

RESEARCH PAPER

Increase in prevalence of physician-diagnosed asthma in Helsinki during the Finnish Asthma Programme: improved recognition of asthma in primary care? A cross-sectional cohort study

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Abstract

Background: The continuing rise in asthma prevalence has been questioned, with recent reports suggesting a plateau.

Aims: To assess a 10-year trend in the age-adjusted prevalence of physician-diagnosed asthma, respiratory and allergic symptoms, and use of asthma medication in the adult population of Helsinki during the Finnish Asthma Programme from 1994 to 2004.

Methods: Two cross-sectional postal surveys were conducted among random Finnish National Population Registry samples 10 years apart using the same protocol. A total of 6,062 subjects (75.9%) and 2,449 subjects (61.9%) participated in 1996 and 2006, respectively.

Results: The prevalence of physician-diagnosed asthma increased from 6.5% in 1996 to 10.0% in 2006 ($p < 0.001$). This was evident in both genders aged <60 years, but particularly in women aged <40 years, paralleling an increased use of asthma medication. Concurrently, the prevalence of allergic rhinoconjunctivitis increased from 37.2% to 44.4% ($p < 0.001$). The prevalence of physician-diagnosed chronic obstructive pulmonary disease remained unchanged (3.7%), while current smoking abated. Subjects with a smoking history had more respiratory symptoms ($p < 0.001$). Among subjects without physician-diagnosed asthma, those reporting allergic rhinoconjunctivitis had a higher prevalence of lower respiratory tract symptoms.

Conclusions: The prevalence of allergic rhinoconjunctivitis and physician-diagnosed asthma has increased in Helsinki during 10 years in adults, especially in women aged <40 years. Concomitantly, the use of asthma medication increased and subjects with physician-diagnosed asthma were less symptomatic. The increase in the prevalence of physician-diagnosed asthma may partly be due to improved diagnostic recognition of asthma in primary care during the Finnish Asthma Programme, but the concurrent rise in allergic rhinoconjunctivitis may reflect a true rise in prevalence.

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Introduction

A rising trend in the prevalence of asthma was observed between the 1960s and 1990s, mostly in western countries.¹⁻⁵ Most studies have suggested that a plateau was reached in the late 1990s,⁶⁻¹⁰ but some studies have shown a continuing rise.^{11,12} The prevalence of asthma increased more among women than men in the Copenhagen City Heart Study from 1976-8 to 2001-4.¹² A steep increase in the prevalence of asthma among women was also reported from Norway, with a greater increase in the prevalence of asthma diagnosis than asthma-related symptoms between 1972 and 1998-9.³ In a follow-up study of the European Community Respiratory Health Survey (ECRHS), the proportion of asthma medication users increased more than the proportion of asthma-related symptoms.¹¹ Additionally, self-reported nasal allergies increased, especially among the youngest.¹¹ In Finland, national programmes for asthma from 1994 to 2004 and chronic obstructive pulmonary disease (COPD) from 1998 to 2007 have been conducted to reduce the burden of these diseases.¹⁴ The timing of our study (1996 and 2006) enables us to assess changes in obstructive respiratory diseases during both national respiratory health programmes.

This is a part of the FinEsS (Finland, Estonia, Sweden) study, which has been in progress from 1996. The main aim of this part was to assess changes in the prevalences and determinants of asthma, allergic rhinoconjunctivitis, and other respiratory symptoms as well as COPD and smoking, comparing population cohorts from 1996 and 2006 using identical questionnaire methods.

Methods

Population

The FinEsS study is a joint Nordic project between Finland, Estonia and Sweden on respiratory epidemiology. In Helsinki, similar postal surveys were conducted in 1996 and 2006 to collect information on diagnosed obstructive airways diseases, respiratory symptoms, and precipitating factors among two random population samples aged 20–69 years. Both population samples were obtained from the Finnish National Population Registry on gender and 10-year age cohorts to represent the adult population of Helsinki, Finland. In 1996

a random sample of 8,000 subjects was selected but, of these, 10 individuals had either died or moved outside Helsinki before the questionnaire was mailed and were thus not invited to participate. In order to have a comparable sample, an identical process was applied to the 2006 sample of 4,000 subjects, yielding a random sample of 3,968 individuals. A total of 6,062 subjects (3,462 women) responded in 1996 and 2,449 subjects (1,365 women) responded in 2006, yielding a participation rate of 75.9% and 61.7% for 1996 and 2006, respectively. The response rate fell more in the younger groups than in older age cohorts, with the greatest reduction in young women aged <30 years from 82.4% in 1996 to 56.0% in 2006 (Table 1). The original results from the 1996 survey have been reported elsewhere.^{15,16} The Finnish version of the FinEsS postal survey has been published previously.¹⁵ The study protocol was approved by the Ethics Committee of the Department of Medicine of Helsinki University Central Hospital.

The characteristics of the two study samples are shown in Table 1. The responders in 2006 were slightly older than in 1996. Current smoking decreased in all age groups except in older men where the prevalence of current smoking remained essentially unchanged (Figure 1).

Definitions

The definitions of key variables based on the questionnaire answers used are summarised in Table 2. Current smoking is defined as those currently smoking or having smoked cigarettes, pipe, or cigars within one year. Former smokers are those who have quit smoking at least one year previously. Ever smokers include both former and current smokers. Smoking data were not available for 0.2% of responders in 1996 and 2.0% of responders in 2006. Obesity was defined as body mass index (BMI) >30 kg/m².

Statistical analysis

All statistical analyses were conducted with the Statistical Package for Social Sciences (PASW Statistics 20.0; IBM-SPSS Inc, Chicago, IL, USA). The crude prevalence of self-reported diagnoses of obstructive airways diseases and allergies, symptoms, and precipitating factors was calculated first unadjusted for each gender and age cohort, comparing 1996 and 2006 directly. Prevalence figures were age-adjusted to the gender and age distribution of Helsinki in 1996 using National Population Registry sentinel data

Table 1. Characteristics of the studied population samples

	1996		2006	
	Men	Women	Men	Women
n (%)	2600 (42.9%)	3462 (57.1%)	1084 (44.3%)	1365 (55.7%)
Mean (SD) age, years	42.8 (13.1)	42.1 (13.3)	45.1 (13.9)	45.4 (14.3)
Current smokers, %	39.0%	30.7%	32.9%	24.2%
Former smokers, %	21.9%	14.6%	24.4%	20.8%
Non-smokers, %	39.0%	54.8%	42.7%	55.0
Response rate				
20-29 years	61.6%	82.4%	43.4%	56.0%
30-39 years	66.0%	80.7%	51.9%	62.7%
40-49 years	68.7%	80.3%	59.0%	66.9%
50-59 years	75.1%	83.9%	63.8%	68.9%
60-69 years	82.3%	84.3%	73.0%	75.9%

Figure 1. The prevalence of (a) physician-diagnosed asthma, (b) use of asthma medication, (c) allergic rhinoconjunctivitis, and (d) current smoking in the FinES Helsinki studies from 1996 and 2006 stratified by gender and age category

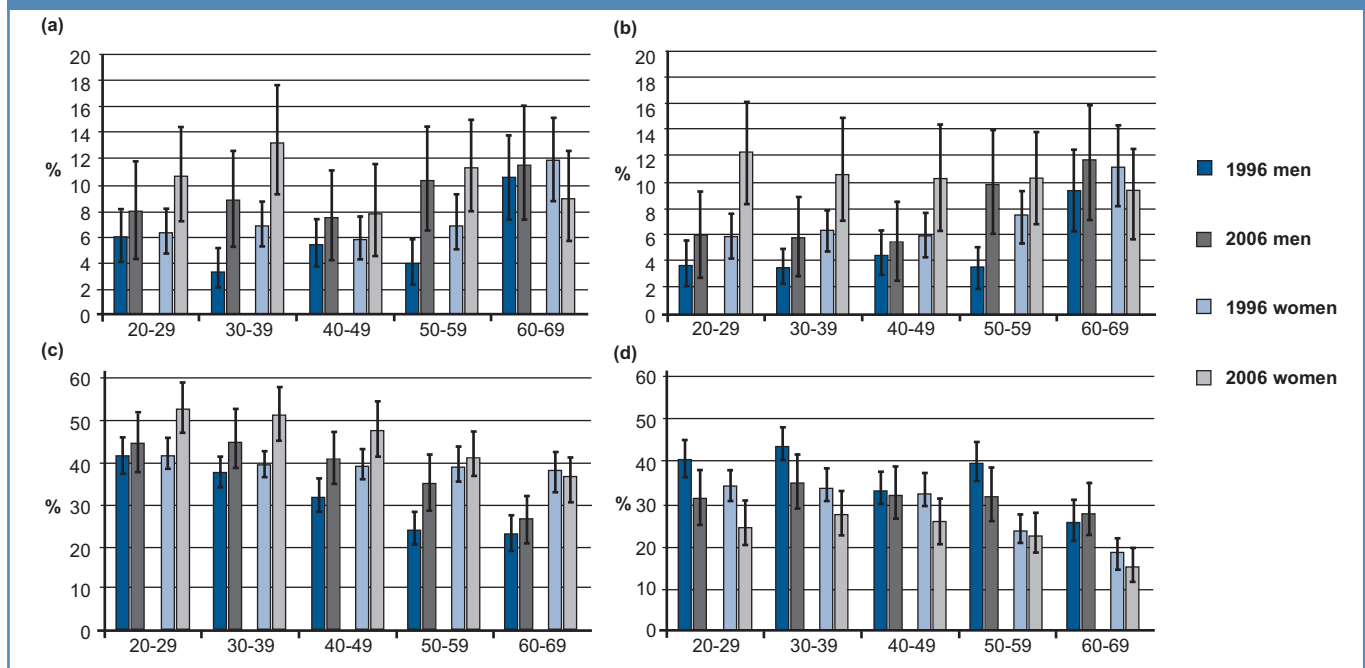


Table 2. Definitions for key variables

Variable	Definition: Positive answer to the question
Physician-diagnosed asthma	"Have you been diagnosed as having asthma by a doctor?"
Physician-diagnosed COPD	"Have you been diagnosed as having chronic bronchitis, COPD or emphysema by a doctor?"
Allergic rhinoconjunctivitis	"Do you have now or have you had allergic rhinitis (e.g. hay fever) or allergic eye symptoms?"
Past year shortness of breath	"Have you had asthma symptoms (intermittent breathlessness or attacks of breathlessness) during the previous 12 months?"
Longstanding cough	"Have you had longstanding cough during recent years?"
Asthma medication	"Do you currently use asthma medication?"
Chronic productive cough	A combined affirmative answer to the questions: "Do you usually have phlegm when coughing, or do you have phlegm which is difficult to bring up?" and "Do you bring up phlegm on most days during periods of at least successive three months?" and "Have you had such periods during at least two successive years?"
Recurrent wheeze	"Have you had wheezing, whistling, or a noisy sound in your chest when breathing?"
Past year wheeze	"Have you had wheezing or whistling in the chest at any time in the last 12 months?"
Triad of wheeze	Combines past year wheeze with two further questions: "Have you been at all breathless when the wheezing sound was present?" and "Did you have wheezing or whistling when you didn't have a cold?"
Childhood farm living	Refers to those who report living on a farm during the first 5 years of life

(www.vaestorekisterikeskus.fi). Chi-square and Fisher's exact tests were used to analyse differences between groups. A multiple logistic regression model was used to assess the odds ratios for reported diagnoses and symptoms suggestive of asthma between 1996 and 2006, the risk factors for prevalent physician-diagnosed asthma, and self-reported allergic rhinoconjunctivitis; p values <0.05 were considered significant in all analyses.

Results

The age-adjusted prevalence of physician-diagnosed asthma

increased from 6.5% to 10.0% ($p<0.001$), with an increase in all age groups except women aged >60 years (Figure 1a). Asthma medication was used by 5.9% in 1996 and by 9.2% in 2006 ($p<0.001$), with the steepest increase in young women (20–29 years) from 5.9% to 12.3% ($p=0.001$). Allergic rhinoconjunctivitis was reported by 37.2% in 1996 and by 44.4% in 2006 ($p<0.001$), and by 42.0% and 53.1% respectively among women aged <30 years ($p=0.002$; Figure 1c).

The prevalence of asthma-related symptoms is shown in Table 3.

Table 3. Age-adjusted* prevalence (%) of respiratory symptoms by self-reported physician-diagnosed asthma among responders of the FinEsS studies 1996 and 2006

	Physician-diagnosed asthma –			Physician-diagnosed asthma +		
	1996 (n=5,664)	2006 (n=3,753)	p Value	1996 (n=398)	2006 (n=246)	p Value
Past year shortness of breath	8.5%	9.5%	NS	75.5%	68.4%	NS
Longstanding cough	18.2%	17.2%	NS	40.9%	32.6%	0.044
Chronic productive cough	10.6%	9.1%	NS	30.3%	23.4%	NS
Recurrent wheeze	5.0%	4.7%	NS	37.6%	24.9%	0.002
Past year wheeze	16.5%	17.9%	NS	72.3%	63.0%	0.017
Triad of wheeze	4.3%	4.8%	NS	50.3%	36.1%	<0.001
Dyspnoea, wheezing or severe cough induced by						
Exercise in cold	19.8%	20.1%	NS	76.4%	74.4%	NS
Animal or pollen	16.4%	18.4%	NS	70.4%	65.6%	NS
Allergic rhinoconjunctivitis	34.7%	40.5%	<0.001	74.4%	78.7%	NS
Asthma medication	1.4%	2.6%	<0.001	70.0%	68.8%	NS
Physician-diagnosed COPD	2.7%	1.8%	NS	14.4%	14.0%	NS

*Age adjusted to National Population Registry data on population age distribution in Helsinki 1 January 1996.

NS=not significant.

Table 4. Age-adjusted* prevalence of respiratory symptoms by smoking status among responders of the FinEsS-Helsinki 1996 and 2006 studies

	1996				2006			
	Non-smokers (n=2,937)	Former smokers (n=1,007)	Current smokers (n=2,118)	p Value†	Non-smokers (n=1,203)	Former smokers (n=526)	Current smokers (n=720)	p Value†
Past year shortness of breath	10.4%	15.0%	15.4%	<0.001	11.7%	16.0%	21.0%	<0.001
Longstanding cough	16.4%	18.2%	25.2%	<0.001	16.1%	14.9%	25.5%	<0.001
Recurrent wheeze	3.8%	6.2%	12.4%	<0.001	3.0%	4.8%	14.2%	<0.001
Past year wheeze	13.0%	19.2%	30.7%	<0.001	13.8%	19.6%	38.7%	<0.001
Triad of wheeze	4.8%	8.0%	10.5%	<0.001	5.5%	8.4%	11.6%	<0.001
Cold and exercise-provoking symptoms	20.5%	23.3%	28.3%	<0.001	22.1%	22.8%	33.0%	<0.001
Pollen-provoking symptoms	15.7%	17.9%	17.2%	NS	18.1%	20.6%	22.5%	0.043

*Age adjustment to National Population Registry data on population age distribution in Helsinki 1 January 1996.

†Pearson's Chi-squared test for difference between non-smokers, former smokers, and current smokers.

Shortness of breath during the past year was overall reported more frequently in 2006, with an increase from 12.9% to 15.4% ($p=0.006$). Subjects reporting physician-diagnosed asthma had slightly fewer symptoms, although this difference was not statistically significant.

Of those subjects reporting shortness of breath during the past year, physician-diagnosed asthma was reported by 37.6% and 44.6% in 1996 and 2006, respectively. Likewise, of those subjects reporting wheeze during 12 months and the triad of wheeze (for definitions see Table 2), 23.2% and 28.1% in 1996 and 44.1% and 46.2% in 2006 reported having physician-diagnosed asthma. Longstanding cough was reported by 19.8% in 1996 and by 18.7% in 2006 and chronic productive cough by 11.9% and 10.5%, respectively, with no significant change. The prevalence of current smoking decreased in all age groups except in men aged >60 years

(Figure 1d). The prevalence of physician-diagnosed COPD remained at 3.7% overall (age-adjusted prevalence 3.0%), with 17.1% of subjects with asthma also reporting a diagnosis of COPD.

All respiratory symptoms except allergen-induced symptoms were significantly associated with smoking habits (Table 4). In 2006 the prevalence of recurrent wheeze increased from 3.0% in non-smokers to 14.2% in current smokers and wheeze in the past year from 13.8% to 38.7% correspondingly. The prevalence of positive answers to the triad of past year wheeze, wheeze with dyspnoea and wheeze outside colds was 5.5% in non-smokers, 8.4% in former smokers, and 11.6% in current smokers ($p<0.001$).

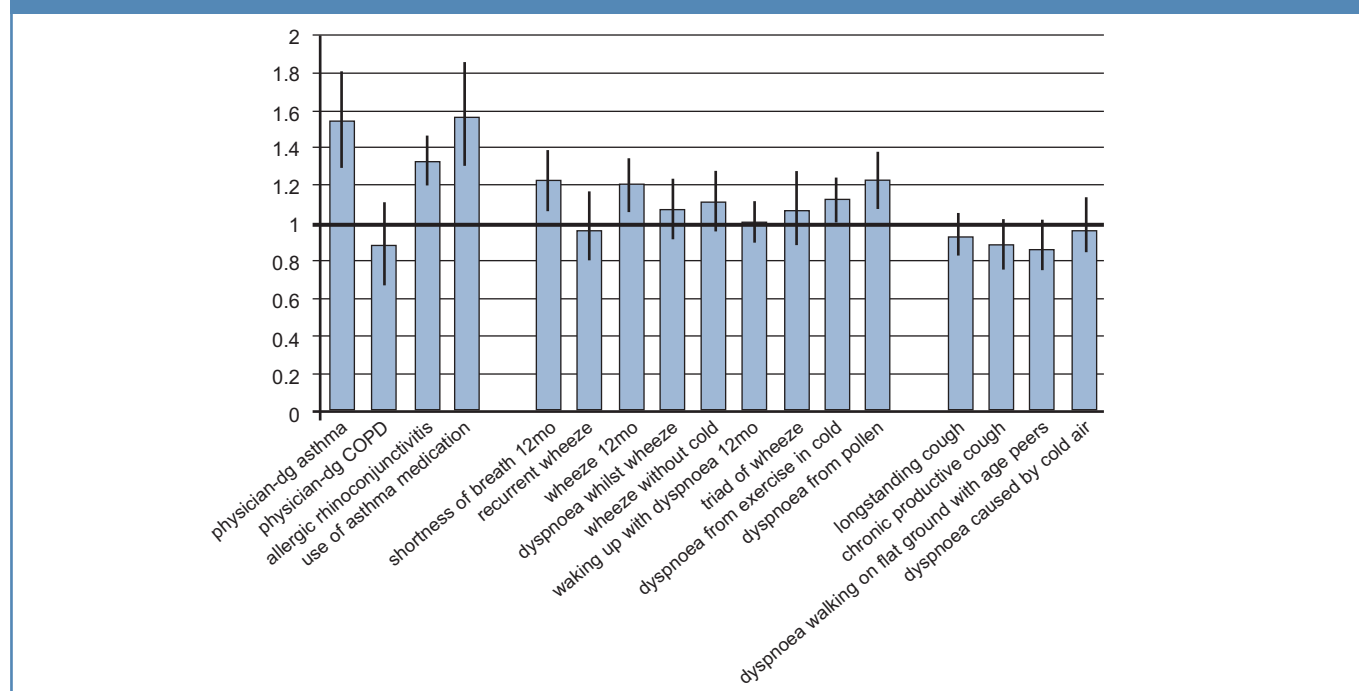
In the 2006 cohort, allergic rhinoconjunctivitis was associated with a higher age-adjusted prevalence of all respiratory symptoms in subjects without asthma: the triad of wheeze increased from 2.5% to 8.0% and past year shortness of breath from 4.5% to 16.5% in

Table 5. Crude prevalence of symptoms by asthma diagnosis among responders of the 1996 and 2006 FinEsS-Helsinki studies stratified by allergic rhinoconjunctivitis (ARC)

	1996				2006			
	Physician-dg asthma –		Physician-dg asthma +		Physician-dg asthma –		Physician-dg asthma +	
	ARC – n=3,714 (65.6%)	ARC + n=1,950 (34.4%)	ARC – n=112 (28.1%)	ARC + n=286 (71.9%)	ARC – n=1,343 (61.0%)	ARC + n=860 (39.0%)	ARC – n=59 (24.0%)	ARC + n=187 (76.0%)
Past year shortness of breath	4.1%	17.0%	72.3%	76.9%	4.5%	16.4%	69.5%	69.0%
Longstanding cough	13.9%	26.6%	46.4%	41.6%	13.1%	23.5%	32.2%	35.8%
Chronic productive cough	8.1%	15.8%	32.1%	31.1%	7.6%	12.4%	27.1%	25.1%
Recurrent wheeze	3.5%	8.1%	36.6%	39.2%	3.9%	7.0%	32.2%	24.6%
Past year wheeze	12.2%	24.3%	64.3%	74.5%	12.8%	25.2%	62.7%	62.6%
Triad of wheeze	2.3%	8.2%	40.2%	53.5%	2.6%	7.9%	30.5%	36.4%
Exercise in cold-provoking symptoms	15.4%	27.7%	74.1%	78.7%	15.3%	27.3%	62.7%	76.5%
Pollen-provoking symptoms	2.2%	35.8%	24.1%	67.1%	3.1%	40.5%	28.8%	75.9%

Statistically significant differences ($p < 0.05$) shown in bold.

ARC=allergic rhinoconjunctivitis; physician-dg=physician-diagnosed.

Figure 2. Adjusted odds ratios (OR) for physician-diagnosed obstructive airways diseases, use of asthma medication, allergic rhinoconjunctivitis, and symptoms suggestive of obstructive airways diseases assessed with a multiple logistic regression model adjusting for categorised age decade, gender, and smoking history between 2006 and 1996

subjects who reported not having or having allergic rhinoconjunctivitis, respectively (Table 5). In subjects with both asthma and allergic rhinoconjunctivitis, respiratory symptoms provoked by allergens and exercise in cold were more common than among those without rhinitis, but no significant difference between the groups was found for other respiratory symptoms. Although the prevalence of physician-diagnosed asthma increased, the prevalence of respiratory symptoms among patients with asthma decreased (Table 3).

In a multivariate logistic regression model in the 2006 cohort, the risk of physician-diagnosed asthma was significantly increased by allergic rhinoconjunctivitis (odds ratio (OR) 4.32, 95% CI 3.13 to 5.98; $p < 0.001$), family history of asthma (OR 1.83, 95% CI 1.34 to 2.48; $p < 0.001$), and obesity defined as BMI > 30 kg/m² (OR 1.63, 95% CI 1.13 to 2.34; $p = 0.009$) after adjusting for gender, family history of allergic rhinoconjunctivitis, age < 40 years, ever smoking, workplace exposure to vapours, gases, dusts or fumes (VGDF), and living on a farm as a child. In a comparable model, the risk of allergic

rhinoconjunctivitis was significantly increased by a family history of allergic rhinoconjunctivitis (OR 4.65, 95% CI 3.85 to 5.61; $p < 0.001$) and workplace exposure to VGDF (OR 1.43, 95% CI 1.17 to 1.74; $p < 0.001$). Living on a farm during the first five years of life was inversely associated with allergic rhinoconjunctivitis (OR 0.73, 95% CI 0.57 to 0.93; $p = 0.01$).

The trends for physician-diagnosed obstructive airways diseases, use of asthma medication, allergic rhinoconjunctivitis, and symptoms suggestive of obstructive airways diseases were assessed with a multiple logistic regression model adjusting for categorised age decade, gender and smoking history between 2006 and 1996 (Figure 2). Odds ratios were 1.53 (95% CI 1.29 to 1.81) for physician-diagnosed asthma, 1.56 (95% CI 1.31 to 1.85) for use of asthma medication, and 1.33 (95% CI 1.21 to 1.47) for allergic rhinoconjunctivitis.

Discussion

Main findings

The present study shows an increase in the prevalence of physician-diagnosed asthma and self-reported allergic rhinoconjunctivitis in subjects aged <60 years during 10 years from 1996 to 2006 in Helsinki. The steepest increase was found among women aged <40 years. This increased prevalence of physician-diagnosed asthma during the Finnish Asthma Programme (from 1994 to 2004) was paralleled by an increase in the use of asthma medication, which doubled among young women.

Strengths and limitations of this study

The FinEsS Helsinki Study has been conducted from 1996 using identical methods in sampling a non-selected population sample from the National Population Registry and identical postal questionnaire items. In 1996 a non-responder study was conducted in the concurrent FinEsS Kemi Study, which showed that typical non-responders were young men and current smokers who reported respiratory symptoms in exercise and asthma less frequently than the responders in the original study.¹⁷ There was a decline in the response rate from 1996 to 2006, but similar response rates during the last years have been reported from other national questionnaire studies.^{10,12} The response rate fell more in younger age cohorts than in older age cohorts, with youngest women having the largest reduction. This can affect the results since we cannot exclude the possibility that people with asthma were more likely to respond, which can increase the prevalence in these age groups. The total number of answers in the actual study was satisfactory.

Interpretation of findings in relation to previously published work

The simultaneous increase in the prevalence of allergic rhinoconjunctivitis and physician-diagnosed asthma suggests that the impact of allergies continues to rise in the population. The changes in prevalence of past year shortness of breath and asthma were in parallel. A recent report showed similar results from the Finnish Karelia, where allergic rhinoconjunctivitis and asthma were significantly more common in 2007 than in 1997.¹⁸ It is possible that the increase in the prevalence of physician-diagnosed asthma could in part be due to increased awareness by patients and general

practitioners following the Finnish Asthma Programme. Also, improved diagnostic processes – including the use of objective measurements of airway obstruction with spirometry and approved criteria of tests for bronchial hyperresponsiveness in Finland – could explain this rise to some extent.^{13,19,20} Thus, the milder forms of the disease might have been better recognised and diagnosed as asthma already in primary care. Those reporting physician-diagnosed asthma were less symptomatic in 2006 than in 1996, which may be related to more active treatment of asthma promoted by the Asthma Programme in Finland.¹³ On the other hand, no change in respiratory symptoms was found among those without asthma.

There are differing views on the best method of defining asthma prevalence in epidemiological studies of trends. In a recent publication from Sweden, an increase in 'current asthma' from 6.3% to 7.8% between 1990 and 2008 was reported and the proportion of subjects using asthma medication increased from 5.2% to 6.9%.²¹ These results are in line with our findings. However, the authors consider that a reduction in symptoms would be a more reliable measure of asthma prevalence and conclude that the rise in asthma prevalence has reached a plateau in Sweden. In countries with highly developed primary care services, with established national guidelines and reimbursement policies that are based on clinical physiological verification of disease, physician diagnoses of established disease are, in our view, a more reliable measure of the trend in disease prevalence. However, we also agree that diagnostic labelling is affected by healthcare policies.

The National Registry for Social Security benefits was searched for data on the number of patients entitled to special reimbursement for asthma medication in Finland (www.kela.fi). An increase from 99,665 cases in 1996 to 135,661 cases in 2006 was found among those aged 20–69 years, which is consistent with our results.

An increasing prevalence of asthma has been found in many parts of the world.²² In our study, the increase in prevalence was greatest among women aged <40 years, which is consistent with results from Denmark and Norway.^{3,12} What is the explanation for this increase in allergy symptoms and asthma among younger age groups? Environmental factors including living on a farm at early ages seems to be protective for allergic rhinoconjunctivitis, which could partially explain the increased prevalence of asthma in younger adults who are less likely to have lived in the countryside during childhood. In the study by Browatzki *et al.* it was hypothesised that the increase is associated with obesity.¹² Unfortunately, we have no data on weight from 1996 and thus are not able to assess the impact of obesity on the trend between 1996 and 2006; but in 2006 our study confirms this finding with BMI >30 kg/m² being a significant risk factor for physician-diagnosed asthma. Similarly, recent data from Finnish Karelia found that younger generations were more atopic than older ones.¹⁸ Our results are also in line with those from Denmark and Norway showing the steepest increase among young women, which suggests that changes in the immunological tolerance have been stronger in women than in men for some unexplained reason.

Allergic rhinoconjunctivitis was common in all age groups, reflecting present or past self-assessed allergic eye or nose

symptoms. We found a protective effect of living on a farm during the first five years of life for allergic rhinoconjunctivitis in adulthood. This protective effect was of similar magnitude to that recently found in Sweden.²³ This suggests that immunological changes occurring in early childhood in a farm environment persist in adulthood. An increased risk of allergic rhinoconjunctivitis was also associated with occupational exposure to vapours, gases, dusts or fumes (VGDF). This effect was stronger in our cohort than in the Swedish study.²³

The continuing educational work in smoking cessation and changes in the legislation have resulted in a decreased prevalence of current smokers in all but the oldest age groups. Despite this decrease, the prevalence of asthma continued to increase, which is in line with results from the Copenhagen City Heart Study.¹² Decreased smoking habits may have contributed to the better control of asthma seen in 2006 as well as the plateau in respiratory symptoms among non-asthmatics, since all symptoms were found to be strongly associated with smoking. The remaining prevalence of typical asthma symptoms such as shortness of breath during the past year (9.5%) suggests that there might still remain a degree of underdiagnosis of obstructive airways diseases in this population. The increase in asthma diagnoses in younger adults might reflect the fact that asthma is more often considered when respiratory symptoms are investigated in younger adults.

In both the 1996 and 2006 studies the prevalence of physician-diagnosed COPD remained at the same level despite the implementation of the Finnish COPD Programme and better awareness of COPD among physicians in primary care.^{24,25} The decreasing smoking habits have probably contributed to the fact that chronic productive cough remained at the same level and no increase in physician-diagnosed COPD was found. The WHO Global Burden of Disease Study has predicted COPD to rise to be the fifth leading cause of loss of disability-adjusted life years in the world by 2020.²⁶ Prevalence estimates of COPD have varied from 4% to 10% internationally.^{27,28} In the Obstructive Lung Disease in Northern Sweden (OLIN) study, the prevalence of COPD was 8–14% among those aged >45 years depending on the lung function criteria used for the diagnosis.²⁹ Similarly, the prevalence of COPD in Finland varied from 5% to 9% depending on the criteria used.³⁰ In a recent Finnish study, no significant change in the prevalence of COPD was found between 1978–80 and 2000–1.³¹

Implications for future research, policy and practice

Our results indicate that perhaps milder forms of asthma were recognised particularly in younger adults among whom allergic rhinoconjunctivitis is also more prevalent. Patients with diagnosed asthma were less symptomatic, which could be attributed to more active pharmacological treatment, also seen as an increase in the National Medical Reimbursement Statistics for asthma medication. The diagnostic labelling of COPD is clearly more limited, but the changes in reimbursement criteria for COPD were only implemented in 2006 so are yet to be reflected in this study. A follow-up study on the prevalence of asthma, allergic rhinoconjunctivitis, and COPD is planned for 2013 and 2016 to further evaluate the impacts of the Finnish Asthma Programme, Finnish COPD Programme, and the

ongoing Finnish Allergy Programme. A more in-depth understanding of the diagnostic labelling and patient management practices in primary care and their implications for healthcare costs and diagnostic accuracy are clearly needed.

Conclusions

The results indicate that no plateau in the increase of asthma has yet been attained in Finland in terms of physician-diagnosed asthma, but the patients diagnosed with asthma are less symptomatic and receive more active treatment. The increase in asthma prevalence might be partly due to improved diagnostic processes and recognition of asthma in primary care in Finland following the Finnish Asthma Programme. Allergic rhinoconjunctivitis increased the respiratory symptoms in subjects without physician-diagnosed asthma, suggesting a remaining group of patients with undiagnosed asthma and a true rise in the prevalence of asthma. Further studies are needed to evaluate whether earlier diagnosis and active treatment of milder cases will eventually contribute to more patients with asthma reaching remission.

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Contributorship AK conducted the data processing and analysis and produced the tables and figures for the article. AK and PP drafted the text of the article. AP organised the questionnaire study of 2006 in the Finnish Lung Health Association and participated in editing the paper. PP participated in planning of the original study. AL and AS participated in editing the paper and coordinating the FinEsS Helsinki study.

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