Medicina (Kaunas) 2011;47(12):661-6

Regional Differences in Diagnosing Asthma and Other Allergic Diseases in Estonian Schoolchildren

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Key words: *asthma; allergic diseases; prevalence; schoolchildren.*

Summary. *The aim of this study was to estimate the prevalence of asthma and other allergic diseases among Estonian schoolchildren of the cities lacking special (pediatric allergological) health care.*

Material and Methods. The study, carried out through 1 March to 8 May, 2003, enrolled 5th- to 12th-grade schoolchildren of 4 schools in different regions of Estonia. A three-step protocol was followed: screening questionnaire, examination by a pulmonary resident, and consultation by a pediatric allergologist.

Results. Of the 3132 questionnaires distributed, 1561 (49%) were returned. A total of 828 schoolchildren answered positively to any of the questions about possible allergic disease. After examination by the pulmonary resident, 255 schoolchildren (15.7%) were referred to an allergologist for final diagnosis. Asthma was diagnosed in 4.8%, allergic rhinoconjunctivitis in 4.9%, and atopic eczema in 8.3% of schoolchildren. Asthma, allergic rhinoconjunctivitis, and urticaria occurred more frequently in Narva as compared with Võru.

Conclusion. The 12-month prevalence of asthma among Estonian schoolchildren was 4.8%, and the prevalence of allergic diseases varied from region to region. Less than half (40%) of all asthma cases identified during the study were newly diagnosed, and this clearly indicates that there is a considerable underdiagnosis of the disease among schoolchildren living outside of the centers in Estonia.

Introduction

Earlier epidemiological studies have shown that the prevalence of asthma in Estonian schoolchildren was 2–5 times lower than in the children living in the developed Western countries during the last decade of the previous century (1, 2). There may have been different reasons for that. Bronchial asthma, an illness belonging to the so-called civilization diseases, occurs more frequently in the countries with a high level of socioeconomic development than in the countries with lower socioeconomic development. Another reason may be that in Estonia, asthma was underdiagnosed both in children and in adults, as in other postsocialist countries. Moreover, asthma may progress atypically during childhood and adolescence and in the early stages of the illness, and its symptoms may be weakly expressed. This makes the disease difficult to diagnose. Unlike with many other diseases, an important part in diagnosing childhood asthma is played by thorough questioning of the child and his/her parents. Unfortunately, the family physician does not have enough time and/or experience for that.

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The reorganization of health care system in Estonia and the growing socioeconomic inequalities among different regions of Estonia may also influence the early diagnosis and treatment of asthma. Qualified special medical care is more readily available to the children of the two biggest cities of Estonia: Tallinn and Tartu. Diagnosing asthma and allergic diseases in rural areas and peripheral towns is complicated due to the lack of medical specialists and socioeconomic problems. The organization of the Estonian health care system enables the diagnosis of asthma and other allergic diseases by the family physician, but only a medical specialist (pediatric allergologist) may initiate the treatment. This may lead to a vicious circle, where the family practitioner may suspect the presence of the particular disease, but he/she cannot begin to treat the child. At the same time, the child does not have any possibility to get an appointment with a medical specialist due to the long distance and/or a modest financial situation. All in all this, however, leads to the worsening of asthma and other allergic diseases and the child's quality of life.

Due to rapid changes in Estonia toward a "western lifestyle" during the last 10 years, the prevalence of asthma and other allergic diseases has been in-

creasing during the recent years (2–4). However, all studies have mostly been conducted in Tallinn and Tartu; therefore, there is no survey on the prevalence of asthma and other allergic diseases in children living outside of the two major centers.

The aim of the present study was to estimate the prevalence of asthma, rhinitis, and atopic eczema among the schoolchildren of 4 Estonian towns with no special (pediatric allergological) medical care.

Material and Methods

Study Areas and Population. Schoolchildren (aged 10–20 years, 5th to 12th grade) of the largest schools of 4 counties (Elva Secondary School, Võru Kreutzwald's Secondary School, Pärnu Co-Educational Secondary School, and Central Narva Russian Secondary School) were invited to participate in the study. The schools were selected according to the geographical location, socioeconomic situation, and level of industrial pollution. Võru is a town in southeastern Estonia with the population of about 14 600 inhabitants (small town in ecologically favorable, but economically borderline district, far from medical specialists' center). Pärnu is situated on the Baltic Sea coast in southwestern Estonia with the population of about 44 500 inhabitants (middle-size town in ecologically and economically favorable district, but far from medical specialists' center), and Narva with 67 000 inhabitants is located on the Russian border in northeastern Estonia (bigger than average town in ecologically and economically unfavorable district, far from medical specialists' center). An exception is Elva, a small town with the population of about 6 200 people, which is located nearest to Tartu (25 km) having a easier and cheaper access to medical specialists. The lower age limit of the children involved in the screening was determined by their anticipated ability to actively participate in spirometric research. The upper age limit was the children's age in the top grade of the secondary school. The study was carried out from March to May 2003.

Methods. This screening consisted of 4 phases (Fig.). During the first phase, 3132 questionnaires were distributed in the schools. These were to be completed by the parents together with their children. In the study, the questionnaire of respiratory symptoms, asthma, allergic rhinitis, and eczema was used. This questionnaire was previously validated in the epidemiological study in northeastern part of Europe (Sweden, Poland, and Estonia) during 1992–1993 (1). A total of 1561 questionnaires were returned; the response rate was 49%. Children who gave a positive answer to at least one of the questions concerning eczema and/or rhinoconjunctivitis and/or respiratory symptoms (n=828) were referred on suspicion of possible allergic disease to the second phase of the study. The interviews and the clinical examination of the second phase were conducted by a pulmonary resident. During this phase, 255 schoolchildren underwent screening. During the third part of the research, children were consulted by a pediatric allergologist. According to the current clinical practice, skin prick tests were performed. Spirographic examination with a bronchodilator test was conducted only in cases when the allergologist considered these tests to be relevant for diagnosis of the disease. Asthma was defined on demonstration of asthma symptoms combined with positive bronchial reversibility test.

Standardized allergens (HAL, Allergie GmbH, Düsseldorf) were used for skin prick tests. Histamine hydrochloride (10 mg/mL) was used as a positive and 50% glycerol (HAL, Allergie GmbH, Düsseldorf) as a negative control. The bronchodilator test enabled the evaluation of pulmonary function during the spirometric examination before and 20 minutes after using the bronchodilator. Selective $\beta 2$-agonist (Ventolin® GlaxoSmithKline) was used as a bronchodilator. The study was conducted with a portable spirograph (MicroLAB 3500).

Statistical Analysis. In order to evaluate the results, descriptive statistics was used. The χ^2 test was used to compare the prevalence of asthma and allergic diseases among schoolchildren studying in different schools. A P value of <0.05 was considered to be significant.

Ethical Considerations. The screening was approved by the Ethics Committee of Human Research of the University of Tartu dated November 18, 2002. Only those schoolchildren who gave their own and their parents' written consent were enrolled into the screening.

Results

Table 1 presents the number of the schoolchildren screened in various phases. More than one-third (35%) of those who completed the question-

Phase of the study	Distribution and collection of questionnaires	→	Review of questionnaires	→	Screening of potential asthma patients	→	Examination, spirometry, bronchodilatory test and final diagnosing
Conducted by	Project manager	→	Statistician	→	Resident	→	Pediatric allergologist

Fig. Flow chart of the study

naire were boys. There were 11% of schoolchildren aged 10–12 years, 38% aged 13–16 years, and 51% aged >17 years. The age and sex distribution of those who completed the questionnaire (n=1561) and those (n=255) who were referred to a medical specialist was similar. The lifetime prevalence of asthma diagnosed by the physician based on questionnaires was as in similar range to that demonstrated in the study conducted 10 years earlier in Tallinn and Tartu. Respiratory symptoms, such as wheezing, breast tightness, and nocturnal cough, were significantly more common in 2003 (Table 2). The use of asthma medications did not increase (1.9% vs 1.1%, $P>0.05$). There was no significant change in the prevalence of seasonal rhinoconjunctivitis (9.5% vs. 7.4%, $P>0.05$), but the prevalence of atopic dermatitis increased significantly (16.5% vs. 13.5%, $P<0.05$). Wheezing during the common cold, physical exertion, and/or contact with animals was more frequently reported by the children from Narva as compared with the children from Võru (Table 3). Surprisingly, based on the questionnaire, the children from Narva and Pärnu had the common cold significantly less frequently compared with the children from Võru. Breathlessness and chest tightness and prolonged coughing after

Table 1. The Number of Schoolchildren Being Screened for Asthma and Other Allergic Diseases

Region	Distributed Questionnaires (Total Number)	Answered Questionnaires (Number/% of Total)	Examined by Pulmonary Resident (number/% of Schoolchildren Who Answered)	Consulted by Allergologist (Number/% of Schoolchildren Who Answered)
Pärnu	780	362 (46)	157 (43)	47 (13)
Võru	776	459 (59)	266 (58)	63 (14)
Elva	701	237 (34)	138 (58)	54 (23)
Narva	875	503 (58)	267 (53)	91 (18)
Total	3132	1561 (49)	828 (53)	255 (16)

Table 2. The 12-Month Prevalence of Respiratory Symptoms and Atopic Dermatitis Among Estonian Schoolchildren in 1992–1993 and 2003 Based on the Questionnaire

	2003 n=1561	1992–1993 n=1519	Chi-Square *P* value
Wheezing in the chest during the common cold, physical exertion, and/or contact with animals	10.6	7.0	<0.05
Breathlessness and chest tightness during the common cold, physical exertion and/or in contact with animals	12.0	5.6	<0.0001
Nocturnal cough for a period longer than 4 weeks (without signs of cold or whooping cough)	6.2	4.6	<0.05
Common cold more than 6 times a year	11.6	10.5	NS
Coughing bouts for more than 2 weeks when having the common cold	15.8	16.3	NS
Diagnosed as being asthmatic by a doctor	2.9	2.9	NS
Seasonal rhinoconjunctivitis	9.5	7.4	NS
Atopic dermatitis	16.5	13.5	<0.05

Values are percentages. NS, not significant.

Table 3. The 12-Month Prevalence of Respiratory Symptoms and Atopic Dermatitis Among Schoolchildren of Different Regions of Estonia Based on the Questionnaire

	Pärnu n=362	Võru n=459	Elva n=237	Narva n=503
Wheezing in the chest during the common cold, physical exertion and/or in contact with animals	10.2	7.6	8.9	14.5***
Breathlessness and chest tightness during the common cold, physical exertion and/or in contact with animals	8.6	14.2	9.3	14.5**
Nocturnal cough for a period longer than 4 weeks (without signs of cold or whooping cough)	3.3	4.1	4.2	5.6
Common cold more than 6 times a year	9.4*	14.8	11.4	10.3*
Coughing bouts for more than 2 weeks when having the common cold	12.2	15.7	14.8	18.9**
Diagnosed as being asthmatic by a doctor	1.7	2.6	3.4	4.0
Seasonal rhinoconjunctivitis	8.0	9.8	8.4	10.9
Atopic dermatitis	14.6	14.8	18.5	18.7

Values are percentages. *$P<0.05$, ***$P<0.001$ vs. Võru; **$P<0.01$ vs. Pärnu.

Table 4. Prevalence of Allergic Disorders in 1561 Estonian Schoolchildren Based on the Screening Results

Allergic Disorder	Pärnu n=362	Võru n=459	Elva n=237	Narva n=503	Total n=1561
Asthma	4.1* (15)	3.3 (15)	4.6 (11)	6.8* (34)	4.8 (75)
Allergic rhinitis and/or rhinoconjunctivitis	5.5 (20)	2.6 (12)	4.2 (10)	7.0* (35)	4.9 (77)
Atopic dermatitis	1.9 (7)	9.4 (43)	12.7 (30)	9.9 (50)	8.3 (130)
Urticaria	14.9** (54)	4.8 (22)	18.6** (44)	9.9* (50)	11 (170)

Values are percentage (number). *P<0.05, **P<0.0001 vs. Võru.

respiratory infections were more common in Narva than Pärnu.

Of the 828 children who answered "yes" to at least one question in Tables 2 and 3, 818 continued the screening (10 were absent from school on the day of the screening). Of the 255 schoolchildren screened, 246 were consulted by the pediatric allergologist in the second phase (9 schoolchildren were absent during the consultation). Skin prick tests were performed to 207 schoolchildren; 22.7% of the schoolchildren were sensitized to pollen, 18.3% to cat allergen, 16.9% to tree pollen, and 15% to house dust mites. Table 4 presents the prevalence of asthma and other allergic disorders in 1561 Estonian schoolchildren aged 10–20 years as identified in the current screening program. There was a significant difference in the prevalence of asthma, allergic rhinitis/conjunctivitis, and urticaria comparing the children from Võru and Narva, with the prevalence being higher in Narva. The prevalence of urticaria was found to be higher among children from Pärnu and Elva as compared to their peers from Võru. No significant difference in the prevalence of atopic dermatitis was found in the current study.

During the current screening program, asthma was first diagnosed in 30 schoolchildren (15 schoolchildren in Narva, 11 in Pärnu, 3 in Võru, and 1 in Elva). The 12-month prevalence of asthma diagnosed by physicians was significantly higher as compared with the prevalence of questionnaire-reported asthma (P=0.003). Children from Pärnu and Narva had a significantly higher prevalence of asthma compared with that of questionnaire-based asthma (P<0.05). Nine schoolchildren remained under further supervision due to suspicion of asthma.

Discussion

The prevalence of asthma and atopic sensitization among Estonian schoolchildren during the past decade of the previous century was reported to be low (1, 2). These data are based precisely on epidemiological studies using a questionnaire as an assessment tool. Questionnaires are inexpensive, easy to administer, easy to be standardized and by enabling the assessment of large populations enhance the power of the findings of the study. Subjectivity is the main drawback of the use of questionnaires – people with different social and cultural background understand the questions differently. Many symptoms that occur with asthma are not asthma-specific. In addition, the awareness of some populations about asthma and allergic diseases (including atopic eczema, wheezing, etc.) is probably lower. There is a growing body of literature focused on the best practices to obtain data on asthma prevalence at the community level, specifically for pediatric asthma (3–5). Unfortunately, up to now there is no uniform, standardized epidemiological definition of asthma, which renders a reliable comparison of the distribution of asthma in various parts of the world problematic (6, 7). Therefore, preference is given to the evaluation of the distribution of symptoms indicating asthma (wheezing or shortness of breath). In Estonia, the prevalence of asthma was lower as compared with other countries, while the prevalence of symptoms indicating asthma was higher, and it has been speculated that the mild forms of asthma have not been diagnosed. Underdiagnosis of asthma has repeatedly been highlighted during the past two decades, especially among children and young adults (8–10). Screening studies that used a combination of symptoms and objective indicators of asthma have confirmed this view (11–13).

According to the results of the current study, the 12-month prevalence of questionnaire-based asthma was 2.9%. Nevertheless, the studies carried out during the past years still indicate the growing prevalence of allergic diseases both in Estonian infants and schoolchildren (14–16), the prevalence of physician-diagnosed asthma based on the questionnaire in the areas located outside of the centers is, according to the data of this study, still low. However, according to several studies, asthma and other allergic diseases do indeed occur less frequently in rural population than city dwellers (17–20). This is also confirmed by the study of adult Estonians (21). In contrast to European studies, the analysis of American data showed that asthma was equally distributed among rural and city adolescents or was even more frequent in rural adolescents (22). Regardless of the low prevalence of asthma, the prevalence of asthma and respiratory symptoms was high. Therefore, the justified question arises concerning underdiagnosing asthma in the children of the studied region. By analyzing the data of the second and third phase of the current study, we found that asthma occurred

in 4.8% of the examined children. According to age groups, the prevalence of asthma was lowest among 17–20-year olds (2.3%) and highest among 10–12-year olds (5.2%). There were no significant age and sex differences.

The results of screening showed that the prevalence of asthma was significantly higher as compared with the data obtained from the subjectively answered questionnaires. Based on the structured interviews, the prevalence of asthma, compared with that obtained from postal questionnaires, was also nearly two times higher in the study of adult Estonians (21). The low prevalence of questionnaire-based asthma in relation to current study results suggests that asthma was underdiagnosed in Estonia. According to the current study, the schoolchildren in Narva reported more frequently asthma-like symptoms in written questionnaires and had the highest prevalence of asthma defined based on a clinical assessment. Similarly, according to the FinEsS study of adult Estonians, the number of persons with respiratory symptoms indicating asthma in Narva was higher than that in Tallinn and Saaremaa (21, 23). It is possible that air pollution and external environment of northeastern part of Estonia affect the respiratory symptoms, although the design of the present research does not enable us to claim this with certainty.

During the screening, asthma was first diagnosed in 30 patients. Half (15/30) of the children with previously undiagnosed asthma were from Narva. In children from Pärnu, with the lowest prevalence of asthma (1.7%) as identified with the questionnaires, asthma was found 2.4 times more frequently ($P<0.05$). These data clearly indicate the underdiagnosis of asthma in these regions. Thereby in Elva, located near Tartu, there was only one case of undiagnosed asthma. The underdiagnosis of asthma in the rural areas and peripheral towns in Estonia is probably due to the restricted access to special medical care and poor awareness of asthma symptoms. That it is not a problem limited to Estonia alone was shown by Ownby, who analyzed the articles published in the MEDLINE about underdiagnosed asthma and treatment options for the inhabitants of American rural areas (22). Rural residents are confronted with certain barriers to care that are not as common in the urban setting. These include a lack of health care insurance, geographic obstacles to obtaining care, inability of getting suitable appointments, scarcity of health care professionals, and poor access to information about asthma (10, 22).

During the consultation with the medical specialist, symptoms characteristic of atopic dermatitis (8.3%) and diagnosis of rhinoconjunctivitis (4.9%) were found considerably less frequently than had been indicated in the questionnaires. Parents' confusion with the term atopic dermatitis describing a variety of rashes may explain the higher prevalence estimate for dermatitis based on the questionnaires. However, the trends for respiratory allergic diseases are the same: similarly to asthma, allergic rhinoconjunctivitis occurred much more frequently in the schoolchildren from Narva as compared with their peers from Võru. This, however, could not be observed for atopic dermatitis. At the same time, the schoolchildren from Narva, Pärnu, and Elva had urticaria more frequently compared with the schoolchildren from Võru. It may be speculated that children from the better socioeconomic regions Pärnu and Elva have more opportunities to buy imported foodstuff containing multiple preservatives that cause urticaria symptoms.

There are some limitations to this study. First, the overall response rate was only 49%. However, aggregated ISAAC data demonstrated no response bias when they analyzed data both with and without centers with a response rate of less than 80% (24). Potential bias is avoided also by the fact that there were no major differences in the response rate among the schoolchildren in different regions of Estonia. Second, because of resource constraints, we did not have information about allergy problems in nonresponders. Despite the limitations, the prevalence estimates obtained in this study were similar.

Conclusions

During the last decade, the frequency of respiratory symptoms was found to be increased. The prevalence of allergic diseases varied from one region to other: a significantly higher prevalence of asthma and allergic rhinoconjunctivitis was observed in the schoolchildren from Narva than their counterparts from Võru. Less than half (40%) of all asthma cases, identified during the study, were newly diagnosed, and this clearly indicates that there is a considerable underdiagnosis in towns far from regional health care centers and this deserves additional attention. It will force us to launch better educational programs for health care professionals and facilitate patient support and education in rural residents.

Acknowledgments

We wish to thank doctors Tiina Tamvere, Kaidi Nigol, and Aleksander Koroljov; medical student Margit Paist; and nurses Svetlana Svarõtš, Riina Režetova, Jelena Aleksandrova, and Tiia Kõivist. The screening was supported by a scientific grant from AstraZeneca.

Statement of Conflict of Interest

Maire Vasar has received honoraria for lectures to family doctors from GlaxoSmithKline and Mari Kivivare from MSD.

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Received 10 December 2009, accepted 29 December 2011