

# Variations in the prevalence of respiratory symptoms, self-reported asthma attacks, and use of asthma medication in the European Community Respiratory Health Survey (ECRHS)

## European Community Respiratory Health Survey

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**ABSTRACT:** Asthma is a common chronic disorder which may be increasing in prevalence. However, little is known of its distribution and determinants. The European Community Respiratory Health Survey (ECRHS) is a multicentre survey of the prevalence, determinants and management of asthma. This paper presents a descriptive account of the variation in self-reported attacks of asthma and asthma symptoms across Europe, and in part fulfils the first aim of the study.

A screening questionnaire, including seven questions relating to the 12 month prevalence of symptoms of asthma, was distributed to representative samples of 20–44 year old men and women in 48 centres, predominantly in Western Europe.

The median response rate to the questionnaire was 75% but, after removing from the denominator those who were the wrong age, were known to have moved out of the area, or had died, it was 78% (range 54–100). The prevalence of all symptoms varied widely. Although these were generally lower in northern, central and southern Europe and higher in the British Isles, New Zealand, Australia and the United States, there were wide variations even within some countries. Centres with a high prevalence of self-reported attacks of asthma also reported high prevalences of nasal allergies and of waking at night with breathlessness. The use of asthma medication was more common where wheeze and asthma attacks were more frequent. In most centres in The Netherlands, Sweden, New Zealand and the United Kingdom over 80% of those with a diagnosis of asthma were currently using asthma medication. In Italy, France and Spain the rate was generally less than 70%.

These data are the best evidence to date that geographical differences in asthma prevalence exist, are substantial and are not an artefact of the use of noncomparable methods.

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Asthma is a common chronic disorder in Western countries and there is evidence that it may be increasing in prevalence both among children [1] and young adults [2]. This increase and the very large variations in prevalence recorded in developing countries [3] strongly suggest an important environmental impact on the prevalence of asthma. Nevertheless, the causes of asthma are poorly understood. A few studies have reported variations between countries in the prevalence of asthma and related conditions among children [4–7], but there is little reliable information on variations between Western countries in asthma prevalence among adults. This absence of information is due largely to the lack of any clear definition of asthma and the historical lack of any standardized instrument for the descriptive epidemiology of the condition, as it is impossible to compare studies that have used different methods and questionnaires.

In the 1980s the International Union against Tuberculosis and Lung Disease (IUATLD) started to develop standard methods for studying the epidemiology of asthma. This included the development of the IUATLD questionnaire

[8–11]. In 1988, the European Commission funded a study to: 1) assess the variation in the prevalence of asthma, asthma-like symptoms and bronchial responsiveness in Europe; 2) estimate the variation in exposure to known or suspected risk factors for asthma, to measure their association with asthma and to further assess the extent to which they explain variations in prevalence across Europe; and 3) estimate the variation in treatment practice for asthma in the European Community. This study became known as the European Community Respiratory Health Survey (ECRHS) [12].

This paper reports the prevalence of respiratory symptoms in the centres that provided data to the London coordinating centre by December, 1994.

Participating Centres are listed at the end of the paper.

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## Methods

The methods used in the study have been summarized previously [12], and the detailed methods have been

published by the European Community [13]. Each participating centre was asked to identify a suitable sampling frame for a population aged 20–44 yrs with a total population (all ages) of at least 150,000. From this, random samples of at least 1,500 males and 1,500 females aged 20–44 yrs were selected. A sampling frame could not be identified in Athens and a more complex sampling method had to be used based on households. Samples in Pavia and Caerphilly were drawn from a smaller sampling frame, and other sampling frames, including that in Dublin, did not contain information on date of birth or sex. These centres also had to use slightly different sampling strategies.

A short postal questionnaire was sent to all those in the sample, except in Algiers, Bombay and Dublin, where all questionnaires were delivered at home visits. This questionnaire checked the date of birth and gender of the subject and asked seven main questions and two further questions conditional on a positive answer to the first question. The text of the questionnaire is given in the Appendix. All the centres in Sweden added questions on smoking and chronic cough to this questionnaire. In Bergen, questions were added on other respiratory symptoms, smoking habits, occupational exposures and nutrition during the last 12 months. In Basel, a question was added on smoking. In Dundee, Nancy and Aarhus questionnaires were used which, though some of the questions were identical, did not contain all the questions used in the other centres. Otherwise, the questionnaire was the same in all centres. The questionnaire was sent out in 17 languages. These were translated directly from the English except for the Basque and Catalan questionnaires, which were translated from the Spanish. Back translations into English were checked for the questionnaires in French, Dutch, German, Spanish and Norwegian. All translators were asked to identify difficulties in the translations and these were rare.

Centres entered the results from the questionnaires onto computer files and sent these to the co-ordinating centre in London. These were checked for consistency and, where problems were encountered, centres were asked to check the data, make any necessary corrections and send a revised file.

Most centres sent out the questionnaire up to three times if there was no response. In some centres, this was followed by a telephone call and a home visit if necessary.

Centres were asked to identify on the file the point at which a response had been received, for instance after the first, second or third mailing, or only subsequently following a telephone call or home visit. From this, it was possible to assess prevalence at different response rates. No information on nonresponders was available from Nancy, and for Athens only the number of households not responding could be estimated. Centres were asked to categorize the "nonresponders" as: those who were no longer part of the accessible sampling frame because they were either the wrong age, had moved out of the area or had died; those who had explicitly refused to answer the questionnaire; those who were temporarily away during the time of the survey; those who remained untraced despite efforts to find them in the area; and those who were outstanding nonresponders otherwise unclassified at the end of the survey.

All prevalences were directly standardized by sex and age group, using the age groups 20–24, 25–34 and 35–44 yrs, the first of these being given half the weight of the other two. The effect of adjusting for nonresponse was tested using different assumptions about the

Table 1. – Response rates by centre

Country	Centre	Total	Rep	Exc <sup>#</sup>	Response rate %	
					Abs <sup>‡</sup>	Adj <sup>§</sup>
Iceland	Reykjavik	3600	2903	144	81	84
Norway	Bergen	4300	3452	86	80	82
Sweden	Göteborg	3600	2885	127	80	83
	Umeå	3600	3292	5	91	92
	Uppsala	3600	3146	65	87	89
Estonia	Tartu	3000	2460	107	82	85
Denmark	Aarhus	4328	3629	43	84	85
Netherlands	Bergen op Zoom	4069	3396	14	83	84
	Geleen	4038	3372	4	84	84
	Groningen	4111	3116	12	76	76
Belgium	Antwerp city	4000	2964	363	74	81
	Antwerp south	4027	3076	71	76	78
Germany	Erfurt	4954	3272	475	66	73
	Hamburg	4500	3312	368	74	80
Austria	Vienna	3000	2131	143	71	75
Switzerland	Basel	4999	4082	123	82	84
France	Bordeaux	3501	2936	545	84	99
	Grenoble	5000	2804	1398	56	78
	Montpellier	5556	3736	117	67	69
	Nancy		1263			
	Paris	4252	3113	63	73	74
UK	Caerphilly	3954	2384	426	60	68
	Cambridge	5000	2595	1109	52	67
	Dundee	6000	4275	471	71	77
	Ipswich	5000	3390	519	68	76
	Norwich	5000	3148	681	63	73
Ireland	Dublin	6734	2408	3432	36	73
	Kilkenny-Wexford	3238	1724	886	53	73
Greece	Athens		3325		52 <sup>¶</sup>	
Italy	Pavia	1015	816	71	80	86
	Turin	2996	2505	0	84	84
	Verona	3000	2713	52	90	92
Spain	Albacete	3909	3391	47	87	88
	Barcelona	3236	2731	96	84	87
	Galdakao	3585	3037	162	85	89
	Huelva	3000	2244	97	75	77
	Oviedo	3241	2918	15	90	90
	Seville	3999	2148	738	54	66
Portugal	Coimbra	4254	1764	998	41	54
	Oporto	4047	2086	1337	52	77
Algeria	Algiers	3338	3308	25	99	100
India	Bombay	3497	2210	770	63	81
New Zealand	Auckland	4064	2941	191	72	76
	Christchurch	4061	3024	145	74	77
	Hawkes Bay	3951	2979	136	75	78
	Wellington	4107	3033	206	74	78
Australia	Melbourne	4500	3200	83	71	72
USA	Portland	4402	2982	65	68	69

Rep: replied; Exc: excluded; Abs: absolute; Adj: adjusted. #: excluded = wrong age or area, or known to have moved away or died; ‡: absolute response rate = replied/total; §: adjusted response rate = replied/(total - excluded); ¶: household response rate.

characteristics of nonresponders [14]. In the first adjustment, it was assumed that there was a linear relationship between the response rate on the logistic scale after the first, second and third mailings and the estimated prevalence at these times, and that this could be extrapolated within each centre to a 100% response rate. The second adjustment assumed that nonresponders had the same prevalence as responders at the final mailing or other contact of the same age group and sex. The third adjustment, which was not related to the problem of nonresponse, was a direct standardization of rates for the season in which the questionnaire was completed, as well as for age group and sex.

## Results

### Response

Table 1 shows the response rates for the 48 different centres from 22 countries that had sent fully checked data by December 5, 1994. Information on the age and sex of the nonresponders was available from most centres, though 12 centres were unable to provide information on age and three could not provide information on sex. No information was available on response rates for Athens because of the method of sampling, or for Nancy. The median response rate, based on the initial sampling frames, was 75% (range 36–99). After removing from the sampling frame those who were found to be of the wrong age, those who had moved out of the area and those who had died the median response rate was 78% (range 54–100).

Not all centres supplied information on the age and sex of nonresponders. For those that did, where response rates varied, they were higher in females than in males, except in Huelva. They were also higher in the older age groups, except in Seville, Grenoble, Coimbra, Vienna and Tartu, the differences between those aged 35–44 yrs and 20–24 yrs reaching a maximum of 20% in the centres in New Zealand.

Information was collected during all seasons of the year and just over half of the centres collected some information in all four seasons. There was no season in which data were collected from all the areas.

### Symptom prevalence

The relationship between sex, age and symptoms was not consistent between centres and, as the effect of sex on the variation in symptoms with age also varied between centres, it is difficult to provide any general conclusions regarding the relationship between age or sex and symptoms. Table 2 shows the distribution of responses to the nine questions adjusted to a standard population with an equal distribution by age and sex, but without adjustment for nonresponse. The rates for the different centres are given in table 3 with 95% confidence intervals. Table 4 shows which centres have an estimated prevalence for which the 95% confidence interval does not include the median value for the study. Both table 3 and table 4 include figures for a category which has been designated "diagnosed current asthma" being those who answered "yes" to either Question 5 or Question 6, indicating that either they had had an attack of asthma in the previous 12 months or that they were currently receiving medication for asthma.

In the north of Europe, including the Nordic countries, Estonia and The Netherlands, there was a high prevalence of wheeze but a low prevalence of other symptoms. The principal exceptions were a low prevalence of wheeze in Iceland, a high prevalence of being woken by cough in Tartu and of being woken by cough and shortness of breath in Geleen. There was a high prevalence of people receiving treatment for asthma in the Swedish centres, in proportion to the prevalence of asthma attacks. Nasal allergies were commonly reported in The Netherlands and uncommon in Iceland and Estonia.

In the western part of central continental Europe, including Belgium, France, Germany, Switzerland and Austria, the prevalence of respiratory symptoms was generally low, though there was a high prevalence of "nasal allergies and hayfever". However, there was a high prevalence of reported waking with tightness in the chest and attacks of asthma in France and Switzerland and a low prevalence of nasal allergies in Erfurt and Vienna.

In the British Isles, prevalence rates were high. The main exceptions were the low levels of being woken with cough reported in Kilkenny-Wexford and Ipswich.

In the Mediterranean countries, including Greece, Italy, Spain, Portugal and Algeria, the prevalence of most symptoms was low. This was particularly so in Athens and

Table 2. – Distribution of responses to the questions in the questionnaire

	Number of centres	Percent prevalence				
		Min	25th centile	Median	75th centile	Max
Q1 Wheeze	48	4.1	14.9	20.7	25.2	32.0
Q1.1 Wheeze with breathlessness <sup>#</sup>	46	1.4	7.7	9.8	13.9	16.3
Q1.2 Wheeze without a cold <sup>#</sup>	46	2.0	9.3	12.7	16.2	21.6
Q2 Waking with tightness in the chest <sup>‡</sup>	46	6.2	9.7	13.5	17.5	20.5
Q3 Waking with breathlessness <sup>+</sup>	47	1.5	4.7	7.3	8.9	11.4
Q4 Waking with cough	48	6.0	25.6	27.9	29.5	42.6
Q5 Attack of asthma	48	1.3	2.6	3.1	4.5	9.7
Q6 Treatment for asthma <sup>§</sup>	47	0.6	2.4	3.5	5.0	9.8
Q7 Nasal allergies and hayfever <sup>¶</sup>	45	9.5	16.6	20.9	28.2	40.9

Min: minimum; Max: maximum. <sup>#</sup>: data missing for Nancy and Dundee; <sup>‡</sup>: data missing for Aarhus and Dundee; <sup>+</sup>: data missing for Aarhus; <sup>§</sup>: data missing for Dundee; <sup>¶</sup>: data missing for Aarhus, Nancy and Dundee.

Table 3. – Percentage prevalences of positive responses with 95% confidence intervals

	Q1 Wheeze	Q1.1 Wheeze & breathless	Q1.2 Wheeze no cold	Q2 Chest tightness	Q3 Breathless at night	Q4 Cough at night	Q5 Asthma attack	Q6 Asthma medicine	Q7 Nasal allergy	Q5 or 6 Diagnosed asthma
Reykjavik (Iceland)	18.0 16.6–19.4	9.0 8.0–10.1	11.4 10.2–12.6	11.7 10.5–12.9	1.5 1.1–1.9	20.7 19.2–22.1	2.2 1.7–2.8	2.4 1.8–2.9	17.8 16.4–19.2	3.4 2.7–4.1
Bergen (Norway)	24.6 23.1–26.0	13.6 12.4–14.7	15.8 14.5–17.0	11.4 10.3–12.5	5.0 4.3–5.8	26.1 24.7–27.6	3.1 2.6–3.7	3.4 2.8–4.0	19.5 18.2–20.9	4.3 3.6–5.0
Göteborg (Sweden)	23.2 21.6–24.8	12.3 11.1–13.6	13.5 12.3–14.8	14.7 13.4–16.0	7.1 6.2–8.1	28.2 26.5–29.8	3.1 2.4–3.7	4.8 4.0–5.6	22.2 20.7–23.7	5.8 4.9–6.6
Umeå (Sweden)	19.8 18.5–21.2	11.2 10.1–12.3	12.1 11.0–13.2	10.4 9.4–11.4	4.4 3.7–5.0	26.7 25.2–28.2	3.3 2.7–3.9	6.2 5.4–7.0	21.1 19.7–22.5	6.8 5.9–7.7
Uppsala (Sweden)	19.2 17.8–20.7	10.4 9.3–11.5	11.6 10.4–12.7	9.7 8.6–10.7	4.9 4.2–5.7	25.3 23.8–26.8	3.3 2.7–4.0	5.0 4.2–5.7	22.3 20.8–23.7	6.0 5.2–6.9
Tartu (Estonia)	26.8 25.0–28.6	7.8 6.7–8.9	12.8 11.5–14.2	13.9 12.5–15.3	8.1 7.0–9.3	42.6 40.6–44.6	1.8 1.3–2.4	0.6 0.3–0.9	18.1 16.5–19.7	2.0 1.4–2.5
Aarhus (Denmark)	24.1 22.7–25.5	13.5 12.3–14.6	18.2 17.0–19.5	*	*	26.4 24.9–27.8	3.4 2.8–4.0	2.8 2.2–3.3	*	4.0 3.3–4.6
Bergen op Zoom (Netherlands)	19.7 18.4–21.1	14.2 13.1–15.4	12.8 11.6–13.9	11.3 10.3–12.4	7.7 6.8–8.6	28.8 27.3–30.3	2.9 2.3–3.5	4.0 3.4–4.7	20.7 19.4–22.1	4.7 4.0–5.4
Geleen (Netherlands)	20.9 19.5–22.2	14.6 13.4–15.8	12.3 11.2–13.4	12.6 11.5–13.7	8.9 7.9–9.8	34.2 32.6–35.8	2.3 1.8–2.8	3.8 3.2–4.5	23.8 22.3–25.2	4.4 3.7–5.1
Groningen (Netherlands)	21.1 19.7–22.6	13.9 12.7–15.1	14.5 13.3–15.8	13.1 11.9–14.3	7.6 6.7–8.5	28.9 27.3–30.4	3.0 2.4–3.6	3.6 2.9–4.2	23.6 22.1–25.1	4.3 3.6–5.0
Antwerp city (Belgium)	20.6 19.1–22.0	10.9 9.8–12.0	12.9 11.7–14.1	10.3 9.2–11.4	6.9 6.0–7.8	27.2 25.6–28.8	2.6 2.0–3.2	3.4 2.7–4.0	25.1 23.5–26.7	4.6 3.6–5.0
Antwerp south (Belgium)	12.8 11.6–14.0	5.9 5.1–6.8	7.7 6.8–8.7	6.4 5.6–7.3	3.4 2.8–4.1	19.2 17.8–20.6	1.3 0.9–1.7	2.4 1.8–2.9	20.9 19.4–22.3	2.7 2.2–3.3
Erfurt (Germany)	13.3 12.1–14.5	5.0 4.2–5.7	7.2 6.3–8.1	8.9 8.0–9.9	4.3 3.6–5.0	19.3 18.0–20.7	1.3 0.9–1.7	1.6 1.2–2.0	13.4 12.3–14.6	2.1 1.6–2.6
Hamburg (Germany)	21.1 19.7–22.5	8.0 7.1–8.9	13.3 12.2–14.5	9.6 8.6–10.7	5.0 4.3–5.8	25.8 24.3–27.3	3.0 2.4–3.6	3.4 2.8–4.1	23.0 21.5–24.4	4.4 3.7–5.1
Vienna (Austria)	14.3 12.8–15.8	6.0 5.0–7.1	9.4 8.1–10.6	8.8 7.6–10.1	5.1 4.1–6.0	16.7 15.1–18.3	2.2 1.6–2.9	2.4 1.7–3.1	16.4 14.8–17.9	3.1 2.4–3.9
Basel (Switzerland)	16.9 15.7–18.0	9.9 9.0–10.8	11.9 10.9–12.9	15.1 14.0–16.2	7.6 6.8–8.4	29.1 27.7–30.5	3.9 3.3–4.5	3.5 2.9–4.0	24.0 22.7–25.3	5.4 4.7–6.1
Bordeaux (France)	15.7 14.4–17.0	9.2 8.2–10.3	9.9 8.8–11.0	16.6 15.2–17.9	4.3 3.5–5.0	26.0 24.4–27.6	4.6 3.8–5.3	3.8 3.1–4.4	30.2 28.5–31.9	5.5 4.7–6.3
Grenoble (France)	14.6 13.3–16.0	8.1 7.0–9.1	9.1 8.0–10.2	15.1 13.7–16.4	4.5 3.7–5.2	24.4 22.8–26.0	2.7 2.1–3.3	2.1 1.5–2.6	28.1 26.4–29.8	3.5 2.8–4.2
Montpellier (France)	14.4 13.2–15.5	9.0 8.1–10.0	8.9 7.9–9.8	16.9 15.6–18.1	4.1 3.5–4.8	25.8 24.3–27.2	3.6 3.0–4.2	3.5 2.9–4.1	34.4 32.9–36.0	5.0 4.3–5.7
Nancy (France)	13.6 11.7–15.5	*	*	14.8 12.8–16.8	3.7 2.7–4.8	25.5 23.1–27.9	2.9 2.0–3.8	2.3 1.5–3.1	*	3.7 2.6–4.7
Paris (France)	14.5 13.2–15.8	9.3 8.3–10.4	9.0 7.9–10.0	16.8 15.5–18.2	4.7 3.9–5.5	26.0 24.4–27.5	4.3 3.6–5.1	3.2 2.5–3.8	30.3 28.7–32.0	5.1 4.3–6.0
Caerphilly (UK)	29.8 27.9–31.7	16.3 14.8–17.8	20.5 18.8–22.1	19.9 18.3–21.6	8.8 7.7–10.0	28.8 27.0–30.7	5.6 4.7–6.6	6.8 5.7–7.8	23.6 21.9–25.4	8.0 6.9–9.2
Cambridge (UK)	25.2 23.5–26.9	13.9 12.5–15.2	17.7 16.2–19.2	17.4 15.9–18.9	8.4 7.3–9.5	27.4 25.7–29.2	5.7 4.8–6.6	6.8 5.8–7.8	29.2 27.4–31.0	8.4 7.3–9.5
Dundee (UK)	28.4 27.1–29.8	*	*	*	9.5 8.6–10.4	30.8 29.4–32.2	4.8 4.2–5.5	*	*	*
Ipswich (UK)	25.5 24.0–27.0	13.9 12.7–15.1	17.3 16.0–18.6	17.6 16.3–18.9	8.1 7.1–9.0	26.1 24.6–27.6	5.0 4.2–5.7	6.7 5.8–7.5	26.7 25.2–28.3	7.8 6.9–8.7

\*: question not asked or not supplied.

Table 3. – continued

	Q1 Wheeze	Q1.1 Wheeze & breathless	Q1.2 Wheeze no cold	Q2 Chest tightness	Q3 Breathless at night	Q4 Cough at night	Q5 Asthma attack	Q6 Asthma medicine	Q7 Nasal allergy	Q5 or 6 Diagnosed asthma
Norwich (UK)	25.7 24.1–27.3	14.2 13.0–15.5	18.7 17.3–20.1	18.8 17.4–20.2	7.9 6.9–8.9	29.2 27.6–30.8	5.0 4.2–5.7	6.3 5.4–7.2	28.3 26.6–29.9	7.5 6.6–8.5
Dublin (Ireland)	32.0 30.1–33.9	15.2 13.7–16.7	21.6 19.9–23.3	17.8 16.2–19.3	9.5 8.3–10.7	29.1 27.3–30.9	3.6 2.8–4.3	3.9 3.1–4.7	20.0 18.4–21.6	5.0 4.1–5.9
Kilkenny- Wexford (Ireland)	24.0 21.9–26.0	12.0 10.5–13.6	16.2 14.4–17.9	13.8 12.2–15.5	7.2 5.9–8.4	24.1 22.0–26.1	4.2 3.3–5.2	4.2 3.2–5.2	20.1 18.2–22.0	5.4 4.3–6.5
Athens (Greece)	16.0 14.8–17.3	9.4 8.4–10.4	9.8 8.8–10.9	11.7 10.6–12.8	5.7 4.9–6.5	17.8 16.5–19.2	2.4 1.9–2.9	2.2 1.7–2.7	18.4 17.1–19.7	2.9 2.3–3.5
Pavia (Italy)	8.5 6.6–10.3	1.4 0.6–2.2	5.1 3.6–6.6	6.2 4.5–7.9	6.9 5.2–8.7	28.9 25.8–32.0	2.6 1.5–3.6	1.3 0.5–2.1	12.5 10.2–14.8	3.3 2.1–4.5
Turin (Italy)	10.7 9.5–11.9	4.4 3.6–5.3	7.6 6.5–8.6	9.1 8.0–10.3	8.1 7.0–9.2	31.7 29.8–33.5	4.2 3.4–4.9	2.2 1.6–2.8	16.0 14.6–17.5	4.5 3.7–5.3
Verona (Italy)	9.7 8.6–10.9	1.4 1.0–1.9	6.6 5.6–7.5	8.0 7.0–9.0	6.2 5.3–7.1	27.8 26.1–29.5	3.7 3.0–4.5	2.0 1.5–2.6	16.9 15.4–18.3	4.2 3.4–4.9
Albacete (Spain)	25.0 23.5–26.5	9.2 8.2–10.2	12.7 11.6–13.8	11.9 10.8–13.0	8.2 7.2–9.1	28.1 26.6–29.7	2.6 2.1–3.2	2.4 1.8–2.9	12.1 11.0–13.2	3.9 3.3–4.6
Barcelona (Spain)	19.2 17.7–20.7	5.6 4.7–6.5	10.7 9.5–11.8	7.2 6.3–8.2	4.6 3.8–5.4	28.2 26.5–29.9	2.1 1.5–2.6	2.2 1.7–2.8	13.1 11.9–14.4	3.1 2.5–3.8
Galdakao (Spain)	16.2 14.9–17.5	7.1 6.2–8.0	8.6 7.6–9.6	6.7 5.8–7.6	3.7 3.0–4.3	33.8 32.1–35.5	1.5 1.1–2.0	1.3 0.9–1.7	12.6 11.4–13.8	2.1 1.6–2.7
Huelva (Spain)	29.2 27.3–31.0	13.2 11.8–14.7	18.2 16.6–19.8	18.5 16.9–20.1	11.3 10.0–12.6	32.6 30.6–34.5	2.8 2.1–3.5	5.2 4.2–6.1	17.6 16.0–19.2	6.3 5.3–7.3
Oviedo (Spain)	21.0 19.6–22.5	7.3 6.4–8.3	12.6 11.4–13.8	12.1 10.9–13.3	7.3 6.3–8.2	30.9 29.2–32.5	2.2 1.6–2.7	2.6 2.0–3.1	13.4 12.1–14.6	3.6 2.9–4.3
Seville (Spain)	22.6 20.6–24.5	9.3 7.9–10.7	13.2 11.6–14.8	12.9 11.4–14.5	9.5 8.1–10.9	27.9 25.8–30.1	3.1 2.2–4.0	3.5 2.6–4.4	15.5 13.9–17.3	5.0 4.0–6.1
Coimbra (Portugal)	19.0 17.1–21.0	9.8 8.3–11.2	12.9 11.2–14.5	18.8 16.9–20.7	10.6 9.1–12.1	25.2 23.1–27.4	4.3 3.3–5.3	4.9 3.8–6.0	16.7 14.9–18.6	6.0 4.8–7.2
Oporto (Portugal)	17.7 16.0–19.3	8.3 7.1–9.5	12.1 10.7–13.5	16.2 14.6–17.8	10.3 9.0–11.6	26.0 24.1–27.9	3.0 2.2–3.8	3.5 2.7–4.3	18.9 17.2–20.6	4.3 3.4–5.2
Algiers (Algeria)	4.2 3.5–5.0	3.3 2.7–4.0	2.8 2.2–3.5	6.4 5.5–7.3	4.4 3.6–5.1	6.0 5.1–6.9	2.4 1.8–2.9	2.5 1.9–3.1	9.5 8.5–10.6	3.0 2.4–3.7
Bombay (India)	4.1 3.1–5.2	3.0 2.0–4.0	2.0 1.3–2.7	7.0 5.8–8.3	6.8 5.5–8.2	11.2 9.5–12.8	2.6 1.7–3.5	2.8 1.8–3.8	10.1 8.4–11.9	3.5 2.5–4.5
Auckland (New Zealand)	25.2 23.7–26.8	14.7 13.5–16.0	16.3 15.0–17.7	18.1 16.7–19.5	9.9 8.8–11.0	29.6 28.0–31.2	6.8 5.8–7.7	8.5 7.5–9.6	35.1 33.4–36.8	10.1 9.0–11.2
Christchurch (New Zealand)	26.7 25.1–28.3	15.8 14.5–17.1	18.7 17.3–20.0	18.8 17.4–20.2	10.4 9.3–11.5	31.7 30.1–33.4	8.7 7.7–9.7	9.1 8.0–10.1	36.1 34.4–37.9	11.2 10.1–12.3
Hawkes Bay (New Zealand)	24.2 22.6–25.8	15.1 13.8–16.5	16.1 14.8–17.5	19.5 18.1–21.0	10.6 9.5–11.7	32.0 30.3–33.7	7.2 6.3–8.1	7.7 6.8–8.7	37.8 36.1–39.6	9.0 8.0–10.1
Wellington (New Zealand)	27.3 25.7–28.8	16.0 14.7–17.3	18.0 16.7–19.4	18.1 16.7–19.5	10.4 9.3–11.5	31.2 29.5–32.8	8.6 7.6–9.6	9.8 8.8–10.9	36.6 34.9–38.4	11.3 10.2–12.5
Melbourne (Australia)	28.8 27.2–30.5	16.1 14.8–17.4	20.7 19.3–22.2	20.5 19.1–22.0	11.4 10.2–12.5	28.5 26.9–30.1	9.7 8.7–10.8	9.3 8.3–10.4	40.9 39.2–42.7	11.9 10.7–13.1
Portland, Oregon (USA)	25.7 24.0–27.3	10.5 9.3–11.6	14.9 13.5–16.2	16.6 15.3–18.0	7.7 6.7–8.7	32.5 30.8–34.3	5.8 4.9–6.7	4.8 4.0–5.6	39.4 37.6–41.2	7.1 6.1–8.1
Median	20.7	9.8	12.7	13.5	7.3	27.9	3.1	3.5	20.9	4.5

\*: question not asked or not supplied.

Table 4. – Prevalence rates shown by significantly high and significantly low values

Country	Centre	Q1	Q1.1	Q1.2	Q2	Q3	Q4	Q5	Q6	Q7	"Asthma"
Iceland	Reykjavik	L		L	L	L	L	L	L	L	L
Norway	Bergen	H	H	H	L	L	L				
Sweden	Göteborg	H	H						H		H
	Umeå		H		L	L			H		H
	Uppsala				L	L	L		H		H
Estonia	Tartu	H	L				H	L	L	L	L
Denmark	Aarhus	H	H	H	*	*	L		L	*	H
Netherlands	Bergen op Zoom		H		L						
	Geleen		H			H	H				
	Groningen		H	H						H	
Belgium	Antwerp city				L					H	
	Antwerp south	L	L	L	L	L	L	L	L		L
Germany	Erfurt	L	L	L	L	L	L	L	L	L	L
	Hamburg		L	L	L	L	L			H	
Austria	Vienna	L	L	L	L	L	L	L	L	L	L
Switzerland	Basel	L			H			H		H	H
France	Bordeaux	L		L	H	L	L	H		H	H
	Grenoble	L	L	L	H	L	L		L	H	L
	Montpellier	L		L	H	L	L			H	
	Nancy	L	*	*		L			L	*	
	Paris	L		L	H	L	L	H		H	
UK	Caerphilly	H	H	H	H	H		H	H	H	H
	Cambridge	H	H	H	H			H	H	H	H
	Dundee	H	*	*	*	H	H		*	*	*
	Ipswich	H	H	H	H		L	H	H	H	H
	Norwich	H	H	H	H			H	H	H	H
Ireland	Dublin	H	H	H	H	H					
	Kilkenny-Wexford	H	H	H			L	H			
Greece	Athens	L		L	L	L	L	L	L	L	L
Italy	Pavia	L	L	L	L				L	L	
	Turin	L	L	L	L		H	H	L	L	
	Verona	L	L	L	L	L			L	L	
Spain	Albacete	H			L				L	L	
	Barcelona		L	L	L	L		L	L	L	L
	Galdakao	L	L	L	L	L	H	L	L	L	L
	Huelva	H	H	H	H	H	H		H	L	H
	Oviedo		L		L		H	L	L	L	L
	Seville					H				L	
Portugal	Coimbra				H	H	L	H	H	L	H
	Oporto	L	L		H	H				L	
Algeria	Algiers	L	L	L	L	L	L	L	L	L	L
India	Bombay	L	L	L	L		L			L	
New Zealand	Auckland	H	H	H	H	H	H	H	H	H	H
	Christchurch	H	H	H	H	H	H	H	H	H	H
	Hawkes Bay	H	H	H	H	H	H	H	H	H	H
	Wellington	H	H	H	H	H	H	H	H	H	H
Australia	Melbourne	H	H	H	H	H		H	H	H	H
USA	Portland	H		H	H		H	H	H	H	H

H: significantly high; L: significantly low; \*: not asked; Q1: wheeze; Q1.1: wheeze with shortness of breath; Q1.2: wheeze in the absence of a cold; Q2: waking with tightness in the chest; Q3: woken by an attack of breathlessness; Q4: woken by attack of cough; Q5: attack of asthma; Q6: treatment for asthma; Q7: nasal allergies including hayfever; "Asthma": diagnosed asthma. All questions refer to symptoms in the previous 12 months.

Algiers. However, there were many exceptions. Almost all symptoms were common in Huelva, wheeze was common in Albacete, waking with tightness in the chest or shortness of breath was common in the Portuguese centres and Seville, and waking with cough was common in Turin, Galdakao, and Oviedo. Attacks of asthma were common in Turin and Coimbra, and taking medicines for asthma, which was relatively uncommon in this region, was common in Huelva and Coimbra, the two centres in the region that had high levels of diagnosed current asthma.

In the one centre in India, levels of symptoms were low. In Australasia and in the one centre in the USA,

rates were high, particularly in the centres in Australia and New Zealand.

#### *Adjustment for nonresponse*

Not all the centres could produce the information needed to make adjustment for nonresponse, but adjusted prevalence rates could be calculated for 31 centres and sufficient data were available from each season to enable adjustments for 26 centres for the season in which the questionnaires were returned. All adjustments had a tendency

to reduce estimated prevalence rates but, although the adjustments varied between centres, the rankings of centres were barely affected.

Firstly, the assumption was made that there is a consistent relationship between response rate and non response bias and the estimated prevalence was adjusted accordingly to the value expected for a 100% response rate. This reduced at least one estimated prevalence by at least 10% (e.g. from 20% to less than 18%) or to a value outside the 95% confidence interval of the unadjusted prevalence in 10 of 31 centres. Of the 274 estimates of prevalence, 41 (15%) were altered by this amount, 31 of them by more than 10% and 25 of them significantly. The centres affected (number of prevalences affected are in brackets) were Coimbra (9), Vienna (9), Seville (7), Auckland (4), Norwich (4), Portland (3), Huelva (2), Groningen (1), Hawkes Bay (1), and Erfurt (1).

Secondly, the assumption was made that the prevalence among the nonresponders would have been equal to the prevalence in the responders of the same age group and sex who responded at the final contact. This reduced at least one estimated prevalence by at least 10% or to a value outside the 95% confidence interval of the unadjusted prevalence in 11 of 31 centres. Of the 274 estimates of prevalence, 42 (15%) were altered by this amount, 39 of them by more than 10% and 32 of them significantly. The centres affected (number of prevalences affected are in brackets) were Coimbra (9), Seville (7), Auckland (6), Christchurch (4), Hawkes Bay (4), Wellington (3), Vienna (3), Portland (2), Huelva (2), Paris (1), and Norwich (1).

For the 26 centres for which seasonal adjustments could be made, significant changes, or changes greater than 10% were seen in 15 centres after adjustment for seasonal effects. Of the 234 prevalences estimated in these centres, 3 increased significantly but by less than 10% and 48 (21%) fell. Of the estimates that decreased, 47 decreased by more than 10% and 33 fell significantly. The three increases in prevalence following adjustment all occurred in Hawkes Bay. The prevalences that fell were in the following centres (number of prevalences in each centre affected in brackets): Bordeaux (9), Vienna (9), Athens (5), Oporto (5), Turin (4), Kilkenny (3), Hamburg (3), Oviedo (2), Montpellier (2), Basel (2), Pavia (1), Galdakao (1), Huelva (1), and Bombay (1). Simultaneous analysis of the response rate and the season of response, however, showed that most of the effect appeared to be related to response rate and not to season.

The differences between countries were large and statistically highly significant as judged by unweighted analysis in relation to between centre variation. Forty two of the 48 centres shared a language with at least one other centre. English was used in 13 centres in five countries, and German in four centres, French in six centres, and Dutch in five centres in two countries. Within these four language groups, there were still variations in prevalence between countries except for questions on wheeze and wheeze in the absence of colds. Algeria had lower prevalences than France, with the exception of night-time shortness of breath. Belgium generally had lower prevalences than The Netherlands, and Australia and New Zealand had higher prevalences of self-reported asthma and nasal allergies than the other English speaking countries.

### *Symptoms, attacks of asthma and treatment*

Attacks of asthma were reported more often where there were high prevalences of nasal allergies, including hay fever, and of reported waking at night with shortness of breath. However, in France, where nasal allergies are commonly reported, night-time waking with shortness of breath appears relatively rare when compared to the prevalence of self-reported attacks of asthma.

Levels of treatment of asthma are associated with a high prevalence of self-reported attacks of asthma, and with a high prevalence of wheezing. Sweden, The Netherlands, the United Kingdom, New Zealand and Algeria had relatively high rates of treatment among those with a diagnosis of asthma. Typically, over 80% of those reporting that they had either had an attack of asthma in the last 12 months or were currently receiving treatment for asthma, were currently receiving treatment. In southern Europe, particularly Italy, France and Spain, this percentage was lower and typically less than 70%. In Tartu in Estonia, only 30% of those who claimed to have had an attack of asthma in the last 12 months were on current medication.

### **Discussion**

The present study confirms that there is widespread variation in self-reported attacks of asthma and asthma-like symptoms. This variation includes variations between countries, between centres in different countries that use the same language, and between centres in the same country using the same language. Although the sample of areas is not representative, these variations are between samples of substantial populations and do not represent extreme variations between small and highly selected groups.

Some of this variation may well be due to variations in response rates, language and culture. Response rates were variable but were for the most part high. Response rates are affected by the methods of sampling and the quality of the sampling frames. The major change in response rate from the absolute to the adjusted figures in Dublin was due to the lack of information on age and sex in the sampling frame, necessitating oversampling, followed by exclusion of those of the wrong age. In the centres in East Anglia, a further study of the nonresponders showed that though they contained a higher proportion of people who refused to participate, the largest group of people were still those who had moved and not been deleted from the register used as the sampling frame [15].

Our analysis of the likely effects of differences in response rate between centres suggests that this is likely to be a source of relatively minor variation compared with the observed variation in the study as a whole. DE MARCO *et al.* [16] have raised concerns over the effects of nonresponse based on the analysis of the Italian data, where response rates were high, suggesting that their results would lead to very considerable bias when extrapolated to areas where response rates are low. The relatively small effects of nonresponse observed in this study are due to the rarity of observing both a poor response

rate and a strong association between response rate and estimated prevalence in the same area. However, this conclusion refers to the study as a whole and caution should be exercised when drawing conclusions from comparisons between any two centres, particularly those centres where the adjustment for nonresponse had a more pronounced impact, Coimbra, Vienna, Seville, Norwich and Oporto.

Although there is considerable confounding between country and language, some languages being spoken in only one country and even in only one centre, there is also clearly variation between centres using the same language. The effects of language and culture on the reporting of symptoms is a relatively poorly explored area. Analysis of the second part of the ECRHS, in which physiological measurements were taken in addition to recording symptoms, may throw more light on these possible effects.

The English speaking centres have a generally high prevalence of symptoms and this is so far unexplained. Some of these comparisons have been reported for children on a more limited scale, including the low prevalences in Germany [6] and Sweden [7] compared with England, as well as the relatively high prevalence in Australasia [4]. This might be because the questionnaire was originally in English and that all the translations were in some way less sensitive in picking up positive responses. The size of the difference, however, and the general lack of perceived problems in translating the questionnaires makes this unlikely, as does the report that in children the prevalence of reported asthma in four countries was associated with the prevalence of exercise-induced falls in peak expiratory flow rate in those same countries [7]. It is also possible that language is a marker for genetic traits, as suggested by CAVALLI-SFORZA *et al.* [17], but such large differences in genetically very similar populations would be surprising. Finally, it is possible that English language is a cultural variable that is associated with some of the environmental determinants of asthma.

The study was not designed to investigate the consistency of age effects across different centres. The inconsistency in the associations between age and sex and symptoms between the centres, combined with the differential response rates, necessitated the reporting of age-sex standardized prevalence rates. Nevertheless, the lack of any clear association between age and sex and symptoms consistent over all the centres suggests that the difference between males and females is attributable to differences in environmental exposure to the causes of asthma between males and females. Analysis of exposure data collected in the second part of this study may help to explain some of these differences.

Levels of treatment for asthma are not surprisingly associated with a high prevalence of self-reported attacks of asthma, a finding that reflects the observation that these two variables are closely linked in cross-sectional data from surveys of individuals [9, 10]. However, the distribution of reported attacks of asthma and asthma treatment suggests that there may well be differences both in the labelling of asthma, as suggested by other studies [18], and in the quality of care for patients with asthma. Both these hypotheses will require further exploration using the more detailed information from the second part

of the ECRHS, in which subsamples of those filling in the screening questionnaire were given a more detailed examination and were asked for more detailed information regarding their contacts with the health services.

## Appendix

### Screening Questionnaire

**TO ANSWER THE QUESTIONS PLEASE CHOOSE THE APPROPRIATE BOX IF YOU ARE UNSURE OF THE ANSWER PLEASE CHOOSE 'NO'**

1. Have you had wheezing or whistling in your chest at any time in the last 12 months?  
**IF 'NO' GO TO QUESTION 2, IF 'YES':**
  - 1.1 Have you been at all breathless when the wheezing noise was present?
  - 1.2 Have you had this wheezing or whistling when you did not have a cold?
2. Have you woken up with a feeling of tightness in your chest at any time in the last 12 months?
3. Have you been woken by an attack of shortness of breath at any time in the last 12 months?
4. Have you been woken by an attack of coughing at any time in the last 12 months?
5. Have you had an attack of asthma in the last 12 months?
6. Are you currently taking any medicine (including inhalers, aerosols or tablets) for asthma?
7. Do you have any nasal allergies including hay fever?
8. What is your date of birth?
9. What is today's date?
10. Are you male or female?

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