

The prevalence of sensitization to inhalant allergens in children with atopic dermatitis

Adam J. Sybilski, M.D., Ph.D.,^{1,2} Marta Zalewska, Ph.D.,¹ Konrad Furmańczyk, Ph.D.,¹ Agnieszka Lipiec, M.D., Ph.D.,¹ Edyta Krzych-Falta, Ph.D.,¹ and Bolesław Samoliński, M.D., Ph.D.¹

ABSTRACT

Background: The role of sensitization to inhalant allergens in atopic dermatitis (AD) in children is uncertain. The aim of our study was to assess the relationship of AD symptoms with sensitization to aeroallergens in Polish children ages 6–7 and 13–14 years.

Material and Method: Epidemiology of Allergic Disorders in Poland is a randomized study with medical examination according to the ECRHS II and the International Study of Asthma and Allergies in Childhood standards in nine selected regions of Poland. We studied 6–7-year-old ($n = 4510$) and 13–14-year-old children ($n = 4721$). A total of 1583 children (25%) had a medical examination and a skin-prick test (SPT) with the 15 most common aeroallergens.

Results: AD was diagnosed in 235 children (8.9%) (8.7%, 6–7-year-old children; 9.0%, 13–14-year-old children; 8.6% boys and 9.1% girls). AD was more frequent in urban versus rural habitants (9.6% versus 3.7%; $p < 0.05$) and in participants with a positive atopy history versus those without atopy (9.4% versus 5.1%; $p < 0.05$). Positive SPT was found in 1165 children (43.9%) (38.5% boys, 49.5% girls) and 64.72% with AD versus 41.9% without AD ($p < 0.05$) and more common in the rural region versus urban setting among 6–7 year-olds (71.8% versus 35.0%; $p < 0.05$). The most frequent allergic reaction was *Dermatophagoides pteronyssinus* (13.5%), *Dermatophagoides farina* (11.7%), and grasses/crop plants (11.8%). The same pattern was seen in participants with and those without AD. Children with AD had more frequent positive SPT for all aeroallergens ($p < 0.05$).

Conclusion: AD should be more frequent in children with a positive atopy history and in children who live in the city. Aeroallergens play an essential role in pathogenesis of eczema in children. House-dust mites and grass pollen proved to be the most common relevant aeroallergens.

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Atopic dermatitis (AD) is a common chronic relapsing disease in children. It is associated with atopy.¹ According to the latest Polish data, AD was found in 8.7–9.0% of children and 3.6% of adults.² Pathomechanism of eczema is complex and not fully understood. Despite many studies, so far we have failed to recognize the clear risk factors for eczema. Genetic and environmental factors seem to be crucial in the development of the disease. The presence of atopy, according to the theory of atopic march, implies that children with eczema may develop airway allergy, such as asthma or allergic rhinitis later in life.³ It is important to understand what allergens are prevalent in the triggering and mediating the atopic process. It seems that, in early childhood, we mainly occur with food allergy, but in older children and teenagers the

sensitization to aeroallergens is becoming more important.⁴

The objective of this research, as a part of the Epidemiology of Allergic Disorders in Poland study, was to study the prevalence of sensitization to common aeroallergens in a population of Polish children ages 6–7 and 13–14 years old with AD. The additional aim was to analyze the positive skin test results, depending on age, sex, the region of residence, and atopy history.

MATERIALS AND METHODS

Epidemiology of Allergic Disorders in Poland used the methodology of The International Study of Asthma and Allergies in Childhood,⁵ and involved the populations of eight of the largest urban agglomerations in Poland and, in addition, one rural region because the rural population accounts for 39% of the entire Polish population. According to the International Study of Asthma and Allergies in Childhood protocols, the study included two groups of respondents: children ages 6–7 years and those ages 13–14 years. Detailed methods and protocol requirements were presented in earlier publications.²

From the ¹Department of the Prevention of Environmental Hazards and Allergology, Medical University of Warsaw, Poland, and ²Department of Pediatric and Neonatology, Central Clinical Hospital of Ministry of Internal Affairs, Warsaw, Poland

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Address correspondence to Adam J. Sybilski, M.D., Ph.D., Department of Pediatric and Neonatology, Central Clinical Hospital of the Ministry of Internal Affairs, Włocławska 137, 02–507 Warsaw, Poland

E-mail address: adam.sybilski@cskmswia.pl

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Allergologists diagnosed AD by using the Hanifin and Rajka criteria. Skin-prick testing (SPT) was performed for the 15 most common airborne allergens (Allergopharma, Reinbek, Germany) such as hazel (*Corylus*); alder (*Alnus*); birch (*Betula*); grasses/crop plants; rye (*Secale cereal*); mugwort (*Artemisia*); plantain (*Plantago*); *Alternaria*; *Cladosporium*; and perennial allergens, including Molds I (*Alternariatenis*, *Botrylis cinerea*, *Cladosporium herbarum*, *Culvularia lanata*, *Fusarium monili-forme*, *Helminthosporium*), Molds II (*Aspergillus fumigatus*, *Mucor mucedo*, *Penicillium notatum*, *Rhizopus nigricans*, *Serpula lacrymans*, *Pullularia pullulans*); common species of mites *Dermatophagoides pteronyssinus* and *Dermatophagoides farinae*; and dog and cat dander. The test result was considered negative with a wheal of <3 mm and positive with the wheal of ≥ 3 mm. A positive SPT result for at least one allergen indicated atopy. Results were considered to be statistically significant at $p < 0.05$. The study was approved by the Bioethics Committee of the Medical University of Warsaw.

RESULTS

The study population comprised 2650 children (SPT results were available), 1354 boys and 1296 girls. Among the whole group, AD was diagnosed in 235 participants (8.9%), 116 of the 6–7-year-old children (8.7%) and 119 of the 13–14-year-old children (9.0%). There were no differences between AD occurrence in boys versus girls (8.6% versus 9.1%). AD was more frequent in urban habitants versus the rural region (9.6% versus 3.7%; $p < 0.05$) and in participants with a positive atopy history versus those with no atopy history (9.4% versus 5.1%; $p < 0.05$). The detailed data in the two groups of children are shown in Table 1.

Of the 2650 patients, 1165 (43.9%) had atopic sensitization to at least one aeroallergen by SPT: 523 of 6–7-year-old children (39.3%) and 642 of 13–14-year-old children (48.6%). Atopy was found in 522 boys (38.5%) and 642 girls (49.5%). A total of 152 patients with AD (64.7%) and 1012 persons without AD (41.9%) had positive SPT results, and, in both the groups, atopy was more frequent in participants with AD than in those without AD ($p < 0.05$). Sensitization was more common in the rural region among 6–7-year-old children versus the urban setting (71.8% versus 35.0%; $p < 0.05$). Other differences in the prevalence of sensitization were not statistically significant. The detailed data are shown in Table 2.

The most frequent allergic reaction was *D. pteronyssinus* (13.5%; 10.2% in 6–7-year-old and 17.0% in 13–14-year-old children), *D. farina* (11.7%; 9.4% in 6–7-year-old children and 14.2% in 13–14-year-old children), and grasses/crop plants (11.8%; 10.8% in 6–7-year-old and 12.9% in 13–14-year-old children). The same pattern was seen in patients with AD and in those without AD. Generally,

Table 1 Baseline characteristics of the study population and diagnosis of AD*

	6–7 Years Old		13–14 Years Old		Total	
	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>
Total		1329		1321		2650
Boys	50.6	672	51.6	682	51.1	1354
Girls	49.4	657	48.4	639	48.9	1296
Urban	88.3	1173	87.0	1149	87.6	2322
Rural	11.7	156	13.0	172	12.4	328
Positive atopy history	41.1	546	41.1	543	41.1	1089
AD	8.7	116	9.0	119	8.9	235
Boys	9.1	61	8.2	56	8.6	117
Girls	8.4	55	9.9	63	9.1	118
Urban	9.5	112	9.7	111	9.6	223
Rural	2.6	4	4.7	8	3.7	12
Atopy history						
Positive	11.7	64	11.4	62	11.6	126
Negative	6.6	52	7.3	57	7.1	109

*Statistically significant values are shown in bold.

patients with AD had more common positive SPT results for all airborne allergens, and positive SPT results were more frequent in older children (Table 3).

DISCUSSION

The increase in the prevalence of allergic diseases, including AD, indicates the need for comprehensive studies to help identify persons at risk of allergies as well as contribute to the better care and prevention of these diseases. Although the association between aeroallergen sensitization and AD is known, little is known about the patterns of sensitization to individual aeroallergens in relation to sex, place of residence, and atopy history. This may be explained, at least in part, by the limitations of epidemiologic studies and their methodology. Our study was based on a standardized and validated methodology that provides a fair assessment. In addition, the data analysis was carried out on a relatively large amount of information and the Epidemiology of Allergic Disorders in Poland project involved the populations of eight urban agglomerations. Study areas were selected from the group of the largest towns in Poland (each with >150,000 inhabitants) and, in addition, one rural region, also with a population of >150,000 because the rural population accounts for 39.2% of the entire Polish population. Just the comparison of urban and rural residents distinguishes our study and makes it unique in the literature.

Table 2 Atopy (positive SPT for at least one allergen) in study group (n = 2650)

	6–7 Years Old (n = 1329)				13–14 Years Old (n = 1321)			
	% Total	% AD (+)	% AD (–)	p	% Total	% AD (+)	% AD (–)	p
Total	39.3	60.3	37.3	<0.05	48.6	68.9	46.6	<0.05
Boys	41.1	68.9	38.3	<0.05	54.5	75.0	52.7	<0.05
Girls	37.4	50.9	36.2	<0.05	42.3	63.5	39.9	<0.05
Urban	35.0	58.9	32.4	<0.05	47.1	69.4	44.7	<0.05
Rural	71.8	100.0	71.1	<0.05	58.7	62.5	58.5	<0.05
Atopy history (+)	43.6	65.6	40.7	<0.05	53.8	72.6	51.4	<0.05
Atopy history (–)	36.3	53.8	35.0	<0.05	45.0	64.9	43.4	<0.05

+ = with; – = without.

Table 3 Positive SPT for most common airborne allergens in participants AD (+) and AD (–)

	6–7 Years Old (n = 1329)			13–14 Years Old (n = 1321)		
	% AD (+)	% AD (–)	p	% AD (+)	% AD (–)	p
<i>D. pteronyssinus</i>	29.3	7.0	<0.05	32.4	14.3	<0.05
<i>D. farinae</i>	27.6	6.4	<0.05	33.4	10.0	<0.05
Molds I	12.9	3.3	<0.05	14.6	4.8	
Molds II	6.0	2.7		8.6	3.0	
Cat dander	20.6	3.8	<0.05	21.0	4.3	
Dog dander	13.8	3.3	<0.05	11.3	3.0	
Grasses/crop plants	25.9	8.3	<0.05	33.3	9.2	<0.05
Rye	23.3	5.2	<0.05	22.2	5.9	
Mugwort	13.8	4.2		28.2	7.6	<0.05
Plantain	11.2	1.9	<0.05	12.0	3.1	
Birch	22.4	7.1	<0.05	26.6	6.7	<0.05
Hazel	15.5	3.1	<0.05	19.7	4.2	<0.05
Alder	14.6	3.6	<0.05	19.6	3.3	<0.05
<i>Alternaria</i>	17.3	4.5	<0.05	15.0	4.0	
<i>Cladosporium</i>	9.6	2.1	<0.05	7.7	1.9	<0.05

+ = with; – = without.

We included a randomized group of 2650 children ages 6–7 years and 13–14 years, which was in accordance with the International Study of Asthma and Allergies in Childhood study protocol. It makes our study one of the largest studies on this topic in eastern and central Europe. In all participants, allergists recognized AD in 235 participants (8.9%), in a similar percentage in both age groups. We did not find any significant differences between AD occurrence in boys versus girls (8.6% versus 9.1%). No correlation with sex was seen in some studies from outside of Europe.⁶ Our results are also consistent with earlier reports that AD is more common in children in the urban area. Also, in our study, we observed a statistically significant difference in this relationship. A similar tendency was observed in a number of earlier studies from other countries⁶ and from Poland,⁷ which demonstrated the adverse im-

pact on health when living in big cities. The environmental factors may offer the explanation.

One factor is less environmental pollution in rural areas.^{5,8} Another is the hygiene hypothesis of allergy development whereby increased exposure to microorganisms and plants has a protective function.^{8,9} In addition, higher hygiene levels (frequent washing and drying of the hands or bath-taking, using large amounts of soap and shower gels) in city dwellers may damage or destroy the natural barrier function of the skin, which results in the development of skin disorders, including AD.¹⁰ At the same time, the structure of families who live in rural areas (a larger number of children, housing conditions) seems to have a role in the prevention of AD. A positive family history of allergy seems to be one of the most significant risk factors for AD development.¹¹ Our results fully support this hypothesis and are similar to the data reported by other investigators,^{12–15}

especially that atopy found in one or both parents is a strong risk factor. Thus, a genetic predisposition to atopic disorders seems to be unquestionable and the most important factor in the development of AD and other allergic disorders.

Pathogenesis of AD results from genetic, environmental, and immunologic factors. Skin barrier dysfunction is a major pathogenic factor of AD, but the importance of sensitization to various allergens cannot be overlooked or forgotten.¹⁶ Many researchers highlight the fact that food allergens play the most important role for the presence of symptoms of AD.^{17,18} At the same time, we know that the greatest clinical impact of these allergens occurs mainly in infants <2 years of age. However, in older children and adults, sensitization to aeroallergens begins to have importance as a trigger factor of atopic reactions and atopic eczema; we must remember that sensitization to indoor aeroallergens, such as house-dust mites and molds can begin as early as the first year of life, and sensitization to outdoor airborne allergens derived from external sources, such as tree and grass pollen, begins mainly after 2 years of age.¹⁹ Analysis of our results shows that the positive SPT results to aeroallergens (the sensitization) were significantly more common in children with AD. Almost two-thirds of the subjects had a positive SPT result to at least one aeroallergen. Similar results were obtained by Goveare *et al.*²⁰ in children >6 years of age. At the same time, the presence of sensitization increased with age, both in children with AD and in the group of healthy children. Similar observations were made by both Polish and world researchers.^{20–22} Our findings confirmed previous reports that the most common allergens that sensitized children with AD were house-dust mites and grass pollen and grain. In our studies, *D. pteronyssinus* and *D. farinae* as well as grasses and cereals sensitized ~30% of participants. These results correlated with the data presented by Polish researchers in 2003, who, when studying 226 patients, found sensitization to *D. pteronyssinus* in 30.9% of patients, *D. farinae* in 30.4%, and grass/crop plants in 29.6%.²³ In 2008, a Chinese group obtained a much higher percentage of children with AD sensitized to house-dust mites (~75%) and was significantly higher than to food allergens in all age groups.²² Recent studies also yielded similar results. Wisniewski *et al.*²⁴ concluded that differences in sensitization to cat and dust mite in young children with AD may aid in identifying those at increased risk for disease progression and development of asthma.

In summary, the findings of the reported study clearly demonstrated that AD is a serious health problem in Polish children. It was found that AD should be more frequently expected in children whose parents

have atopic disease themselves and who live in a city. Importantly, aeroallergens play a significant role in the pathomechanism of AD. This is especially important in adolescents, in whom sensitization to food allergens is less frequently observed and to aeroallergens is more common. Knowledge of widespread aeroallergens and proper education of patients in the area to avoid or reduce exposure to allergens could help in prevention of AD and other allergic diseases.

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