

Short communication

Age-dependent differences in the prevalence of allergic rhinitis and atopic sensitization between an eastern and a western German city

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Recent studies have found a higher prevalence of allergic rhinitis and atopic sensitization among adults living in eastern than those living in western Germany. We hypothesize that prevalence rates were similar before Germany was divided and diverged after the division. Because there are no historical data comparing atopic status between the two parts of Germany, we tested this hypothesis by comparing the prevalence of atopy among persons who were born during different decades. As part of the EC Respiratory Health Survey, a respiratory health questionnaire was mailed to a population-based sample of 8363 subjects aged 20–44 years from a city in the former West Germany (Hamburg) and a city in the former East Germany (Erfurt). Of the target population, 6428 (77%) subjects responded. Subsamples of 731 subjects from Erfurt and 1159 subjects from Hamburg participated in medical examinations, including skin prick tests and specific IgE measurements. Prevalence rates of allergic sensitization were similar in Hamburg and Erfurt for those born in the periods 1946–51 and 1952–61, respectively, but differed between Hamburg and Erfurt subjects born in the period 1962–71. After adjustment for several potential predictors, the younger subjects from Hamburg had a higher odds ratio (OR) of sensitization than those Hamburg subjects born before 1952 (skin prick test reactivity: OR 2.06, any specific IgE > 0.35 kU/l: OR 1.61). The younger subjects from Erfurt were not more frequently sensitized than the older subjects (skin prick test reactivity: OR 1.05, any specific IgE > 0.35 kU/l: OR 0.79). No single allergen could be identified as responsible for the observed difference. We conclude that factors related to a “Western lifestyle”, which were prevalent in the West German city during the 1960s and 1970s, may be responsible for the higher prevalence of allergic sensitization observed in Hamburg.

**J. Heinrich¹, D. Nowak²,
G. Wassmer^{1,3}, R. Jörres², M. Wjst¹,
J. Berger⁴, H. Magnussen²,
H.-E. Wichmann^{1,5}**

¹GSF-Institut für Epidemiologie, Neuherberg;

²Krankenhaus Grosshansdorf, Zentrum für
Pneumologie und Thoraxchirurgie,

Grosshansdorf; ³Universität zu Köln, Institut für
Medizinische Statistik, Informatik und

Epidemiologie, Köln; ⁴Universitäts-Krankenhaus
Eppendorf, Institut für Mathematik und

Datenverarbeitung in der Medizin, Hamburg;

⁵Ludwig-Maximilians-Universität, Institut für
medizinische Informationsverarbeitung,
Biometrie und Epidemiologie, München,
Germany

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Dr Joachim Heinrich
GSF-Institut für Epidemiologie
Postfach 1129
D-85758 Oberschleißheim
Germany

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Comparisons of the epidemiology of respiratory symptoms, illnesses, and allergies have shown differences between eastern and western Germany. Among eastern German adults, wheezing, asthma, allergic rhinitis, positive methacholine challenge tests, and positive skin prick tests have been found to be less prevalent than among western German

adults (1–4). Similarly, among eastern German children, lower prevalence rates of asthma, positive cold air challenge tests, and positive skin prick tests, as well as lower specific IgE levels, have been found relative to western German children (3, 5–10).

The division of Germany in 1949 and the reunification in 1990 allow the observation and

investigation of numerous factors that affect morbidity. The importance of environmental factors during infancy in relation to primary sensitization to inhalant allergens is widely recognized. This study design rests on the premise that susceptibility to environmental factors for primary allergic sensitization is much higher during early childhood than during adulthood (6, 8). Therefore, age-specific prevalence could be used as a proxy for different environmental exposure between different birth cohorts in eastern and western Germany. We hypothesize that the prevalence of allergies was the same in eastern and western Germany before the division of Germany but began diverging after the division of Germany, resulting in higher rates in western than in eastern regions. To test this hypothesis, we analyzed the age dependency of allergic diseases and sensitization to allergens in adults in Erfurt, a city in the former East Germany, and in Hamburg, a city in the former West Germany.

Material and methods

Population

Erfurt, with a population of approximately 200 000, is located in the southwestern part of the former East Germany. Hamburg (population 1 700 000) is situated in the north of the former West Germany near the North Sea coast. Although the two cities have different population sizes, both cities are administrative urban centers. The target population consisted of adults aged 20–44 years randomly selected from the registry of city residents. The questionnaire response rate was 74% in Erfurt and 80% in Hamburg. A subsample of 4494 subjects was invited to the medical examination. In Erfurt, a randomly selected subsample of the responders to stage I and in Hamburg all responders to stage I were invited for further examination. The participation rates for the medical examination were 55% and 37% in Erfurt and Hamburg, respectively.

Methods

This study* is part of the EC Respiratory Health Survey (11), the methods of which have been described previously (2, 11). The study was conducted in two stages: in stage I, a questionnaire was mailed to a population-based sample; in stage II, a random subsample of the stage I sample was examined.

*It is the policy of the EC Respiratory Health Survey to indicate that the results presented are from a local analysis, and any final international comparison may use a different form of analysis.

Screening questionnaire (stage I). The screening questionnaires in stage I (11) were mailed between September 1991 and November 1992 with two follow-up mailings, telephone contacts, and home visits for nonrespondents. Allergic rhinitis was defined by an affirmative answer to the question, "Do you have nasal allergies, including hay fever?"

Skin prick test and specific IgE measurement (stage II). The medical examination consisted of an interviewer-administered questionnaire; lung function testing including a methacholine challenge test; and skin prick tests to *Dermatophagoides pteronyssinus*, cat, *Cladosporium herbarum*, *Alternaria tenuis*, birch, grass, histamine (positive control), and uncoated Phazets (negative control), as well as CAP Pharmacia measurements of specific IgE to *D. pteronyssinus*, cat, *Cladosporium*, birch, and timothy, and of total IgE. All allergens except grass were supplied via Phazets for the purposes of the EC Respiratory Health Survey, by Pharmacia, Uppsala, Sweden. The grass allergen used was from Allergopharma, Reinbek, Germany. The same batch of Phazets for skin prick testing used was, and the CAP assay was analyzed in the same laboratory (Pharmacia) after shipping the frozen sera to Uppsala. After exclusion of those subjects who showed no reaction to histamine solution or who had a wheal diameter ≥ 3 mm to the uncoated Phazets, a skin prick test was considered positive if the wheal diameter was ≥ 3 mm.

Long questionnaire (stage II). Possible confounding factors, such as number of siblings, family history of asthma and allergy, bedroom sharing, active and passive smoking, housing and heating conditions, cat ownership, etc., were assessed by the detailed questionnaire. A family history of atopy was assumed if at least one parent or sibling had asthma or allergy.

Statistical analyses

Confidence intervals for the prevalence and for the differences in prevalence rates were calculated with the normal approximation. Logistic regression analyses were performed with the allergy outcomes as the dependent variables. The region-specific age dependency of the odds ratios (OR) was modeled by dummy coding of the period of year of birth of a subject. Since three groups of years of birth were evaluated (1946–51, 1952–61, and 1962–71), four binary indicators were introduced that compared a specific birth group with the oldest group (1946–51) for each region separately. Furthermore, we subsequently could enter potential confounding

factors into the model. All statistical analyses were done with SAS 6.11.

Results

Response rate

No significant differences in age, sex, and respiratory symptoms assessed by a screening questionnaire were found between stage I participants and nonparticipants. For study of a possible selection bias in stage II responders, the prevalence rates of allergic rhinitis were compared between the responders to the screening questionnaire and the responders to the medical examination. No statistically significant differences in the age- and sex-specific prevalence of self-reported allergic rhinitis were observed. Furthermore, participation rates differed only slightly between age groups. Therefore, the lower participation rate in the medical examination probably did not cause selection bias.

Descriptive analysis

The overall self-reported prevalence of allergic rhinitis in adults aged 20–44 years was 13.3% in Erfurt and 23.1% in Hamburg. There was an increase in the age-specific prevalence in both Erfurt and Hamburg with later birth year (Table 1). The biggest difference in prevalence of allergic rhinitis between Erfurt and Hamburg was found for the youngest birth cohort (Table 1). The prevalence of sensitization to *D. pteronyssinus*, birch, cat, *Alternaria*, *Cladosporium*, or grass was slightly higher in Hamburg than in Erfurt (Table 2). In Erfurt, no trend was found in the age-specific prevalence of sensitized subjects, while in Hamburg these prevalences were higher in the later birth cohort. The overall sensitization rates in both centers were mostly influenced by sensitization to grass, mite, and birch and in Hamburg to cat as well. In Hamburg, higher sensitization rates to mite in the youngest age group were found, leading to the differences in prevalence between Erfurt and Hamburg in subjects born in the period 1962–71.

The prevalence of any specific IgE > 0.35 kU/l to timothy, birch, *D. pteronyssinus*, cat, and *Cladosporium* was higher in Hamburg in the youngest age group. Changing cutoffs did not alter this result. In Hamburg, the age-specific prevalences of elevated specific IgE were higher in the younger and similar in the older subjects. Hence, the differences in prevalence of any specific IgE > 0.35 kU/l between Erfurt and Hamburg increased with later birth. The differences between the two cities in the prevalence of elevated specific IgE to birch and cat dander increased with later birth too.

Table 1. Prevalence of allergic rhinitis ascertained by questionnaire in Erfurt (east) and Hamburg (west) – stage I of EC Respiratory Health Survey (1991–2)

Prevalence of allergic rhinitis (%)						
Birth cohort	Total no.	Erfurt (east)	Total no.	Hamburg (west)	Difference in prevalence	95% CI
Total	3254	13.3	3153	23.1	9.8	(7.9; 11.7)
1962–71	1212	14.7	1207	26.8	12.1	(8.8; 15.3)
1952–61	1442	12.9	1218	21.5	8.6	(5.8; 11.5)
1945–51	600	11.7	728	19.8	8.1	(4.1; 12.1)

Regression results

The two basic logistic regression models indicated significantly higher adjusted OR for the youngest birth cohort than the oldest birth group for allergic sensitization assessed by skin test with an OR of 2.06 (1.32; 3.23), and by specific IgE values with an OR of 1.61 (1.03; 2.52) in Hamburg (Table 3). In Erfurt, no trend in adjusted OR of the prevalence for allergic sensitization was found. Of the included potential risk factors, the OR were significantly higher than 1 for a positive family history of atopy in parents or siblings, and significantly lower than 1 for subjects who had lived with more than two siblings in their home during childhood. None of the included potential predictors for sensitization in the early childhood showed OR that were significantly different from 1. However, current exposure to environmental tobacco smoke, as well as the presence of wall-to-wall carpeting, was associated with higher sensitization assessed by skin prick tests. All crude OR differed only slightly from the adjusted OR.

Like the OR for overall allergic sensitization to major allergens, the adjusted OR for only the youngest birth group were significantly increased in Hamburg for birch (prick test OR 1.68 [0.97; 2.93], specific IgE OR 2.20 [1.19; 4.09]), for grass (prick test OR 2.06 [1.23; 3.45], specific IgE OR 1.77 [1.04; 2.99]), and for cat dander (prick test OR 3.12 [1.40; 6.92], specific IgE OR 2.82 [1.26; 6.34]).

Table 2. Difference in prevalence rates of positive skin prick test (any wheal diameter ≥ 3 mm for birch, *Dermatophagoides pteronyssinus*, cat, *Alternaria*, *Cladosporium*, grass) between Erfurt (east) and Hamburg (west)

Prevalence of skin prick test positivity (%)						
Birth cohort	Total no.	Erfurt (east)	Total no.	Hamburg (west)	Difference in prevalence	95% CI
Total	726	30.0	972	35.7	5.7	(1.1; 10.2)
1962–71	271	28.8	367	46.3	17.5	(9.9; 25.2)
1952–61	317	32.8	385	30.1	–2.7	(–9.6; 4.2)
1945–51	138	26.1	220	27.7	1.6	(–7.8; 11.1)

Table 3. Results of logistic regression analyses with positive skin prick test reaction and positive specific IgE values as dependent variables. Region-specific birth-group effects are adjusted for selected potential confounding effects³

		Skin prick test ¹ (n = 1698)		Specific IgE ² (n = 1612)	
		Odds ratio	95% CI	Odds ratio	95% CI
Hamburg	1962–71 (vs 1946–51)	2.06	(1.32; 3.23)	1.61	(1.03; 2.52)
	1952–61 (vs 1946–51)	0.99	(0.65; 1.51)	0.86	(0.57; 1.29)
Erfurt	1962–71 (vs 1946–51)	1.05	(0.62; 1.79)	0.79	(0.48; 1.30)
	1952–61 (vs 1946–51)	1.27	(0.78; 2.08)	0.76	(0.48; 1.21)

¹ At least one wheal diameter from six allergens tested ≥ 3 mm (birch, *D. pteronyssinus*, cat, *Alternaria*, *Cladosporium*, grass).

² At least one specific IgE value examined > 0.35 kU/l (birch, *D. pteronyssinus*, cat, *Cladosporium*, timothy).

³ Sex, number of siblings, family history of asthma and atopy, and potential predictors in early childhood – bedroom sharing, attendance at nursery school, serious respiratory tract infections, environmental tobacco smoke (ETS), keeping cat; current potential predictors – smoking, exposure at workplace, age of building, heating and cooking fuels, carpeting, visible mold, and keeping cat.

No significantly increased OR of the youngest birth cohort in Erfurt were found. Using higher cutoffs for specific IgE led to similar results.

Discussion

The importance of the environment in early childhood for sensitization is widely accepted. The underlying mechanisms have been investigated *in vitro* and in animal models (12), as well as in man. Several investigations have found a relationship between month of birth and allergic sensitization later in life (13, 14). This may be related to exposure of neonates to pollen and mites during the first few months of life (15, 16). The timing of the indoor exposure probably influences the development of allergic reactions. Therefore, a higher indoor exposure to allergens later in life may only modify the development of allergies to a small degree. Nevertheless, we found higher OR for current potential predictors of sensitization than for predictors of sensitization in early childhood. The lower OR for predictors of sensitization in early childhood may be due to more misclassification. The retrospective estimation of exposure to allergens in very early childhood without quantitative measurements of allergen exposure is probably imprecise.

The time trends of allergic diseases and atopic sensitization in Erfurt and Hamburg can be understood if one assumes that exposure in infancy plays the dominant role in allergic sensitization in later life. If we assume this, the similar prevalences in Erfurt and Hamburg for persons born before 1962 suggest that the relevant exposure conditions were comparable in both cities. The increase, however, in prevalence rates of allergic sensitization in Hamburg for those born after 1962, an increase which is not seen in Erfurt, suggests that the relevant exposure changed in the West, but not in the East. This

“Western lifestyle factor” appeared to play a role among the children born in the 1960s and 1970s.

The higher prevalence of self-reported allergic rhinitis in Hamburg may be partly due to an increased awareness of allergies in the western part of Germany in recent years. The increased detection of allergic rhinitis could account for the rise in physician consultations and for the higher awareness of allergic rhinitis (17, 18). However, the higher sensitization rates and the higher specific IgE levels cannot be explained by the awareness of this disease. Factors such as increased exposure to allergens, higher exposure to motor vehicle exhaust, less “training” of immunologic defense by infectious diseases, lower prevalence of parasites, and nutritional factors are possible explanations for the East–West differences in allergic symptoms and diseases between eastern and western German cities (19).

Atopic sensitization and rates of allergic rhinitis were compared between Erfurt and Hamburg to study differences in morbidity between an eastern and a western city. We did not assume that the samples examined are necessarily generalizable to the entire eastern and western German adult populations. Nevertheless, our results were consistent with a large nationwide, population-based study. In 1990–2, the National Environmental and Health Survey enrolled 5311 subjects from western and 2617 subjects from eastern Germany aged 24–70 years. Subjects born before the division of Germany in 1949 did not show any East–West differences in the prevalence rates of allergies (20). Among subjects born after 1950, however, those from western Germany showed increasingly higher prevalence rates of allergies and higher specific IgE levels with age than those in eastern Germany.

Similar results were seen in a cross-sectional study of 1113 children aged 10–12 years from central Poland and from Sundsvall in northern Sweden

(21). The children from the former socialist country of Poland had a much lower prevalence of sensitization to allergens than the Swedish children. Presumably, this has to be attributed to differences in lifestyle, which are analogous to those between the former East and West Germany (21).

Obviously, there are strikingly higher prevalences of atopic sensitization in some northern and western European countries than in eastern European countries. The reason for this remains unknown. Inclusion of some known accepted risk factors for atopic sensitization in statistical modeling did not explain the differences in the prevalence of atopic sensitization between Erfurt and Hamburg. However, since the reunification of Germany in 1990, the lifestyles of persons living in eastern and western Germany are becoming more similar. It will be interesting to see whether these changes influence the differences in the prevalence rates of allergic diseases and sensitization between eastern and western Germany.

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