

Natural course and comorbidities of allergic and nonallergic rhinitis in children

Marit Westman, MD,^{a,b} Pär Stjärne, MD, PhD,^{a,b} Anna Asarnej, MD,^{c,d} Inger Kull, PhD,^{d,e} Marianne van Hage, MD, PhD,^f Magnus Wickman, MD, PhD,^{d,g} and Elina Toskala, MD, PhD^{d,h,i} Stockholm, Sweden, Helsinki, Finland, and Philadelphia, Pa

Background: Not much data are available from large, unselected, birth cohort studies on the natural course and comorbidities of rhinitis in children.

Objective: To study phenotypes of rhinitis in relation to the natural course and comorbidities of allergic diseases in preschool-age and early school-age children.

Methods: We analyzed data from a birth cohort of 2024 children, for whom information on IgEs against 8 common inhaled allergens was available, collected at age 4 and 8 years. The children were assigned to groups of allergic rhinitis (rhinitis with sensitization to allergens), nonallergic rhinitis (rhinitis without sensitization), allergic sensitization but no rhinitis, or neither rhinitis nor sensitization.

Results: The proportion of children with allergic rhinitis increased from 5% to 14% from age 4 to 8 years, whereas the proportion of children with nonallergic rhinitis decreased slightly over the same period of development, from 8% to 6%. Of the children with allergic rhinitis when they were 4 years old, 12% underwent remission by the time they were 8 years old; of the children with nonallergic rhinitis, 73% underwent remission during this period of development. Among 4-year-olds without rhinitis who were sensitized to allergen, 56% had allergic rhinitis when they were 8 years old. Among 4- and 8-year-olds, allergic rhinitis and nonallergic rhinitis were associated with asthma, eczema, and food hypersensitivity. Twenty-five percent of 8-year-olds with allergic rhinitis also had oral allergy syndrome.

Conclusions: Fewer preschool-age children with allergic rhinitis undergo remission than do those with nonallergic rhinitis. Sensitization to inhaled allergens at an early age (4 years) precedes the development of allergic rhinitis, whereas symptoms

of rhinitis do not. Oral allergy syndrome is common among 8-year-olds with allergic rhinitis. (*J Allergy Clin Immunol* 2012;129:403-8.)

Key words: Allergic rhinitis, allergy, BAMSE, children, food allergy, IgE, rhinitis, sensitization

Noninfectious rhinitis in children is a global health problem,¹ but little is known about the natural course of allergic or nonallergic pediatric rhinitis. There is some evidence that the incidence of allergic rhinitis increases with age.²⁻⁴ Allergic rhinitis has been defined as symptoms of sneezing and nasal itching, with obstruction and mucosal discharge, caused by an IgE-mediated reaction.¹ However, few longitudinal studies have used the combination of symptoms of rhinitis and an objective measure for IgE in the definition of pediatric allergic rhinitis. The occurrence of nonallergic rhinitis among children is even less studied. Studies of the prevalence and comorbidities of nonallergic rhinitis, especially in different age groups, are needed.⁵

Rhinitis is generally considered to be a mild disease. However, studies have shown that allergic rhinitis can affect children's daily life, quality of sleep, and school performance, as well as physical and emotional health.^{6,7} Allergic and nonallergic rhinitis have each been associated with asthma.⁸⁻¹¹ Allergic rhinitis is also associated with eczema^{8,10} and reactions to foods—mainly to foods of plant origin, such as fruits from the Rosaceae family, tree nuts, peanuts, and some vegetables.¹²⁻¹⁵ Individuals who are allergic to birch pollen, in particular, have reported symptoms in the mucosa of the oropharyngeal area when eating such foods.^{12,13,15} Although the period during which patients with rhinitis have the most symptoms (the pollen season) is short, especially for individuals with sensitization to only 1 of leaf tree, grass, or weed pollen, oral symptoms to pollen-related food allergens can persist throughout the year.¹²

We investigated different phenotypes of noninfectious rhinitis in children (4-8 years old) and compared these with the natural course of disease and other allergic disorders, in an unselected, population-based, birth cohort.

METHODS

Study design

We analyzed data from the population-based birth cohort Barn/Children, Allergy/Asthma, Milieu, Stockholm, Epidemiologic (BAMSE) study of 4089 children born from 1994 to 1996 in Stockholm, Sweden. The study design, enrolment procedure, and inclusion criteria are described in Wickman et al.¹⁶ In brief, children were enrolled at a median age of 3 months, and detailed information on background exposures was obtained. When the children were 1, 2, 4, and 8 years of age, they were sent questionnaires about which diseases they had developed, focusing on allergy-related disorders. At age 4 and 8 years, the children who had completed the questionnaires were invited for clinical tests, which included analysis of blood samples for IgEs against specific inhaled allergens.

From ^aCLINTEC, Karolinska Institutet, Stockholm; ^bthe Department of ENT Diseases, Karolinska University Hospital, Stockholm; ^cthe Astrid Lindgren Children's Hospital, Stockholm; ^dthe Institute of Environmental Medicine, Karolinska Institutet, Stockholm; ^ethe Department of Education and Clinical Science, Södersjukhuset, Karolinska Institutet, Stockholm; ^fthe Department of Medicine, Clinical Immunology and Allergy Unit, Karolinska Institutet, Karolinska University Hospital, Stockholm; ^gSachs' Children's Hospital, Södersjukhuset, Stockholm; ^hthe Finnish Institute of Occupational Health, Helsinki; and ⁱthe Children's Hospital of Philadelphia, Research Institute, Philadelphia.

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Corresponding author: Marit Westman, MD, Institute of Environmental Medicine, Karolinska Institutet, PO Box 210, SE 171 77 Stockholm, Sweden. E-mail: marit.westman@ki.se.

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Abbreviations used

BAMSE: Barn/Children, Allergy/Asthma, Milieu, Stockholm, Epidemiologic
 ISAAC: International Study of Asthma and Allergy in Childhood
 ISAAC-RC: Rhinoconjunctivitis according to the ISAAC definition
 OAS: Oral allergy syndrome

Serum samples from patients were analyzed by using the Phadiatop test for allergic sensitization (to birch, timothy, mugwort, cat, dog, horse, *Cladosporium herbarum*, and house dust mite [*Dermatophagoides pteronyssinus*]; ImmunoCAP System, Phadia AB, Uppsala, Sweden). Samples with positive scores in this test (levels of IgE \geq 0.35 kU/L) were analyzed for IgEs against each individual allergen included in the test. Samples with IgE levels of 0.35 to 100 kU/L were registered, and IgE antibody concentrations of 100 kU/L and more were assigned a value of 100 kU/L for statistical analyses. Data on specific IgEs were collected from 2614 4-year-olds and 2480 8-year-olds.

Because our primary aim was to study phenotypes of rhinitis based on the presence or absence of sensitization to inhaled allergens, we analyzed data only from those children who were tested for Phadiatop at both 4 and 8 years of age and had completed the questionnaires at age 0, 4, and 8 years. Of the children in the BAMSE cohort, 2024 met the requirements for final analysis.

Classification of outcomes

The questionnaires for 4- and 8-year-olds included questions about rhinitis (sneezing or a runny or blocked nose in the last 12 months without common cold or flu) according to the International Study of Asthma and Allergy in Children (ISAAC), ISAAC-rhinoconjunctivitis (ISAAC-rhinitis but including itchy, watery eyes), and upper-airway symptoms when exposed to inhaled allergens (pollen or furred animals).

Patients were classified into the following groups:

- Allergic rhinitis: rhinitis symptoms according to the ISAAC definition or reported upper-airway symptoms after exposure to pollen or furred animals, in combination with sensitization to the inhaled allergens tested.
- Nonallergic rhinitis: rhinitis symptoms according to the ISAAC definition or reported nasal symptoms after exposure to pollen or furred animals, with no sensitization to any of the inhaled allergens tested.
- Sensitization: Sensitization to inhalants only, without any reported symptoms of rhinitis.
- Symptoms of neither rhinitis nor sensitization.

Asthma was defined as at least 4 episodes of wheezing, or at least 1 episode of wheezing among patients who had received a prescription for inhaled steroids, in the last 12 months.¹⁷ *Eczema* was defined as dry skin in combination with itchy rash for 2 or more weeks, at typical localizations, within the last 12 months and/or doctor's diagnosis of this disorder.¹⁷ *Food hypersensitivity* was defined by the development of at least 1 specific symptom (of the nose or eyes, or itchy mouth, breathing problems, urticaria, vomiting or diarrhea, eczema or avoiding specific foods because of symptoms) after eating at least 1 specific food item (milk, egg, fish, wheat, soy, apple, peach, kiwi, avocado, banana, raw carrot, peanut, or tree nuts).¹⁸ *Oral allergy syndrome (OAS)* was defined as itchy mouth from eating apple, peach, kiwi, banana, or raw carrot. Children who reported systemic reactions were not included in this analysis. *Sensitization* was defined as a positive result from the Phadiatop test.

Permission for the study was obtained from the Ethics Committee of Karolinska Institutet, Stockholm, Sweden. The parents of all participating children gave informed consent.

Statistical analyses

STATA Statistical Software version 11 (College Station, Tex) was used. Prevalence rates are presented as percentage of the population. Associations were analyzed by using the Pearson's χ^2 approximation or the Fisher exact

test, when appropriate. Levels of IgE are expressed as geometric means. T tests were used to analyze the continuous IgE variables, with a previous logarithmic transformation. The internal missing for single questions in the questionnaires varied from 0.05% to 2.4%. The statistical significance level was set at P less than .05 or when 95% confidence intervals did not overlap.

RESULTS

Baseline characteristics such as sex, parental history of allergic disease, or socioeconomic status did not vary between the 2024 children included in the study and the rest of the BAMSE cohort (4089 children; data not shown).

The prevalence values for ISAAC-rhinitis, ISAAC-rhinoconjunctivitis, nasal symptoms following exposure to allergen, sensitization to any inhalant allergen, and allergic rhinitis all increased significantly among children from age 4 to 8 years (Fig 1). Furthermore, the interrelationship between these groups changed with time. The proportions of 4-year-olds with allergic rhinitis (Fig 1, C-G) or nonallergic rhinitis (Fig 1, B) were 5.4% and 8.1%, respectively; the proportions of 8-year-olds with these diseases were 14.0% and 6.3%, respectively.

The development of the different phenotypes of rhinitis, from age 4 to 8 years, is presented in Table I. Of 4-year-olds with allergic rhinitis, 93 (87%) continued to have this disorder until they were 8 years old; 13 (12.0%) underwent remission, defined as absence of rhinitis symptoms by the time they were 8 years old. Among the 161 children with nonallergic rhinitis when they were 4 years old, only 9 (5.6%) had allergic rhinitis when they were 8 years old. When the analysis of children with nonallergic rhinitis was restricted to those who reported upper-airway symptoms following exposure to an allergen or rhinoconjunctivitis (36 children), just 1 child (2.8%) had allergic rhinitis by age 8 years, which is comparable to 5.8% among children who reported ISAAC-rhinitis ($P = .68$). Of the children sensitized to inhalant allergens, but without symptoms of rhinitis at age 4 years, 116 (56%) fulfilled the definition of allergic rhinitis at age 8 years. When children with other allergic diseases (asthma, food hypersensitivity, and eczema) were excluded from this group, 49% had allergic rhinitis by an age of 8 years (compared with 3% in the reference group; $P < .001$). Only 18 (9%) of the children who had sensitization to airborne allergens when they were 4 years old lost this allergic sensitization by the time they were 8 years old, whereas 117 (73%) of the children who had nonallergic rhinitis when they were 4 years old lost this disorder by the time they were 8 years old. Eighty-nine (70%) 8-year-olds with nonallergic rhinitis had no previous symptoms of rhinitis. Among the 1504 children who had no sensitization to inhalants or symptoms of rhinitis when they were 4 years old, 4% had developed allergic rhinitis by the time they were 8 years old.

Among 4- and 8-year-old children with allergic rhinitis, birch pollen was the inhaled allergen to which they were most commonly sensitized (Table II). The proportion of children sensitized to timothy, mugwort, and dog increased significantly from age 4 to 8 years (Table II). Levels of IgE against different inhaled allergens were analyzed among children with allergic rhinitis (Table III). We compared IgE levels between children with transient and persistent allergies and between children with persistent and new allergies. Children with persistent allergic rhinitis had significantly higher geometric mean scores in the Phadiatop test and levels of IgE against birch pollen than did children with

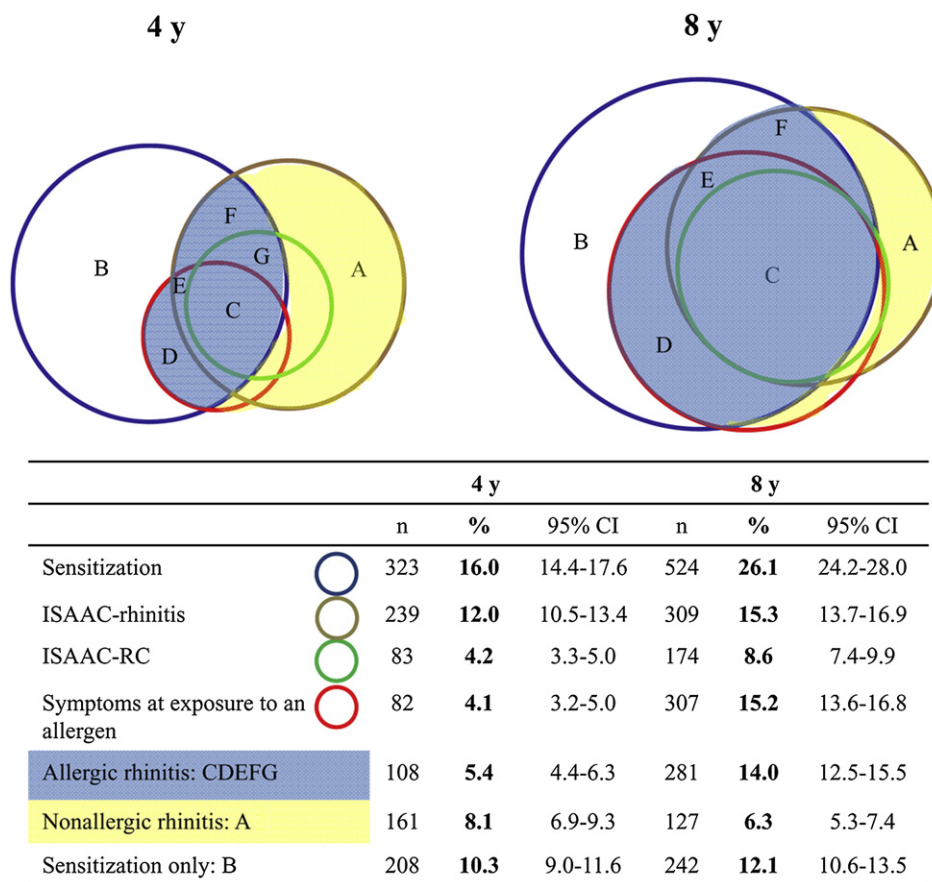


FIG 1. Reported rhinitis symptoms and sensitization to allergens, and the degree of overlap among 2024 4- and 8-year-olds in the BAMSE cohort.

transient allergic rhinitis or those who developed new allergies by the time they were 8 years old.

Allergic rhinitis, nonallergic rhinitis, and sensitization without rhinitis were all significantly associated with asthma, eczema, and food hypersensitivity among 4- and 8-year-olds (Table IV). Allergic rhinitis was the only disorder associated with OAS. Twenty-five percent of children with allergic rhinitis also had OAS. Comparing children with allergic rhinitis and sensitization to birch to children with allergic rhinitis with sensitization other than birch, the proportions of OAS were 31% and 5%, respectively ($P < .001$). Sensitization to timothy was not associated with OAS (data not shown).

Allergic rhinitis at age 4 years was significantly associated with asthma at age 8 years (17.3% had asthma; $P < .001$), as well as food hypersensitivity (48.4% had food hypersensitivity $P < .001$) and OAS (31.1% had OAS; $P < .001$). The comparison group refers to children with neither rhinitis nor sensitization at age 4 years. Nonallergic rhinitis at age 4 years was associated with eczema at age 8 years (19.1% developed eczema; $P < .001$) but not with asthma, food hypersensitivity, or OAS (data not shown).

In comparing children with persistent allergic rhinitis at age 8 years to new cases, children with persistent disease had higher rates of comorbidities (asthma, food hypersensitivity, and OAS—but not eczema) (data not shown). More children with persistent allergic rhinitis had food hypersensitivity (but not asthma or

eczema) when they were 4 years old than did children with transient allergic rhinitis.

DISCUSSION

There seem to be different prognoses for 4-year-olds with allergic and nonallergic rhinitis, based on outcomes at age 8 years. Children with allergic rhinitis are more likely to have a persistent disease than are children with nonallergic rhinitis, who seem to remit. Among children with allergic rhinitis, sensitization to inhaled allergens seems to precede symptoms of rhinitis rather than symptoms of rhinitis preceding sensitization. OAS is common among school-aged children with allergic rhinitis who are sensitized to birch.

We investigated features of rhinitis in children at age 4 and 8 years, in relation to sensitization to inhaled allergens. The proportion of children with allergic rhinitis increased from 5.4% to 14.0% from age 4 to 8 years; these findings are consistent with those from other longitudinal studies.^{3,4} The proportion of children with nonallergic rhinitis decreased slightly, from 8.1% to 6.3%, during the same period. This should be considered in light of the fact that the prevalence of rhinitis, in general, increased from age 4 to 8 years, from 14% to 20%. The proportion of children with rhinitis symptoms who had nonallergic rhinitis was higher at age 4 years (60%) than at 8 years (31%). Studies have shown that almost 50% of 5-year-olds¹⁹ and 27% of

TABLE I. Different groups of rhinitis and sensitization

	8 y (N = 2024)											
	Allergic rhinitis, n = 281 (14.0%)			Nonallergic rhinitis, n = 127 (6.3%)			Sensitization,* no rhinitis,† n = 242 (12.1%)			No rhinitis,† no sensitization,* n = 1352 (67.4%)		
	n	Percent	P value	n	Percent	P value	n	Percent	P value	n	Percent	P value
4 y (N = 2024)												
Allergic rhinitis, n = 108 (5.4%)	93	86.9	<.001	1	0.9	.026	12	11.2	.615	1	0.9	<.001
Nonallergic rhinitis, n = 161 (8.1%)	9	5.6	.276	32	20.3	<.001	14	8.7	.676	103	65.2	<.001
Sensitization,* no rhinitis† n = 208 (10.3%)	116	56.3	<.001	2	1.0	.001	71	34.5	<.001	17	8.2	<.001
No rhinitis,† no sensitization* n = 1504 (75.6%)	57	3.8	Ref	87	5.8	Ref	145	9.7	Ref	1200	80.5	Ref

Data presented show changes with time, from age 4 to 8 y, among 2024 children from the BAMSE cohort. *P* compared with reference group = no rhinitis, no sensitization at age 4 y. Pearson's χ^2 test of independence.

*Phadiatop test result, ≥ 0.35 kU/L.

†Rhinitis according to ISAAC definition and/or upper-airway symptoms at exposure to pollen or furred animals.

TABLE II. Proportion of children who were sensitized to inhaled allergens

	Study population						Allergic rhinitis					
	4 y (N = 2024)			8 y (N = 2024)			4 y (n = 108)			8 y (n = 281)		
	n	Percent	95 % CI	n	Percent	95 % CI	n	Percent	95 % CI	n	Percent	95 % CI
Specific IgE > 0.35 kU/L												
Birch	190	9.5	8.2-10.8	312	15.6	14.0-17.2	81	79.4	71.4-87.4	215	77.9	73.0-82.8
Timothy	122	6.1	5.0-7.1	291	14.6	13.0-16.1	46	44.2	34.5-53.9	190	68.8	63.3-74.3
Mugwort	32	1.6	1.0-2.1	144	7.2	6.1-8.3	20	19.6	11.8-27.4	114	41.6	35.7-47.5
Cat	121	6.0	5.0-7.0	255	12.7	11.2-14.2	50	46.7	37.1-56.3	172	61.4	55.7-67.2
Dog	96	4.8	3.8-5.7	234	11.7	10.3-13.1	43	40.2	30.7-49.6	179	64.2	58.5-69.8
Horse	64	3.2	2.4-3.9	134	6.7	5.6-7.8	27	25.5	17.0-33.9	105	37.9	32.2-43.7
Mite	36	1.8	1.2-2.4	84	4.2	3.3-5.1	10	9.6	3.9-15.4	38	13.8	9.7-17.9
Mold	20	1.0	0.6-1.4	42	2.1	1.5-2.7	6	5.8	1.2-10.3	30	11.0	7.2-14.7

Allergens listed are those included in the Phadiatop test.

TABLE III. Levels of IgEs against allergens among children with allergic rhinitis

	Allergic rhinitis														
	4 y							8 y							
	Transient (n = 14)			Persistent (n = 93)				<i>P</i> value	Persistent (n = 93)			New cases (n = 183)			
	n	Percent	G	n	Percent	G	n		Percent	G	n	Percent	G	<i>P</i> value	
Specific IgE ≥ 0.35 kU/L															
Phadiatop	14	100	1.2	93	100	7.1	<.001	93	100	22.3	183	100	13.9	.008	
Birch	7	53.9	3.8	73	83.0	13.9	.039	82	88.2	26.1	129	72.5	15.0	.025	
Timothy	1	7.1	1.8	44	49.4	2.4	NA	74	79.6	5.2	113	63.5	6.1	.513	
Cat	2	14.3	4.7	47	51.1	3.0	.617	67	72.0	5.8	103	56.6	4.6	.356	

Presented as geometric mean of results from the Phadiatop test and tests for the 3 most common airborne allergens among children with allergic rhinitis, categorized into transient (allergic at 4 y but not 8 y), persistent (allergic at 4 and 8 y), and new cases (allergic 8 y only). *P* value from 2-sample *t* test of logarithmic-transformed IgE concentrations, comparing persistent versus transient (4 y) and persistent versus new cases (8 y) of allergic rhinitis.

G, Geometric mean; NA, not applicable.

10-year-olds⁸ have nonallergic rhinitis, whereas 25% to 33% of adolescents and adults have this disorder.²⁰⁻²² These findings show that the proportion of nonallergic rhinitis among individuals with rhinitis changes with age, or that the definition of nonallergic rhinitis is more accurate for children who are 8 years old.

Nonallergic rhinitis in the pediatric population has not been well studied, probably because there are several causes of blocked or runny noses in children. Recurrent viral infections that produce runny nose as the main symptom can be misclassified as prolonged, noninfectious rhinitis. An enlarged or chronically infected adenoid can mimic rhinitis symptoms. It is important to note that 73% of 4-year-olds with nonallergic rhinitis undergo

remission by age 8 years. The size and bacterial colonization of the adenoid is somewhat age dependent, as are recurrent viral respiratory infections. This might be the reason why symptoms of nonallergic rhinitis in preschool-age children are more common than in school-age children and remit more often than those of allergic rhinitis.

Symptoms of rhinitis have been proposed to precede sensitization.^{10,19} The few studies of adults to determine whether nonallergic rhinitis progresses to allergic rhinitis have produced conflicting results.^{23,24} We found that of the children who reported nonallergic symptoms of rhinitis at age 4 years, only 5.6% had developed allergic rhinitis at age 8 years. This is

TABLE IV. Comorbidities among children in different groups of rhinitis and sensitization

N = 2024	No rhinitis,* no sensitization†		Allergic rhinitis			Nonallergic rhinitis			Sensitization,† no rhinitis*		
	n = 1504	75.9 %	n = 108	5.5 %	P value	n = 161	8.1 %	P value	n = 208	10.5%	P value
4 y	n	Percent	n	Percent	P value	n	Percent	P value	n	Percent	P value
Asthma, n = 151 (7.5%)	71	4.8	30	28.0	<.001	20	12.7	<.001	24	11.6	<.001
Eczema, n = 430 (21.3%)	241	16.1	54	50.0	<.001	48	29.8	<.001	78	37.5	<.001
Food hypersensitivity, n = 224 (11.3%)	109	7.4	40	38.1	<.001	28	17.7	<.001	44	21.5	<.001
8 y	n = 1352	67.5%	n = 281	14.0 %	P value	n = 127	6.3 %	P value	n = 242	12.1 %	P value
Asthma, n = 146 (7.3 %)	42	3.1	70	25.5	<.001	14	11.0	<.001	17	7.0	.003
Eczema, n = 344 (17.4%)	162	12.3	88	32.4	<.001	35	28.2	<.001	55	23.1	<.001
Food hypersensitivity, n = 281 (14.0%)	84	6.2	142	51.1	<.001	17	13.4	.002	34	14.1	<.001
OAS‡ n = 100 (5.0%)	22	1.6	69	24.8	<.001	3	2.4	.470	6	2.5	.352

P values compared with the reference group (no rhinitis, no sensitization).

*Rhinitis according to the ISAAC definition and/or nasal symptoms at exposure to pollen or furred animals.

†Phadiatop test result >0.35 kU/L.

‡OAS: Itchy mouth from eating apple, peach, kiwi, raw carrot, or banana. Children who reported systemic reactions were excluded from the analysis.

comparable to the 3.8% of 8-year-olds with allergic rhinitis who did not have symptoms of rhinitis or sensitization to inhaled allergens when they were 4 years old ($P = .29$). Some children with nonallergic rhinitis who had symptoms of rhinoconjunctivitis or nasal symptoms upon exposure to inhaled allergens could have local allergic rhinitis, without circulating, specific, IgEs.²⁵⁻²⁷ We did not examine the noses of children in our study, and therefore cannot exclude this possibility. However, among these children, only 1 of 36 had allergic rhinitis at age 8 years. On the other hand, among 4-year-olds who were sensitized to inhaled allergens but not had symptoms of rhinitis, 56% met our definition of allergic rhinitis at age 8 years. The association between sensitization to inhaled allergens at age 4 years and having allergic rhinitis at age 8 years could only partly be accounted for by the presence of asthma, eczema, or food hypersensitivity at age 4 years. The low level of rhinitis symptoms among the 4-year-olds was not associated with seasons of low pollen counts, based on data obtained from the Palynological Laboratory, The Swedish Museum of Natural History, Stockholm, Sweden. It therefore seems likely that sensitization precedes allergic rhinitis rather than symptoms of rhinitis preceding sensitization, consistent with the findings of Bodtger et al²³ in adults.

As expected based on previous studies, allergic rhinitis was associated with other allergic disorders such as asthma, eczema, and food hypersensitivity.^{1,10,19,28} However, nonallergic rhinitis was also associated with asthma, eczema, and food hypersensitivity. Nonallergic rhinitis was previously associated with asthma^{8,10,11,29}; its association with eczema is consistent with findings from a study of 10-year-olds, in which rhinitis, with and without sensitization to allergen, was associated with eczema.⁸ However, a study of 7-year-olds associated allergic rhinitis, but not nonallergic rhinitis, with eczema.¹⁰

The high prevalence of food hypersensitivity among children with allergic rhinitis probably results from cross-reactions to pollen among children who are sensitized to birch. Symptoms corresponding to OAS were reported by 25% of children with allergic rhinitis. Among children with allergic rhinitis and birch sensitization, this proportion was 31%. In other studies, the

prevalence of OAS among patients with allergies to birch pollen has varied from 50% to 90%.^{12,14} We used a strict definition of OAS, and so we might have underestimated its prevalence in our cohort. In our region, birch allergen is the most common sensitizing airborne allergen; sensitization to birch pollen is a prerequisite for reactions to food allergens that are homologous to birch pollen allergens.¹⁵ The prevalence of OAS might differ in regions where grass and weed pollens are more common. However, it is important to note that 5% of the population studied could have cross-reactions to foods that are related to their allergy to birch pollen—symptoms that could persist throughout the year.

Strengths and limitations

The strengths of this study are its prospective, population-based design, sample size, and the participation rate of 84% at the 8-year follow-up. The fact that the final results were based on data from almost 50% of the children who originally participated should not affect their interpretation since background factors related to the development of allergic disease in the children included in the final analysis did not differ from those of the whole cohort. Children were recruited for the BAMSE study on a population-based level, which allows for extrapolation of its results to a larger population. Data collected from almost 2000 children on allergen-specific IgEs against the 8 most common inhaled allergens among 4- and 8-year-olds allowed us to distinguish between allergic- and nonallergic-associated rhinitis.

Rhinitis was diagnosed on the basis of data collected from questionnaires—the major limitation of this study. However, our ability to associate reported symptoms with sensitization data strengthened the diagnoses of allergic rhinitis. Its associations with other allergic diseases, including OAS, would not have been observed if the prevalence of allergic rhinitis had been overestimated. Symptoms of rhinitis are instead at risk of being underestimated, because parents of children with chronically blocked noses do not always report these symptoms. Furthermore, symptoms of nonallergic rhinitis, especially among 4-year-olds,

probably do not result from a single disorder. If children's noses had been examined or if nasal challenge tests had been performed, we would probably have identified children with enlarged or infected adenoids or perhaps local allergic rhinitis. Still, the phenotype of nonallergic rhinitis describes the prevalence of rhinitis symptoms that are not caused by allergies in young children and also shows that nonallergic rhinitis symptoms are associated with asthma, eczema, and food hypersensitivity. It will be of interest to study different phenotypes of nonallergic rhinitis in the aspect of natural course and comorbidities during childhood.

In summary, preschool-age children with allergic and nonallergic rhinitis have different prognoses until early school age. Children with early allergic rhinitis, according to our definition, seem to have a persistent disease, whereas most preschool-age children with nonallergic rhinitis have transient symptoms. Sensitization of 4-year-olds to inhaled allergens, irrespective of concomitant asthma, eczema, or food hypersensitivity, seems to precede allergic rhinitis at age 8 years. OAS associated with cross-reactions to birch pollen is common among school-age children with allergic rhinitis.

We thank all the participating families and all the staff working within the BAMSE project.

Key messages:

- Allergic rhinitis symptoms among 4-year olds are more persistent than non-allergic rhinitis symptoms, until 8 years of age.
- Sensitization to inhalant allergens seems to precede symptoms of rhinitis rather than symptoms of rhinitis preceding sensitization.
- OAS associated with birch pollen-related food is common among school-aged children with allergic rhinitis

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