Atopy in Children and Parental Social Class

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Objectives. This analysis was conducted to determine whether atopic disorders were related to social class in a pediatric population of a former socialist country.

Methods. A cross-sectional study of 2471 schoolchildren was carried out in 1992 and 1993 in 3 towns in the former East Germany. Parents completed a standardized questionnaire regarding health events and lifestyle factors. In addition, skin-prick tests were performed and total serum immunoglobulin (IgE) was determined.

Results. Lifetime prevalence rates for atopic diseases and rates of allergic sensitization were highest in children from social class III (in which parents had more than 10 years of formal education) and lowest in social class I (less than 10 years of parental education), while rates in social class II (10 years of parental education) were constant at an intermediate level.

Conclusions. The data confirmed the assumption that in formerly socialist countries social inequalities existed under the socialist system, which were reflected by a social gradient in health outcomes. The findings support the hypothesis that increased access to modern lifestyle could be one reason for the increasing rates of atopic disorders during the last 3 decades. (Am J Public Health. 1998;88:1319–1324)

In industrialized Western countries, atopic diseases and allergic sensitization in both children and adults have been reported to occur more frequently in higher than in lower socioeconomic groups.1-5

Little is known about the distribution of health parameters in general and atopic diseases in particular in the different social categories in populations of the formerly communist countries of Eastern Europe. Studies performed shortly after the collapse of the communist system revealed that prevalence rates for atopic diseases and allergic sensitization in children and young adults in Eastern European countries were substantially lower than those observed in Western Europe.6-8 It has been postulated that factors associated with Western lifestyle may be responsible for the differences in these ethnically similar populations.9,10

The fact that differences in the prevalence of allergic diseases parallel differences in resource distribution within Western societies and between West and East leads to the speculation that increased access to modern lifestyle might be associated with a rise in allergic disorders. Detecting a similar social gradient for atopy in an Eastern European population would provide additional evidence in favor of this theory.

In the past, East German society was regarded as characterized by a relatively uniform distribution of resources and living conditions. In the German Democratic Republic, as in all former communist countries, income differences between social groups were relatively small. Education and basic health care were equally accessible to all groups in society. Health prevention programs represented an important aspect of the health care system and were implemented by a network of medical facilities in kindergartens, schools, and places of employment. Immunization programs were highly successful and day care facilities employing well-trained personnel were widely accessible.11 Nevertheless, in spite of a general lifestyle uniformity, subtle social stratification in former socialist countries existed. This study was designed to determine whether the occurrence of atopic disorders in schoolchildren in the former East Germany was related to parental social class.

Subjects and Methods

Study Population

The cross-sectional health survey was conducted in 1992 and 1993 in 3 communities of the state of Sachsen-Anhalt. All eligible schoolchildren in Hettstedt and Zerbst were invited to participate. One third of the schools from each administrative subdistrict of the Bitterfeld area were arbitrarily selected to represent the total regional area of Bitterfeld. All eligible children in those selected schools were included in the study. There were 2932 target subjects; questionnaires were distributed to 2773 children and returned by 2471. Information on social status was obtained for 2402 subjects (81.9%). Participation rates in the different phases of the study and age and sex...
distributions by social class are presented in Table 1. There are no statistically significant differences in age and sex distribution between the 3 social classes. The study protocol was evaluated and approved by the responsible ethics committee, and informed consent was obtained from the children’s parents.

Social Categories

The children were allocated to 3 social classes on the basis of questionnaire information on parent’s education. The social level of a family was defined by the highest school grade completed by either the mother or the father: social class I, less than 10 grades (years); social class II, 10 years; social class III, more than 10 years. We considered parental education to be a good indicator of social status in eastern Germany. Although income differences between social groups in the former German Democratic Republic were small, a higher education ensured better living and working conditions in general and access to better housing and consumer goods. The educational level paralleled factors considered to be characteristic of modern domestic comfort, such as central heating and wall-to-wall carpeting, and was inversely related to the degree of crowding in the home.

Our use of the highest school grade completed by either parent to define the social status of a family was arbitrary. We assumed that in families with discordant educational levels (38% of the sample) the parent with the highest educational level, regardless of sex, had the decisive influence on the family’s social behavior. This approach took into account the active role East German women played in the workforce and in society in general.

The classification of study participants into 3 social classes and the fact that children whose parents did not complete 10 years of formal education (social class I) represented only a small group (8%) reflected social stratification and educational policy in the former German Democratic Republic quite well, in our opinion. Achieving an intermediate level of education for most citizens was one of the priorities of socialist school policy. Persons in East Germany who did not achieve this standard educational level (10 grades) represented a very distinct social group, an assumption that was reinforced by the study findings on housing conditions and parental health behavior.

Health Parameters

We developed a self-administered questionnaire to be filled out by the parents, using items tested in several national and international studies that were in part adapted to fit conditions in the former East Germany. The 78 questions concerned the child’s respiratory and allergic diseases and symptoms, family history of atopic diseases, environmental smoking exposure, breast-feeding history, history of preterm birth, medication use and surgical history, education of parents, attendance at day-care centers, and outdoor and indoor environmental exposures. Information on birthweight and immunization history were extracted from the child’s official health booklet. The general medical examination included anthropometric measurements, inspection of the oral cavity, and a complete skin examination performed on all study subjects by one trained dermatologist using a standardized examination protocol focusing on the detection of atopic dermatitis. The interviewers and physicians did not have access to information concerning the social status of the children examined.

Sensitivity to 12 common allergens (house dust-mite allergens Der p I and Der f 1, Aspergillus fumigatus, Alternaria alternata, cat epithelium, mixed local grasses, mugwort, hazel, birch, platan, milk, and egg) was assessed by skin-prick tests with a standardized application protocol. Commercially available purified and immunochemically characterized allergens produced by Allergopharma (Reinbek, Germany) were applied to the child’s forearm via a standard uncoated needle for each allergen. A 1:1000 titer of histamine was used as a positive control and a 0.9% saline solution as a negative control. Results were read after 15 minutes by drawing a line around the perimeter of the wheel with a ballpoint pen. A strip of transparent tape was used to transfer the prints to the data sheet.

Wheat diameters were read at the widest point and at 90° of the diameter at the midpoint. A skin test was considered positive if a wheal at least 3 mm in diameter was present in response to at least 1 allergen and if the wheal diameter was 3 mm or larger for histamine and 2 mm or smaller for the saline solution. To avoid investigator-related variability, the skin-prick tests were performed on all study subjects by the same physician in all locations.

Blood collection, serum storage, and analyses of the samples were performed according to a standardized procedure protocol. Total serum immunoglobulin (IgE) was determined with a nephelometer analyzer and commercially available NA-latex-IgE-reactants supplied by the Behringwerke (Marburg, Germany).

Statistical Analyses

Data were analyzed with the SAS and Epi Info computer packages. The prevalence of diseases under consideration and 95% confidence intervals were computed for each social class, and $\chi^2$ tests with Yates correction for continuity if Fisher exact tests were performed for rate comparisons. Unconditional logistic regression techniques were used to determine crude and adjusted odds ratios and their corresponding 95% confidence intervals. Social classes II and III were compared with social class I, which served as a reference group. A set of covariates was selected a priori: total serum IgE, sex, parental atopy, season when skin-prick test was performed, method of home heating, study region, presence of wall-to-wall carpeting, and smoking.

### Table 1—Participation Rates (%) and Age and Sex Distribution (%) of Study Subjects by Social Class: Sachsen-Anhalt, Germany, 1992–1993

<table>
<thead>
<tr>
<th>Study Aspect</th>
<th>I (n = 192)</th>
<th>II (n = 1183)</th>
<th>III (n = 1027)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Questionnaire information</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physician-diagnosed diseases</td>
<td>99.0</td>
<td>99.8</td>
<td>99.7</td>
</tr>
<tr>
<td>Symptoms</td>
<td>96.4</td>
<td>97.0</td>
<td>97.5</td>
</tr>
<tr>
<td>Parental smoking</td>
<td>97.9</td>
<td>98.9</td>
<td>98.8</td>
</tr>
<tr>
<td>Housing</td>
<td>100.0</td>
<td>99.8</td>
<td>100.0</td>
</tr>
<tr>
<td>Immunization information</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skin-prick test</td>
<td>85.9</td>
<td>89.4</td>
<td>89.2</td>
</tr>
<tr>
<td>Serum IgE</td>
<td>78.7</td>
<td>83.2</td>
<td>83.6</td>
</tr>
<tr>
<td>Dermatologic examination</td>
<td>84.9</td>
<td>89.0</td>
<td>88.5</td>
</tr>
<tr>
<td>% Boys</td>
<td>47.9</td>
<td>52.1</td>
<td>49.1</td>
</tr>
<tr>
<td>Age, y</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5–7</td>
<td>29.7</td>
<td>32.0</td>
<td>30.0</td>
</tr>
<tr>
<td>8–10</td>
<td>30.7</td>
<td>30.3</td>
<td>35.3</td>
</tr>
<tr>
<td>11–14</td>
<td>39.6</td>
<td>37.7</td>
<td>34.8</td>
</tr>
</tbody>
</table>

*The social level of a family was defined by the highest school grade completed by either the mother or the father of the study subject. Families with parental education of less than 10 grades were defined as belonging to social class I; 10 grades, class II; more than 10 grades, class III.
exposure. The effects of these potentially confounding variables were assessed in bivariate models that included each covariate separately. Additionally, covariates reaching significance levels of .1 or less in the bivariate analyses were selected for the final multivariate model.

Results

Lifetime prevalence rates for most of the atopic diseases and characteristic symptoms reported by the parents were highest in children from families with the highest level of parental education (social class III) and lowest in children from families with the lowest level of parental education (social class I). In children from social class II, prevalence rates were consistently at an intermediate level (Table 2).

In the physical examination, atopic dermatitis (eczema) was diagnosed in 2.0% of the children classified as belonging to social class III and in 3.3% of the children in social class II, while none of the 163 examined children in social class I presented signs of atopic dermatitis. Other health parameters assessed at the physical examination did not reveal significant differences between the social categories. Height, weight, and state of the tonsils were comparable in all 3 groups (data not shown).

Allergic sensitization, defined as a positive response of 3 mm diameter to at least 1 of the 12 tested allergens, was found in 20.6% of the children. The allergic sensitization rates were 22.1%, 20.6%, and 11.5% in the children from social classes III, II, and I, respectively. Allergic sensitization against allergen groups or individual allergens as well as skin reactions to 2 or more antigens showed a similar social gradient (Table 2).

To assess the influence of total serum IgE on the relationship between social class and allergic sensitization, the subjects were stratified into a group with IgE levels above or equal to 140 IU/mL (80th percentile of the entire population) and a group whose IgE levels were below this cutoff point. Although children with high total serum IgE levels presented higher rates of allergic sensitization than children in the low IgE group, the effect of social class on allergic sensitization was evident in both strata (Figure 1).

The distribution of health-relevant factors and lifestyle characteristics among subjects in the 3 social classes is presented in Table 3. These factors were assessed to elucidate living conditions that may explain the observed differences in health outcomes between the social classes.

The influence of potentially confounding covariates on the association between allergic sensitization (dependent variable) and social class (explanatory independent variable) and the existence of interaction were analyzed for 1938 study subjects with complete data for the relevant variables. Children in social classes II and III were compared with participants in social class I, which served as the reference group.

The unadjusted odds ratio for allergic sensitization comparing social class III with class I was 2.1, while the odds ratio comparing class II with class I was 2.0 (Table 4). Adjustment for individual covariates did not substantially influence the association between allergic sensitization and social class. Bivariate models containing covariates reaching a significance level of .1 are presented in Table 4. Interaction, assessed by including into each of the bivariate models mentioned above the interaction variable between social class and the covariate under scrutiny, was not present in any of the tested models. The final multivariate model included all variables selected a priori on theoretical grounds (sex, parental atopy, season when skin-prick test was performed, smoking exposure, and total serum IgE). Only 2 other variables, study region and method of home heating, reached a significance level of .05 or less and met the criteria required for inclusion in the final multivariate model.

Total serum IgE (converted to the natural logarithm and treated as a continuous variable) had a considerable influence on the association between social class and allergic sensitization. Inclusion of the IgE variable in

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TABLE 2—Lifetime Prevalence of Atopic Diseases and Characteristic Symptoms as Reported by Parents and Point Prevalence of Physician-Diagnosed Atopic Dermatitis, Allergic Sensitization, and Elevated Total Serum IgE in Children Aged 5 to 14 Years (n = 2402), by Social Class: Sachsen-Anhalt, Germany, 1992–1993

<table>
<thead>
<tr>
<th>Social class</th>
<th>I</th>
<th>II</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prevalence, % (95% CI)</td>
<td>Prevalence, % (95% CI)</td>
<td>Prevalence, % (95% CI)</td>
<td></td>
</tr>
<tr>
<td>No.</td>
<td>No.</td>
<td>No.</td>
<td></td>
</tr>
<tr>
<td>Atopic disease or symptom (questionnaire information)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asthma or wheezy bronchitis</td>
<td>191</td>
<td>4.7 (2.2, 8.8)</td>
<td>173</td>
</tr>
<tr>
<td>Wheezing (more than once)</td>
<td>190</td>
<td>8.7 (4.9, 13.9)</td>
<td>1180</td>
</tr>
<tr>
<td>Eczema</td>
<td>189</td>
<td>8.5 (4.9, 13.4)</td>
<td></td>
</tr>
<tr>
<td>Eczematous rashes</td>
<td>190</td>
<td>1.1 (0.1, 3.8)</td>
<td></td>
</tr>
<tr>
<td>Allergic rhinitis</td>
<td>190</td>
<td>10.5 (6.5, 15.8)</td>
<td>1180</td>
</tr>
<tr>
<td>Allergic reaction</td>
<td>163</td>
<td>0.0 (0.0, 2.2)</td>
<td></td>
</tr>
<tr>
<td>Atopic dermatitis (dermatologic examination)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total serum IgE ≥ 140 IU/mL</td>
<td>151</td>
<td>27.8 (20.8, 35.7)</td>
<td>984</td>
</tr>
</tbody>
</table>

Note. CI = confidence interval.

*The social level of a family was defined by the highest school grade completed by either the mother or the father of the study subject.

Families with parental education of less than 10 grades were defined as belonging to social class I; 10 grades, class II; more than 10 grades, class III.

*Physician-diagnosed diseases as reported by parents.

*Perceived by parents.

*This value represented the 80th percentile of the entire population.
the bivariate model increased the odds ratios by 25% and 33%, respectively. Concomitant adjustment for all the other covariates in the final multivariate model influenced the magnitude of the association between allergic sensitization and social class and produced odds ratios that were 16% and 25% lower than the ones found in the bivariate model containing IgE as the only covariate, but which were comparable to the unadjusted odds ratios.

**Discussion**

The present study is to our knowledge the first to investigate in detail the social distribution of atopic disorders in a formerly socialist country. Atopic diseases as reported by parents, physician-diagnosed atopic dermatitis (eczema), and allergic sensitization all showed a linear increase with the social gradient.

The data confirmed the assumption that, in spite of a relatively uniform distribution of resources, social inequalities in the former socialist societies of Eastern Europe existed and that these inequalities were reflected in differences in health outcomes.

Since the lifetime occurrence of atopic diseases and symptoms in study subjects was assessed by self-administered parental questionnaires, interpretation of the data should take into account the pitfalls encountered in using this retrospective ascertainment method. Perception of child's symptoms, use of health facilities, and recollection of diagnoses may depend on the parent's educational level, and this may have biased the results. Social differences in the symptom and disease reporting of parents were paralleled by results obtained by objective ascertainment methods such as dermatologic examination and skin-prick tests; we assume, therefore, that parental information was most likely reliable, even though recall and reporting bias cannot be ruled out completely. Furthermore, our findings generally agree with the results obtained in studies performed in Western industrialized countries, which also detected higher prevalence rates of atoplc disorders in higher social groups. 1,2,5,16-18

Given the ubiquitous presence of the outdoor and indoor allergens tested and their allergenic potential, it appears unlikely that allergic sensitization to 1 or more allergens that were not tested might have occurred exclusively in one social group, biasing the study results.

The association between social class and allergic sensitization persisted after adjustment for several potentially confounding variables. Despite higher exposure rates to assumed risk factors, such as parental smoking, dampness in the home, and so forth, children in the lowest social class had rates of allergic sensitization roughly half as high as those found in children in the 2 upper social classes. Rates in the upper and intermediate social classes were comparable, suggesting comparable exposures to risk factors.

Previous studies on allergic sensitization conducted in Western industrialized countries as well as in developing countries detected higher rates of skin-prick test reactivity among members of privileged social groups. 1,2,18,19 In Western European studies atopic dermatitis, ascertained by questionnaires and by objective examinations, and allergic rhinitis were more common in socially privileged groups. 1,6-18 In our study physician-diagnosed asthma or wheezy bronchitis and wheezing showed the same social-class gradient as eczema and allergic rhinitis. Previous reports have presented conflicting results concerning the social-class distribution of asthma and wheezing. Some studies reported more wheezing and more severe asthma symptoms in lower socioeconomic groups, 1,6-18 others could not detect any association. 20-28 and older studies found an excess of asthma in the upper social classes. 1,9,21

The present results are in concordance with previous findings that showed that in European populations with a common ethnic background, prevalence rates for atopic diseases were lower in formerly socialist Eastern European countries than in Western Europe. 2,23 Even if the age distribution of our study populations and the tested allergens are not exactly comparable, our data seem to support previous findings of higher prevalence rates of allergic sensitization in western Germany than in eastern Germany. 22

Our findings of a clear social gradient for atopic disorders in a pediatric population in a formerly socialist country tends to support the hypothesis that factors characteristic of a modern lifestyle may represent a risk factor for atopic diseases and allergic sensitization.
Assuming a strong relationship between modern lifestyle and income and educational level, we expect an unequal exposure to modern lifestyle within Western European societies, a fact that is reflected by a social gradient in atopic diseases and allergic sensitization, and between Western and formerly socialist Eastern European countries. Although living conditions and access to consumer goods in formerly socialist countries were much more uniform than in the West, disparities between social groups did exist, as shown by our study. It could be speculated that an increased exposure to modern lifestyle is a risk factor for an increase in prevalence rates of atopic diseases and skin test reactivity.

It is unknown at this time what the underlying factors characterizing a modern lifestyle are, but housing conditions are plausible candidates. Even though the social-class effect for allergic sensitization remained after adjustment for housing variables, alone or combined, we cannot rule out the possibility that indoor factors that are correlates of educational status and that were not controlled for in our study may be responsible for the observed differences in health outcomes. Dust-mite allergens in the home environment, which seem to be highly dependent on a favorable domestic microclimate, have been incriminated as possible causes for allergic sensitization. 14-30 Other factors that are possibly associated with social class—for example, helminthic infections, early social contacts, close contact with pets, travel habits, frequent use of soaps or detergents, use of chemical cleaning products, exposure to ultraviolet light, higher maternal age at birth, and dietary characteristics—need to be considered as possible explanations for the described results.

### Acknowledgments
The study was supported exclusively by a governmental funding source, the Federal Environmental Agency (Umweltbundesamt), grant Z1.5-917420/15. Dr. I. F. Goldstein was supported by grant F6E TWO 1976 from the Fogarty International Center, National Institutes of Health.

The authors thank all collaborators who assisted in fieldwork and data management. Especially we would like to thank Mr. H. Schneller for data handling; Dr. H. Adam and Dr. H. Bach for examining the children; Dr. I. Hörhold, Dr. D. Bodesheim, Dr. I. Keller, and Dr. S. Löwe for collecting the blood specimens; Dr. R. Stiller-Winkler for laboratory analysis; Mr. G. Burmester and Ms. B. Hollstein for local assistance; and Dr. U. Härkel for statistical and methodological advice.
TABLE 4—Crude and Adjusted Odds Ratios (with 95% Confidence Intervals) for Allergic Sensitization Among Children Aged 5 to 14 Years, by Social Class: Sachsen-Anhalt, Germany, 1992–1993

<table>
<thead>
<tr>
<th>Social Classa</th>
<th>II (n = 964)</th>
<th>III (n = 830)</th>
<th>$\chi^2$</th>
<th>df</th>
</tr>
</thead>
<tbody>
<tr>
<td>Odds ratio, unadjusted</td>
<td>2.0 (1.2, 3.3)</td>
<td>2.1 (1.3, 3.6)</td>
<td>9.2</td>
<td>2</td>
</tr>
<tr>
<td>Odds ratio adjusted for individual covariates</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>log (total serum IgE)</td>
<td>2.5 (1.4, 4.4)</td>
<td>2.8 (1.6, 5.0)</td>
<td>196.4</td>
<td>3</td>
</tr>
<tr>
<td>Sex</td>
<td>1.9 (1.1, 3.2)</td>
<td>2.1 (1.2, 3.6)</td>
<td>42.0</td>
<td>3</td>
</tr>
<tr>
<td>Parental atopy</td>
<td>1.9 (1.1, 3.2)</td>
<td>1.9 (1.1, 3.3)</td>
<td>29.3</td>
<td>4</td>
</tr>
<tr>
<td>Season when test was performed</td>
<td>1.9 (1.1, 3.3)</td>
<td>2.1 (1.2, 3.6)</td>
<td>28.4</td>
<td>5</td>
</tr>
<tr>
<td>Method of home heating</td>
<td>1.9 (1.1, 3.2)</td>
<td>2.0 (1.2, 3.4)</td>
<td>15.5</td>
<td>3</td>
</tr>
<tr>
<td>Study region</td>
<td>1.9 (1.1, 3.3)</td>
<td>2.1 (1.2, 3.6)</td>
<td>15.2</td>
<td>2</td>
</tr>
<tr>
<td>Presence of wall-to-wall carpeting</td>
<td>1.9 (1.1, 3.2)</td>
<td>2.0 (1.2, 3.5)</td>
<td>12.2</td>
<td>3</td>
</tr>
<tr>
<td>Smoking exposure</td>
<td>1.9 (1.1, 3.2)</td>
<td>2.0 (1.2, 3.4)</td>
<td>11.4</td>
<td>4</td>
</tr>
<tr>
<td>Odds ratio adjusted for log (total serum IgE) + sex + parental atopy + season when test was performed + smoking exposure + study region + method of home heating</td>
<td>2.1 (1.2, 3.7)</td>
<td>2.1 (1.2, 3.8)</td>
<td>272</td>
<td>14</td>
</tr>
</tbody>
</table>

Note. Odds ratios are from multivariate analyses of data for the 1938 subjects with complete data for dependent and independent variables. Social class I (n = 144) was the reference category.

aThe social level of a family was defined by the highest school grade completed by either the mother or the father of the study subject. Families with parental education of less than 10 grades were defined as belonging to social class I; 10 grades, class II; more than 10 grades, class III.

References