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Asthma, chronic bronchitis and respiratory symptoms among adults in Estonia according to a postal questionnaire

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Abstract Epidemiological studies indicate a lower prevalence of asthma in Eastern than Western Europe. This study of the prevalence of asthma, chronic bronchitis, and respiratory symptoms was performed in three different regions of Estonia, a state incorporated in the Soviet Union until 1991. A postal questionnaire was sent to a random sample of 24 307 of the population aged 15–64 years. The response rate was 77·6%. The prevalence of physician-diagnosed asthma was 2·0% or considerably lower than in Northern and Western European countries. The prevalence of wheezing last 12 months, 21·7%, recurrent wheeze, 13·3%, and attacks of shortness of breath, 12·5%, were similar or even higher compared with prevalence rates found in the Nordic countries. The prevalence of physician-diagnosed chronic bronchitis was 10·7%, and was higher among women than in men, although the proportion of current smokers among men, 57%, was considerably greater than in women, 28%. A possible explanation to the high prevalence of respiratory symptoms also among non-smoking women may be exposure to environmental tobacco smoke in small, crowded Estonian homes. Diagnostic criteria based on the Soviet-time definitions is discussed as a possible explanation to the low prevalence of physician-diagnosed asthma and high prevalence of chronic bronchitis in Estonia compared with other Northern European countries.

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Keywords asthma; chronic bronchitis; respiratory symptoms; epidemiology; postal questionnaire.

INTRODUCTION

Recent studies on asthma have shown that the prevalence in several West European countries varies from 6 to 9% (1–5). In Eastern Europe a lower prevalence of asthma has been reported (1–5). The prevalence of asthma in Estonia in 1990 in the city of Tallinn and the island of Saaremaa was found to be only 0·5% and 0·4%, respectively (6). In 1994 the prevalence of asthma in Tartu, the second biggest city of Estonia, was estimated at 2·0%, compared with 3·3% in a parallel study in Uppsala, Sweden (7).

The prevalence of chronic bronchitis in Estonia in 1977 was reported to be 7·1% in Tallinn and 8·0% in Saaremaa among subjects aged 18 years or more (8). Even higher prevalence rates of chronic bronchitis have been reported from Finland (9,10), while the prevalence of chronic bronchitis in Sweden in 1970s and 1980s was estimated at around 4% (11–13).

The aim of this study was to estimate the prevalence of asthma, chronic bronchitis and respiratory symptoms among adults in Estonia by a postal questionnaire survey. Three areas of the country were selected for the survey. In order to obtain sufficient data for calculation of risks of the diseases and to have a reliable starting point for longitudinal studies, 24 307 adults were invited to participate. A second aim was to evaluate if different diagnostic labelling compared to western countries could have had an influence on reported prevalence rates. The current study was the first large epidemiological investigation of obstructive airways diseases in Estonia, and Eastern Europe as well, after the restitution of the independence of the Baltic countries.

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MATERIALS AND METHODS

Study area

Estonia is the most northern country of the three Baltic States. The country is situated on the north-west part of the East European Plain Territory. The area of Estonia is 45 227 km^2; it had 1 446 000 inhabitants in 1996. The proportion of the urban population is around 70%. Major ethnic groups are Estonians (65%) and Russians (28%). The study covered the capital of the country, Tallinn, an agricultural island in the Baltic Sea, Saaremaa, and a heavily industrialized town located at the Russian border, Narva (Fig. 1, Table 1). The data about atmospheric air pollution has been issued by the Estonian Environmental Research Centre. The data was measured continuously in permanent locations within the study areas and annual means based on monthly means have been given.

Study population

The study sample was randomly selected from the Estonian State Computing Center based on data of July 1995. The sample consisted in total of 24 307 subjects aged 15–64 years, of which 12 494 were living in Tallinn, 6013 in Narva, and 5800 in Saaremaa. In order to achieve representative samples of the population allowing for comparison of results between the areas, the samples in each area were stratified according to age and gender. Randomization was performed within strata, and each age group (15–24 years; 25–34 years; 35–44 years; 55–64 years) included similar numbers of men and women, approximately 1200 in Tallinn, and respectively 600 in Narva and Saaremaa.

Methods

The study was a postal survey with similar design as in parallel studies (14) in progress in Finland and Sweden, the FinEsS studies. As the study aimed to screen for asthma, chronic bronchitis and COPD, a validated questionnaire covering these conditions, the Obstructive Lung Disease in Northern Sweden Studies (OLIN) questionnaire (13,15), which is a commonly used questionnaire in the Nordic countries, was chosen. The questionnaire had been developed from a Swedish variant (11) of the British MRC Questionnaire (16), with influences from the US Tucson and National Heart, Lung and Blood Institute (NHLBI) questionnaires (17), and the American Thoracic Society (ATS) questionnaire (18) regarding questions about asthma. In the current study questions about wheezing from the International Union Against Tuberculosis and Lung Disease (IUATLD) questionnaire (19,20) were added, questions that had been used in the European Community Respiratory Health Survey (ECRHS) (1). The English version of the expanded OLIN questionnaire was translated to Estonian and additional questions about socio-demographic data were added. The questionnaire was further translated from English into Russian, and both the Estonian and Russian versions were translated back into English. The questionnaire included 28 questions about respiratory symptoms and diseases, diagnoses confirmed by physicians, symptoms in special circumstances or due to specific exposures, family history, use of medicines, smoking habits and profession. The questions about symptoms and diagnoses required either 'yes' or 'no/don't know' answers. Subjects who had stopped smoking more than 12 months prior to the study were classified as ex-smokers. Those who

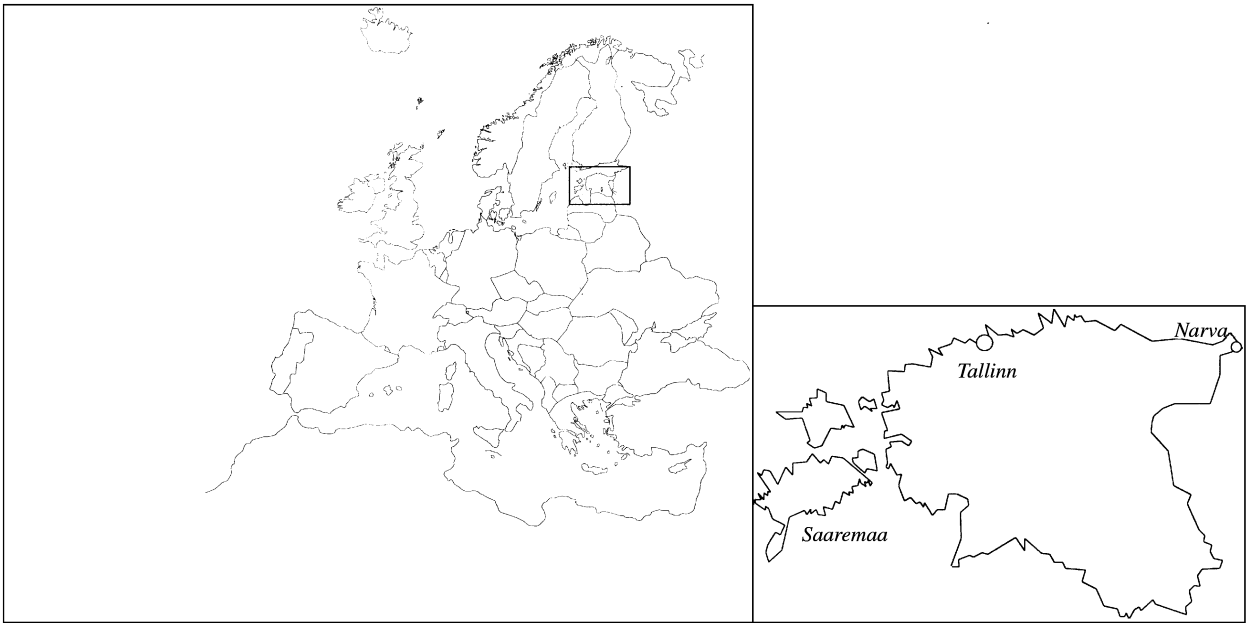

Fig. 1. Map of Estonia.

Table I. Characteristics of the study areas

	Tallinn	Narva	Saaremaa
Population 1 January 1994	442 679	79 094	40 822
Territory in km^2	158	85	2992
Population density in km^{-2}	2800	930	14
Type of settlement	Urban	Urban	Rural/urban 60/40%
Type of industry	Industrial	Power plants	Farming
	Commercial	Chemical plants	Fishing
	Administrative	Textile factories	Tourism
Ethnic composition	Estonians 50%	Estonians 6%	Estonians 98%
	Non-Estonians 50%	Non-Estonians 94%	Non-Estonians 2%
Average temperature (°C)			
February	−6	−6	−3
July	+16	+17	+16
Air pollution (1996)	Measured in three different places	Measured in three different places	Measured in coast
SO_2 ($\mu g\,m^2$, annual means)	7·5	7·7	2·5
Rates	1–20	5–10	0·4–9·8
Standard deviation	4·3	1·4	2·9
NO_2 ($\mu g\,m^2$, annual means)	21·7	16·2	3·5
Rates	3–68	8–31	3–7
Standard deviation	15·3	4·3	1·9

currently smoked or had stopped smoking within the last 12 months prior to the study were classified as smokers.

The questionnaires with an accompanying letter and an enclosed stamped addressed reply envelope were mailed in November 1995. The Estonian version was sent to the subjects with Estonian names, and the Russian version to the subjects with non-Estonian names. In case of uncertain nationality, questionnaires in both languages were sent. A reminder and a new questionnaire were sent to subjects who did not respond within 2 months. If necessary, the second reminder was sent 2 months later. All data were collected from November 1995 to May 1996.

The study was approved by the Tallinn Ethics Committee.

Diagnostic criteria

The diagnoses were based on the answers to questions or combinations of questions about respiratory symptoms and diseases, and these were considered to prevail when the corresponding questions were answered 'yes' as follows:

Longstanding cough: 'Have you had longstanding cough during the last years?'

Sputum production: 'Do you usually have phlegm when coughing, or do you have phlegm on your chest, which is difficult to bring up?'

Chronic productive cough: The criterion for sputum production fulfilled, and in addition a 'yes' answer to the question 'Have you had such periods on most days during at least 3 months at least 2 successive years?'

Any wheeze last 12 months: Have you had wheezing or whistling in your chest at any time in the last 12 months?'

Recurrent wheeze: 'Have you usually wheezing, whistling, or a noisy sound in your chest when breathing?'

Attacks of shortness of breath last 12 months:' Have you had asthma symptoms during the last 12 months (intermittent breathlessness or attacks of shortness of breath; the symptoms may exist simultaneously with or without cough or wheezing)?'

Self-reported (ever) asthma: 'Have you now or have you had asthma?'

Self-reported (ever) chronic bronchitis: 'Have you now or have you had chronic bronchitis or emphysema?'

Physician-diagnosed asthma: 'Have you been diagnosed as having asthma by a physician?'

Physician-diagnosed chronic bronchitis: 'Have you been diagnosed as having chronic bronchitis or emphysema by a physician?'

Statistical methods

Statistical analyses were performed by using the Statistical Package for Social Sciences (SPSS) at the Respiratory Unit at the National Institute for Working Life in Sweden. Categorical comparisons were performed by

using Student's *t*-test and Chi-squared test. One way analysis of variance (ANOVA) was used to test for trends. Multiple logistic regression analysis was used to assess the simultaneous influences of possible determinants of symptoms or diseases and effects of possible interaction. The independent variables included age, gender, a family history of asthma or chronic bronchitis, smoking habits and area of domicile, which reflects air pollution and degree of urbanization as well.

RESULTS

Participation

Of the 24 307 randomly selected subjects 1728, or 7·1% of the original study sample, were either dead, had moved abroad or were living elsewhere having other addresses. Thus, the remaining 22 579 subjects constituted the adjusted study cohort.

In total, 19 253 answers were received. Among the answers, 341 were received from subjects not included in the sample, for instance other family members or persons living at the addresses but not included in the study sample. After exclusion of all incorrect answers, the remaining 17 525, or 77·6% of the real study sample, could be included in the study. The response rate was 88·5% in Saaremaa, 78·4% in Narva and 72·9% in Tallinn. With a few exceptions, no large differences between age groups were found. The lowest participation rate was found among men in Tallinn aged 35–44 years, 64·0%, and the highest among women aged 15–24 years in Saaremaa, 93·5%. The participation rate was generally higher among women, 81·1%, than among men, 73·7% ($P < 0·001$).

Smoking habits

Less than 1% of the responders did not answer to the questions about smoking habits. The proportion of smokers was 57·2% in men and 28·1% in women, and similar in the three study areas: 39·1% in Saaremaa, 42·5% in Narva and 41·3% in Tallinn. In all centers the highest proportion of smokers were found in the age group 25–34 years. Among men 14·7% were ex-smokers and among women 7·4%, while 28·0% of men and 64·2% of women were non-smokers. Smoking habits are shown in Fig. 2.

Respiratory symptoms

The most common symptom was sputum production, 29·5%, followed by longstanding cough 24·0%. The prevalence of any wheeze during the last 12 months was 21·7%, of recurrent wheeze 13·3% and attacks of shortness of breath were reported by 12·5%. The prevalence of respiratory symptoms increased with age, while no major gender differences were found, though the proportion of smokers among men were considerably higher than among women. All respiratory symptoms were most prevalent in Narva. The prevalence rates were in general lowest in Saaremaa, however, the prevalence of any wheeze during the last 12 months was lowest in Tallinn (Table 2).

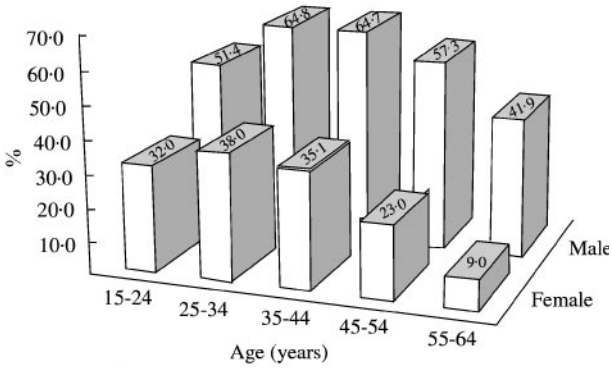

Fig. 2. Prevalence (%) of current smokers by age and gender.

Wheezing, attacks of shortness of breath, or severe cough were reported by 26% when exposed to tobacco smoke, and to dust, respectively. At least one respiratory symptom was reported by 45% of all responders, and the regional distribution was 51% in Narva, 42% in Tallinn and 38% in Saaremaa.

Respiratory symptoms and smoking were strongly correlated (Tables 2–5, Fig. 3). Smokers generally had twice more respiratory symptoms than non-smokers. Most symptoms increased significantly with the numbers of cigarettes smoked per day. The effect of smoking habits on the prevalence of respiratory symptoms was stronger in women than in men.

Asthma

The prevalence of physician-diagnosed asthma was 2·0%. Of the three areas it was the lowest in Saaremaa, 1·6%. Ever asthma was reported by 2·7%, use of asthma-medicines by 2·4, and the prevalence rates were similar in the three areas and among men and women. Both *physician-diagnosed* and *ever asthma* was more common in the youngest and the oldest age groups compared with middle-aged. The prevalence of the symptom combination *attacks of shortness of breath* and *recurrent wheeze* was 6·6% (Table 3). A family history of asthma was reported by 10% of the responders.

Chronic bronchitis

The prevalence of physician-diagnosed and self-reported (ever) chronic bronchitis was 10·5% and 10·7%, respec-

Table 2. Prevalence (%) of the respiratory symptoms by age, sex and geographic area. Difference (*P*-value) by sex, age, smoking habits and area

	15–24 years	25–34 years	35–44 years	45–54 years	55–64 years	All		Differences by			
						Men	Women	Smoking habits	Sex	Area	Age
Longstanding cough											
Tallinn	21·9	21·8	27·6	25·2	26·6	22·3	26·4				
Narva	24·0	28·4	28·6	32·1	30·3	27·5	29·5				
Saaremaa	18·3	17·6	17·8	21·0	19·8	18·0	19·5				
All	21·3	22·0	25·5	25·8	25·9	22·3	25·4	<0·0001	<0·0001	<0·0001	<0·0001
Sputum production											
Tallinn	27·1	28·9	31·2	27·2	31·2	28·9	29·3				
Narva	34·8	38·2	35·8	39·6	38·0	37·7	36·8				
Saaremaa	21·4	22·7	24·1	25·6	22·4	24·1	22·2				
All	27·1	29·1	30·7	29·7	30·8	29·6	29·4	<0·0001	0·857	<0·0001	0·021
Any wheeze last 12 months											
Tallinn	19·0	18·7	21·5	21·8	23·8	22·7	19·7				
Narva	23·1	22·4	23·9	24·7	24·0	26·4	21·5				
Saaremaa	20·5	19·1	21·5	22·7	23·2	23·4	19·3				
All	20·4	19·7	22·2	22·7	23·7	23·8	20·0	<0·0001	<0·0001	0·0003	<0·0001
Recurrent wheeze											
Tallinn	8·3	10·0	14·3	12·6	14·7	13·5	10·9				
Narva	16·9	19·3	21·2	23·2	23·7	23·1	19·1				
Saaremaa	7·1	5·8	8·3	11·7	11·3	9·6	7·7				
All	9·9	10·8	14·7	14·9	16·2	14·7	12·1	<0·0001	<0·0001	<0·0001	<0·0001
Attacks of breathlessness last 12 months											
Tallinn	10·1	10·6	13·1	13·4	15·0	12·5	12·5				
Narva	10·8	12·7	13·2	17·8	17·6	14·3	14·4				
Saaremaa	8·8	9·5	10·6	14·5	12·2	11·0	10·7				
All	9·9	10·7	12·5	14·7	15·0	12·5	12·5	<0·0001	0·772	<0·0001	<0·0001

Table 3. Prevalence (%) of asthma and symptom combinations associated with asthma by age and sex. Difference (*P*-value) by age, sex, geographic area and smoking habits

	15–24	25–34	35–44	45–54	55–64	All		Differences by			
						Men	Women	Sex	Smoking	Area	Age
Ever asthma	3·0	1·7	2·0	2·9	4·0	2·7	2·7	0·836	0·203	0·293	<0·001
Physician diagnosed asthma	2·4	1·3	1·6	2·1	2·9	2·0	2·1	0·218	0·053	0·042	<0·001
Use of asthma medicines	2·2	1·5	1·5	3·3	3·5	2·1	2·6	<0·001	0·534	0·680	<0·001
Wheezing last 12 months with breathlessness without cold (triad)	3·1	3·0	4·5	5·5	5·6	4·6	4·1	0·004	<0·001	0·166	<0·001
Attacks of breathlessness + recurrent wheeze	4·3	4·7	6·9	8·3	9·2	7·2	6·1	<0·001	<0·001	<0·001	<0·001
Attacks of shortness of breath + any wheeze last 12 months	6·8	7·6	9·3	11·2	11·6	9·7	8·9	<0·001	<0·001	0·01	<0·001
Ever asthma and triad	5·3	4·2	5·8	6·6	7·8	6·3	5·6	<0·001	<0·001	0·329	<0·001

Table 4. Prevalence rates of self-reported and physician diagnosed chronic bronchitis and chronic productive cough by smoking habits and sex

	Non-smokers	Ex-smokers	Smokers < 5 cigarettes day^{-1}	Smokers 5–14 cigarettes day^{-1}	Smokers > 15 cigarettes^{-1}	All	
						Men	Women
Self-reported chronic bronchitis							
Tallinn	9·5	11·7	9·3	10·5	13·8	9·3	11·4
Narva	14·3	10·8	13·6	16·1	17·5	12·5	16·5
Saaremaa	6·7	7·4	7·7	8·8	7·1	7·1	7·5
All	10·0	10·2	10·1	11·5	13·1	9·5	11·6
Physician-diagnosed chronic bronchitis							
Tallinn	9·3	10·8	9·2	10·8	14·3	9·6	11·0
Narva	15·3	12·7	13·4	16·8	16·2	12·6	17·5
Saaremaa	5·8	6·0	6·7	8·2	6·4	6·1	6·7
All	9·8	9·6	9·7	11·6	12·8	9·3	11·5
Chronic productive cough							
Tallinn	6·0	5·8	7·9	10·2	18·0	9·7	7·6
Narva	9·8	10·2	12·7	18·8	23·1	15·1	12·4
Saaremaa	3·2	3·2	3·2	8·5	10·9	6·6	3·8
All	6·2	5·7	8·0	11·9	17·6	10·1	7·8

tively (Table 4). Physician-diagnosed chronic bronchitis was reported by 15·3% in Narva, 10·4% in Tallinn and by 6·4% in Saaremaa. Both physician-diagnosed and self-reported chronic bronchitis were slightly, however significantly, more common among women, increased with age and were related to smoking. The prevalence of chronic productive cough increased considerably with increasing age, was strongly correlated to smoking, and in contrast to physician-diagnosed chronic bronchitis the prevalence of chronic productive cough was more common among men. A family history of chronic bronchitis was reported by 13%.

Multivariate relationships

Risk factors for the symptoms chronic productive cough, recurrent wheeze, attacks of shortness of breath, and

Table 5. Risk factors for symptoms chronic productive cough, recurrent wheeze, attacks of shortness of breath, and physician-diagnosed asthma by multiple logistic regression analysis. Risks in odds ratios (OR) with 95% confidence intervals (95% CI)

Independent variables		Dependent variables							
Variables	Categories	Chronic productive cough		Recurrent wheeze		Attacks of breathlessness last 12 months		Physician-diagnosed asthma	
		OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)
Age (years)	15–24	1		1		1		1	
	25–34	1·28*	(1·04–1·57)	0·91	(0·77–1·08)	0·97	(0·83–1·14)	0·56**	(0·33–0·94)
	35–44	1·67***	(1·37–2·03)	1·28**	(1·09–1·51)	1·14	(0·96–1·38)	0·61**	(0·37–0·97)
	45–54	2·03***	(1·65–2·49)	1·49***	(1·26–1·78)	1·49***	(1·27–1·78)	0·84	(0·71–1·11)
	55–64	2·64***	(2·16–3·23)	2·08***	(1·85–2·41)	1·74***	(1·42–2·23)	1·12	(0·90–1·36)
Sex	Male	1		1		1		1	
	Female	1·06	(0·96–1·18)	1·30**	(1·18–1·45)	1·35***	(1·23–1·50)	0·99	(0·86–1·19)
Family history	No	1		1		1		1	
	Yes	2·76***	(2·14–3·42)	3·52***	(2·89–4·30)	3·45***	(2·80–4·21)	4·29***	(3·03–6·19)
Smoking habits	Non-smoker	1		1		1		1	
	Ex-smoker	1·0	(0·62–1·40)	1·30**	(1·04–1·41)	1·39**	(1·11–1·81)	1·31	(0·97–1·82)
	Smoker <5 cigarettes day^{-1}	1·57***	(1·20–2·13)	1·97***	(1·41–2·87)	1·45***	(1·13–1·98)	1·01	(0·59–1·66)
	Smoker 5–14 cigarettes day^{-1}	2·47***	(1·79–3·56)	3·56***	(2·48–5·26)	2·09***	(1·48–3·07)	0·78	(0·55–1·10)
	Smoker ≥ 15 cigarettes day^{-1}	3·55***	(2·41–5·29)	5·06***	(3·61–7·14)	2·76***	(1·71–4·25)	0·85	(0·51–1·21)
Area of domicile	Saaremaa	1		1		1		1	
	Tallinn	1·63***	(1·21–2·18)	1·39***	(1·19–1·83)	1·09	(0·97–1·26)	1·47**	(1·09–2·05)
	Narva	2·86***	(2·23–3·79)	2·88***	(2·33–3·58)	1·32***	(1·08–1·70)	1·42*	(1·02–0·03)

*$P<0·05$, **$P<0·01$, ***$P<0·001$.

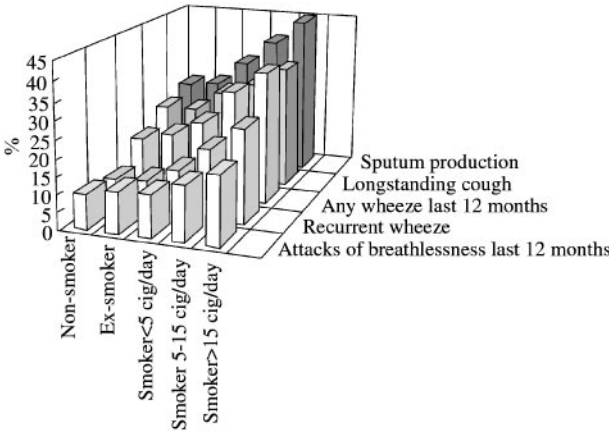

Fig. 3. Prevalence (%) of respiratory symptoms by smoking habits.

physician-diagnosed asthma were calculated by using multiple logistic regression analysis (Table 5). The independent variables used in the model were age, sex, family history of obstructive airway disease (asthma or chronic bronchitis/emphysema), smoking habits and area of domicile.

The risk for chronic productive cough increased nearly linearly with the number of smoked cigarettes. Smokers smoking $>$ 15 cigarettes per day compared to non-smokers had an OR of 3·5. The other significant risk factors for chronic productive cough were increasing age and a family history of obstructive airway disease, OR 2·8, while gender had no influence. A similar risk factor pattern, but less pronounced with lower odds ratios, was seen also for physician-diagnosed chronic bronchitis. Family history was an even stronger risk factor for physician-diagnosed chronic bronchitis than the symptom chronic productive cough.

The risks for recurrent wheeze and for attacks of shortness of breath were partly similar, however, the risks for recurrent wheeze were also similar to those for chronic productive cough. Recurrent wheeze was even more smoking dependent than chronic productive cough, but not as much dependent of increasing age than chronic productive cough. The main risk factor for asthma was family history of asthma, OR 4·3.

Living in Narva compared with living in Saaremaa was associated with an increased risk for most of the above-mentioned conditions, yielding odds ratios from OR 1·3 (attacks of shortness of breath) to 2·9 (both chronic productive cough and recurrent wheeze). The odds ratios for living in Tallinn compared with living in Saaremaa were 1·6 for chronic productive cough, 1·4 for recurrent wheeze and 1·5 for physician-diagnosed asthma.

Analyses were performed by multiple logistic regression in order to examine weather or not interaction existed between to two important risk factors, area of domicile and smoking. A multiplicative effect for the risk of having recurrent wheeze, or chronic productive cough, respectively, between area of domicile and smoking habits. Thus the OR for recurrent wheeze for current smokers living in Narva *vs*. non-smokers living in Saaremaa was of 9·9 and the comparison between corresponding citizens in Tallinn *vs.* Saaremaa was 4·7. The OR for current smokers *vs.* non-smokers in the pooled data from all three areas was 3·4.

When performing the analyses for having chronic productive cough, similar but slightly lower odds ratios were found. The corresponding figures for smokers in Narva and smokers in Tallinn, respectively, *vs*. non-smokers in Saaremaa were OR 7·4 and 4·3, respectively, while the OR for current smokers *vs*. non-smokers in the pooled data from all three areas was 2·8. Interactions of greater magnitude than additive or multiplicative effects were not found.

DISCUSSION

The study was the first large-scale study about respiratory symptoms and diseases performed in Estonia after the restitution of the independence in 1991. The European Community Respiratory Health Survey (ECRHS) performed in the city of Tartu in 1994 (7) studied the prevalence of asthma related respiratory symptoms, type I allergy, and hyper-reactivity among adults aged 20–44 years. Our study aimed to estimate the prevalence not only of asthma, but also of chronic bronchitis and respiratory symptoms in three different geographic areas of Estonia including subjects aged up to 64 years.

The selection of the areas aimed to give a cross-sectional picture of Estonia including the rural area of the island Saaremaa, the capital Tallinn, and the heavily industrialized town Narva. The ethnical composition of the population necessitated the use of questionnaires both in the Estonian and the Russian languages. As far as we know the use of questionnaires in different languages created no adverse problems. Analyses of differences in symptoms, smoking habits, as well as of cultural aspects between Estonians and Russians are in progress, and a separate paper about this topic is planned.

The response rate to the postal questionnaire was 78%. It was similar or slightly lower compared with recent studies in the Nordic countries (11–13,21) and the local ECRHS (7), but higher or of similar range as the ECRHS in France (22) and in other European countries.

The prevalence of male smokers, 57·2% was approximately twice as high as compared with the results from recent studies from the Nordic countries (14,21,23–26). Of the Estonian men, 24% were heavy smokers consuming 15 cigarettes or more per day. The prevalence of female smokers was considerably lower and similar to

levels in the Nordic countries (13,14,23,26). The proportion of current smokers decreased gradually after the age of 40 years both among men and women. The same trend has been observed in Sweden (11–13).

According to our study, the prevalence of physician-diagnosed asthma was only 2%, which is lower compared to the prevalence found in studies in Nordic countries. The most recent studies in the neighbouring countries Sweden and Finland have shown the prevalence of physician-diagnosed asthma among adults to be 5–9% (3,14,23–27). In contrast to the low prevalence of physician-diagnosed asthma, the prevalence of symptoms common in asthma, such as attacks of shortness of breath, frequent wheeze, any wheeze during the last 12 months, and combination of such symptoms, were similar or even higher than reported from studies in the Nordic countries (3,14,23–26), indicating that asthma could be under-diagnosed in Estonia. It is also noteworthy that the prevalence of asthma medicine users was higher than the prevalence of physician-diagnosed asthma.

Nevertheless, the large differences between Estonia and neighbouring Nordic countries in prevalence on disease level, and the more limited differences on symptom level, is probably the result of differences in diagnostic labelling of disease. Until the end of 1980s, the definitions of chronic non-specific respiratory diseases officially accepted in the Soviet Union were used in Estonia. Asthma was defined as an allergic disease including as essential symptoms: bronchospasm, dyspnoea, hypersecretion and swelling of bronchial mucosa (28). According to the Soviet Union era, asthma was defined as an allergic disease (20,21) either as an atopic disease or due to 'infection allergy' (28–30). Other types of variable broncho-obstruction, according to this definition, should not be classified as asthma. Further, asthma was often considered as a complication of, or a subgroup to chronic bronchitis, or even to 'chronic pneumonia' (29,30). It is noteworthy that asthma patients in the Soviet Union were generally not allowed to travel abroad, so physicians might hesitate to make the diagnosis of asthma. These facts support our opinion that asthma, according to current criteria, has been underdiagnosed.

Chronic bronchitis was during the Soviet era defined as a diffuse, usually progressive damage of the bronchial tree caused by long-standing irritation of airways due to different exposures, characterized by changes in secretory system of the mucosa, development of an inflammatory process and of sclerotic changes on deeper levels of the bronchial wall, accompanied by hypersecretion of mucus, disturbance of bronchial clearance, factors which all may be expressed clinically as permanent or recurrent cough with sputum, and in case of damage of small bronchi and bronchioli accompanied with dyspnoea. The symptoms should not have been caused by the other diseases (29, 30).

When comparing our findings with the results of studies performed up to 30 years ago in the Baltic States, the prevalence of chronic bronchitis has not markedly changed (8). The prevalence of diagnosed chronic bronchitis in Estonia is nearly twice as high as in Scandinavian countries (11–13), but similar to that in the United Kingdom, where chronic bronchitis was found to affect 17% of men and 7% of women (31). Despite the higher prevalence of smokers among men than women in our study, the prevalence of chronic bronchitis was found to be higher in women. Further, in all different smoking categories, and in all study areas, physician-diagnosed chronic bronchitis was more common among women. The notably high prevalence of cough, sputum production and chronic bronchitis in non-smoking women in Estonia, but not of asthma, is an important finding and point out the need of further studies of the topic. The finding may in part be due to the local classification of disease, and a hypothesis is that many of these women may have asthma.

Exposure from environmental tobacco smoke (ETS) may contribute to these high prevalence rates among non-smokers, in particular non-smoking women. In Estonia, compared to the Nordic countries, many families have small apartments and live in overcrowded conditions (33). This means that if, for example, the father in a family smokes, the other non-smoking family members are at risk for considerable ETS exposure. The effects of ETS in women may be more serious than in men, since women may be more susceptible tobacco smoke (34).

In contrast to other studies in Europe (9–14,21,23,31), the prevalence of chronic productive cough was lower than the prevalence of physician-diagnosed chronic bronchitis, which became apparent especially among non-smokers, a finding that may be a result of different diagnostic labelling influenced by the criteria used in former Soviet Union (29). There was no minimum time limit for the symptomatic period, e.g. 3 months a year during at least 2 successive years (35), to make the diagnosis of chronic bronchitis according to the Soviet definition of chronic bronchitis.

The prevalence of at least one respiratory symptom was 45% among the Estonian adults, results similar or only slightly higher than found in Norway and Sweden (11–13,21). Generally, the risk for respiratory symptoms increased with increasing number of smoked cigarettes. Of the risk factors, also obstructive airway disease in the family was significantly related with every symptom or condition, and was the greatest risk factor found for asthma, OR 4, results in accordance with others (3,24). Female sex was a risk factor for symptoms common in asthma, however, for diagnosed asthma no gender differences were found.

Living in the polluted area of Narva was associated with the highest risk for mainly bronchitic symptoms,

even after taking into consideration the smoking habits, age, gender, and family history of obstructive airway diseases. In addition to general air pollution, the industrial setting of the Narva region may also contribute to occupational airborne exposure of importance. Living in the rural Saaremaa was associated with the lowest risk for all symptoms and conditions. Multiplicative effects was found for having recurrent wheeze or chronic productive cough between smoking habits and area of domicile. For smokers living in Narva *vs*. non-smokers living in Saaremaa the ORs were 8–10 for having either one or the other of these two conditions. In agreement with others (33,36), an urban factor was also found for asthma and living in Tallinn or Narva, compared with Saaremaa yielded an increased risk of being diagnosed as having asthma or symptoms common in asthma.

In conclusion, we found a large proportion of smokers among Estonian men, and the prevalence of most respiratory symptoms were similar or higher than in the Nordic countries by using the same questionnaire which has been used in several studies in the Nordic countries. Despite a high prevalence of symptoms common in asthma, the prevalence of physician-diagnosed asthma was low indicating an underdiagnosis of asthma in Estonia probably due to diagnostic traditions based on the Soviet-time definitions of asthma. High prevalence of respiratory symptoms may be due not only to smoking, but probably also to exposure to ETS in overcrowded Estonian homes. This important indication of the deleterious effect of indoor climate, especially intensive exposure to ETS, needs further studies.

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