

The Prevalence, Characteristics of and Risk Factors for Eczema in Belgian Schoolchildren

Elke Govaere, M.D.,* Dirk Van Gysel, M.D.,* Katia M.C. Verhamme, M.D., Ph.D.,† Erenik Doli, M.D.,* Arnold P. Oranje, M.D., Ph.D.,‡ and Frans De Baets, M.D., Ph.D.§

*Department of Pediatrics, O.L.Vrouw Hospital, Aalst, Belgium, †Department of Epidemiology, O.L.Vrouw Hospital, Aalst, Belgium, ‡Department of Dermatology and Venereology—Pediatric Dermatology, Sophia Children's Hospital, Erasmusmc-Sophia, Rotterdam, The Netherlands, §Department of Pediatric Pulmonology, University of Ghent, Ghent, Belgium

Abstract: Childhood eczema is common in infants, but its nature and extent during later childhood remains unclear. In this cross-sectional study we examined the prevalence and characteristics of eczema in an unbiased community population of 2,021 Belgian schoolchildren, aged 3.4 to 14.8 years with skin prick testing and parental questionnaires. Our study identified an eczema prevalence of 23.3% and a considerable allergic comorbidity, mainly in sensitized children. The reported prevalence of eczema in infancy was 18.5% and for current eczema 11.6%. The overall sensitization rate (33.2%) as well as sensitization rates for the individual allergens were significantly higher in children with “eczema ever.” Sensitization to *Dermaphagoides pteronyssinus* (19.6%), mixed grass pollen (15.1%), and cat (9.1%) were most common. Until the age of 6 years, boys with eczema were significantly more sensitized than girls ($p = 0.007$). Children with both eczema in infancy and current eczema show a tendency to be more sensitized than children with eczema in infancy only or current eczema only, but significance was only noted for a few individual allergens. Analysis of factors associated with eczema revealed a predominantly atopic profile characterized by family or personal history of allergy. Breastfeeding and environmental factors seemed to assume little relevance except for a protective effect of prematurity and having a dog at birth.

Eczema is a common, often chronic health problem in childhood. It has an obvious negative effect on the quality of life of patients as well as their family, most commonly disturbing sleep (1). The condition also creates a great financial burden for both the family and society (2). When it comes to a medical diagnosis, most of these children have atopic dermatitis, but in a minority of them, contact

allergic eczema, endogenous nummular eczema and juvenile seborrheic eczema can be found. Atopic dermatitis is often easily recognized on clinical grounds. In 60% of patients the first manifestations of atopic dermatitis occur in the first year of life (3). The condition waxes and wanes over the years with frequent flare-ups. No specific tests are available that indisputably confirm the diagnosis.

Address correspondence to Dr. Dirk Van Gysel, M.D., Department of Pediatrics, O.L.Vrouw Hospital, Moorselbaan 164, B-9300 Aalst, Belgium, or e-mail: dirk.van.gysel@olvz-aalst.be

Allergic disorders, including asthma, allergic rhinitis and atopic dermatitis, have been observed to have increased over the past several decades (4–9), but some recent research has suggested a current stabilization of the prevalence and incidence of atopic dermatitis (10,11). The cutaneous manifestations of atopy often represent the beginning of the atopic march (12,13).

The cause of atopy is probably multifactorial, with influences from both genetic (14–16) and environmental factors, although the rapid increase in prevalence in the past decades suggests environmental precipitants (17). Observations of inverse associations between sibling order, day care attendance, a farming lifestyle and inhalant atopic disease and sensitization support the hygiene hypothesis (18–20), which is currently a widely used concept in atopic diseases research. However, most studies investigating the hygiene hypothesis have focused on asthma and hay fever. Authors of recent publications failed to find a protective effect of environmental factors on atopic dermatitis (21–23) or results are inconclusive (21,24). The spatial distribution of atopic dermatitis differs from that of asthma and rhinoconjunctivitis, suggesting that atopic dermatitis may follow a different risk pattern than these diseases (25).

Several studies showed a marked and statistically significant variation in atopic dermatitis prevalence across different geographic regions (26–28). The International Study of Asthma and Allergies in Childhood (ISAAC) 12-month prevalences of symptoms of atopic dermatitis showed a more than 60-fold variation between different centers worldwide (26,28).

In this cross-sectional study, as a part of the Aalst Allergy Study, we analyzed the prevalence of parental reported eczema in a nonbiased sample of 2,021 Belgian school children between 3.4 and 14.8 years of age. We further investigated which factors were associated with the presence of eczema at present or in the (personal) history.

METHODS

Study Population

The Aalst Allergy Study was performed in a nonselected sample of children (3.4–14.8 years, mean age 9.3 years) attending randomly selected nursery, primary and secondary schools in the city of Aalst and surroundings. Aalst is a Flemish-speaking Belgian municipality, 19 miles northwest of Brussels. Aalst has a total population of 76,852 for a total area of 78.12 km² which gives a population density of 983.83 inhabitants per square kilometer.

All two thousand six hundred seventy-four children of the 2nd grade of nursery school, the 1st, 3rd, and 5th grade of primary school and the 1st grade of secondary school were contacted, received a questionnaire (see below) and were invited to participate in this study. The parents of 2,021 children (75%) returned a completed questionnaire and gave permission by written consent to perform skin prick testing in their child.

We studied 2,021 children aged 3.4 to 14.8 years of age (mean 9.3 years) in a period of 18 months, from January 2004 to June 2005. One thousand thirty-one (51%) were female. To study the prevalence rate of sensitization in view of age, the children were divided into five different age groups, as they were recruited from five different grades in school: 358 children were younger than 6 years (17.7%), 278 children were aged from 6 to 8 years (13.8%), 302 children were aged from 8 to 10 years (14.9%), 666 children were aged from 10 to 12 years (33%), and 417 children were older than 12 years (20.6%). The percentage of girls in the different age groups varied from 46.4% to 55.4%. The parents of 1842 (91.1%) children were both Belgian; 179 (8.9%) children had at least one parent of non-Belgian origin. Most of the children were born in Aalst (67.4%) or in a neighboring municipality (29.7%); only 58 children (2.9%) were born abroad.

Questionnaire

Parental questionnaires were distributed by the medical school doctors of the involved schools in Aalst and surroundings. The questions on respiratory and allergic disorders, that is rhinoconjunctivitis and asthma, were adapted and translated from the ISAAC questionnaire (26) and also covered the items of the Brief Pediatric Asthma Screen Plus (BPAS+) (29) (the scoring for the asthma component of the BPAS+ is a positive response to any one of four items: wheeze, persistent cough, night cough, and response to change in air temperature). The presence of eczema, as well as the time of occurrence, was documented by parentally reported eczema. The questions regarding eczema history in our questionnaire were as follows: has your child ever had eczema? If yes: (1) has your child had this condition (1) only in infancy, (2) in infancy and at present, (3) at present only? (2) What treatment was prescribed? (3) Who prescribed this treatment: (1) dermatologist, (2) family doctor, (3) pediatrician? The questionnaire further included questions about demographic characteristics (age, gender, nationality, maternal, and paternal profession) and potential risk factors for sensitization, such as prematurity, feeding practices in the neonatal period, family history of allergy, number of siblings, frequency of

childhood infections, vaccinations, place of residence (urban or rural), housing characteristics (age of building, heating, dampness, bedroom conditions), animal contacts and tobacco smoke exposure (pre- and postnatal).

Skin Prick Tests

Skin prick testing with the most common aeroallergens was performed by the same two trained pediatricians to ensure uniformity in testing technique and interpretation. The allergen panel consisted of *Dermatophagoides pteronyssinus*, *Alternaria tenuis*, cat, dog, mixed grass pollens (orchardgrass, Kentucky bluegrass, perennial ryegrass, gramineae and timothy), tree pollens (common alder, common birch, hazel, and European hornbeam) and *Blatella germanica* (cockroach); the concentration of allergen extracts was 100 I.R./mL (Stallergenes, Waterloo, Belgium). Histamine solution in distilled water, 10 mg/mL, was used as a positive control and saline as negative control. Each child was tested on the volar surface of the forearm using 1 mm prick lancets (Stallergenes). The skin reaction was recorded after 15 minutes by evaluating the skin response rate to inoculation of each allergen extract in comparison with the wheal given by the positive and the negative control. The size of each wheal was documented as the mean of the longest diameter and the diameter perpendicular to it. A positive test was defined as a mean wheal size, after subtraction of the negative control, of at least 3 mm.

H1 antihistaminic drugs were stopped at least 7 days before skin prick testing. Atopy was defined as at least one positive skin test to any of the seven allergens tested (30).

Statistical Analysis

Descriptive statistical analysis methods were used to study the eczema categories and the prevalence of sensitization according to different age groups and gender. Chi-square test or Fisher's exact test was used to study the differences for the different age categories and between genders.

Logistic regression analysis was used to study the association between co-variables and the outcome (eczema or not). In a univariate analysis, the association between each covariate and eczema was studied. We then added one by one all risk factors for sensitization into the model. If any of these factors changed the estimate with more than 5%, these risk factors were entered into the final model defined for each research question.

For all analyses, a p-value of <0.05 (two-tailed) was considered significant. All analyses were done using spss/PC 13.0 software (SPSS Inc., Chicago, IL).

RESULTS

A total of 2,021 children participated in the study. Gender was equally distributed among the five different age categories ($p = 0.14$). Table 1 shows the baseline characteristics of the study population.

Information on "eczema ever" was available from the questionnaires for 1993 (98.6%) of the children. Four hundred sixty-four children (23.3%, 95% CI: 21.5–25.2%) had a history of "eczema ever" in the personal history (Table 2), of which 238 (24.5%, 95% CI: 21.9–27.3%) were boys and 226 (22.1%, 95% CI: 19.7–24.7%) girls.

Detailed information on the period of occurrence was available for 1,986 (98.3%) of the children. These children were further categorized into three different groups according to the presence of eczema in infancy only (11.4%, 95% CI: 10.0–12.8%), at present only (4.6%, 95% CI: 3.7–5.6%) or both in infancy and at present (7.0%, 95% CI: 6.0–8.3) (Table 2). After stratification by age, no significant difference was found between the different age categories. After stratification by gender, we found more boys (14.0%, 95% CI: 12.0–16.3%) than girls (8.7%, 95% CI: 7.1–10.6%) to have eczema in infancy only. Eighteen and a half percent (95% CI: 16.9–20.3%) of the whole study group had eczema in infancy, whereas only 11.4% (95% CI: 10.3–13.1%) of the children were reported to have eczema at the time of the study.

Allergic sensitization was present in 483 children of the whole study population (23.9%, 95% CI: 22.1–25.8%). In children with reported "eczema ever," the overall sensitization rate (33.2%, 95% CI: 29.0–37.6%) ($p < 0.001$) as well as the sensitization rates for the individual tested allergens (except cockroach) were significantly higher than in children without eczema (Table 3). This holds true for boys and girls.

As for the individual allergens, sensitization to *D. pteronyssinus* (19.6%, 95% CI: 16.2–23.4%), mixed grass pollen (15.1%, 95% CI: 12.0–18.6%), and cat (9.1%, 95% CI: 6.7–11.9%) were most common in the group of children with reported "eczema ever."

The other way round, children who were atopic were 1.5 times as likely to have eczema as their nonatopic counterparts (32.4% [95% CI: 28.3–36.7%] vs 20.4% [95% CI: 18.5–22.5%]).

No significant difference in overall sensitization or sensitization to individual allergens was found between all children with eczema in infancy (comprising the groups of children with eczema in infancy only and the group of children with eczema both in infancy and at present) and all children with eczema at present (comprising the groups of children with eczema at present only

TABLE 1. Baseline Characteristics of the Study Population

	Study population (n = 2,021)
Age (in yrs)	3.4–14.8 (mean 9.3 ± 0.1)
3.4–<6	358 (17.7)
6–<8	278 (13.8)
8–<10	302 (14.9)
10–<12	666 (33.0)
12–14.8	417 (20.6)
Sensitization	
Nonsensitized	1,538 (76.1)
Monosensitized	301 (14.9)
Multiply sensitized	182 (9.0)
Gender	
Male	990 (49)
Female	1,031 (51)
Current animals	
No animals	627 (31.0)
Cat	395 (19.5)
Dog	494 (24.4)
Cat and dog	500 (24.7)
Missing	5 (0.2)
Animals at birth	
None	1,103 (54.6)
Cat	217 (10.7)
Dog	486 (24.0)
Cat and dog	179 (8.9)
Missing	36 (1.8)
Passive smoke exposure	
No smoking	1,160 (57.4)
Smoking mother	211 (10.4)
Smoking father	337 (16.7)
Smoking mother and father	287 (14.2)
Missing	26 (1.3)
Maternal smoking during pregnancy	
No	1,657 (82.0)
Yes	307 (15.2)
Missing	57 (2.8)
Prematurity	
No	1,867 (92.4)
Yes	122 (6.0)
Missing	32 (1.6)
Breastfeeding	
No	1,128 (55.8)
0–3 mos	506 (25)
3–6 mos	222 (11)
> 6 mos	108 (5.3)
Missing	57 (2.8)
Respiratory symptoms	
Wheezing ever	
No	1,551 (76.7)
Yes	410 (20.3)
Missing	60 (3.0)
Dyspnea ever	
No	1,713 (84.8)
Yes	252 (12.5)
Missing	56 (2.8)
Chronic cough	
No	1,439 (71.2)
Yes	551 (27.3)
Missing	31 (1.5)
Doctor diagnosed asthma	
No	1,891 (93.6)
Yes	100 (4.9)
Missing	30 (1.5)
Rhinoconjunctivitis	
No rhinoconjunctivitis	1,492 (73.8)
Conjunctivitis	52 (2.6)

TABLE 1. (Continued)

	Study population (n = 2,021)
Rhinitis	262 (13)
Rhinoconjunctivitis	153 (7.6)
Missing	62 (3.1)
Family history of allergy	
No allergy	628 (31.1)
Parental allergy only	490 (24.2)
Sibling allergy only	171 (8.5)
Parental and sibling allergy	315 (15.6)
Missing	417 (20.6)
Day-care center attendance	
No	1,190 (58.9)
Yes	773 (38.2)
Missing	58 (2.9)

Values in parentheses are given as percentages.

and the group of children with eczema both in infancy and at present) (overall sensitization 30.7%, 95% CI: 24.9–36.9% and 35.8%, 95% CI: 29.8–42.1%, respectively; data for individual allergens not shown). Children with eczema both at present and in infancy were significantly more sensitized for cat ($p = 0.03$) than children with a history of eczema in infancy only and significantly more sensitized for mixed grass pollen ($p = 0.02$) and tree pollen ($p = 0.03$) than children with eczema at present only. Children with eczema in infancy only were significantly more sensitized for tree pollen ($p = 0.03$) than children with eczema at present only.

Boys with eczema were significantly more sensitized (94/238; 39.5%, 95% CI: 33.4–45.8%) than girls with eczema (60/226; 26.5%, 95% CI: 21.1–32.6%) ($p = 0.003$). When stratifying for age categories this holds true for the youngest age category, but the difference is no longer statistically significant from the age of 6 years on (Table 4). Familial and environmental factors relating to the hygiene hypothesis were analyzed by multivariate logistic regression analyses (Table 5).

In general, the prevalence of “eczema ever” was significantly lower in children born prematurely (less than 36 wks) and children having a domestic dog at birth. The most important factors associated with eczema were a history of sensitization (cat, dog, mixed grass pollen, tree pollens, *A. tenuis*, cow’s milk protein allergy), a history of atopic respiratory symptoms (wheeze, dyspnea, wheezy bronchitis, and airway hyperreactivity) and a positive family history for atopy. All other analyzed factors such as age, gender, month of birth, testing month, family composition, housing conditions (both at present and at birth), breastfeeding, exposure to animals (both at birth and at present), pre- and postnatal passive smoke exposure, day-care attendance, a personal history of rhinoconjunctivitis or chronic cough showed no significant association with the presence of eczema.

TABLE 2. Prevalence Data of Eczema in 1,993 Belgian Schoolchildren, as an Overall Group and Categorized by Age

Age (yrs)	No eczema			“Eczema ever”			Eczema in infancy only†			Eczema at present only†			Eczema in infancy and at present†		
	All	Boys	Girls	All	Boys	Girls	All	Boys	Girls	All	Boys	Girls	All	Boys	Girls
3–6 (100%)	264 (75.6)	135 (74.2)	129 (76.3)	87 (24.4)	47 (25.8)	40 (23.7)	34 (9.7)	23 (12.5)	11 (6.5)	14 (4.0)	6 (3.3)	8 (4.8)	37 (10.6)	17 (9.4)	20 (11.9)
6–8 (100%)	209 (76.8)	107 (73.8)	102 (79.7)	64 (23.2)	38 (26.2)	26 (20.3)	36 (13.2)	24 (16.6)	12 (9.4)	4 (1.5)	3 (2.1)	1 (0.8)	23 (8.5)	11 (7.6)	12 (8.5)
8–10 (100%)	232 (77.6)	110 (76.4)	122 (78.7)	67 (22.4)	34 (23.6)	33 (21.3)	33 (11.0)	19 (13.2)	14 (9.0)	20 (6.7)	9 (6.3)	11 (7.1)	14 (4.7)	6 (4.2)	8 (5.2)
10–12 (100%)	496 (75.6)	234 (73.8)	262 (76.8)	162 (24.4)	83 (26.2)	79 (23.2)	78 (11.9)	44 (14.0)	34 (10.0)	35 (5.3)	17 (5.4)	18 (5.3)	47 (7.2)	20 (6.3)	27 (7.9)
> 12 (100%)	328 (80.0)	147 (80.3)	181 (79.0)	84 (20.0)	36 (19.7)	48 (21.0)	44 (10.7)	26 (14.2)	18 (7.9)	18 (4.4)	4 (2.2)	14 (6.2)	20 (4.9)	6 (3.3)	14 (6.2)
Overall (100%)	1,529 (76.7)	733 (75.5)	796 (77.9)	464 (23.3)	238 (24.5)	226 (22.1)	227 (11.4)	136 (14.0)*	89 (8.7)*	92 (4.6)	39 (4.0)	52 (5.1)	140 (7.0)	60 (6.2)	81 (8.0)

Numbers represented as absolute count (percentage within age category).

†The numbers of “eczema in infancy only,” “eczema at present only,” and “eczema in infancy and at present” do not add up to the number of “eczema ever” because of missing data on specific time of occurrence of eczema in seven children.

*Significance assessed by Pearson chi-square or Fisher’s exact test. Significant difference between boys and girls if the p-value < 0.05.

When analyzing the group of children not having eczema in infancy, multivariate analyses for current eczema shows only a significant positive association with maternal “eczema ever” (OR_{adj} 2.5; 95% CI: 1.3–4.9), maternal eczema at present (OR_{adj} 2.7; 95% CI: 1.2–6.0), paternal “eczema ever” (OR_{adj} 3.9; 95% CI: 1.6–9.2), paternal eczema at present (OR_{adj} 8.2; 95% CI: 2.9–23.6), and the history of wheezy bronchitis (OR_{adj} 3.1; 95% CI: 1.1–8.5) in the child.

When repeating these analyses in the group of children who did have eczema in infancy, only age (OR_{adj} 0.9; 95% CI: 0.8–1.0) was negatively associated with eczema at present, while female gender (OR_{adj} 2.2; 95% CI: 1.0–4.4) and a history of maternal eczema (OR_{adj} 2.9; 95% CI: 1.3–7.0) showed a positive association.

Concomitant atopic symptoms are illustrated in Table 6. Table 6a shows the presence of concomitant atopic symptoms in children with and without “eczema ever.” Table 6b contrasts the presence of concomitant atopic symptoms in sensitized versus nonsensitized children with “eczema ever.”

No significant differences in concomitant atopic symptoms were noted when comparing the group of children with eczema in infancy only and the group of children with eczema at present only (data not shown).

DISCUSSION

Our study identifies an eczema prevalence of 23.3% for the whole group of children, equally distributed in the different age groups (Table 2). This illustrates that eczema most likely developed before the age of 3.4 years (the lower range of our youngest age group) in the majority of children. No significant gender effect could be observed. Findings of gender differences for atopic dermatitis in the literature have been inconsistent, with some showing a slightly higher incidence in girls (3,31), and others showing no gender difference at all (4,32–34).

Differentiating the children with “eczema ever,” we found a higher prevalence of eczema in infancy than of eczema at the time of the study. A history of eczema was clearly associated with allergic co-morbidity in the form of asthma, rhinitis, and conjunctivitis. These findings are consistent with the concept of an “atopic march,” in which eczema precedes the other allergic symptoms in the growing child and the fact that children outgrow their eczema.

The allergic co-morbidity was significantly stronger in the sensitized children than in the nonsensitized children with “eczema ever,” which is in accordance with the data from some other recent studies on atopic dermatitis (35–37). No significant differences in concomitant atopic symptoms were noted when comparing

TABLE 3. *Prevalence of Sensitizations in Children with and Without Eczema*

	No eczema	"Eczema ever"			Eczema in infancy only	Eczema at present only	Eczema in infancy and at present
	All	All	Boys	Girls			
Overall	321 (21.0)	154 (33.2)*	94 (39.5)*	60 (26.5)*	69 (30.4)	27 (29.3)	56 (40.0)
House dust mite	194 (12.7)	91 (19.6)*	57 (23.9)*	34 (15.0)*	41 (18.1)	19 (20.7)	31 (22.1)
<i>Alternaria tenuis</i>	32 (2.1)	24 (5.2)*	13 (5.5)*	11 (4.9)*	10 (4.4)	4 (4.3)	9 (6.4)
Mixed grass pollen	132 (8.6)	70 (15.1)*	43 (18.1)*	27 (11.9)*	32 (14.1)	8 (8.7)§	29 (20.7)§
Tree pollens	36 (2.4)	29 (6.3)*	18 (7.6)*	11 (4.9)*	17 (7.5)‡	1 (1.1)‡,§	11 (7.9)§
Cat	54 (3.5)	42 (9.1)*	28 (11.8)*	14 (6.2)*	16 (7.0)†	6 (6.5)	20 (14.3)†
Dog	29 (1.9)	23 (5.0)*	13 (5.5)*	10 (4.4)*	9 (4.0)	3 (3.3)	11 (7.9)
<i>Blatella germanica</i>	10 (0.7)	1 (0.2)	0 (0)	1 (0.4)	0 (0.0)	0 (0.0)	1 (0.7)

Values in parentheses are given as percentages.

Significance assessed by Pearson chi-square or Fisher's exact test. Significant if the p-value < 0.05.

*Distribution of sensitization between the eczema and non-eczema group, statistically significant.

†Distribution of sensitization between the subgroups of children with eczema in infancy only and children with eczema in infancy and at present, statistically significant.

‡Distribution of sensitization between the subgroups of children with eczema in infancy only and children with eczema at present only, statistically significant.

§Distribution of sensitization between the subgroups of children with eczema at present only and children with eczema in infancy and at present.

TABLE 4. *Sensitization Rates in Boys and Girls with "Eczema Ever" According to Age Category*

Age (yrs)	Boys with eczema		Girls with eczema		p-value
	N (%) not sensitized	N (%) sensitized	N (%) not sensitized	N (%) sensitized	
3-6	29 (61.7)	18 (38.3)*	35 (87.5)	5 (12.5)*	0.007
6-8	25 (65.8)	13 (34.2)	23 (88.5)	3 (11.5)	0.08
8-10	23 (67.6)	11 (32.4)	28 (84.8)	5 (15.2)	0.1
10-12	51 (61.4)	32 (38.6)	50 (63.3)	29 (36.7)	0.8
> 12	16 (44.4)	20 (55.6)	30 (62.5)	18 (37.5)	0.1

Numbers represented as absolute count (percentage within age category).

*Significance assessed by Pearson chi-square or Fisher's exact test. Significant if the p-value < 0.05 between boys and girls with eczema.

the group of children with eczema in infancy only and the group of children with eczema at present only (data not shown).

Overall sensitization as well as sensitization to individual tested allergens (except for cockroach) was higher in the group of children with eczema than in the group of children without eczema. The absence of a higher sensitization rate for cockroach in the eczema children may have been influenced by a lack of power resulting from the low number of cockroach sensitized children in our population (38,39). The sensitization prevalences found in this study are comparable with those found in another population-based German study by Zutavern et al (25), and are lower than those from other studies that have been hospital-based and included children that most likely had more severe symptoms (40).

Boys with eczema are significantly more sensitized than girls with eczema. When stratifying for age categories, this difference is statistically significant for the youngest age category, but is no longer significant from the age of 6 years on. The observed higher percentages of

sensitized girls with eczema in the older age categories is consistent with the gender ratio of sensitization for the different age categories in the whole population-based study group as described in detail elsewhere (38). In that article, we demonstrated that the overall sensitization increased significantly with increasing age. Male sex was strongly associated with sensitization. Male predominance was more obvious in the younger children, but in the older children a significant increase in sensitized females occurred. No significant difference in overall sensitization or sensitization to individual allergens was found between children with eczema in infancy and children with eczema at present.

Children with eczema both at present and in infancy show a tendency to be more sensitized than children with eczema in infancy only or with current eczema only. The same tendency was found for most individual allergens, but significance was only found for a few. Because of the low numbers of children in the different subgroups, these data and their possible clinical relevance must be interpreted with caution.

TABLE 5. *Multivariate Analyses*

Factors	No eczema, <i>N</i> (%)	"Eczema ever," <i>N</i> (%)	Crude OR	OR _{adj} *	95% CI
Prematurity	104 (6.9)	16 (3.5)	0.5	0.4	0.2–0.9
Domestic dog at birth	528 (35.1)	129 (28.2)	0.7	0.7	0.5–1.0
Father allergic	323 (23.4)	139 (32.5)	1.6	1.5	1.1–2.0
Overall sensitization	321 (21.0)	154 (33.2)	1.9	1.6	1.1–2.2
Wheezy bronchitis	87 (5.9)	56 (12.2)	2.2	1.7	1.1–2.8
Mother eczema	218 (15.3)	120 (27.6)	2.1	1.8	1.3–2.5
Airway reactivity by varying weather conditions	109 (7.3)	62 (13.7)	1.7	1.9	1.2–3.2
Cat sensitization	54 (3.5)	42 (9.1)	2.7	2.0	1.0–3.7
BPAS+ asthma	604 (39.5)	241 (51.9)	2.1	2.3	1.7–3.0
Mixed grass pollen sensitization	132 (8.6)	70 (15.1)	1.9	2.3	1.5–3.6
Dyspnea ever	159 (10.7)	91 (20.0)	2.1	2.4	1.6–3.6
Dog sensitization	29 (1.9)	23 (5.0)	2.7	2.4	1.1–5.3
Wheeze ever	258 (17.3)	150 (33.1)	2.4	2.4	1.7–3.4
Father eczema	83 (6.1)	64 (15.2)	2.8	2.7	1.7–4.3
Tree pollen sensitization	36 (2.4)	29 (6.3)	2.8	2.7	1.3–5.7
Alternaria sensitization	32 (2.1)	24 (5.2)	2.6	3.2	1.5–7.0
Parental and sibling atopy	206 (22.0)	109 (38.1)	3.4	3.3	2.2–6.0
Sibling atopy only	116 (12.4)	53 (18.5)	2.9	3.4	2.0–6.0
Cow's milk protein allergy	54 (3.6)	70 (15.2)	4.9	5.8	3.4–10.1

Significant factors associated with eczema in aggravating order. Numbers represented as absolute count (percentage).

*Odds ratio adjusted for all factors that changed the crude OR with more than 5% for the specific research item (checked factors: age, gender, passive smoke exposure, housing conditions now and at birth, maternal smoking during pregnancy, prematurity, breastfeeding, day care attendance, domestic pets at present and at birth, family history of atopy, number of siblings and chronological position of the child in the family).

Crude OR, crude odds ratio; OR_{adj}, adjusted odds ratio; 95% CI, 95% confidence interval.

TABLE 6. *The Presence of Concomitant Atopic (a) Symptoms in Children with and Without "Eczema Ever" and (b) Sensitized versus Not Sensitized Children with "Eczema Ever"*

	"Eczema ever" (100%) <i>N</i> (%)	No eczema (100%) <i>N</i> (%)	p-value
(a)			
Wheezing			
Ever	150 (33.1)	258 (17.3)	< 0.001
Current	40 (8.8)	86 (5.7)	< 0.001
Dyspnea			
Ever	91 (20.0)	159 (10.7)	< 0.001
Current	40 (9.7)	69 (4.6)	0.001
Chronic cough	148 (32.2)	397 (26.3)	0.01
Doctor's diagnosis of asthma	44 (9.5)	54 (3.6)	< 0.001
Wheezy bronchitis	56 (12.2)	87 (5.9)	< 0.001
Airway hyperreactivity	89 (19.6)	191 (12.8)	< 0.001
Conjunctivitis	77 (17.2)	128 (8.6)	< 0.001
Rhinitis	128 (28.4)	284 (19.1)	< 0.001
Children with eczema	Not sensitized (100%) <i>N</i> (%)	Sensitized (100%) <i>N</i> (%)	p-value
(b)			
Wheezing			
Ever	80 (26.7)	70 (45.8)	< 0.001
Current	19 (6.3)	35 (23.2)	< 0.001
Dyspnea			
Ever	48 (15.9)	43 (28.3)	0.002
Current	16 (5.3)	24 (16.0)	< 0.001
Chronic cough	101 (32.8)	47 (31.1)	0.7
Doctor's diagnosis of asthma	21 (6.8)	23 (15.0)	0.005
Wheezy bronchitis	31 (10.1)	25 (16.4)	0.05
Airway hyperreactivity	48 (15.8)	41 (27.3)	0.004
Conjunctivitis	33 (11.0)	44 (29.7)	< 0.001
Rhinitis	61 (20.3)	67 (45.0)	< 0.001

Numbers represented as absolute count (percentage).

Significance assessed by Pearson chi-square or Fisher's exact test. Significant if the p-value < 0.05.

Studying correlations with “eczema ever,” we identified strong associations with a personal and family history of allergy, indicating a strong, genetically mediated influence for atopy in eczema development (14). The association was stronger with a family history of eczema than with a family history of asthma or rhinoconjunctivitis. Unlike in some other studies (41), the maternal influence appeared to be less important than the paternal influence in our population.

Other factors associated with eczema were overall sensitization, specific sensitization for cat, dog, mixed grass pollen, tree pollen, *A. tenuis*, and a personal history of cow's milk protein allergy. The environment may be an important risk factor for eczema (25,42,43). Our study documented a possible protective effect of prematurity and domestic exposure to dogs in infancy.

Preterm birth seems to be protective in the development of eczema, whereas birth-weight did not in our study population. This is in accordance with the results from Moore et al (33) and David et al (44). Zutavern et al however found birth-weight and not birth-term to be of importance. The possible protective effect of being brought up with a dog in early life has been described previously (17,45) and is in line with the hygiene hypothesis. We found no evidence that breastfeeding provided a protective effect. The concept of the protective role of breastfeeding is controversial (46) with some studies showing benefit (24,31,47–49), others showing no effect (41,50–52) or documenting breastfeeding as a risk factor for atopic dermatitis (53,54).

No significant association of the presence of eczema with the other analyzed risk factors with conflicting evidence in the literature—age, month of birth, testing month, size of sibship and birth order, ethnicity, housing conditions at present and at birth, exposure to animals at present, passive smoke exposure pre- and postnatally, day-care attendance, a personal history of rhinoconjunctivitis or chronic cough—could be documented.

Major difficulties in the interpretation and comparison of epidemiologic studies on atopic dermatitis arise from the use of different disease definitions. Some studies use “reported eczema,” others use the UK diagnostic criteria (41) and still others use the questions from the ISAAC questionnaire (26,28), translated into the native language with all the problems that may arise from that (55). Definitions relate alternatively to life time prevalence, last-year prevalence and point prevalence of atopic dermatitis. As we are fully aware of the limitations by the use of parental report of eczema as the outcome variable, we deliberately used “eczema” and not “atopic dermatitis.” Those children with parentally reported eczema or doctor-diagnosed eczema are likely to include some with

other eczema types, such as seborrheic eczema or other rashes such as irritant dermatitis. Our prevalence rates might therefore be an overestimation of the prevalence rates for atopic dermatitis. However, maternal report of physicians' diagnoses of eczema has been previously validated versus clinical examination in the United States (56) and versus chart-recorded diagnosis in the UK (41), and our results are comparable with the Belgian data from the ISAAC phase I (28). Further limitations result mainly from the cross-sectional design, as the time sequence of events cannot be established with certainty and reporting of early life exposures might have been affected by recall bias.

In conclusion, this study highlights that eczema is a common problem in school-aged children. The inherited predisposition towards atopy reflected by the presence of a family or personal history of allergy and allergic sensitization is a very important factor in determining the occurrence of eczema. Except for a possible protective effect of prematurity and the presence of a dog at birth, no other environmental factors could be associated with the occurrence of eczema.

ACKNOWLEDGMENTS

This study is part of the Aalst Allergy Study (AAS) and was supported by a grant from UCB Pharma, Numico and Stallergenes Belgium. We thank the collaborators of the AAS (Patrick De Weert, Anne-Marie Van Heesvelde, Trees Evenepoel, Hedwige Creus, their colleagues and the nurses of the participating medical school centers, the colleagues and medical school students of the Department of Pediatrics of the O. L. Vrouw Hospital Aalst) for their support in realizing this project.

REFERENCES

1. Su JC, Kemp AS, Varigos GA et al. Atopic eczema: its impact on the family and financial cost. *Arch Dis Child* 1997;76:159–162.
2. Herd RM, Tidman MJ, Prescott RJ et al. The cost of atopic eczema. *Br J Dermatol* 1996;135:20–23.
3. Kay J, Gawkrödger DJ, Mortimer MJ et al. The prevalence of childhood atopic eczema in a general population. *J Am Acad Dermatol* 1994;30:35–39.
4. Aberg N, Hesselmar B, Aberg B et al. Increase of asthma, allergic rhinitis and eczema in Swedish schoolchildren between 1979 and 1991. *Clin Exp Allergy* 1995; 25:815–819.
5. Burney PG, Chinn S, Rona RJ. Has the prevalence of asthma increased in children? Evidence from the national study of health and growth 1973–86. *Br Med J* 1990; 300:1306–1310.
6. Ninan TK, Russell G. Respiratory symptoms and atopy in Aberdeen schoolchildren: evidence from two surveys 25 years apart. *Br Med J* 1992;304:873–875.

7. Schultz Larsen F. Atopic dermatitis: a genetic-epidemiologic study in a population-based twin sample. *J Am Acad Dermatol* 1993;28:719–723.
8. von Mutius E. The rising trends in asthma and allergic disease. *Clin Exp Allergy* 1998;28(Suppl. 5):45–49; discussion 50–41.
9. Williams HC. Is the prevalence of atopic dermatitis increasing? *Clin Exp Dermatol* 1992;17:385–391.
10. Olesen AB, Bang K, Juul S et al. Stable incidence of atopic dermatitis among children in Denmark during the 1990s. *Acta Derm Venereol* 2005;85:244–247.
11. Riedi CA, Rosario NA, Ribas LF et al. Increase in prevalence of rhinoconjunctivitis but not asthma and atopic eczema in teenagers. *J Investig Allergol Clin Immunol* 2005;15:183–188.
12. Determinants of total and specific IgE in infants with atopic dermatitis. ETAC Study Group. Early Treatment of the Atopic Child. *Pediatr Allergy Immunol* 1997;8:177–184.
13. Kjellman NI, Nilsson L. From food allergy and atopic dermatitis to respiratory allergy. *Pediatr Allergy Immunol* 1998;9:13–17.
14. Hoffjan S, Epplen JT. The genetics of atopic dermatitis: recent findings and future options. *J Mol Med* 2005;83:682–692.
15. Morar N, Bowcock AM, Harper JJ et al. Investigation of the chromosome 17q25 PSORS2 locus in atopic dermatitis. *J Invest Dermatol* 2006;126:603–606.
16. Sugiura H, Ebise H, Tazawa T et al. Large-scale DNA microarray analysis of atopic skin lesions shows overexpression of an epidermal differentiation gene cluster in the alternative pathway and lack of protective gene expression in the cornified envelope. *Br J Dermatol* 2005;152:146–149.
17. Flohr C, Pascoe D, Williams HC. Atopic dermatitis and the 'hygiene hypothesis': too clean to be true? *Br J Dermatol* 2005;152:202–216.
18. Kramer U, Heinrich J, Wjst M et al. Age of entry to day nursery and allergy in later childhood. *Lancet* 1999;353:450–454.
19. Riedler J, Braun-Fahrlander C, Eder W et al. Exposure to farming in early life and development of asthma and allergy: a cross-sectional survey. *Lancet* 2001;358:1129–1133.
20. Strachan DP. Hay fever, hygiene, and household size. *Br Med J* 1989;299:1259–1260.
21. Bønn CS, Melbye M, Wohlfahrt J et al. Cohort study of sibling effect, infectious diseases, and risk of atopic dermatitis during first 18 months of life. *Br Med J* 2004;328:1223.
22. Kramer MS, Guo T, Platt RW et al. Does previous infection protect against atopic eczema and recurrent wheeze in infancy? *Clin Exp Allergy* 2004;34:753–756.
23. McKeever TM, Lewis SA, Smith C et al. Early exposure to infections and antibiotics and the incidence of allergic disease: a birth cohort study with the West Midlands General Practice Research Database. *J Allergy Clin Immunol* 2002;109:43–50.
24. Kerkhof M, Koopman LP, van Strien RT et al. Risk factors for atopic dermatitis in infants at high risk of allergy: the PIAMA study. *Clin Exp Allergy* 2003;33:1336–1341.
25. Zutavern A, Hirsch T, Leupold W et al. Atopic dermatitis, extrinsic atopic dermatitis and the hygiene hypothesis: results from a cross-sectional study. *Clin Exp Allergy* 2005;35:1301–1308.
26. Worldwide variation in prevalence of symptoms of asthma, allergic rhinoconjunctivitis, and atopic eczema: ISAAC. The International Study of Asthma and Allergies in Childhood (ISAAC) Steering Committee. *Lancet* 1998;351:1225–1232.
27. McNally NJ, Williams HC, Phillips DR et al. Is there a geographical variation in eczema prevalence in the UK? Evidence from the 1958 British Birth Cohort Study. *Br J Dermatol* 2000;142:712–720.
28. Williams H, Robertson C, Stewart A et al. Worldwide variations in the prevalence of symptoms of atopic eczema in the International Study of Asthma and Allergies in Childhood. *J Allergy Clin Immunol* 1999;103:125–138.
29. Wolf RL, Berry CA, Quinn K. Development and validation of a brief pediatric screen for asthma and allergies among children. *Ann Allergy Asthma Immunol* 2003;90:500–507.
30. Dreborg S, Frew A. Allergen standardisation and skin tests. EAACI '93 subcommittee on skin tests. *Allergy* 1993;48:82.
31. Butland BK, Strachan DP, Lewis S et al. Investigation into the increase in hay fever and eczema at age 16 observed between the 1958 and 1970 British birth cohorts. *Br Med J* 1997;315:717–721.
32. Marks R, Kilkenney M, Plunkett A et al. The prevalence of common skin conditions in Australian school students: 2. Atopic dermatitis. *Br J Dermatol* 1999;140:468–473.
33. Moore MM, Rifas-Shiman SL, Rich-Edwards JW et al. Perinatal predictors of atopic dermatitis occurring in the first six months of life. *Pediatrics* 2004;113:468–474.
34. Olesen AB, Ellingsen AR, Olesen H et al. Atopic dermatitis and birth factors: historical follow up by record linkage. *Br Med J* 1997;314:1003–1008.
35. Bohme M, Wickman M, Lennart Nordvall S et al. Family history and risk of atopic dermatitis in children up to 4 years. *Clin Exp Allergy* 2003;33:1226–1231.
36. Brown S, Reynolds NJ. Atopic and non-atopic eczema. *Br Med J* 2006;332:584–588.
37. Wuthrich B, Schmid-Grendelmeier P. Natural course of AEDS. *Allergy* 2002;57:267–268.
38. Govaere E, Van Gysel D, Massa G et al. The influence of age and gender on sensitization to aero-allergens. *Pediatr Allergy Immunol* 2007;18:671–678.
39. Van Gysel D, Govaere E, Doli E et al. Cockroach sensitisation in Belgian children. *Eur J Pediatr* 2006;165:662–664.
40. Flohr C, Johansson SG, Wahlgren CF et al. How atopic is atopic dermatitis? *J Allergy Clin Immunol* 2004;114:150–158.
41. Harris JM, Cullinan P, Williams HC et al. Environmental associations with eczema in early life. *Br J Dermatol* 2001;144:795–802.
42. Kramer U, Lemmen CH, Behrendt H et al. The effect of environmental tobacco smoke on eczema and allergic sensitization in children. *Br J Dermatol* 2004;150:111–118.
43. McNally NJ, Williams HC, Phillips DR. Atopic eczema and the home environment. *Br J Dermatol* 2001;145:730–736.
44. David TJ, Ewing CI. Atopic eczema and preterm birth. *Arch Dis Child* 1988;63:435–436.

45. Zirngibl A, Franke K, Gehring U et al. Exposure to pets and atopic dermatitis during the first two years of life. A cohort study. *Pediatr Allergy Immunol* 2002;13:394–401.
46. Gdalevich M, Mimouni D, David M et al. Breast-feeding and the onset of atopic dermatitis in childhood: a systematic review and meta-analysis of prospective studies. *J Am Acad Dermatol* 2001;45:520–527.
47. Kull I, Bohme M, Wahlgren CF et al. Breast-feeding reduces the risk for childhood eczema. *J Allergy Clin Immunol* 2005;116:657–661.
48. Laubereau B, Brockow I, Zirngibl A et al. Effect of breast-feeding on the development of atopic dermatitis during the first 3 years of life—results from the GINI-birth cohort study. *J Pediatr* 2004;144:602–607.
49. Saarinen UM, Kajosaari M, Backman A et al. Prolonged breast-feeding as prophylaxis for atopic disease. *Lancet* 1979;2:163–166.
50. Peters TJ, Golding J. The epidemiology of childhood eczema: II. Statistical analyses to identify independent early predictors. *Paediatr Perinat Epidemiol* 1987;1:80–94.
51. Tariq SM, Matthews SM, Hakim EA et al. The prevalence of and risk factors for atopy in early childhood: a whole population birth cohort study. *J Allergy Clin Immunol* 1998;101:587–593.
52. Wjst M, Dold S, Reitmeier P et al. [Does breast feeding prevent asthma and allergies? Results of the Munich asthma and allergy study]. *Monatsschr Kinderheilkd* 1992;140:769–774.
53. Bergmann RL, Diepgen TL, Kuss O et al. Breastfeeding duration is a risk factor for atopic eczema. *Clin Exp Allergy* 2002;32:205–209.
54. Purvis DJ, Thompson JM, Clark PM et al. Risk factors for atopic dermatitis in New Zealand children at 3.5 years of age. *Br J Dermatol* 2005;152:742–749.
55. Miyake Y, Ohya Y, Sasaki S et al. Was the prevalence of Japanese childhood atopic eczema symptoms overestimated in the ISAAC study? *J Allergy Clin Immunol* 2004;113:571.
56. Laughter D, Istvan JA, Tofte SJ et al. The prevalence of atopic dermatitis in Oregon schoolchildren. *J Am Acad Dermatol* 2000;43:649–655.