

Increase in Allergic Sensitization in Schoolchildren: Two Cohorts Compared 10 Years Apart



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What is already known about this topic? Allergic sensitization is the cornerstone in allergic diseases and a major risk factor for asthma and allergic rhinitis.

What does this article add to our knowledge? High incidence and low remission of allergic sensitization among schoolchildren explain the increased prevalence by increasing age. Both incidence and prevalence increased significantly compared with a cohort examined identically 10 years earlier.

How does this study impact current management guidelines? As a consequence of increasing incidence and prevalence of allergic sensitization, the prevalence of allergic diseases may continue to increase in the population.

BACKGROUND: Time trends of incidence of allergic sensitization are unknown and recent trends of prevalence and risk factors are lacking.

OBJECTIVE: To estimate the incidence, prevalence, remission, risk factors, and time trends for allergic sensitization among schoolchildren followed from age 7 to 8 years to age 11 to 12 years.

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METHODS: In 2006, all children in grades 1 and 2 aged 7 to 8 years in 2 municipalities in northern Sweden were invited to a questionnaire survey and to skin prick testing to 10 common airborne allergens. The cohort was reexamined in 2010, with additional blood sampling for specific IgE. Participation rates were 90% (n = 1700) at age 7 to 8 years and 85% (n = 1657) at age 11 to 12 years. The results were compared with a cohort examined by identical methods 10 years earlier.

RESULTS: The prevalence of positive skin prick test result to any allergen increased from 30% at age 7 to 8 years to 41% at age 11 to 12 years ($P < .001$). The cumulative 4-year incidence was 18%, while remission was low. Sensitization to pollen and furred animals was most common. A family history of allergy was significantly associated with incident sensitization, whereas the presence of furred animals at home was negatively associated. The prevalence at age 7 to 8 years and at age 11 to 12 years and the 4-year incidence were all significantly higher compared with the cohort examined 10 years earlier.

CONCLUSIONS: The prevalence of allergic sensitization increased by age as a consequence of a high incidence and a low remission. The trends of increasing incidence and prevalence among schoolchildren imply future increases in the prevalence of allergic diseases. © 2016 American Academy of Allergy, Asthma & Immunology (J Allergy Clin Immunol Pract 2017;5:457-63)

Key words: Allergic sensitization; Prevalence; Incidence; Risk factors; Longitudinal study; Schoolchildren

Allergic diseases among children are important issues of public health.¹ The prevalence of asthma and rhinitis has increased particularly in high-income countries in recent decades, and developing countries seem to follow.² The prevalence may have leveled in some countries with a high prevalence, although results are ambiguous.³⁻⁵ Studies of prevalence trends and incidence of allergic sensitization have a high clinical relevance because allergic

Abbreviations used

OLIN- Obstructive Lung diseases In Northern Sweden

OR- Odds ratio

RR- Risk ratio

SPT- Skin prick test

sensitization is a major risk factor for development^{6,7} and persistence of asthma from childhood through adolescence.⁸ However, few studies have investigated trends in the prevalence of allergic sensitization by using objective methods, and existing studies are not consistent.^{3,4,9-14}

The prevalence of allergic sensitization to airborne allergens increases with age during childhood and adolescence as a consequence of high incidence and low remission.¹⁵⁻¹⁷ Among adults, incidence is low and remission substantial.¹⁸ A family history of allergy is consistently reported as a risk factor for allergic sensitization,^{17,19,20} as is male sex if sex difference is recognized.²¹ A protective effect of rural living,²² having older siblings,²³ growing up on a farm,^{24,25} and having furry animals at home has been found in some, but not all studies.^{17,26}

When studying incidence, it is vital to examine the same study population repeatedly with identical methods. Despite existing objective methods such as skin prick test (SPT) and specific IgE, large population-based cohort studies of allergic sensitization are scarce,¹⁵⁻¹⁷ and very few studies have investigated risk factors based on incident cases. We have previously reported a major increase in the prevalence of allergic sensitization at age 7 to 8 years in 2 population-based cohorts examined 10 years apart.¹³ We also have reported about the high incidence of allergic sensitization during school age.¹⁷ To our knowledge, no study comparing incidence over time has been published.

The aim of the present study was to determine the prevalence, incidence, and remission of allergic sensitization and to identify risk factors for incidence in a population-based cohort of children followed from age 7 to 8 years to age 11 to 12 years. These results were compared with a cohort investigated with identical methods in the same geographic area 10 years earlier.¹⁷

METHODS**Study population**

Within the Obstructive Lung diseases In Northern Sweden (OLIN) studies, 2 pediatric longitudinal cohort studies are ongoing. The OLIN pediatric cohort II was recruited in 2006 when all children in grades 1 and 2, aged 7 to 8 years in 3 municipalities, Kiruna, Luleå, and Piteå, were invited to participate in a questionnaire study about asthma and allergy. The children in Kiruna and Luleå were also invited to skin prick testing, and 1700 (90% of invited) participated.¹³ The cohort was reexamined in 2010 when all children in grades 5 and 6 now aged 11 to 12 years were reinvited using identical methods, and 1657 (85% of invited) participated in SPT.¹³ In total, 1450 children participated in SPT both at age 7 to 8 years and at age 11 to 12 years. In addition, at age 11 to 12 years, all children in Kiruna and a random sample of children in Luleå were invited to blood sampling for IgE, and 696 (71%) participated.²⁷ Participation rates did not differ by municipality and sex. For comparisons of time trends of incidence and prevalence at age 11 to 12 years, the OLIN pediatric cohort I, which was recruited in 1996 and described below, was used (Figure 1).

Consent for SPT was obtained from children and parents. The studies were approved by the regional ethics review board at Umeå University.

Questionnaire

The study questionnaire included the International Study of Asthma and Allergy in Childhood questionnaire²⁸ and additional questions about physician diagnoses, use of medication, symptoms and risk factors for allergic sensitization, asthma, rhinitis, and eczema, and has been described previously.^{13,29,30} The questionnaire was distributed by the teachers and completed by the parents.

Allergic sensitization

SPTs were carried out between February and April at all surveys by a limited number of experienced and specifically trained staff following the European Academy of Allergy and Clinical Immunology recommendations.³¹ The tests were performed on the volar aspect of the forearm by using a lancet with a 1-mm tip. The tested allergens were birch, timothy, mugwort, dog, cat, horse, *Dermatophagoides farinae*, *D pteronyssinus*, *Cladosporium*, and *Alternaria* (Soluprick, ALK, Hørsholm, Denmark). The potency of the extracts was 10 HEP, except the 2 moulds, which were 1:20 w/v. Histamine 10 mg/mL and glycerol were used as positive and negative controls. A positive reaction was defined as a mean wheal diameter of 3 mm or more after 15 minutes.

Serum samples were collected at the occasion of the SPT.²⁷ Total IgE and specific IgE levels against the same allergens as at SPT, except *Alternaria*, were measured by the Immuno CAP system (Thermo Fisher, Uppsala, Sweden). IgE concentrations of 0.35 IU/mL or more were considered positive.

The OLIN pediatric cohort I

The OLIN pediatric cohort I was recruited 10 years earlier, in 1996, and has been investigated using identical methods as the OLIN pediatric cohort II described above (Figure 1). We have previously in detail reported about the prevalence and incidence of allergic sensitization in this cohort.^{13,17,29} Briefly, participation in SPT at age 7 to 8 years was 2148 (88% of invited) and at age 11 to 12 years was 2155 (88% of invited); 1870 children participated at both occasions. At age 11 to 12 years, a random sample in Luleå and all children in Kiruna were invited to blood sampling, and 845 (78%) children participated. Specific IgE levels to birch, timothy, cat, and dog were measured by the Immuno CAP system (Pharmacia Upjohn, Uppsala, Sweden).³²

Definitions

Any positive SPT: A positive reaction to any of the tested allergens.

Any pollen: A positive reaction to birch, timothy, or mugwort.

Any animal: A positive reaction to cat, dog, or horse.

Any mite: A positive reaction to *D farinae* or *D pteronyssinus*.

Any mould: A positive reaction to *Cladosporium* or *Alternaria*.

Additional sensitization: Any positive SPT result while negative to the specific allergen at age 7 to 8 years and positive SPT result to the specific allergen at age 11 to 12 years, that is, an already sensitized individual developing further sensitization toward the specific allergen during the study period.

Information about potential risk factors was obtained from the questionnaire at age 7 to 8 years. The following definitions were used:

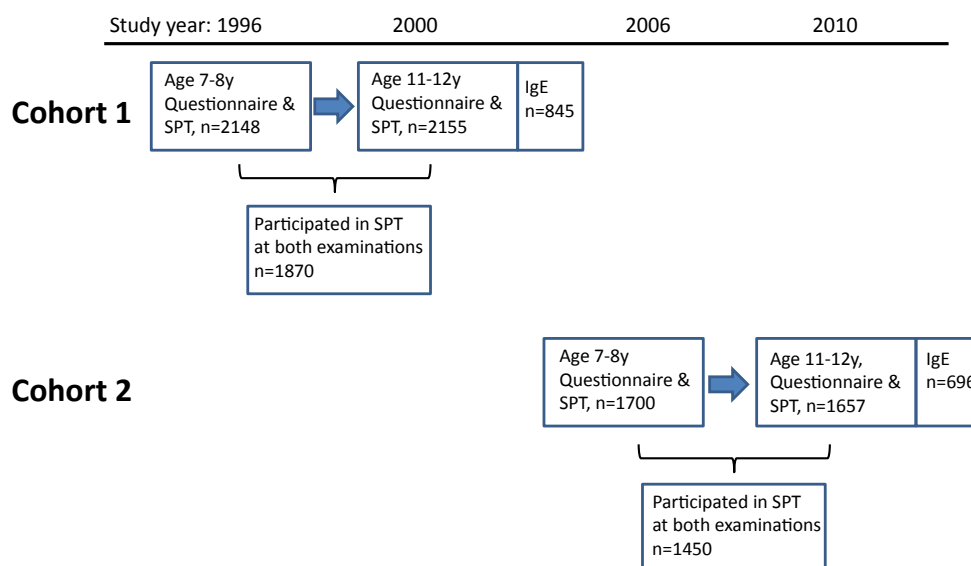


FIGURE 1. Flowchart of the study and study population in the OLIN pediatric cohorts 1 and 2.

Family history of allergy: Mother or father with allergic rhinitis.
Ever cat/dog: Previously or presently having cat/dog at home.
Rural living in early life: Reported rural living during the first year of life.
Smoking mother: Presently smoking mother.
Home dampness: Reported damp damage or mould in present housing.
Respiratory infection: History of croup, pertussis, severe respiratory infection, or pneumonia.

Statistical analysis

Statistical analyses were performed using SPSS, version 22 (IBM Corporation, Armonk, NY), and OpenEpi (Open Source Epidemiologic Statistics for Public Health, www.OpenEpi.com). Prevalence estimates of allergic sensitization at age 7 to 8 years and at age 11 to 12 years were based on the 2 cross-sectional surveys performed in 2006 and 2010. Analyses of incidence and remission estimates were based on the children who participated in SPT both at age 7 to 8 years and at age 11 to 12 years ($n = 1450$). The incidence of sensitization was calculated among the children with negative SPT result to all allergens at age 7 to 8 years. In addition, sensitization was calculated among those with a negative SPT result to the specific allergen of interest but a positive SPT result to any other allergen, that is, *additional sensitization*. *Remission* was defined as positive SPT result at age 7 to 8 years and a negative SPT result at age 11 to 12 years. Children who participated in both SPT and IgE at age 11 to 12 years ($n = 688$) were included in analyses of comparisons of these methods. These results were expressed as sensitivity and specificity of SPT with IgE as reference. The results regarding prevalence at age 7 to 8 years and at age 11 to 12 years and incidence and remission during the 4 years were compared with the results in the cohort examined 10 years earlier.²⁹

Chi-square tests were used for bivariate analysis, and a P value of less than .05 was considered statistically significant. Risk ratios (RRs) with 95% CIs were calculated for determinants of incidence of *any positive SPT* result. Variables included in bivariate analysis were male sex, family history of allergy, ever cat/dog at home, rural living in early life, smoking mother, breast-feeding for 3 months or less, growing up on a farm, number of siblings, order in siblings, damp

housing, respiratory infections, and study area. Multiple logistic regression analyses were performed by using the independent variables that were significantly associated with *any positive SPT* result in the bivariate analyses, and the associations were expressed as odds ratios (ORs) with 95% CIs. Independent samples t test was used for comparison of continuous variables between groups.

RESULTS

Prevalence of allergic sensitization by age

The prevalence of *any positive SPT* result was 41.4% at age 11 to 12 years, a significant increase from 29.9% at age 7 to 8 years. A significant increase by age was found for the prevalence of positive SPT result to all major allergens. Among subjects with *any positive SPT* result, the number of positive SPT reactions increased from age 7 to 8 years to age 11 to 12 years: mean 2.50 and 2.78 ($P < .001$). The prevalence of *any positive SPT* result at age 11 to 12 years was significantly higher among boys, 45.7% compared with 37.0% among girls ($P < .001$). This difference by sex was significant for all major allergens. Among individual allergens, sensitization to cat was most common, 26.6%, followed by dog, 22.6%, timothy, 22.2%, and birch, 21.3%. Sensitizations to *any pollen* and *any animal* were close to identical, 31% (Table I). The prevalence of allergic sensitization at age 7 to 8 years ($n = 1700$) and at age 11 to 12 years ($n = 1657$), respectively, and among children who participated at both examinations ($n = 1450$), was almost identical (see Table E1 in this article's Online Repository at www.jaci-inpractice.org).

Incidence and remission of allergic sensitization

Using the population at risk defined as a negative SPT result to all allergens at the age of 7 to 8 years, we found that the 4-year cumulative incidence of *any positive SPT* result was 18.3%. For individual allergens, the incidence was highest for cat, followed by timothy, birch, and dog. The incidence of sensitization to *any allergen*, *any pollen*, and *any animal* was significantly higher among boys than among girls, and a similar trend was found for sensitization to specific allergens (Table II).

TABLE I. Prevalence (%) of positive skin prick test (SPT) for specific allergens and allergen groups at ages 7-8 years (n = 1700) and 11-12 years (n = 1657) by sex and age

Allergen	Age (y)	Boys	Girls	Total	P value	
					Difference by sex	Difference by age
Birch	7-8	14.3	12.0	13.1	.163	
	11-12	22.8	19.8	21.3	.136	<.001
Timothy	7-8	13.1	8.8	10.9	.004	
	11-12	25.0	19.3	22.2	.005	<.001
Mugwort	7-8	2.1	2.7	2.4	.401	
	11-12	5.6	4.4	5.0	.282	<.001
Cat	7-8	20.6	17.7	19.1	.131	
	11-12	29.5	23.5	26.6	.005	<.001
Horse	7-8	10.1	8.0	9.0	.131	
	11-12	13.9	11.2	12.6	.097	<.001
Dog	7-8	18.7	12.7	15.7	.001	
	11-12	25.0	20.1	22.6	.018	<.001
Any mite	7-8	2.0	0.8	1.4	.044	
	11-12	2.4	1.4	1.9	.125	.311
Any mould	7-8	2.4	0.8	1.6	.013	
	11-12	3.3	2.5	2.9	.294	.011
Any animal	7-8	25.8	20.5	23.2	.009	
	11-12	34.8	27.1	31.0	<.001	<.001
Any pollen	7-8	19.9	16.7	18.3	.093	
	11-12	33.8	28.3	31.1	.015	<.001
Any allergen	7-8	32.7	27.0	29.9	.010	
	11-12	45.7	37.0	41.4	<.001	<.001

TABLE II. Cumulative incidence (%) of allergic sensitization from age 7-8 years to age 11-12 years among children not sensitized at age 7-8 years, measured by skin prick test (SPT)

Allergen	Incidence (%) of allergic sensitization between age 7-8 y and age 11-12 y (n = 1015)					
	Boys		Girls		Total, %	Difference by sex, P value
	%	n	%	n		
Birch	7.4	36	5.1	27	6.2	.141
Timothy	10.0	49	6.7	35	8.3	.052
Mugwort	1.8	9	1.0	5	1.4	.225
Cat	10	49	6.1	32	8.0	.021
Horse	1.6	8	1.7	9	1.7	.926
Dog	5.5	27	4.9	26	5.2	.679
Any pollen	15.5	76	10.5	55	12.9	.016
Any animal	12.3	60	8.4	44	10.2	.040
Any mite	0.6	3	0.2	1	0.4	—
Any mould	0.0	0	0.2	1	0.1	—
Any allergen	21.3	104	15.6	82	18.3	.019

The incidence of specific sensitization was higher when using the population at risk defined as *any positive SPT* result at age 7 to 8 years but negative to the specific allergen studied, that is, *additional sensitization*. The allergen-specific incidence was highest for dog, 36.3%, followed by cat, 28.9%, timothy, 27.8%, and birch, 27.2%. The incidence of sensitization to *any pollen* was higher than for *any animal*, 37.1% and 31.2%, respectively (Figure 2). No significant difference by sex was found. Remission was low, with only 27 (6.2%) cases having *any positive SPT* result at age 7 to 8 years and a negative SPT result to

all allergens at age 11 to 12 years. Of these 27 cases, 24 had a single positive SPT result at age 7 to 8 years.

Risk factors for incidence of allergic sensitization

Significant risk factors for the 4-year cumulative incidence of *any positive SPT* result in bivariate analysis were family history of allergy (RR, 1.52), male sex (RR, 1.36), and rural living during the first year of life (RR, 1.35). Ever having a cat at home and dog at home were protective factors (RR, 0.57, and RR, 0.70, respectively). In the multivariate analysis including the significant

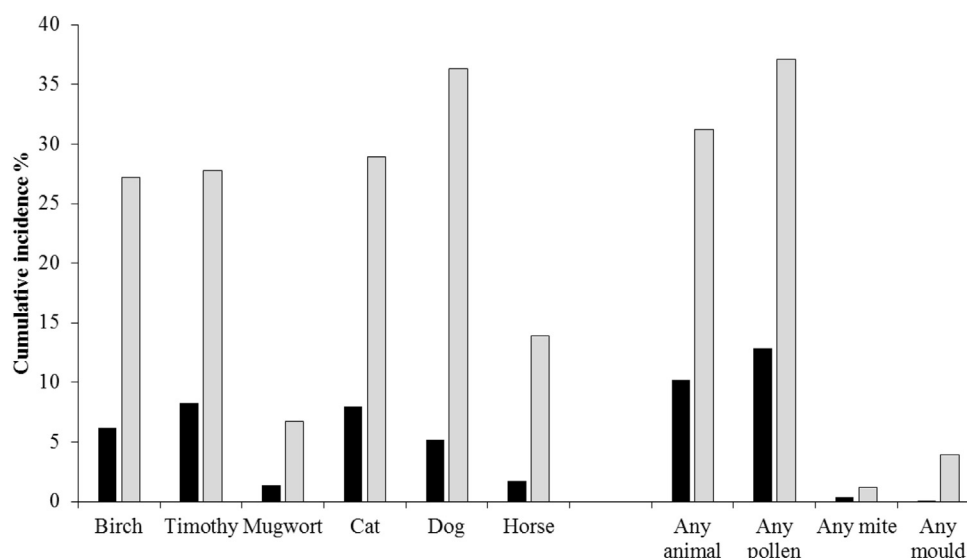


FIGURE 2. Four-year incidence (%) of positive skin prick test (SPT) result to specific allergens and allergen groups by using different population at risk; subjects with a negative SPT result to all allergens at age 7 to 8 years (black bar), and subjects with a negative SPT result to the specific allergen but positive to any other allergen at age 7 to 8 years, that is, additional sensitization (gray bar).

determinant from the bivariate analysis, family history of allergy (OR, 1.61; 95% CI, 1.11-2.32) and ever having a cat (OR, 0.58; 95% CI, 0.35-0.94) and dog (OR, 0.64; 95% CI, 0.42-0.98) remained significantly associated with the incidence of any positive SPT result (Table III).

Comparison between SPT and serum IgE

The prevalence of allergic sensitization at age 11 to 12 years defined as a specific IgE level of 0.35 IU/L or more was in high accordance with the corresponding SPT results, especially regarding the most common allergens. Using any positive IgE as reference, any positive SPT result had a sensitivity of 91.3% and a specificity of 92.3%. For specific allergens, the specificity was generally high. Sensitivity was somewhat lower (see Table E2 in this article's Online Repository at www.jaci-inpractice.org).

Comparisons with the cohort recruited 10 years earlier

In the current cohort, both the prevalence of any positive SPT result at age 7 to 8 years and at age 11 to 12 years and the 4-year incidence of allergic sensitization from age 7 to 8 years to age 11 to 12 years were significantly higher compared with that in children of the same age in the OLIN pediatric cohort I recruited in 1996. The serum IgE analyses confirmed the increase in prevalence. The remission of any positive SPT result was similar, 5% versus 6%, in the 2 cohorts (Figure 3).

DISCUSSION

In this population-based cohort, the prevalence of sensitization to airborne allergens increased significantly from 30% at age 7 to 8 years to 41% at age 11 to 12 years. This increase was explained by a high incidence, 18%, and low remission during the 4-year period. Regarding both prevalence and incidence, the major allergens were pollen and furred animals. A family history of allergy was a significant risk factor for developing allergic sensitization. Ever having had a cat or a dog at home was

TABLE III. Risk factors for incidence of allergic sensitization between age 7-8 years and age 11-12 years, in bivariate and multivariate analyses expressed as RR and OR, respectively, with 95% CIs

Risk factor	Incidence, %	Incidence, % (n)	Bivariate analysis, RR (95% CI)	Multivariate analysis, OR (95% CI)
Sex				
Girl	15.6	(82)		
Boy	48.2	21.3 (104)	1.36 (1.05-1.77)	1.38 (0.96-1.99)
Family history of allergy				
No	14.6	(75)		
Yes	49.4	22.2 (111)	1.52 (1.16-1.98)	1.61 (1.11-2.32)
Rural living in early life				
No	16.8	(113)		
Yes	30.1	22.7 (66)	1.35 (1.03-1.77)	1.43 (0.97-2.12)
Ever cat				
No	19.0	(118)		
Yes	28.8	10.8 (27)	0.57 (0.38-0.84)	0.58 (0.35-0.94)
Ever dog				
No	21.3	(115)		
Yes	41.5	14.9 (57)	0.70 (0.52-0.94)	0.64 (0.42-0.98)

associated with a lower incidence of sensitization. Compared with results from a cohort investigated 10 years earlier with identical methods, both prevalence and incidence of allergic sensitization had increased significantly.

Few studies have investigated changes in prevalence by age. An increase of similar magnitude by age as in our study has been reported from the Isle of Wight, United Kingdom,¹⁵ and New South Wales, Australia,¹⁶ in corresponding ages. In a Swedish study, sensitization to airborne allergen increased from 15% at

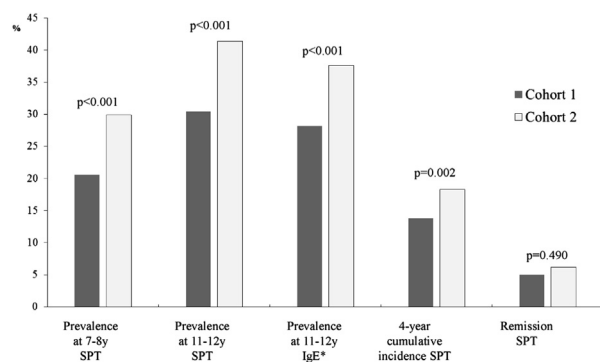


FIGURE 3. Prevalence (%) at age 7 to 8 years and at age 11 to 12 years, respectively, and 4-year incidence (%) and remission (%) of allergic sensitization to any allergen measured by skin prick test (SPT) and specific IgE. * Comparison between the OLIN pediatric cohort I recruited in 1996 with follow-up in 2000 (black bar) and cohort II recruited in 2006 with follow-up in 2010 (gray bar). *Specific IgE ≥ 0.35 to any of cat, dog, birch, or timothy.

age 4 years to 25% at age 8 years.³³ In addition to the increase in *any positive SPT* result from age 7 to 8 years to age 11 to 12 years, multisensitization increased during this period due to additional sensitization among those already sensitized. Few studies have investigated this aspect of sensitization, but there is support for the pattern of monosensitization to multisensitization by increasing age.¹⁵

Regarding the prevalence of allergic sensitization at specific ages, the prevalence among children aged 10 years in 2011 on the Isle of Wight was 24%,¹⁴ while 45% has been reported in a US population aged 6 to 19 years.²¹ A German study also reported 45% at age 11 to 13 years after testing 20 allergens.³⁴ In light of this, the prevalence of 41% in our cohort at age 11 to 12 years must be regarded as moderate or even high.

Studies of time trends in prevalence of allergic sensitization have revealed conflicting results, with some indicating a plateau while others show continuous increase.^{3,4,9-12,14,35} In our study area in Northern Sweden, the prevalence of allergic sensitization at age 7 to 8 years,^{13,17} and also according to the current study at age 11 to 12 years, was about 10% units greater in the cohort recruited in 2006 compared with the cohort from 1996. Also, sensitization to the major specific allergen showed the same pattern. Thus, our studies strongly support a continuous increase in allergic sensitization.

Given the age group studied, a high incidence was expected. The high prevalence at age 7 to 8 years in 2006 could challenge this. However, the 4-year cumulative incidence was high, 18%. In Australia, the 4-year incidence was 15%,¹⁶ while a lower incidence was reported from Isle of Wight, 14%, over 6 years.¹⁵ However, completely accurate comparisons are difficult because the ages under study and the studied allergens differ somewhat.^{15,16} Interestingly, in our study area, the incidence of allergic sensitization from age 7 to 8 years to age 11 to 12 years had increased significantly from 14% to 18% over 10 years. Our study is the first to present time trends of the incidence of allergic sensitization. The results suggest a continuous increase over time not only in prevalence but also in the incidence of allergic sensitization. The observed low remission of allergic sensitization is in line with previously performed studies among

schoolchildren¹⁷ but contrasts with studies among adults and elderly, where remission is common.¹⁸ Worth noting is that 24 out of 27 remittent cases were positive to only 1 allergen at age 7 to 8 years. There is a possibility that some of these cases were originally false positives. This would cause an overestimation of a phenomenon already rare.

In contrast to most studies globally, sensitization in our study was mainly explained by sensitization to furred animals and pollens, not dust mite.³⁶ This was expected because of unfavorable conditions for dust mites and mould, thereby minimizing the exposure to these allergens in the study area, and in line with previous results.^{13,32} Interestingly, the incidence of sensitization to pollen tended to be higher than to furred animals after the age of 7 years, and the same pattern was observed when studying the incidence among individuals sensitized to any other allergen at age 7 to 8 years, that is, additional sensitization. In contrast, at age 7 to 8 years, sensitization to furred animals was most common. This is in line with the theory of the atopic march, where sensitization and symptoms to airborne indoor allergens precedes outdoor allergens due to earlier and continuous exposure.³⁷

Allergic sensitization, measured as both prevalence and incidence, was more common among boys than girls. When studying incidence from age 7 to 8 years to age 11 to 12 years, the association became weaker, and did not reach significance in the adjusted analysis. This implies that the effect of male sex decreases with age, and confirms earlier findings.^{15,38} A family history of allergy was a significant risk factor for the incidence of sensitization to any allergen, while ever having had a cat or dog at home was protective. These findings are in line with cross-sectional and the few existing longitudinal studies of risk factors for allergic sensitization.^{17,19,39} Rural living has often been reported as a protective factor,²² but a recent study does not fully support this.²⁴ In the OLIN cohort I studied 10 years earlier, rural living in early life was indeed a significant protective factor for early incidence,¹⁷ whereas this was not the case in the current cohort. The loss of a protective effect has probably contributed to the increased prevalence of allergic sensitization in the more recent cohort. However, the underlying reason of the alteration of early rural living impact is unclear but changes in rural lifestyle over time might have occurred.

The high participation rate is a major strength of our study. The longitudinal cohort was considered representative as the prevalence of positive SPT result at age 7 to 8 years was almost identical among the children who participated in both surveys compared with the entire cohort at age 7 to 8 years (Table E2). The use of SPT in combination with IgE provided reliable objective measurements of allergic sensitization, and when using IgE as reference, sensitivity and specificity of SPT were high. This supports high validity of the SPT results. The use of different batches of allergen extracts in the 2 surveys may have caused bias. However, the same manufacturer supplied the extracts. Although equal potency was certified by the manufacturer, interbatch differences have been demonstrated.⁴⁰ When comparing studies using different manufacturers, this infers risk of bias. In our study, the results of SPT were validated against IgE in both cohorts at different ages with good consistency.^{17,27,36} Thus, batch differences have unlikely influenced the validity of our results. Furthermore, such differences are not likely systematic, but random. The external validity is supported by similar rates of prevalence in our study compared with other similar socioeconomic regions globally. Furthermore, the risk factor pattern found in our study is in line with previous findings.

In conclusion, the high incidence and low remission of allergic sensitization in schoolchildren resulted in increased prevalence by age in this population-based cohort to 41% at age 11 to 12 years. A family history of allergy was a significant risk factor for incident allergic sensitization, while ever having had furred animals at home was protective. Compared with a cohort investigated 10 years earlier with identical methods, both prevalence and incidence had increased significantly. The results imply a future increase in the prevalence of allergic diseases.

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TABLE E1. Prevalence (%) of positive skin prick test (SPT) result at ages 7-8 years and 11-12 years among all participants in the examinations at age 7-8 years (n = 1700) and at age 11-12 years (n = 1657), respectively, and among children who participated in both examinations (n = 1450)

Allergen	Age (y)	All participants in the examinations	Participants at both examinations
N	7-8	1700	1450
	11-12	1657	1450
Birch, %	7-8	13.1	13.2
	11-12	21.3	21.6
Timothy, %	7-8	10.9	11.2
	11-12	22.2	21.8
Mugwort, %	7-8	2.4	2.3
	11-12	5.0	4.8
Cat, %	7-8	19.1	19.5
	11-12	26.6	26.8
Horse, %	7-8	9.0	9.2
	11-12	12.6	12.2
Dog, %	7-8	15.7	15.9
	11-12	22.6	22.8
Any mite, %	7-8	1.4	1.2
	11-12	1.9	1.4
Any mould, %	7-8	1.6	1.7
	11-12	2.9	2.3
Any animal, %	7-8	23.2	23.6
	11-12	31.0	31.2
Any pollen, %	7-8	18.3	18.3
	11-12	31.1	31.0
Any allergen, %	7-8	29.9	30.0
	11-12	41.4	41.2

TABLE E2. Prevalence (%) of allergic sensitization based on skin prick test (SPT) and IgE, respectively, and sensitivity and specificity of SPT with IgE as reference

Allergen	Positive		Sensitivity	Specificity
	SPT result (n = 688)	IgE ≥ 0.35 IU/mL (n = 688)		
Birch	22.8	20.6	93.0	95.4
Timothy	20.3	17.9	88.6	94.5
Mugwort	5.2	5.8	62.5	98.3
Cat	27.8	24.0	95.8	93.7
Horse	13.8	16.0	78.2	98.4
Dog	23.5	23.5	84.6	95.2
<i>D pteronyssinus</i>	1.2	3.9	25.9	99.8
<i>D farinae</i>	1.2	3.9	22.2	99.7
Cladosporium	2.0	3.9	37.0	99.4
Any allergen	41.1	40.0	91.3	92.3