

ORIGINAL ARTICLE

Allergic diseases and respiratory symptoms in urban and rural children in Grodno Region (Belarus)

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To cite this article: Shpakou A, Brożek G, Stryzhak A, Neviartovich T, Zejda J. Allergic diseases and respiratory symptoms in urban and rural children in Grodno Region (Belarus). *Pediatr Allergy Immunol* 2011; doi:10.1111/j.1399-3038.2011.01263.x

Keywords

allergies; asthma; children; eczema; epidemiology; respiratory symptoms; rhinitis.

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Accepted for publication 3 December 2011

DOI:10.1111/j.1399-3038.2011.01263.x

Abstract

Background: Because of the unknown frequency of asthma and other common allergic diseases in children living in Belarus, we conducted a population-based respiratory health survey. The objective of the study was to estimate the prevalence of allergic diseases and major allergic symptoms in children of the Grodno Region (Western Belarus) and to examine their familial and environmental correlates.

Methods: The cross-sectional study was conducted in 2010 and included 2606 urban and 2422 rural children aged 6–16 years. Physician-diagnosed respiratory diseases and symptoms were ascertained using the ISAAC questionnaire completed by the parents. Both family and environmental factors were examined for their association with respiratory health outcomes including asthma and spastic bronchitis. Descriptive statistics and multiple logistic regression analysis were used to test associations.

Results: The prevalence of asthma, atopic eczema and allergic rhinitis was 1.39%, 10.25%, and 3.84%, respectively. Spastic bronchitis was reported for 6.74% of children. Chronic respiratory symptoms occurring in the past 12 months and suggestive of asthma included chest wheeze (9.71%) attacks of dyspnea at rest (1.77%), symptoms of hay fever (2.45%) attacks of sneezing and nasal congestion without a cold (6.78%), and recurrent itchy rash (13.48%). All diseases except for asthma and spastic bronchitis as well as symptoms of hay fever, congested nose and itchy rash were more frequent in urban than in rural children ($p < 0.05$). Results of multivariate logistic analysis confirmed associations ($p < 0.05$) between asthma and parental asthma (OR = 4.82) and dampness in home (OR = 2.12) after adjustment for age, gender and place of residence. Spastic bronchitis in children who did not have a concurrent diagnosis of asthma was related ($p < 0.05$) to parental asthma (OR = 2.18), dampness in the home (OR = 1.68) and less use of coal-based heating (OR = 0.64). Allergic rhinitis and atopic eczema were associated ($p < 0.05$) with parental asthma (OR = 5.07 and OR = 1.91, respectively), dampness (OR = 2.33 and OR = 1.51, respectively), lower parental education (OR = 0.74 and OR = 0.68, respectively) and household density (OR = 0.84 and OR = 0.92), respectively.

Conclusions: The findings show a low prevalence of allergic diseases and symptoms in children of Western Belarus, following similar East-West gradients described in the literature. All allergic disorders except asthma were less frequent in the rural population. A very low prevalence of childhood asthma and the possibility of underdiagnosis of the disease in the surveyed population deserve further investigation.

Allergy, and in particular childhood allergy, is a well-recognized public health priority (1, 2). The disorder is subject to many national and international investigations into its

occurrence and risk factors (3–5). The magnitude of the problem justifies preventive measures, undertaken in a number of countries (6–9). Despite the long history of epidemiologic

studies on the topic, the body of evidence is far from being complete and there are countries or regions without a current and standardized assessment of the occurrence and risk factors of the disease. Belarus is one of those regions.

The nationwide data on the magnitude of the problem in this country come from reports on hospitalizations, based on a 10% sample of hospital discharge files. However, the data cannot be used for conclusive comparisons with figures obtained via standard epidemiological studies performed in other countries and – above all – cannot be used to estimate the likely occurrence of allergic diseases in Belarus. Recently published findings of a large cohort study in this country showed a low prevalence of allergic symptoms and atopic sensitization in children (10). However, the study was not designed as a population-based investigation into the distribution of allergic disorders. Results were only relevant to a narrow age-span of children and reported for selected allergic disorders including chest wheeze, symptoms of hay fever, recurrent rash, and atopy. A literature search yielded no other publications investigating childhood allergy in Belarus. The lack of previous studies and a need to estimate the magnitude of the problem occurring in the general population of children in Belarus served as a rationale for our study (11).

The country's western part of Belarus known as the Administrative Region of Grodno is a good candidate for such an assessment. The Grodno Region includes well-defined urban and rural populations and also borders Poland and Lithuania, thus allowing direct international comparisons of epidemiological findings with data available in these neighboring countries (8, 12–15). The town of Grodno (population: 320 000) is an industrialized municipality, known for chemical and metal industries as well as industrial and machinery manufacturing plants. The surrounding region (population: 54 000) is a typical rural area with well-developed livestock and intensive crop production. Children from both urban and rural areas in the Grodno Region are covered by national health services available to all children under the supervision of a large medical university located in the town of Grodno. Another advantage of this study is the unique opportunity of exploring allergic disorders in urban and rural children where the urban–rural gradient in the prevalence of childhood allergy is an intriguing issue in terms of the previously reported geographical differences in specific risk factors, provision of specialized health services and lifestyle-related factors (16, 17).

The lack of epidemiological data on allergic diseases in the Grodno Region formed the basis for this population-based respiratory health survey of urban and rural school children. The primary objective of the study was to estimate the prevalence of allergic diseases and major allergic symptoms in urban and rural children in the Grodno Region. The secondary objective of the study was to examine familial and environmental correlates of those diseases and symptoms.

Methods

Study subjects were children 6–16 years old, attending primary and secondary schools. In the study area, there were

28 199 potential urban candidates in 36 schools and 4842 rural candidates in 32 schools. Using a cluster sampling approach with primary and secondary schools as the sampling unit, we selected 3000 children from 10 schools in the city of Grodno and 3000 children from 20 rural schools in the Grodno Region. Parents or guardians of all selected children were asked to fill in questionnaires according to the instructions provided during parent/project team meetings.

The questionnaire was composed of standard questions included in the International Study of Asthma and Allergy in Children (ISAAC) respiratory questionnaire (1). All questions were translated from English to Russian and their syntax was verified by back-translation. Each questionnaire was accompanied by an explanatory letter of study objectives. Parents of 2606 urban children (response rate 87.9%) and of 2422 rural children (response rate 80.7%) gave informed written consent and returned the questionnaire to the schools. The questionnaire included questions about established diagnoses, symptoms, family history of respiratory and allergic disorders, and socioeconomic status. The study protocol was approved by the Ethics Committee at Yanka Kupala University (Grodno).

The list of analyzed allergic and respiratory diseases included diagnoses established during the child's lifetime by a physician and reported by subjects' parents for asthma, atopic eczema, and allergic rhinitis. Two other physician-diagnosed conditions included on the questionnaire were spastic bronchitis and unspecified allergy. Spastic bronchitis is a traditional diagnosis of the region and is used to describe chronic or recurrent asthmatic symptoms such as 'wheezy bronchitis'. Unspecified allergy was defined as any 'allergic sensitivity' diagnosed by a physician. Respiratory symptoms in the past 12 months were assessed by: 'Has your child had wheezing or whistling in the chest in the past 12 months?' (chest wheeze); 'Has your child had an attack of shortness of breath that came on during the day when she/he was at rest at any time in the past 12 months?' (attack of dyspnea); 'Has your child ever had any nasal allergies, including hay fever?' (hay fever); 'Has your child had a problem with sneezing or a runny or blocked nose when she/he did not have a cold or the flu in the past 12 months?' (non-infectious rhinitis); and 'Has your child ever had an itchy rash which was coming and going for at least 6 months?' (recurrent itchy rash).

Several variables were considered as potential correlates of respiratory outcomes. Parental asthma was defined as a positive history of physician-diagnosed asthma by either the mother or father. The highest level of education was categorized as high school or greater than high school. Parental employment was defined when at least one parent had a paid job. Exposure to tobacco smoke was present when at least one family member smoked at home. High household density was identified when the number of residents exceeded one per room. The presence of pets in the home was considered if there was an every-day contact of a child with dog, cat, rodents, or birds at home. Dampness at home was defined as the presence of mold or damp spots on any surfaces in a child's house.

Statistical analysis was performed using SAS software version 9.1.3, licensed to Medical University of Silesia in

Katowice, Poland (SAS Institute Inc., Cary, NC, USA). Continuous variables were described by arithmetic mean values and standard deviations. Categorical variables were described by frequencies and proportions along with their 95% confidence intervals (95%CI). Statistical significance of between-group differences in mean values was assessed by *t*-test and in categorical variables was examined by means of chi-square test.

Results of simple analyses were verified by multiple logistic regression analyses with the following dependent variables: asthma, spastic bronchitis, allergic rhinitis, atopic eczema and allergy (sensitivity ever diagnosed by physician), and the above-mentioned respiratory symptoms. Because of the potential association between asthma and spastic bronchitis, the model with spastic bronchitis as the dependent variable did not include observations with concurrent diagnoses of asthma. All other models included all observations. For each model, the same, fixed set of independent variables was tested to examine their association with the dependent variable and to control for potential confounding: subject's age, parental education and employment, exposure to tobacco smoke at home, type of housing, household density, dampness, and pets at home. Because of a statistically significant association between occurrence of parental asthma and parental allergic diseases ($p < 0.0001$), only parental asthma was retained in a model. For a similar reason, the variable expressing the type of home heating and not a type of cooking was used in the analysis. The strength of the associations between the independent and dependent variables was quantified by odds ratios and their 95% confidence intervals (CI). Statistical inference was based on the criterion $p < 0.05$.

Results

The study group included 2606 urban children (mean age, 11.2 ± 2.5 years) and 2422 rural children (mean age, 10.9 ± 2.3 years). Boys constituted 51.7% of urban and 50.1% of rural subgroups. Among the explored allergic diseases, unspecified allergy was the most frequent disorder and was found in 727 children (14.46%), followed by atopic eczema (10.24%), spastic bronchitis (6.74%), and allergic rhinitis (3.84%). The prevalence of physician-diagnosed asthma was 1.39%. Among the 727 children with unspecified allergy, 5.78% had a diagnosis of asthma, 19.26% had spastic bronchitis, 13.48% had allergic rhinitis, and 33.7% had atopic eczema. Fig. 1 presents the prevalence of allergic diseases according to age group. The category '6–8 years' included 904 children (17.9%), category '9–10 years' included 1257 children (25.0%), category '11–12 years' included 1251 children (24.9%), category '13–14 years' included 1256 children (25.0%), and category '15–16 years' included 360 children. Statistically significant age-related differences were found in relation to spastic bronchitis (more common in younger children – $p = 0.005$) and atopic eczema (more common in younger children – $p = 0.007$).

With regard to chronic respiratory symptoms suggestive of asthma that occurred in the last 12 months, chest wheeze was reported in 9.71% of children, and attacks of dyspnea at rest were reported in 1.77% of children. Symptoms of hay fever, attacks of sneezing, and recurrent itchy rash were reported in 2.45%, 6.78%, and 13.48% of children, respectively. Fig. 2 shows the prevalence of allergic symptoms according to age.

Figure 1. Prevalence of asthma (AS), spastic bronchitis (SB), allergic rhinitis (AR), atopic eczema (AE) and unspecified allergy (AL) according to age group of children of the Grodno Region.

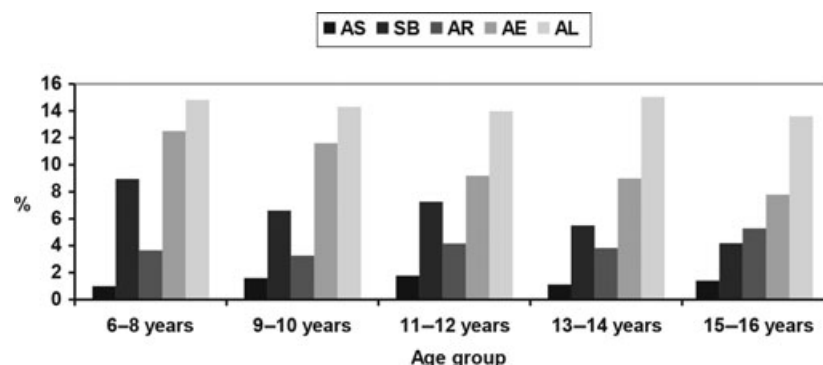


Figure 2. Prevalence of chest wheeze (WH), attacks of dyspnea at rest (AD), symptoms of hay fever (HF), noninfectious rhinitis (NR) and recurrent itchy rash (IR) according to age group of children of the Grodno Region.

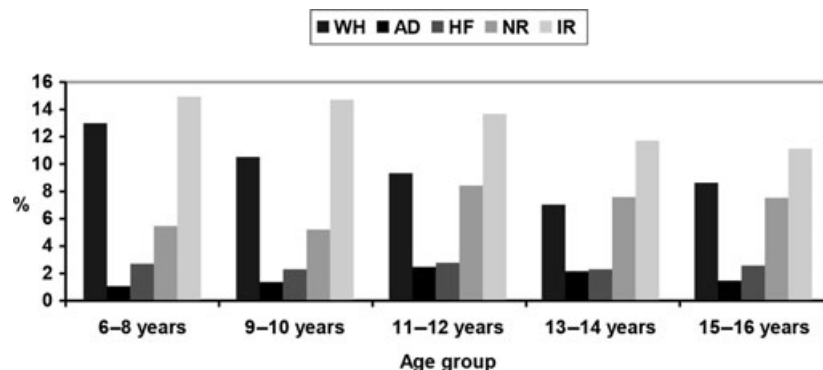


Table 1 Allergic diseases (physician-established diagnoses) and allergic symptoms in urban and rural children of the Grodno Region (relative frequencies and their 95% CI in the brackets)

Disease/symptom	Urban children				Rural children				p-Value*
	Boys N = 1346 % 95% CI	Girls N = 1260 % 95% CI	Total N = 2606 % 95% CI		Boys N = 1214 % 95% CI	Girls N = 1208 % 95% CI	Total N = 2422 % 95% CI		
Asthma (dgn)	2.0 (1.2–2.7)	0.8 (0.3–1.2)**	1.4 (0.9–1.8)		1.5 (0.8–2.2)	1.1 (0.5–1.7)	1.3 (0.9–1.8)		0.8
Spastic bronchitis (dgn)	8.8 (7.3–10.3)	5.5 (4.2–6.8)**	7.2 (6.2–8.2)		6.8 (5.4–8.2)	5.5 (4.2–6.8)	6.1 (5.2–7.1)		0.1
Allergic rhinitis (dgn)	7.2 (5.8–8.5)	3.4 (2.4–4.5)**	5.4 (4.5–6.2)		2.3 (1.4–3.1)	2.0 (1.2–2.7)	2.1 (1.5–2.7)		0.001
Atopic eczema (dgn)	12.4 (10.7–14.2)	11.5 (9.8–13.3)	12.0 (10.8–13.3)		9.0 (7.4–10.6)	7.5 (6.0–9.0)	8.3 (7.2–9.4)		0.0001
Allergy – not specified (dgn)	20.5 (18.3–22.6)	16.2 (14.2–18.3)**	18.4 (16.9–19.9)		10.7 (9.0–12.5)	9.5 (7.8–11.1)	10.1 (8.9–11.3)		0.0001
Chest wheeze – last year	10.8 (9.1–12.4)	7.8 (6.3–9.2)**	9.2 (8.1–10.3)		11.2 (9.4–12.9)	9.3 (7.7–11.0)	10.2 (9.0–11.4)		0.2
Attacks of dyspnea at rest – last year	2.5 (1.6–3.3)	1.2 (0.5–1.7)**	1.8 (1.3–2.4)		1.6 (0.9–2.3)	1.6 (0.9–2.3)	1.6 (1.1–2.1)		0.5
Symptoms of hay fever	5.7 (4.4–6.9)	1.6 (0.9–2.3)**	3.7 (2.7–4.1)		1.1 (0.5–1.6)	1.0 (0.4–1.5)	1.0 (0.6–1.4)		0.0001
Sneezing and congested nose (outside colds)	12.7 (11.0–14.5)	7.7 (6.2–9.1)**	10.3 (9.1–11.4)		7.1 (5.7–8.6)	6.5 (5.1–7.9)	6.8 (5.5–7.8)		0.0001
Recurrent itchy rash	45.7 (43.1–48.4)	44.6 (41.9–47.4)	45.2 (43.3–47.1)		32.3 (29.6–34.9)	32.9 (30.3–35.6)	32.6 (30.7–34.4)		0.0001

*Statistical significance level (p-value) of chi-square test of differences between total urban and total rural subgroups. **Statistically significant difference ($p < 0.05$) between urban boys and girls.

Statistically significant age-related differences were found in relation to chest wheeze (more common in younger children – $p = 0.0001$) and non-infectious rhinitis (less common in younger children – $p = 0.006$).

Table 1 shows the prevalence of physician-made diagnoses of allergic diseases and the prevalence of allergic symptoms. Differences in the prevalence of respiratory diseases and symptoms between urban and rural populations were statistically significant ($p < 0.05$) for allergic rhinitis, atopic eczema, unspecified allergy, symptoms of hay fever, non-infectious rhinitis, and recurrent itchy rash, all more frequent in urban than in rural children. There were no statistically significant differences between boys and girls living in the rural settings for any of the physician-diagnosed diseases or symptoms. However, urban boys as compared to urban girls were more likely to have a diagnosis of asthma ($p = 0.008$), spastic bronchitis ($p = 0.001$), allergic rhinitis ($p < 0.0001$), and unspecified allergy ($p = 0.005$). There were more boys than girls living in the urban setting who had respiratory symptoms in the past 12 months, and the difference was statistically significant for chest wheeze ($p = 0.008$), attacks of dyspnea ($p = 0.01$), hay fever ($p < 0.0001$), sneezing ($p < 0.0001$), and marginally significant for recurrent itchy rash ($p = 0.05$).

Table 2 shows the prevalence of familial and environmental factors that were explored as potential correlates of respiratory diseases and symptoms. Comparison of urban and rural subjects showed statistically significant ($p < 0.05$) differences in all analyzed characteristics except dampness in the home. Rural children were slightly younger. The prevalence of parental asthma was greater in urban families, and a similar difference was found in relation to parental allergy. Coal or wood used for cooking and heating purposes was more frequent in the rural setting. No statistically significant differences were found for household density and ownership of pets.

Table 3 and 4 shows the results of multivariable analyses. After adjustment for age and gender, asthma was associated ($p < 0.05$) with parental asthma and with dampness in home. Spastic bronchitis in children with no concurrent diagnosis of asthma was related ($p < 0.05$) to parental asthma, type of heating, and dampness in home. Atopic eczema was associated with ($p < 0.05$) parental asthma and education, dampness in home, as well as with place of residence. Allergic rhinitis was associated ($p < 0.05$) with parental asthma, dampness in home, and place of residence. Unspecified allergy was related ($p < 0.05$) to parental asthma and education, household density, dampness in home, and place of residence.

Chest wheeze and attacks of dyspnea were associated with parental asthma and dampness in home. Symptoms of hay fever as well as non-infectious rhinitis and congested nose were associated ($p < 0.05$) with a history of parental asthma, higher parental education, household density, home dampness, and place of residence. Recurrent itchy rash was associated with parental asthma and higher parental education, type of house, home dampness, and place of residence.

Table 2 Familial and environmental factors explored as potential correlates of respiratory diseases and symptoms in urban and rural children of the Grodno Region (relative frequencies and their 95% CI in the brackets)

Variable	Urban children				Rural children				p-Value*
	Boys N = 1346 % 95% CI	Girls N = 1260 % 95% CI	Total N = 2606 % 95% CI		Boys N = 1214 % 95% CI	Girls N = 1208 % 95% CI	Total N = 2422 % 95% CI		
Age below 11 years	42.7 (40.0–45.3)	40.0 (37.2–42.7)	41.4 (39.5–43.2)		46.4 (43.6–49.2)	42.8 (40.0–45.6)	44.6 (42.6–46.6)		0.05
Parental asthma	2.8 (1.9–3.7)	3.1 (2.1–4.0)	2.9 (2.3–3.6)		1.7 (1.0–2.4)	1.9 (1.1–2.6)	1.8 (1.2–2.3)		0.0001
Parental allergy	26.2 (23.8–28.5)	21.1 (18.9–23.4)**	23.7 (22.1–25.4)		13.6 (11.7–15.1)	14.8 (12.8–16.8)	14.2 (12.8–15.6)		0.0001
Parental education: high school or above	90.0 (88.4–91.6)	91.5 (89.9–93.0)	90.7 (89.6–91.8)		86.0 (84.0–87.9)	88.5 (86.7–90.3)	87.2 (85.9–88.6)		0.001
Unemployed parents	5.5 (4.2–6.7)	5.7 (4.4–6.9)	5.6 (4.7–6.4)		5.6 (4.3–6.8)	7.2 (5.7–8.6)	6.4 (5.4–7.3)		0.2
Cigarette smokers at home	48.6 (45.9–51.3)	44.9 (42.1–47.6)**	46.8 (44.9–48.7)		49.7 (46.9–52.5)	51.4 (48.5–54.2)	50.5 (48.5–52.5)		0.008
Residence in a block of flats	83.3 (81.3–85.3)	83.4 (81.3–85.4)	83.3 (81.9–84.8)		44.8 (42.0–47.6)	43.9 (41.1–46.7)	44.3 (42.4–46.3)		0.0001
Coal or wood used for cooking at home	1.0 (0.5–1.5)	0.7 (0.2–1.1)	0.8 (0.5–1.2)		9.5 (7.9–11.2)	10.4 (8.7–12.1)	9.9 (8.8–11.1)		0.0001
Coal or wood used for heating at home	1.1 (0.5–1.6)	0.7 (0.3–1.2)	0.9 (0.5–1.3)		2.1 (1.3–2.9)	2.7 (1.8–3.6)	2.4 (1.8–3.0)		0.001
Household density: >1 person/room	44.6 (41.9–47.3)	43.0 (40.2–45.7)	43.8 (41.9–45.7)		44.8 (42.0–47.6)	44.4 (41.6–47.2)	43.6 (42.6–46.6)		0.5
Dampness at home	29.9 (27.4–32.3)	29.9 (27.3–32.4)	29.9 (28.1–31.6)		30.3 (27.7–32.9)	29.5 (26.9–32.1)	29.9 (28.1–31.7)		0.9
Pets at home	55.8 (53.2–58.5)	63.7 (61.0–66.3)**	59.6 (57.7–61.5)		76.6 (74.2–78.9)	75.3 (72.9–77.7)	75.9 (74.2–77.6)		0.0001

*Statistical significance level (p value) of chi-square test of differences between total urban and total rural subgroups. ** Statistically significant difference ($p < 0.05$) between urban boys and girls.

Table 3 Association of allergic diseases with familial and environmental factors in urban and rural children of the Grodno Region

Independent variable	Dependent variable				
	Asthma	Spastic bronchitis	Allergic rhinitis	Atopic eczema	Allergy
Parental asthma	4.82 (1.99–11.64)	2.18 (1.17–4.08)	5.07 (2.92–8.82)	1.91 (1.14–3.19)	2.13 (1.36–3.32)
Parental education: high school or above	0.92 (0.48–1.78)	1.04 (0.76–1.42)	0.74 (0.48–1.15)	0.68 (0.52–0.88)	0.60 (0.47–0.76)
Unemployed parents	1.97 (0.47–8.21)	1.02 (0.60–1.73)	1.25 (0.60–2.61)	0.92 (0.62–1.37)	1.36 (0.92–2.02)
Cigarette smokers at home	0.91 (0.53–1.55)	0.88 (0.68–1.15)	0.81 (0.45–1.12)	1.07 (0.87–1.31)	0.84 (0.71–1.01)
Residence in a block of flats	0.68 (0.34–1.33)	0.88 (0.62–1.23)	0.84 (0.53–1.33)	0.90 (0.68–1.18)	0.89 (0.70–1.13)
Coal or wood used for heating at home	1.04 (0.50–2.16)	0.64 (0.44–0.93)	0.86 (0.52–1.44)	0.96 (0.71–1.29)	0.80 (0.62–1.04)
Household density: >1 person/room	0.97 (0.56–1.66)	0.86 (0.66–1.12)	0.84 (0.61–1.16)	0.92 (0.75–1.13)	0.74 (0.62–0.89)
Dampness at home	2.12 (1.24–3.61)	1.68 (1.29–2.20)	2.33 (1.70–3.21)	1.51 (1.23–1.87)	1.77 (1.48–2.11)
Pets at home	0.69 (0.39–1.20)	0.98 (0.74–1.31)	0.80 (0.57–1.11)	0.99 (0.80–1.24)	1.02 (0.85–1.23)
Rural residence	0.83 (0.44–1.55)	1.02 (0.76–1.39)	0.41 (0.27–0.63)	0.68 (0.53–0.87)	0.58 (0.47–0.72)

Logistic odds ratios and their 95% confidence intervals (in the brackets), adjusted for gender and age.

Table 4 Association of allergic symptoms with familial and environmental factors in urban and rural children of the Grodno Region

Independent variable	Dependent variable				
	Chest wheeze	Attacks of dyspnea	Hay fever	Sneezing/congested nose	Recurrent itchy rash
Parental asthma	2.03 (1.20–3.43)	3.77 (1.68–8.48)	6.62 (3.56–12.31)	2.79 (1.63–4.75)	2.36 (1.50–3.71)
Parental education: high school or above	0.79 (0.61–1.02)	0.82 (0.48–1.42)	0.49 (0.25–0.93)	0.69 (0.50–0.95)	0.66 (0.52–0.83)
Unemployed parents	0.83 (0.57–1.22)	1.08 (0.43–2.72)	1.94 (0.60–6.28)	1.46 (0.82–2.60)	1.15 (0.79–1.67)
Cigarette smokers at home	1.12 (0.91–1.38)	1.50 (0.95–2.37)	0.67 (0.41–1.01)	0.83 (0.65–1.06)	1.12 (0.93–1.34)
Residence in a block of flats	0.98 (0.75–1.28)	1.16 (0.64–2.09)	0.59 (0.34–1.03)	0.91 (0.65–1.27)	0.75 (0.59–0.95)
Coal or wood used for heating at home	1.28 (0.97–1.69)	1.02 (0.55–1.87)	0.89 (0.47–1.69)	1.11 (0.78–1.59)	0.93 (0.72–1.20)
Household density: >1 person/room	0.95 (0.75–1.17)	0.80 (0.51–1.26)	0.58 (0.38–0.88)	0.83 (0.65–1.06)	0.90 (0.75–1.08)
Dampness at home	1.75 (1.42–2.16)	1.95 (1.25–3.0)	2.91 (1.97–4.31)	2.03 (1.58–2.59)	1.75 (1.45–2.10)
Pets at home	0.85 (0.68–1.07)	0.83 (0.52–1.34)	0.68 (0.45–1.02)	0.74 (0.57–0.95)	1.06 (0.87–1.29)
Rural residence	1.01 (0.80–1.29)	1.14 (0.68–1.91)	0.26 (0.15–0.46)	0.66 (0.49–0.89)	0.79 (0.63–0.97)

Logistic odds ratios and their 95% confidence intervals (in the brackets), adjusted for gender and age.

Discussion

To our knowledge, this study presents for the first time the population-based estimates of the prevalence of asthma, major allergic diseases, and respiratory symptoms in urban and rural children living in Western Belarus. Epidemiological estimates were obtained using standardized questionnaires allowing international comparisons, in particular with figures provided by ISAAC studies.

The principal finding of our study is the low prevalence of asthma in both urban and rural children residing in the region under study. The overall prevalence of childhood asthma was estimated at 1.39% much lower than expected when compared to other European countries. Also, the prevalence was not significantly different between urban (1.42%) and rural (1.36%) children 6–16 years of age. Results from ISAAC studies have already shown a lower

prevalence of childhood asthma in Eastern Europe compared with Western Europe (18). In Western Europe, the prevalence of asthma in children aged 13–14 years was 16.3% and in children aged 6–7 years, it was 9.1%, while the prevalence in Northern & Eastern Europe was reported to be 5.9% in children aged 13–14 years and 4.5% in children aged 6–7 years. Estimates from the current study are lower than those reported above for Eastern Europe. In Poland, the prevalence of asthma was ranged between 5.8% and 6.8% (19). The results from the ISAAC Phase III project conducted in Eastern European countries showed that the prevalence of asthma of children living in Ukraine, Latvia, and Estonia was 5.8%, 5.6%, and 4.0%, respectively (18). In Russia, asthma prevalence in children 13–14 years of age ranged between 3.9% and 7.4% (5, 20, 21). In Lithuania, the recent estimate of the prevalence of asthma among children aged 6–7 years was 2.6% (8).

As childhood asthma estimates are based on physician-diagnosed cases, it cannot be excluded that a low prevalence of the disease in Belarus reflects the underdiagnosis of the disease (22). It remains uncertain to what extent real asthma cases are being diagnosed as spastic bronchitis which in the current study was relatively more frequent than asthma in either urban (7.25%) or rural (6.19%) populations. It is recognized in the medical community but not verified that spastic bronchitis is traditionally used to describe chronic occurrence of asthma-like symptoms. The potential misclassification of asthma cases as spastic bronchitis cases has been previously discussed in the findings from another Eastern European study of childhood asthma (13). The design of our study did not allow the direct verification of that suspicion. However, improved diagnostic measures, including guidelines for asthma and increased general awareness about the disease, may explain the rising trend of childhood asthma seen in other countries, and this increase appears to be made more distinct by a greater proportion of those children with mild symptoms being diagnosed with asthma (23, 24). The prevalence of asthma in Belarus could increase in the future with the recent issuing of guidelines on diagnostic criteria of childhood asthma by the Ministry of Health in Belarus (25).

Compared to asthma, other conditions under study, namely physician-diagnosed allergic rhinitis and atopic eczema, were more common. However, both age-specific figures obtained in the current study were significantly different from data observed in other studies of similar child populations. For example, Phase III of the ISAAC study showed that allergic rhinitis in Polish children was as high as 33.0% (23). Moreover, other country-specific estimates obtained within that program showed that the prevalence of the atopic eczema in the age group 13–14 years in Poland was 11.5%, in Ukraine – 5.3%, in Lithuania – 3.0%, and in Russia – 6.6%. In the younger age group (6–7 years), the respective country-specific figures were 8.5%, 5.7%, 1.8%, 3.8% (3, 26). On the other hand, the prevalence of eczema ('recurrent itchy rash in the past 12 months') was high in currently studied children, 12.5% in subjects aged 6–8 years and 11.7% in subjects aged 13–14 years. Phase III ISAAC estimates of that symptom were lower in countries surrounding Belarus (27). In two study groups of children, 6–7 years and 13–14 years, their respective prevalences of eczema were: 11.5% and 8.5% in Poland, 4.4% and 3.8% in Ukraine, 2.8% and 2.4% in Lithuania, and 6.6% and 3.8% in Russia.

The frequency of current wheeze and attacks of dyspnea at rest, suggestive of asthma in children, was 9.71% and 1.77%, respectively. Comparable data from other countries show similar prevalence. For example, in one study (18), the prevalence of wheeze (in the past 12 months) in Polish and Ukrainian children ages 6–7 was 12.3% in both countries and 11.3% in Russian children of the same age. In children aged 13–14 years, the prevalence of wheeze was 9.0% in Poland, 16.9% in Ukraine, 10.6% in Russia, and 7.5% in Lithuania.

However, it is possible that the relatively low estimates of the prevalence of all examined disorders could reflect the eastern pattern of the 'East-West gradient' in asthma and other allergic diseases reported by others (28–30). In one

study, the prevalence of atopy-related disorders in childhood was found to be higher in Scandinavia than in Estonia, Latvia, and Poland. However, the figures from these three latter countries were higher than figures obtained from other countries of Eastern Europe further supporting the view that 'Western life style' is associated with a higher prevalence of childhood allergy (29). As well, it is suggested that the prevalence of asthma in Western Europe has reached a plateau, while it is still increasing in Eastern Europe (3). The apparent gradient, also seen between western Belarus and other countries of Eastern Europe, remains an intriguing finding especially since the population in the current study tends to resemble populations in Poland and Lithuania in terms of diet and lifestyle factors (10). When compared to data obtained in other countries in the region, our findings show that the difference in the prevalence of respiratory symptoms is not as large as the analogous difference found with diagnosed clinical allergic conditions. As discussed previously, the gradient might be explained in part by varying diagnostic practices in pediatric allergology. The indirect support for such an explanation comes from a recent ISAAC-based observation that while the prevalence of allergic symptoms has not increased over a 7-year follow-up, the frequency of clinical diagnoses of allergic diseases has increased over the same study period (3).

Our study has limitations that are pertinent to all questionnaire-based cross-sectional studies, including surveys on respiratory health of children. The lack of objective measurements of the allergic status of children results in uncertainties about the accuracy of parental reported physician-made diagnoses. Moreover, the assessment of environmental factors that are pertinent to allergic disorders was based on questionnaire-derived information. Those limitations could result in misclassification of the examined disorders and in potential underestimation of the association between those disorders and their environmental correlates. Nevertheless, some findings seem to add credibility to our results. Almost all non-asthmatic allergic disorders were more frequent in urban than in rural children. Moreover, rural living was a consistent protective factor for most allergic diseases and symptoms, as suggested by the results of multivariate analysis. This finding is also in keeping with 'hygiene hypothesis' of allergic disease (18, 29). The lack of such a rural/urban difference in relation to childhood asthma might reflect different diagnosing patterns for asthma between rural and urban practitioners in the study area. Another finding supporting the reliability of our data concerns the familial and environmental correlates of explored disorders obtained in our study which follows a well-known palette of risk factors for allergy (30).

In conclusion, our study showed a very low prevalence of allergic diseases and symptoms in children of Western Belarus, following the East–West gradient described in the literature. Explored allergic disorders are mostly associated with family history of allergy, parental education, and dampness at home. All allergic disorders, excluding asthma, are less frequent in the rural population. A very low prevalence of childhood asthma and a possibility of an underdiagnosis of the disease in the surveyed population deserve further investigation.

Acknowledgments

Study partially supported by the grant of Józef Mianowski Fund – A Foundation for the Promotion of Science and grant of the Ministry of Foreign Affairs (Poland) – Polish

Aid 2011: 'Polish Assistance to the Prevention of Large Public Impact Lung Diseases in Belarus and Ukraine'. The authors thank Dr. D. Rennie and Dr. J. Lawson for their comments and suggestions concerning the manuscript of this study.

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