83–1.04)	1.02 (0.90–1.15)	0.90 (0.80–1.02)BL	0.97 (0.88–1.07)	1.19 (0.97–1.46)
Breastfeeding >3 months	0.97 (0.87–1.07)	0.92 (0.82–1.03)	1.03 (0.92–1.15)	1.20 (1.09–1.32)***	0.94 (0.79–1.11)
Lower respiratory infections first 2 yr	3.20 (2.87–3.56)***	4.09 (3.63–4.61)***	1.77 (1.58–1.98)***	1.58 (1.44–1.73)***	1.29 (1.06–1.55)**
Day-care first 3 yr	0.97 (0.87–1.09)	0.99 (0.88–1.12)	0.98 (0.86–1.11)	1.16 (1.05–1.28)**	0.94 0.79–1.11)
Gas boiler	1.03 (0.91–1.17)	1.05 (0.92–1.19)	1.13 (1.00–1.29)BL	1.04 (0.94–1.17)	0.95 (0.79–1.15)
Mould exposure	1.72 (1.53–1.94)***	1.63 (1.43–1.85)***	1.40 (1.23–1.60)***	1.39 (1.24–1.55)***	2.10 (1.78–2.48)

Crude odds ratios (95% confidence interval) by bivariate analyses.
BL, border-line significant $0.05 < p < 0.1$; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

for dog in the first year, $p < 0.05$) and, finally, children with rather than without lower respiratory infections in the first 2 yr of life (11% vs. 9% for dog in other periods, $p < 0.001$). When exposure to cat was dealt with, its prevalence was significantly higher in children exposed rather than unexposed to moulds (9% vs. 7% and 12% vs. 10% for cat in the first year and in other periods, respectively, $p < 0.001$), those currently exposed to passive smoke (8% vs. 7% and 13% vs. 10%, $p < 0.001$), those whose mothers smoked in the first year of life (9% vs. 6%, and 13% vs. 10%, $p < 0.001$), those who had a dog at home ever in life (15% vs. 5% and 19% vs. 9%, $p < 0.001$) and children who attended a day-care school rather than those who did not (8% vs. 7% and 11% vs. 10%, $p < 0.001$).

A logistic regression analysis was performed taking into account cat or dog exposure at different times in life and adjusting for gender, age, area of residence, questionnaire compiler, interview season, parental education, cat exposure, mould exposure, current passive smoking, maternal smoking during the first year of life, presence of a gas water heater at home, day-care attendance during the first 3 yr of life, lower respiratory infections (bronchiolitis/bronchitis/pneumonia) in the first 2 yr of life, breastfeeding, and family history of asthma/rhinitis/eczema.

The results for dog exposure are shown in Table 4. Neither significant effects of dog exposure in the first year of life nor in other periods were found on respiratory and allergic symptoms after adjusting for the other covariates. No substantial changes were found when the models were further adjusted for the interactions between dog exposure categories and maternal education, paternal education, exposure to moulds, current passive smoking, maternal smoking during the first year of life, cat ownership ever in life, breastfeeding, day-care atten-

Table 4. Crude and adjusted associations between exposure to dog at different times in life and respiratory or allergic symptoms (reference category: 'never exposed') (valid cases in the adjusted models n = 14717)

Symptom/diagnosis	Dog at home	Crude OR (95% CI)	Adjusted* OR (95% CI)	Adjusted† OR (95% CI)
Current wheeze	In the 1st year of life	1.11 (0.92–1.34)	1.02 (0.81–1.28)	0.95 (0.53–1.73)
	In other periods only	1.15 (0.97–1.36)	0.97 (0.78–1.20)	1.01 (0.58–1.76)
Current asthma	In the 1st year of life	0.97 (0.79–1.20)	0.80 (0.62–1.05)	0.63 (0.29–1.38)
	In other periods only	0.96 (0.79–1.17)	0.86 (0.68–1.09)	1.04 (0.54–1.98)
Current rhinoconjunctivitis	In the 1st year of life	1.14 (0.93–1.39)	1.02 (0.79–1.31)	0.99 (0.54–1.83)
	In other periods only	0.91 (0.75–1.12)	0.92 (0.73–1.17)	0.70 (0.38–1.29)
Eczema	In the 1st year of life	1.00 (0.84–1.19)	0.99 (0.81–1.21)	0.74 (0.44–1.24)
	In other periods only	0.95 (0.81–1.12)	0.89 (0.73–1.07)	0.83 (0.51–1.36)
Cough/phlegm	In the 1st year of life	1.00 (0.74–1.37)	0.98 (0.68–1.43)	0.98 (0.37–2.57)
	In other periods only	0.95 (0.71–1.27)	0.89 (0.62–1.28)	1.01 (0.40–2.55)

*Models adjusted for gender, age, area of residence, questionnaire compiler, interview season, parental education, cat exposure, mould exposure, current passive smoking, maternal smoking during the first year of life, presence of a gas water heater at home, day-care attendance during the first 3 yr of life, lower respiratory infections (bronchiolitis/bronchitis/pneumonia) in the first 2 yr of life, breastfeeding, and family history of asthma/rhinitis/eczema.
†Models with further adjustment for interactions between dog exposure categories and maternal education, paternal education, exposure to moulds, current passive smoking, maternal smoking during the first year of life, cat ownership ever in life, breastfeeding, day-care attendance during the first 3 yr of life, lower respiratory infections (bronchiolitis/bronchitis/pneumonia) during the first 2 yr of life.

dance during the first 3 yr of life, lower respiratory infections (bronchiolitis/bronchitis/pneumonia) during the first 2 yr of life.

The results for cat exposure are shown in Table 5. Cat exposure in the first year of life was significantly and independently associated with current wheezing [OR (95% CI) 1.35 (1.08–1.68), p < 0.01] and current rhinoconjunctivitis [OR (95% CI) 1.38 (1.08–1.75), p < 0.01] after adjusting for the other covariates. No other effects of cat exposure were found on respiratory and allergic symptoms. After further adjustment for the interactions between cat exposure categories and exposure to moulds, current passive smoking, maternal smoking during the first year of life, dog ownership ever in life, day-care attendance during the first 3 yr of life, cat exposure in the first year of life was significantly and independently associated with current

wheezing [OR (95% CI) 1.88 (1.33–2.68), p < 0.001] and current asthma [1.74 (1.10–2.78), p < 0.05] and border-line associated with current rhinoconjunctivitis [1.43 (0.97–2.11), p = 0.07].

To overcome the possible effects of the partial overlapping between early pet exposure and late pet exposure, we repeated the analysis using pet exposure in the first year of life and late pet exposure as two separate variables, thus adjusting pet exposure in the first year of life by pet exposure in the subsequent years. The results were very similar, having dog exposure in the first year of life an OR (95% CI) of 1.04 (0.82–1.32) for current wheeze, 0.88 (0.67–1.15) for current asthma, 1.09 (0.84–1.42) for current rhinoconjunctivitis, 1.05 (0.85–1.29) for eczema and 1.11 (0.75–1.63) for cough/phlegm, while children who had had a cat at home during the first year

Table 5. Crude and adjusted associations between exposure to cat at different times in life and respiratory or allergic symptoms (reference category: 'never exposed') (valid cases in the adjusted models n = 14717)

Symptom/diagnosis	Dog at home	Crude OR (95% CI)	Adjusted† OR (95% CI)	Adjusted‡ OR (95% CI)
Current wheeze	In the 1st year of life	1.21 (1.00–1.47)*	1.35 (1.08–1.68)**	1.88 (1.33–2.68)***
	In other periods only	0.93 (0.78–1.11)	0.97 (0.79–1.20)	0.84 (0.59–1.20)
Current asthma	In the 1st year of life	0.91 (0.73–1.15)	1.08 (0.83–1.41)	1.74 (1.10–2.78)*
	In other periods only	0.86 (0.71–1.04)	0.92 (0.73–1.17)	0.99 (0.64–1.53)
Current rhinoconjunctivitis	In the 1st year of life	1.26 (1.03–1.54)**	1.38 (1.08–1.75)**	1.43 (0.97–2.11)BL
	In other periods only	0.80 (0.66–0.98)*	0.86 (0.68–1.09)	0.96 (0.66–1.41)
Eczema	In the 1st year of life	1.00 (0.83–1.20)	0.98 (0.79–1.21)	0.98 (0.68–1.40)
	In other periods only	1.17 (1.01–1.35)*	1.08 (0.91–1.29)	1.06 (0.79–1.41)
Cough/phlegm	In the 1st year of life	0.90 (0.64–1.27)	1.09 (0.73–1.63)	0.92 (0.45–1.88)
	In other periods only	0.78 (0.58–1.06)	1.03 (0.72–1.45)	1.21 (0.69–2.13)

†Models adjusted for gender, age, area of residence, questionnaire compiler, interview season, parental education, dog exposure, mould exposure, current passive smoking, maternal smoking during the first year of life, presence of a gas water heater at home, day-care attendance during the first 3 yr of life, lower respiratory infections (bronchiolitis/bronchitis/pneumonia) in the first 2 yr of life, breastfeeding, and family history of asthma/rhinitis/eczema.
‡Models with further adjustment for interactions between cat exposure categories and exposure to moulds, current passive smoking, maternal smoking during the first year of life, dog ownership ever in life, day-care attendance during the first 3 yr of life.
*p < 0.05; **p < 0.01; ***p < 0.001; BL, border-line significant p = 0.07.

of life had an OR (95% CI) of 1.36 (1.08–1.72) for current wheeze, 1.14 (0.86–1.50) for current asthma, 1.50 (1.17–1.93) for current rhinoconjunctivitis, 0.9 (0.77–1.20) for eczema and 1.09 (0.72–1.67) for cough/phlegm.

Discussion

We have assessed the respiratory and allergic symptoms at the age of 7 yr in 20,016 Italian children who had been exposed to cats or dogs in the first year of life. We found that cat exposure in the first year of life was independently associated with current wheezing, current asthma and current rhinoconjunctivitis at the age of 7, whilst no significant associations were found between dog exposure in the first year of life and respiratory or allergic symptoms at the age of 7.

Recently, several studies have addressed the question of the potential harmful effect of pet exposure on the development of allergic and respiratory disorders in children and adolescents. However, up to now no general agreement on this topic has been reached. We focused our attention on the first year of life in view of the importance of early life events in the natural history of the disease. Other studies have focused their attention on pet exposure during the first years of life. Our results are in accordance with a cross-sectional Swedish study on 10,851 children (2) showing that pet-keeping in the first year of age was significantly associated with wheezing, doctor-diagnosed asthma, and rhinitis at the ages from 1 to 6 yr, when adjusting for the behaviour of avoiding pets because of allergy in the family. Also, a recent cross-sectional survey on 4479 Bulgarian 2–8 yr old children showed that keeping a furred pet (cat, dog and/or rodent) during the first years of life was a significant risk factor for rhinitis on pet exposure later in life (3). Our main results are also in accordance with a Swedish study on 181 asthmatic children, aged 1–4 yr and followed for 2 yr, which showed that early exposure to cat increased the risk of allergic sensitization and further development of more severe asthma later in childhood (5). Finally, substantially in agreement with our study a recent report on two ongoing birth cohorts showed that dog ownership in early childhood was not associated with dog sensitization or allergic symptoms and diseases up to age 6, even though it was associated with a significantly lower rate of mixed pollen and inhalant sensitization (20).

In contrast, several prospective studies have found a protective effect of dogs and cats on the subsequent development of respiratory and allergic symptoms or allergic sensitization (7–10). The German Multicentre Allergy Study (MAS-Study) found no relation between early indoor allergen exposure (measurement of mite and cat allergens in carpet dust) and the prevalence of asthma, wheezing, and bronchial hyper-responsiveness at the age of 7 yr (11). However, the same group found that lung function at school age was significantly reduced in children sensitized to perennial allergens (house dust mite, cat and dog hair) early in life and exposed to high levels of the respective allergens in the first 3 yr of life, compared with non-sensitized or sensitized but less exposed children (21). In a recent prospective inner-city birth cohort study, cat ownership was a protective factor for wheeze at the age of 5 yr, despite a positive association with cat allergen sensitization (12). However, when adult subjects are considered, as in the European Community Respiratory Health Survey (ECRHS) on 18156 subjects aged 20–44 yr from Europe, North America and Oceania, De Marco et al. reported that pet ownership in childhood had a protective effect only on asthma starting at 0–10 yr of life and not on the incidence of asthma later in life (22).

Our results about the risk of early cat exposure in children are also in agreement with the prospective study of McConnell et al. (4) on newly diagnosed asthma in adolescents, which reported a relative risk of 1.6 (95% CI: 1.0–2.5) from having a furry pet at home and 1.4 (95% CI: 1.0–2.0) from specifically having a dog at home. The results of the present study are also substantially in agreement with the previous reports of the ISAAC study in Great Britain (1), in which the ownership of a furry pet as a significant and independent risk factor for wheezing and rhinitis in the previous 12 months was demonstrated in 25393 12–14 yr old children. Moreover, our findings are partially consistent with a large amount of analysed data in a systematic review by Apelberg et al. (6) regarding 32 articles published between 1966 and 1999, the final conclusion of which is that exposure to pets may increase the risk of asthma and wheezing in children older than 6 yr of age. Also, the data of a Dutch study on almost 3000 primary school children as part of the ISAAC study showed that wheezing, asthma, and bronchial responsiveness were not associated with current pet ownership, whilst past pet ownership was significantly associated with asthma, suggesting pet avoidance in families with respiratory symptoms (23).

In our study exposure to cats in the first year of life was associated with current wheezing, asthma and rhinoconjunctivitis at the age of 7.

One possible explanation is that children exposed to cat may become sensitized to cat allergen early in life and have symptoms afterwards when re-exposed (24). It has also been pointed out (25, 26) that high levels of cat allergen may induce tolerance and protect against wheeze in very young children, but the allergen domestic exposure, which tends to be maintained overtime within households (27), may provoke symptoms in older children predisposed to wheeze for various reasons.

As in other studies (5, 8), the effects we found were different for cat or dog exposure. In fact, a dose–response relationship exists between cat allergen exposure and sensitization to cat, although the allergic sensitization may be more likely to develop in children exposed to moderate levels of this allergen than in children exposed to high amounts of Fel d 1 (28), supporting that cat allergen exposure may be considered a risk factor for the development of respiratory disorders in children. On the contrary, such relationship was not found between exposure and sensitization to dog allergen and also the early dog ownership seemed to be associated with a lower risk of asthma (29).

One of the main limitations of our study is the cross-sectional study-design with information collected through questionnaire, resulting in a potential recall bias. However, it is to point out that this is a very large population-based survey and that questionnaires have been used in many other large-scale studies (1, 2, 16, 22, 23). The validity of questionnaires in such studies has already been established (22). At last, as above mentioned, we decided to concentrate our analyses on pet exposure in the first year of life in view of the importance of early life events in the natural history of the disease. Indeed, the presence of a pet at home at the time of a child's birth is probably more difficult to forget than the presence of a pet in the subsequent years. This is also the reason why we focused on pet ownership during the first year of life irrespective of pet ownership at any other time afterwards, in the attempt to minimize the effects of a potential recall bias.

Another possible limitation of this study is the potential presence of selective pet avoidance in families with allergic or respiratory symptoms. This is a common problem in studies assessing the relationship between pet exposure and symptoms (2, 6, 22, 23). It has been shown that the distribution of pet keeping in the population is largely explained by avoidance behaviour, i.e. those who keep pets are mainly those who can stand them, which results in a 'healthy pet-keeping effect' (2, 23). It has been recently confirmed that a part of the protective effects of owing a cat in childhood on asthma and allergy can be attributed to selective avoidance, whilst avoidance was generally not observed for dogs or birds (30). However, in our study, the proportion of children with a dog or a cat at home during the first year of life was not different in those with a positive family history of asthma/rhinitis/eczema with respect to those with a negative family history.

At last, the results of this study might, at least in part, be limited by the fact that we mainly investigated the presence of pets at home. Children could actually have been exposed to cat or dog allergens in a variety of different mechanisms (passive transfer from visitors with pets, staying in relatives' homes with pets, vacation homes with pets, dander's transport in schools, etc.). Such a limitation could only be overcome in small scale studies on children with personal monitors or environmental monitors in the rooms where they live (at home, at school, etc.).

In conclusion, cat exposure in the first year of life was an independent risk factor for current wheezing, current asthma and current rhinoconjunctivitis at the age of 7. On the contrary, no significant associations were found between dog exposure in the first year of life and respiratory or allergic symptoms at the age of 7. These data add more information to the conflicting scenario of the results regarding the effects of cat and dog exposure in children.

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