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National prevalence of respiratory allergic disorders

R. Dahl[a,*], P.S. Andersen[b], T. Chivato[c], E. Valovirta[d], J. de Monchy[e]

[a]*Lungemedicinsk Afdeling, Århus Kommunehospital, Århus C 8000, Denmark*
[b]*ALK-Abelló A/S, Bøge Allé 6-8, Hørsholm, Denmark*
[c]*Department of Allergology, Hospital Aire, C/Arturo Soria 82, Madrid, Spain*
[d]*European Federation of Asthma and Allergy Associations and Turku Allergy Center, Kotkaukatu 2, Turku, Finland*
[e]*State University Hospital, Groningen, The Netherlands*

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Summary *Background:* Many epidemiological studies have assessed the prevalence of respiratory allergic disorders in confined geographical locations. However, no study has yet established nationally prevalence data in a uniform manner representing whole countries and, thus, enabling cross-national comparisons.

Methods: In 10 European countries, screening of random, representative samples of telephone numbers identified the target population aged 16–60. The inclusion criteria were a positive reporting of respiratory allergy to named allergens and, concomitantly, an unassisted description of appropriate symptoms. To obtain a truly representative, national prevalence of each country, the data were weighted against the actual sex and age composition.

Results: 31,065 screening interviews were performed. The nationally balanced prevalence varied significantly among the 10 countries ($P<0.001$) from 11.7% in Spain to 33.6% in Italy. The overall weighted prevalence for Europe was 24.4%.

Comparing males and females, overall, the odds-ratio was 0.874 ($P<0.001$). For age intervals of 16–29, 30–49, and 50–60 years, the odds-ratios for males were 1.104 ($P<0.088$), 0.827 ($P<0.001$), and 0.658 ($P<0.001$), respectively. The prevalence correlated inversely with age.

Conclusions: Respiratory allergic disorders constitute a huge health problem in Europe, and the impact may be increasing as the prevalence is highest among young people.

Introduction

The prevalence of respiratory allergic disorders has been assessed in several epidemiological studies and the associated health problems because of hay fever and asthma have been increasing during the last few decades.[1–5] These studies have been performed in a confined geographical location and no study has yet measured nationally balanced respiratory allergy prevalence in a uniform manner enabling a cross-national comparison.

Irrespective of specific approach and applied methodology, the epidemiological studies within allergic respiratory diseases have established prevalence data for certain well-defined regions within a country, often around an allergy centre of excellence. Additionally, it is the prevalence of asthma or hay fever, which has been examined, and

*Corresponding author.

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not the prevalence of respiratory allergy. In such studies, the reported allergy prevalence in Europe varies more than five-fold among the different countries.[5–7] These variations may be due to actual differences between countries, or rather regions, but may also be influenced by different means of collecting data conceivably representing the nation. Especially in large nations like Italy and Spain, large variations have been reported.[5]

The aims of this study called ''Allergy—Living & Learning'' were (1) to evaluate the national prevalence of respiratory allergic diseases in the populations of 10 European countries by national screening of random and representative samples of the populations, (2) to identify which factors are important to the allergic patient's perception and management of own respiratory disease and influence on social life, (3) to investigate the potential consequences of specific diagnosis and treatment for the patient, and (4) to make comparisons between the 10 European countries included.

This study is a report on nationally balanced prevalence of respiratory allergy in 10 European countries, i.e. Austria, Denmark, Finland, Germany, Italy, The Netherlands, Norway, Spain, Sweden, and the United Kingdom.

Materials and methods

The methodology relevant for the reported prevalence results is described below. The full Allergy—Living & Learning study set-up has been described in detail elsewhere.[8]

Methodology

The target population aged 16–60 was identified by telephone screening of random, national, representative samples of telephone numbers. The inclusion criteria of the study were a positive reporting of respiratory allergy to pollens (i.e. trees, grasses, or weeds), house dust mites, moulds, dog, cat or other animals and, concomitantly, an unassisted description of appropriate symptoms.[8] In order to be eligible for participation, though asked, the respondent should not necessarily be able to report a specific medical diagnosis such as rhinitis or hay fever. Consequently, the population included in the study reported to be suffering from a respiratory allergy, irrespective of the degree of symptoms and specific diagnosis.

To avoid the bias of parents answering on behalf of their children, the study did not include children. People older than 60 years of age were not included as they often have non-allergic respiratory conditions that may mimic allergic respiratory disorders.

If the first intended contact with a household was negative, the interviewer asked to talk to a second person from the same household. When including these data in the calculation, an estimate of the household prevalence of perceived respiratory allergy was established. For further explanation of the methodology for these calculations in Denmark, The Netherlands, Austria, the UK, Spain and Italy, data for the calculation of both the nationally balanced prevalence and the household prevalence were established simultaneously with the potential conduct of the full Allergy—Living & Learning interview.[8] Initially, Germany, Finland and Sweden stored data from first and potentially second contact in one database and the household prevalence was thereby established. The conduct of 481, 570, 1276, and 1505 additional screening interviews in Finland, Germany, Sweden, and Norway, respectively, allowed the calculation of the remaining prevalence figures. For Sweden, Finland and Germany, the second screening rounds included only the first contact made, i.e. the person with the first upcoming birthday. In Finland, Sweden, and Norway, respectively, the second round was conducted 9–12 weeks after the original study and for Germany 22–23 weeks later.

Ethical standards

All interviews were conducted in accordance with the Code of Conduct of the European Standards of Market Analysis and Research (ESOMAR, Amsterdam, The Netherlands). This code of conduct guarantees full anonymity and integrity of the respondents.

Weighting and statistical methods

In order to estimate the overall prevalence of all 10 European countries, the national prevalence of each country was weighted against the size of the respective population. The sizes of the national populations were obtained from the European Commission, Brussels.[9]

Stratified analyses were performed to evaluate the association between prevalence of allergy and country, between prevalence of allergy and three age intervals of 16–29, 30–49, and 50–60 years, and between prevalence of allergy and gender. Controlling for confounding variables, the Mantel–Haenzel procedure was used to calculate summary statistics.

A two-sided *P* value of 0.05 was the criterion for statistical significance. All statistical analyses were made with the SAS software package (version 6.12).

Results

A total of 31,065 screening interviews were performed in the 10 European countries establishing data for calculation of nationally balanced and household prevalence of respiratory allergy.

The nationally balanced prevalence varied significantly among the countries ($P<0.001$) from 11.7% in Spain to 33.6% in Italy (Table 1). Spain and Austria had significantly lower nationally balanced prevalence than all other countries. Spain was significantly lower than Austria, and Italy had a significantly higher prevalence than all other countries ($P<0.05$) (Table 1). Household prevalence ranged from 18.1% in Spain to 39.0% in Sweden (Table 1).

The overall prevalence of respiratory allergic disorders in the 10 countries was 24.4% when weighting by population sizes (Table 2).

Within national sub-groups, age and gender, the prevalence of respiratory allergic disorders was calculated in percentage and as odds-ratios (Tables 3 and 4). Data were breakdowns of the nationally balanced prevalence of all countries but The Netherlands, where the figures were a breakdown of the household prevalence.

For all countries pooled, the prevalence was reduced in the respondents the older they were ($P<0.001$), in Austria ($P<0.001$), the UK $P<0.002$), Spain ($P<0.001$), Italy ($P<0.001$), and in The Netherlands (household, $P<0.001$) (Table 3).

For males, the reduction in prevalence the older they were was significant for all countries pooled ($P<0.001$), for Austria ($P<0.001$), Germany ($P<0.001$), Italy ($P<0.001$), The Netherlands (household, $P<0.001$), Spain ($P<0.001$), and for the UK ($P<0.002$). For females, the trend of the individual countries was less strong. However, a significant age-related reduction was observed when pooling all countries ($P<0.001$), and for individual countries this was also the case in both The Netherlands (household) and Spain ($P<0.001$) (Table 3).

In all countries but Sweden, females reported a higher prevalence of respiratory allergic disorders; this was statistically significant for all countries pooled ($P<0.001$), in Spain ($P<0.001$) and in the UK ($P<0.049$) (Table 3).

Comparing males and females, overall, the odds-ratio was 0.874 ($P<0.001$) (Table 4). For the age

Table 1 Nationally balanced prevalence and household prevalence of respiratory allergic disorders in 10 European countries.

	Austria	Denmark	Finland	Germany	Italy	The Netherlands	Norway	Spain	Sweden	The UK
Initial screening round	3223	2162	1761	4049	3761	2276		6519		3482
Allergics identified during first contact	514	445			1263	550		762		914
Total allergics identified	586	540	591	1007	1391	604		1179		1038
Second screening round			*481*	*570*			*1505*		*1276*	
Allergics identified during first contact			*125*	*134*			*404*		*342*	
Total allergics identified							*455*		*498*	
Household prevalence (%)	18.2	25.0	33.6	24.9	37.0	26.5	30.2	18.1	39.0	29.8
Nationally balanced prevalence (%)	15.9	20.6	*26.0*	23.5	33.6	24.2	26.8	11.7	26.8	26.2
95% confidence interval [±] of national prevalence (%)	1.26	1.70	3.92	3.48	1.52	1.81	2.24	0.78	2.43	1.46

The 95% confidence interval is listed. Values in *italics* represent figures established from the second screening round.

Table 2 Prevalence of respiratory allergic disorders in the 10 countries based on nationally balanced prevalence and weighted against the size of national populations.

	Austria	Denmark	Finland	Germany	Italy	The Netherlands	Norway	Spain	Sweden	The UK
Prevalence (%)	15.9	20.6	26.0	23.5	33.6	24.2	26.8	11.7	26.8	26.2
Population* (1000)	8075	5295	5147	82.057	57.563	15.654	4418	39.348	8848	59.090
Allergic population (1000)	1288	1090	1338	19.291	19.331	3783	1186	4599	2371	15.511
Weighted prevalence	24.4%									

It is assumed that the nationally balanced prevalence in the age group of 16–60-year-olds is applicable to the total population of each country.
*Ref. [8].

Table 3 Prevalence of respiratory allergic disorders within national sub-groups, age and gender.

	Austria	Denmark	Finland	Germany	Italy	The Netherlands	Norway	Spain	Sweden	The UK
Basis	3223	2162	481	570	3761	2276	1505	6519	1276	3482
Subgroups										
16–29 years (%)	*19.8**	23.2	31.4	29.2	*37.4**	*34.0**	29.9	*17.6**	31.0	*28.8***
30–49 years (%)	*15.6**	20.1	26.8	23.0	*33.0**	*26.5**	26.6	*10.2**	25.0	*26.7***
50–60 years (%)	*12.0**	18.9	22.4	19.4	*29.7**	*18.4**	24.5	*7.1**	25.3	*20.3***
Males (%)	15.7	19.1	22.1	21.6	32.6	26.0	24.6	*10.2**	27.4	*24.2****
Females (%)	16.2	21.9	28.7	24.6	34.6	26.6	28.3	*12.3**	25.9	*27.3****
Males										
16–29 years (%)	*21.3**	22.6	33.3	*37.3**	*42.8**	*34.7**	28.0	*16.5**	30.9	*30.0***
30–49 years (%)	*15.1**	19.4	23.0	*21.0**	*29.1**	*26.3**	25.2	*6.9**	25.9	*23.8***
50–60 years (%)	*9.7**	14.7	15.9	*7.5**	*24.5**	*14.5**	20.3	*4.9**	26.6	*16.1***
Females										
16–29 years (%)	18.4	23.6	30.0	24.1	33.6	*33.6**	31.1	*18.3**	30.7	28.2
30–49 years (%)	16.1	20.8	29.3	24.0	35.8	*26.5**	27.5	*11.4**	23.6	28.2
50–60 years (%)	13.8	22.1	27.2	26.4	33.4	*20.3**	27.5	*7.8**	24.2	22.6

Data are breakdowns of the nationally balanced prevalence of all countries but The Netherlands, where the figures are a breakdown of household prevalence. Italic entries, taken columnwise or rowwise, not interrupted by extra spaces differ significantly, *$P < 0.001$,** $P < 0.002$,*** $P < 0.049$.

Table 4 Differences in prevalence of respiratory allergy between genders in three age groups.

	Austria	Denmark	Finland	Germany	Italy	The Netherlands	Norway	Spain	Sweden	The UK	All countries
Odds-ratio											
16–29 years	1.2	0.9	1.2	1.9	1.5	1.1	0.9	0.9	1.0	1.1	1.104
30–49 years	0.9	0.9	0.7	0.8	0.7	1.0	0.9	0.6	1.1	0.8	0.827
50–60 years	0.7	0.6	0.5	0.2	0.6	0.7	0.7	0.6	1.1	0.7	0.658
Age pooled	0.96	0.84	0.71	0.89	0.91	0.95	0.83	0.73	1.09	0.85	0.874
P-value											
16–29 years	0.297	0.769	0.766	0.106	0.002	0.797	0.523	0.339	0.966	0.566	0.088
30–49 years	0.586	0.568	0.268	0.564	0.003	0.929	0.479	0.001	0.516	0.034	0.001
50–60 years	0.101	0.029	0.091	0.006	0.006	0.119	0.110	0.078	0.644	0.078	0.001
Age pooled	0.631	0.108	0.106	0.388	0.149	0.572	0.109	0.001	0.493	0.049	0.001

The top half of the table shows odds-ratios for males against females having respiratory allergy, listed according to age, and the bottom half shows the corresponding *P*-values.

intervals of 16–29, 30–49, and 50–60 years, the odds-ratios for males were 1.104 ($P<0.088$), 0.827 ($P<0.001$), and 0.658 ($P<0.001$), respectively.

Discussion

In the present study, the nationally balanced prevalence of respiratory allergy was established for 10 European countries representing a total population exceeding 285 million inhabitants by assessing truly random, national representative samples of the total population.

The survey methodology applied has not previously been used for assessing prevalence of chronic diseases such as respiratory allergic disorders but one recent study assesses asthma control in patients identified by telephone screening.[10] Nevertheless, the telephone-based sampling techniques are widely used and statistically fully validated, and subsequently recognised as a means of establishing valuable and reliable nationally balanced data in many areas. Additionally, the massive number of studies implying this methodology have created an enormous base of experience in both practical and theoretical statistical aspects of surveys based on telephone interviews.[11–13]

The present study samples were truly random and representative of each nation; however, an objective disease parameter such as positive skin prick test or the measurement of specific IgE was not done or asked for as an inclusion criterion. This would have caused logistic and interpretational difficulties and bias. In addition, in order to further minimise potential bias, information on the purpose of the study was kept from the respondents until completion of the screening phase.

Studies that previously have addressed the prevalence of allergic diseases selected the study samples in a limited geographical area defined as, e.g. a specific postal code or the geographical territory of an allergy centre of excellence.[3–5]

Such a sample may rarely be characterised as random and representative of the full population of a country. The advantage is the opportunity of verifying the diagnosis by objective disease parameters, which may be necessary should a precise characterisation of the disease be needed[14] or for the performance of specific laboratory tests.

In 1998, Linneberg et al.[4] found that the prevalence of allergic rhinitis symptoms in persons at the age of 15–41 living in the capital region of Denmark was up to 35.1%. In the present study, the Danish nationally balanced prevalence of allergic respiratory disorders was 20.6%. This discrepancy could partly or fully be explained by the difference in sampling area but underlines the magnitude of respiratory allergy.

Unfortunately, it is a necessity for inclusion of objective disease parameters that the potential patient physically visits a medical clinic and undergoes testing in order to obtain the specific test result. Such a procedure is time consuming and perhaps even involves expenses. Therefore, it may cause a serious skew of the sample composition. Additionally, the potential patient may feel a loss of anonymity.

Actually, at no point did the set-up include a direct confrontation of the respondent with anyone and the full anonymity was not broken or jeopardised as the telephone contact represented the only means of contact.

The prevalence of respiratory allergic disorders established in this study equals 24.4% when weighting by the population of the 10 countries. This number is within the range of earlier reports on asthma and hay fever prevalence[15–17] and verifies the immense health problem that respiratory allergic diseases represent.

The Mediterranean countries, Italy and Spain, though located in the same geographical region, represent the highest and lowest prevalence of this study. Findings in the ISAAC study[5,14] may support the difference found. However, in this study the prevalence of rhinitis and asthma in both Italy and Spain varies considerably among participating centres. The reasons for the differences in measured national prevalence in the present study and in other European epidemiological studies are not easily explained and need further examination potentially including demographic and socio-economic parameters.

The occurrence of respiratory allergic disorders is inversely correlated with age in the 10 European countries included. This finding may support the increase in asthma prevalence reported in a number of studies.[18,19] Furthermore, the result suggests that the increase in asthma is likely to originate from an increase in allergic sensitisation and not solely in severity of respiratory symptoms. This is in accordance with the result of Upton et al.,[3] who observed that the increase in asthma between 1972–1976 and 1996 was solely explained by an increase in allergic asthma, whereas the prevalence of non-allergic asthma was unchanged.

Though just outside the interval of statistical significance, there is a trend that young boys may be more susceptible to allergic respiratory disorders than girls. This is reverted when maturing. It may be speculated whether this is due to shift in the sex distribution of respiratory allergic

disorders, an indication of boys ''grow out of their allergic disease'' easier than girls, or merely the fact that females express the disease later in life than males. It is a well-known fact that asthma is more prevalent in boys and the influence of sex and age appears to be real. The effect of sex and age on the prevalence of wheeze and asthma in 11–16-year-old children was examined by Venn et al.,[20] who found that the prevalence of wheeze decreased with age in boys and increased with age in girls.

In conclusion, the Allergy—Living & Learning study provides evidence for a high prevalence of respiratory allergy in Europe and national differences are present. A clear inverse age relation to respiratory allergy was seen. Lastly, in addition, respiratory allergy was influenced by gender, i.e. more prevalent in younger males and older females.

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