

Asthma and allergies among children in West and East Germany: a comparison between Münster and Greifswald using the ISAAC phase I protocol

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ABSTRACT: The study aim was to compare the prevalence of asthma, rhinitis and eczema in children living in Münster, western Germany, and Greifswald, eastern Germany, and to investigate associations of several characteristics and exposures with atopic disease symptoms.

In 1994 and 1995, questionnaire information was gathered on 5–8 yr old children (n=3,741 in Münster and n=2,857 in Greifswald) and 12–15 yr olds (n=4,003 and n=3,153, respectively) using the phase I protocol of the International Study of Asthma and Allergies in Childhood (ISAAC).

The 12 month period prevalences of reported atopic disease symptoms in 5–8 yr olds were generally higher in Münster than in Greifswald, whereas only a few prevalence differences were observed in 12–15 yr olds. In both age groups the reported lifetime prevalences of asthma, hay fever and eczema were lower in Greifswald. Indoor exposures such as wood or coal heating and feather bedding were negatively associated with symptoms, whereas exposures such as truck traffic in a residential street or active smoking were positively associated with symptoms. Wood or coal heating could partly explain the prevalence difference of allergic rhinitis symptoms among 5–8 yr olds between Münster and Greifswald.

The findings provide additional evidence for a role of several characteristics and exposures as potential determinants of asthma and allergies in children.

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A number of epidemiological studies have observed an increase in the prevalence of allergic diseases in several countries [1–6]. This is thought to be due mainly to factors associated with "western lifestyle", with its rapid change of environmental and behavioural factors over the past decades. Indirect support for this hypothesis comes from epidemiological studies comparing populations [7] in western and eastern Europe [8, 9], especially the ethnically similar populations of West and East Germany [10–12].

The International Study of Asthma and Allergies in Childhood (ISAAC) was initiated to develop a standardized methodology and to facilitate comparisons of national and international data in order to maximize the value of epidemiological research into asthma and allergies [13, 14]. Germany contributes to phase one of the ISAAC project [13, 14] with two national centres: the city of Münster in north-west Germany and the area of Greifswald in the north-eastern part of Germany, close to the Baltic Sea, allowing comparisons of disease prevalences and exposure conditions between populations in West and East Germany.

The aims of this study were: 1) to compare the prevalence of symptoms of asthma, allergic rhinitis and eczema between Münster and Greifswald; and 2) to evaluate the impact of several characteristics and exposures on current

atopic disease symptoms in 5–8 yr old and 12–15 yr old children living in the two study areas.

Methods

Study area and population

Münster has approximately 270,000 inhabitants with a relatively affluent population. It is mainly an administrative and educational centre, with only a small amount of industry and a wide range of residential settings, including suburban and rural areas. The Greifswald area has a population of about 230,000 inhabitants and consists of the coastal city of Greifswald and two islands in the Baltic Sea, Rügen and Usedom, which are located in relatively close proximity (30–70 km) to the city of Greifswald; the study area has a mainly rural character with very few industrial settings. With the exception of two small districts in the far north of the island of Rügen, all schools in the Greifswald area participated in the study. In Münster a random sample of schools was selected. Both surveys targeted all children in those two school grades with the highest proportion of 6–7 and 13–14 yr olds. All children

Table 1. – Characteristics of the study population

		5–8 yr olds*		12–15 yr olds**	
		Münster n=3458 ⁺	Greifswald n=2813 ⁺	Münster n=3745 ⁺	Greifswald n=3107 ⁺
Age	5 yrs	15	-	656	89
	6 yrs	1108	419	1529	1297
	7 yrs	1667	1394	1198	1389
	8 yrs	668	1000	362	332
Sex	Male	1752	1444	1858	1508
	Female	1706	1369	1887	1599
Data collection period		August 1994–January 1995	January 1995	August 1994–January 1995	April 1995–May 1995

*: parental reports; **: self-reports; +: participants with German nationality and known age and sex.

in these classes were studied and analysed and are referred to as "5–8 yr olds" and "12–15 yr olds", respectively. In Münster data were collected from August 1994 to January 1995; in the Greifswald area, data were collected in 5–8 yr olds in January 1995 and in 12–15 yr olds from April to May 1995 (table 1). Field work was conducted in the same standardized way in both study areas [15].

Study instruments

Study instruments comprised the parental ISAAC questionnaire on asthma, rhinitis and eczema for 5–8 yr olds and the corresponding questionnaire for self-completion by 12–15 yr olds [13]. The latter group also completed the

Caucasian version of the ISAAC video questionnaire on wheezing [16]. Other measurements of atopic disease, such as skin-prick test, measurement of immunoglobulin (Ig)E or lung function, were not performed. We asked mostly identical questions on lifestyle, environmental exposures and other characteristics in both study areas and age groups [13, 14].

Current atopic disease symptoms

Based on the information of the ISAAC core questionnaire items (table 2) we defined the following outcome variables for assessing current atopic disease symptoms (table 3). Participants were classified as having asthma

Table 2. – Crude prevalences of symptoms of asthma, rhinitis and eczema according to the International Study of Asthma and Allergies in Childhood (ISAAC) questionnaires

	5–8 yr olds ⁺		12–15 yr olds [‡]	
	Münster n=3458 [†]	Greifswald n=2813 [†]	Münster 3745 [†]	Greifswald n=3107 [†]
Asthma questions (written questionnaire)				
Wheeze ever	28.6***	16.9	23.7*	21.4
Current wheeze	10.0***	7.5	14.5	13.7
Current attacks of wheeze (≥1)	8.4***	5.8	13.1	12.5
Current sleep disturbance (any)	5.5**	3.8	4.2	4.1
Speech-disturbing wheeze	2.2	1.8	6.2	5.3
Asthma ever	3.8	3.0	7.1***	4.3
Current wheeze with exercise	6.3***	4.0	22.1	24.1
Current night cough	14.5***	8.4	20.7	22.3
Asthma questions (video questionnaire)				
Current wheeze while at rest	NA	NA	5.8	4.8
Current wheeze with exercise	NA	NA	17.0	17.9
Current sleep disturbance due to wheeze	NA	NA	3.8	3.5
Current sleep disturbance due to cough	NA	NA	10.9	9.7
Current severe wheeze	NA	NA	4.2*	3.1
Rhinitis questions				
Nose symptoms ever	15.1***	12.0	37.3	38.3
Current nose symptoms	12.8**	10.6	29.6	29.8
Current eye symptoms	6.0*	4.6	16.0***	12.9
Interference with activities (any)	8.8*	7.1	15.7	18.3**
Hay fever ever	5.7***	2.8	21.5***	11.9
Eczema questions				
Rash ever	13.6**	11.0	13.1	11.9
Current rash	8.2	7.8	9.3	8.4
Involvement of flexural areas	9.1**	7.1	9.0**	7.0
Onset <2 yrs	5.5**	4.0	NA	NA
Current rash cleared	7.0***	3.4	8.1***	4.8
Waking due to rash (any)	2.7	3.1	2.8	2.6
Eczema ever	14.7***	9.9	10.6***	5.9

Values are percentages. +: parental reports; ‡: self-reports; †: participants with German nationality and known age and sex; *: p<0.05; **: p<0.01; ***: p<0.001; NA: not asked; ever: life-time prevalence; current: 12 month period prevalence.

Table 3. – Crude 12 month period prevalences of current atopic disease symptoms, by age group, study area and gender

Current atopic disease symptom [¶]	5–8 yr olds ⁺						12–15 yr olds [‡]					
	Münster n=3458 [†]			Greifswald n=2813 [†]			Münster n=3745 [†]			Greifswald n=3107 [†]		
	F	M	Total	F	M	Total	F	M	Total	F	M	Total
Asthma symptoms (written quest.)	6.7	10.2	8.5***	4.3	7.8	6.1	14.0	12.1	13.1	14.5	11.1	12.8
Asthma symptoms (video quest.)	NA	NA	NA	NA	NA	NA	23.2	16.5	19.9	25.6	15.2	20.5
Allergic rhinitis symptoms	3.9	7.5	5.7*	3.4	5.6	4.5	15.9	13.5	14.7*	14.1	10.9	12.6
Eczema symptoms	6.8	7.4	7.1	8.4	5.6	7.0	9.4	5.1	7.3	9.3	4.0	6.7

Values are percentages. ⁺: parental reports; [‡]: self-reports; [¶]: definition of current atopic disease symptoms in methods; [†]: participants with German nationality and known age and sex; F: female; M: male; quest.: questionnaire. *: p<0.05; ***: p<0.001. NA: not asked.

symptoms if they had in the last 12 months: 1) wheezing or whistling in the chest; and 2) at least one attack of wheezing, sleep disturbance due to wheezing or speech limiting wheeze. Participants were classified as having allergic rhinitis symptoms if they had in the last 12 months: 1) a problem with sneezing, or a runny or a blocked nose when not having a cold or the flu; and 2) itchy, watery eyes at the same time. Those who had in the last 12 months: 1) an itchy rash which was coming and going for at least 6 months; and 2) an involvement of flexural areas at any time, were classified as having eczema symptoms. These combinations of ISAAC core questions were chosen to achieve higher specificity for the respective diseases. Twelve to fifteen year olds who reported experiencing symptoms during the last year, similar to those adolescents depicted in the first three video scenes, were defined as having asthma symptoms, based on the video questionnaire. The symptom-based health-outcome variables were used instead of information on the lifetime diagnoses of asthma, hay fever and eczema to minimize the potential for diagnostic labelling bias.

Data analysis

To keep the study populations of both study areas as similar as possible with regard to ethnic background, the

analysis was restricted to participants of German nationality. Participants without information on age and sex were excluded.

We present crude prevalences of symptoms of asthma, rhinitis and eczema and disease-related questions of the ISAAC questionnaire (table 2), of the current atopic disease symptoms (table 3) and of several characteristics and exposures (table 4) for Münster and Greifswald. Prevalences were calculated by dividing the number of participants who responded affirmatively to a question by the number of those who answered the question. Two-tailed Fisher's Exact Test was calculated to compare prevalences and frequencies between the two study areas within the two age groups (tables 2, 3, and 4). To evaluate the association of different characteristics and exposures with current atopic disease symptoms, multivariate logistic regression (MLR) analysis, stratified by age group and study area, was used to calculate age- and sex-adjusted prevalence odds ratios (PORs) [17] although neither age nor sex showed a strong confounding effect. To evaluate the effect of characteristics or exposures on the prevalence differences between the study areas, the datasets within age groups were combined and MLR analyses were performed including a 0–1 Greifswald/Münster area variable. Participants with missing values on questions were excluded from analyses involving these questions.

Table 4. – Frequency of characteristics and exposures

Characteristics and exposures	5–8 yr olds ⁺		12–15 yrs olds [‡]	
	Münster n=3458 [†]	Greifswald n=2813 [†]	Münster n=3745 [†]	Greifswald n=3107 [†]
Wood or coal heating				
At present	6.7	32.1***	12.2	28.8***
During 1st year of life	10.5	67.1***	NA	NA
Any parental atopic disease	35.3***	20.2	24.6***	15.3
Asthma	8.9***	4.7	5.3***	3.3
Hay fever	27.5***	11.7	19.4***	10.9
Eczema	10.6*	8.7	3.4*	2.5
Feather bedding	64.4	67.2*	NA	NA
Allergen avoidance	13.5***	8.3	NA	NA
Frequency of truck traffic				
Never	22.0***	8.5	26.6***	6.0
Seldom	53.8	51.5	52.2	53.7
Frequent or constant	24.3	39.9***	21.2	40.3***
Mould or wet spots in bedroom	5.1	12.7***	NA	9.0
Environmental tobacco smoke	55.5	56.4	48.1	54.7***
Active smoking in last month	NA	NA	21.8	38.5***
Parental school education				
≤11 yrs	48.4	79.9***	NA	NA
>11 yrs	51.6***	20.1	NA	NA
Furry pets	35.5	44.5***	50.4	61.0***

Values are percentages. ⁺: parental reports; [‡]: self-reports; [†]: participants with German nationality and known age and sex; *: p<0.05, ***: p<0.001. NA: not asked.

Results

The parental ISAAC questionnaire was completed for 3,741 5–8 yr olds in Münster (response rate 81.2%) and for 2,857 5–8 yr olds in Greifswald (response rate 85.9%). The questionnaire for the 12–15 yr olds was completed by 4,003 participants in Münster and 3,153 in Greifswald (response rates 94.0% and 87.6%, respectively). Exclusion of non-German participants and those with no information on age or sex reduced the number of 5–8 yr olds to 3,458 in Münster and 2,813 in Greifswald and of 12–15 year olds to 3,745 in Münster and 3,107 in Greifswald (table 1).

Prevalences of symptoms

Table 2 shows crude prevalences of symptoms of asthma, rhinitis and eczema obtained with the ISAAC questionnaire, comparing 5–8 yr olds and 12–15 yr olds in Münster and Greifswald. Prevalences in 5–8 yr olds were generally higher in Münster. In 12–15 yr olds, however, some prevalences of respiratory symptoms were higher in Greifswald. No statistically significant difference between Münster and Greifswald was observed for asthma symptoms in 12–15 yr olds, except for wheeze ever (written questionnaire) and severe wheeze (video questionnaire). The lifetime prevalences of the diagnosis of asthma, hay fever and eczema were consistently higher in Münster, although no statistically significant difference between the study areas was found for the prevalence of the lifetime diagnosis of asthma in 5–8 yr olds.

Table 3 gives the 12 month period prevalences of the current atopic disease symptoms derived from the ISAAC questionnaire by age group and gender. The prevalences of symptoms of asthma in 5–8 yr olds and of allergic rhinitis in both age groups were statistically significantly higher in Münster. No statistically significant prevalence differences between the two study areas were observed for asthma symptoms in 12–15 yr olds, and for eczema symptoms in both age groups. For 5–8 yr olds, parents reported respiratory symptoms more often in boys; for eczema symptoms, however, the prevalence was similar for boys and girls in Münster and higher for girls in Greifswald. In 12–15 yr olds all current atopic disease symptoms were more often reported by girls in both study areas.

Frequencies of characteristics and exposures

Frequencies of characteristics and exposures are shown in table 4. Wood or coal heating was more often reported in Greifswald. This type of heating has decreased drastically (from 67.1% during the child's first year of life to 32.1% at present) and may also be an indicator of exposure changes within flats and buildings in eastern Germany. Parental atopy (*i.e.* parental history of asthma, hay fever or eczema) was more frequently reported in both age groups in Münster; the difference in the prevalence of parental atopy between the age groups probably reflects underreporting of parental atopic disease by 12–15 yr olds. The frequency of feather bedding was slightly higher in Greifswald. Fewer parents in Greifswald indicated avoidance of either carpets in the child's bedroom or of pets due

to an allergic disease of a family member (allergen avoidance). With regard to the self-reported frequency of truck traffic in a residential street, the highest exposure category was more often reported in Greifswald. Mould or wet spots in the child's bedroom were reported less often for 5–8 yr olds in Münster than in Greifswald. The frequency of exposure to environmental tobacco smoke (ETS) at home was higher in Greifswald and the proportion of 12–15 yr olds reporting active smoking during the last month was almost twice as high in the East German study area. A higher percentage of parents in Münster had more than 11 yrs of school education and more participants in Greifswald indicated that they had furry pets (*i.e.* cats, dogs, hamsters, guinea-pigs or rabbits) at home.

Multivariate logistic regression analysis

Table 5 refers to 5–8 yr olds and gives age and sex-adjusted PORs with 95% confidence intervals (95% CIs) stratified by study area for the associations of characteristics and exposures with current atopic disease symptoms. Wood or coal heating was inversely associated with allergic rhinitis symptoms in Greifswald. This type of heating during the first year of life was also inversely associated with asthma and allergic rhinitis symptoms for participants in Münster. Parental atopy was positively associated with atopic disease symptoms in both study areas. Inverse associations were found between feather bedding and atopic disease symptoms, which persisted after adjusting for "parental atopy" and "allergen avoidance" (adjusted PORs were for symptoms of asthma in Münster 0.48 (95% CI 0.37–0.62) and Greifswald 0.58 (95% CI 0.41–0.81), for symptoms of allergic rhinitis in Münster 0.70 (95% CI 0.51–0.96) and in Greifswald 0.64 (95% CI 0.44–0.94), and for symptoms of eczema in Münster 0.77 (95% CI 0.58–1.03) and in Greifswald 0.71 (95% CI 0.52–0.97), respectively). Reported frequent or constant truck traffic in a residential street was positively associated with symptoms in both study areas. However, statistically significant associations were only found for asthma and eczema symptoms in Münster. Mould or wet spots in the child's bedroom were positively related to atopic disease symptoms with statistically significant associations only for asthma symptoms. Associations of ETS at home with atopic disease symptoms were only weak, whereas parental school education was positively associated with allergic rhinitis symptoms. Ownership of furry pets showed only weak associations with current atopic disease symptoms; adjusting for "allergen avoidance" did not change these PORs substantially. Male gender was positively associated with symptoms of asthma and allergic rhinitis, but was negatively associated with eczema symptoms in Greifswald.

Table 6 gives PORs for 12–15 yr olds. Wood or coal heating was inversely associated with allergic rhinitis symptoms in both study areas, with a statistically significant estimate for Greifswald. In Münster this exposure showed a positive association with asthma symptoms assessed by video questionnaire. Parental atopy was positively associated with atopic disease symptoms, as was frequent or constant truck traffic in a residential street with statistically significant estimates for asthma symptoms (except for asthma symptoms obtained by written questionnaire in Greifswald) and allergic rhinitis symptoms. Weak or no

Table 5. — Prevalence odds ratios for the association of characteristics and exposures with current atopic disease symptoms. Results for 5–8 yr olds

	Asthma symptoms		Allergic rhinitis symptoms		Eczema symptoms	
	Münster	Greifswald	Münster	Greifswald	Münster	Greifswald
Wood or coal heating						
In first year (yes vs no [†])	0.51** (0.31–0.85)	1.27 (0.89–1.81)	0.45* (0.23–0.85)	0.52*** (0.36–0.75)	0.64 (0.39–1.06)	0.89 (0.65–1.21)
At present (yes vs no [†])	0.91 (0.55–1.50)	1.19 (0.85–1.66)	1.02 (0.57–1.83)	0.54** (0.35–0.84)	1.56 (0.99–2.45)	0.84 (0.60–1.16)
Parental atopy (yes vs no [†])	1.78*** (1.40–2.28)	3.00*** (2.16–4.17)	2.70*** (2.01–3.64)	4.28*** (2.97–6.17)	2.16*** (1.66–2.82)	3.61*** (2.66–4.89)
Feather bedding (yes vs no [†])	0.39*** (0.31–0.50)	0.48*** (0.35–0.66)	0.58*** (0.43–0.77)	0.53*** (0.37–0.76)	0.64*** (0.49–0.83)	0.63** (0.47–0.85)
Truck traffic (never [†])						
Seldom	1.35 (0.96–1.90)	0.73 (0.41–1.31)	0.97 (0.66–1.42)	1.54 (0.70–3.41)	1.61* (1.09–2.37)	1.20 (0.66–2.17)
Frequent or constant	1.79** (1.23–2.60)	1.14 (0.64–2.03)	1.31 (0.86–1.99)	1.67 (0.75–3.73)	2.03*** (1.34–3.09)	1.41 (0.77–2.58)
Mould or wet spots in bedroom (yes vs no [†])	1.71* (1.08–2.71)	1.77** (1.18–2.65)	1.58 (0.91–2.75)	1.37 (0.85–2.23)	1.37 (0.81–2.34)	1.05 (0.68–1.63)
ETS at home (never [†])						
Seldom	1.12 (0.84–1.49)	0.96 (0.67–1.37)	0.96 (0.68–1.34)	0.77 (0.51–1.16)	1.32 (0.99–1.77)	0.80 (0.57–1.11)
Constant	1.19 (0.88–1.61)	0.96 (0.62–1.47)	0.83 (0.57–1.21)	0.83 (0.51–1.36)	0.77 (0.54–1.10)	0.72 (0.47–1.09)
Parental school education (>11 yrs vs ≤11 yrs [†])	1.01 (0.78–1.30)	1.14 (0.78–1.66)	1.36* (1.01–1.85)	1.74** (1.16–2.62)	1.03 (0.78–1.35)	1.21 (0.85–1.73)
Furry pets (yes vs no [†])	1.25 (0.97–1.60)	0.90 (0.65–1.25)	0.81 (0.59–1.11)	0.74 (0.51–1.08)	0.92 (0.70–1.22)	1.12 (0.84–1.51)
Sex [‡] (male vs female [†])	1.58*** (1.23–2.02)	1.88*** (1.35–2.61)	1.98*** (1.46–2.67)	1.68*** (1.16–2.43)	1.09 (0.84–1.42)	0.64** (0.47–0.86)
Study area [‡] (Münster vs Greifswald [†] in joint analysis)	1.40*** (1.14–1.72)		1.37** (1.08–1.73)		1.06 (0.87–1.30)	
Study area ^{‡‡} (Münster vs Greifswald [†] in joint analysis)	1.26 (0.94–1.69)		0.81 (0.59–1.13)		0.85 (0.64–1.13)	

Values are age and sex-adjusted prevalence odds ratios, and 95% confidence intervals in parentheses, parental reports for children with German nationality and known age and sex (n=3,458 in Münster and 2,813 in Greifswald). [†]: reference group; [‡]: adjusted for age only; ^{‡‡}: adjusted for age and sex; ^{‡‡‡}: additionally adjusted for wood or coal heating at present and during first year of life, parental atopy, feather bedding, allergen avoidance, truck traffic, mould or wet spots in bedroom, environmental tobacco smoke (ETS), parental school education and furry pets; *: p<0.05; **: p<0.01; ***: p<0.001. For definition of current atopic disease symptoms, see methods.

associations were observed for mould or wet spots in the bedroom. Exposure to ETS was associated with asthma symptoms in Greifswald, whereas active smoking during the last month was positively associated with all atopic respiratory symptoms in both study areas and with eczema symptoms in Münster. Having furry pets at home showed weak or no associations with symptoms, and male gender was inversely associated with all atopic disease symptoms in both study areas.

In pooled age and sex-adjusted multivariate data analyses, asthma symptoms in 5–8 yr olds and allergic rhinitis symptoms in both age groups were positively associated with the study area Münster (tables 5 and 6).

When parental atopy was included in the joint analysis of 5–8 yr olds, age and sex-adjusted PORs decreased considerably for the association of the study area Münster with asthma symptoms, from 1.40 (95% CI 1.14–1.72) to 1.23 (95% CI 1.00–1.52), with allergic rhinitis symptoms, from 1.37 (95% CI 1.08–1.73) to 1.10 (95% CI 0.86–1.40), and with eczema symptoms from 1.06 (95% CI 0.87–1.30) to 0.89 (95% CI 0.72–1.10). Including instead the variable "wood or coal heating during the first year of life" had a similar effect on the association between the study area and allergic rhinitis symptoms and

reduced the POR from 1.37 (95% CI 1.08–1.73) to 0.93 (95% CI 0.71–1.23); including both "wood or coal heating during the first year of life" and "parental atopy" jointly in the latter age and sex-adjusted model decreased the POR to 0.77 (95% CI 0.58–1.03). Additionally, adjusting for the other investigated factors listed in table 5 did not change the estimates much further in 5–8 yr olds (PORs for asthma symptoms 1.26 (95% CI 0.94–1.69), for allergic rhinitis symptoms 0.81 (95% CI 0.59–1.13), and for eczema symptoms 0.85 (0.64–1.13); table 5). In 12–15 yr olds, adjustment for all the factors listed in table 6 had little effect on the respective age and sex-adjusted PORs (table 6).

Discussion

The determinants of the differences in atopic disease prevalence between East and West Germany are currently the focus of intense research. We were able to evaluate the influence of several characteristics and exposures which may play a role in the two study areas.

An inverse association between wood or coal heating and the prevalence of allergic rhinitis symptoms was observed in 5–8 yr olds, and to a lesser extent in 12–15 yr

Table 6. — Prevalence odds ratios for the association of characteristics and exposures with current atopic disease symptoms. Results for 12–15 yr olds

	Asthma symptoms (written questionnaire)		Asthma symptoms (video questionnaire)		Allergic rhinitis symptoms		Eczema symptoms	
	Münster	Greifswald	Münster	Greifswald	Münster	Greifswald	Münster	Greifswald
Wood or coal heating (yes vs no [†])	1.02 (0.74–1.41)	0.94 (0.74–1.20)	1.38* (1.07–1.77)	0.91 (0.75–1.12)	0.79 (0.57–1.09)	0.77* (0.60–0.99)	1.17 (0.79–1.74)	0.78 (0.56–1.09)
Parental atopy (yes vs no [†])	2.06*** (1.69–2.53)	2.23*** (1.73–2.87)	1.65*** (1.39–1.97)	1.69*** (1.34–2.13)	2.32*** (1.92–2.81)	2.18*** (1.69–2.81)	1.87*** (1.44–2.43)	1.35 (0.95–1.94)
Truck traffic (never [†]) Seldom	1.06 (0.83–1.36)	1.05 (0.63–1.73)	1.10 (0.90–1.35)	1.27 (0.82–1.97)	1.18 (0.93–1.48)	1.18 (0.69–2.03)	0.71* (0.52–0.97)	0.77 (0.41–1.45)
Frequent or constant	1.68*** (1.28–2.21)	1.46 (0.88–2.41)	1.60*** (1.26–2.02)	1.72* (1.11–2.67)	1.75*** (1.34–2.27)	1.96* (1.15–3.35)	1.38 (0.99–1.92)	1.21 (0.65–2.25)
Mould or wet spots in bedroom (yes vs no [†])	NA	0.79 (0.53–1.18)	NA	1.13 (0.83–1.53)	NA	0.84 (0.57–1.25)	NA	1.25 (0.79–1.97)
ETS exposure at home (yes vs no [†])	1.10 (0.90–1.34)	1.47*** (1.18–1.83)	1.14 (0.96–1.34)	1.33** (1.11–1.60)	1.21* (1.00–1.46)	0.99 (0.80–1.23)	1.03 (0.80–1.33)	1.02 (0.77–1.36)
Active smoking in last month (yes vs no [†])	1.88*** (1.51–2.34)	1.91*** (1.54–2.38)	1.85*** (1.53–2.24)	1.59*** (1.32–1.91)	1.44*** (1.16–1.78)	1.29* (1.04–1.61)	1.39* (1.04–1.87)	1.25 (0.93–1.67)
Furry pets (yes vs no [†])	0.89 (0.74–1.08)	0.81 (0.65–1.01)	1.03 (0.88–1.21)	0.90 (0.75–1.09)	0.94 (0.78–1.13)	0.80* (0.64–1.00)	0.94 (0.73–1.20)	0.97 (0.72–1.30)
Sex [‡] (male vs female [†])	0.83 (0.69–1.01)	0.73** (0.59–0.90)	0.66*** (0.56–0.78)	0.52*** (0.43–0.63)	0.82* (0.68–0.98)	0.74** (0.60–0.92)	0.52*** (0.40–0.67)	0.41*** (0.30–0.56)
Study area [‡] (Münster vs Greifswald [†] in joint analysis)	1.05 (0.91–1.21)		0.95 (0.84–1.08)		1.23** (1.07–1.42)		1.09 (0.90–1.32)	
Study area ^{‡‡} (Münster vs Greifswald [†] in joint analysis)	1.06 (0.89–1.26)		1.02 (0.88–1.18)		1.26** (1.06–1.49)		1.04 (0.83–1.30)	

Values are age and sex-adjusted prevalence odds ratios, and 95% confidence intervals in parentheses, self-reports of adolescents with German nationality and known age and sex (n=3,745 in Münster and 3,107 in Greifswald). [†]: reference group; [‡]: adjusted for age only; [‡]: adjusted for age and sex; ^{‡‡}: additionally adjusted for wood or coal heating, parental atopy, truck traffic, environmental tobacco smoke (ETS), active smoking in the last month, and furry pets; *: p<0.05; **: p<0.01; ***: p<0.001. NA: not asked. For definition of current atopic disease symptoms, see methods.

olds. Similar results have recently been reported for 9–11 yr olds in rural Bavaria using measurements of bronchial hyperresponsiveness (BHR) and atopic sensitization as outcome variables [18]. A possible mechanism to explain this association may be an increased risk in early childhood of upper and lower respiratory tract infections when exposed to wood burning stoves at home, which may play a protective role in the development of atopic diseases [18–20].

In 5–8 yr olds, only wood or coal heating during the first year of life and a history of parental atopy were able to explain a considerable amount of the observed prevalence difference for allergic rhinitis symptoms between Münster and Greifswald. Similarly, in a recent study in adults [12] "wood or coal heating" and a "reported family history of atopy among parents and siblings" were also able to explain differences in skin-prick test reactivity to common aeroallergens in West and East German populations from Erfurt and Hamburg, indicating the importance of these factors for East-West differences in prevalence rates. With regard to the observed effect of parental atopy we think that this factor is likely to be a surrogate measure for some environmental factors rather than only a genetic disposition, since the populations in West and East Germany are ethnically similar. However, differences in diagnostic labelling of parental atopy in the two study areas may also partly explain these findings.

Feather bedding was negatively associated with symptoms of asthma, allergic rhinitis and eczema. This association is not unexpected because avoidance of feather bedding is frequently recommended as a preventive measure to atopic individuals. In addition, parents who themselves suffer from an atopic disease may have avoided feather bedding even before their child developed symptoms. However, we reduced this potential bias by controlling for parental atopy and for indicators of allergen avoidance and still observed strong negative associations for symptoms of asthma and to a lesser extent for symptoms of allergic rhinitis and eczema. Similar results were recently reported for feather bedding and asthma symptoms [21, 22]. Thus, our findings support the hypothesis that feather bedding is, independent from parental atopy and indicators of allergen avoidance, negatively associated with asthma symptoms [21, 22] and, to a lesser extent, with symptoms of allergic rhinitis and eczema. Further research, however, is needed before any causal mechanism concerning the observed negative association between the use of feather bedding and atopic disease symptoms can be assumed [22–24].

Results of our prior studies in 12–15 yr olds [25, 26] in Münster and Bochum of a positive association between the self-reported frequency of truck traffic in residential street and symptoms of asthma and allergic rhinitis could be confirmed in Greifswald. In addition, statistically significant positive associations for frequent or constant

truck traffic with asthma and eczema symptoms were also found in 5–8 yr olds in Münster. Since misclassification due to parental- and self-reports of exposure may have influenced these findings, we do not know whether our results indicate a causal association or a reflection of concerns among parents and adolescents about possible ill effects of motor vehicle traffic. However, besides other studies a recent Dutch investigation using "objective" measures of exposure and outcome variables (*i.e.* traffic count data, distance of motorway from home, air pollution measurements in classrooms and lung function measurements) also found adverse effects of motor vehicle traffic on lung function and respiratory symptoms of children which appeared to be associated mainly with diesel powered truck traffic [27].

In 5–8 yr olds we found a positive association of reported moulds or wet spots in the child's bedroom with symptoms of asthma. While such a finding has been frequently observed, it has been suggested that parental over-reporting may account for much of this association [28]. Therefore, our results in 5–8 yr olds should be interpreted with caution. However, recent case-control studies in children and adults [29, 30], using objective information on dampness in homes, have also shown positive associations with respiratory symptoms and asthma.

Environmental tobacco smoke showed weak or no associations with atopic disease symptoms in 5–8 yr olds, but it was positively and statistically significantly associated with asthma symptoms in 12–15 yr olds in Greifswald. Furthermore, active smoking during the last month was one of the strongest factors associated with respiratory atopic disease symptoms in 12–15 yr olds. Because it is clearly an avoidable risk factor, more emphasis should be put on primary prevention helping young people to refrain from smoking [31].

Besides questionnaire information, no other measurements of atopic disease, such as skin-prick test, measurement of IgE concentration or lung function, were performed. However, the ISAAC written and video questionnaires were especially designed for population based surveys and they have been shown to be valid instruments to assess the prevalence and severity of atopic disease symptoms [13, 14, 16, 32–35]. It is an important feature of ISAAC that the assessment of asthma, rhinitis and eczema relies mainly on symptoms and not on diagnosed disease, since the latter may be strongly influenced by diagnostic fashion in different places. Therefore, our outcome variables will adequately reflect the atopic disease status of the participants.

The data collection periods in the two study areas were not identical (table 1) and seasonal effects may account for some of the observed prevalence differences [36]. Because all 12–15 yr olds in Greifswald were examined during the pollen season in April and May, the slightly higher prevalences for some rhinitis symptoms shown in table 2 might be due to seasonal factors.

We found considerable differences in the lifetime prevalences of diagnosed asthma, hay fever and eczema between Münster and Greifswald (table 2), which were also observed among the parents (table 4). Similar East-West differences in the lifetime prevalence of diagnosed atopic diseases were previously reported in children [11] and adults [12] and probably reflect, apart from possible differences in diagnostic labelling, real differences in disease prevalences.

In conclusion, we have described several factors that may play a role in the aetiology of atopic disease symptoms. Some of them, such as exposure to wood or coal heating during the first year of life, or parental atopy, were able to explain a considerable amount of the prevalence differences in 5–8 yr olds between the two study areas. Due to the cross-sectional nature of the study and the comparison of only two areas, our findings concerning East-West prevalence differences should be interpreted with caution. With regard to the investigation of risk factors of atopic disease, however, our data from Münster and Greifswald provide additional evidence for a role of several characteristics and exposures, such as wood or coal heating, parental atopy, feather bedding, truck traffic and smoking, as potential determinants of asthma and allergies in children.

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