

ORIGINAL ARTICLE

High Prevalence of Asthma Symptoms in the Canary Islands: Climatic Influence?

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The worldwide variation in asthma prevalence prompted us to carry out a study to assess the variability of asthma-related symptoms in young adults on the islands of Gran Canaria and Tenerife. We used the questionnaire used in the European Community Respiratory Health Survey with the addition of two questions on smoking and ancestors from the Canary Islands. In each island, this questionnaire was distributed to a random sample of 5000 subjects aged 20–44 years. Of the 10,000 subjects, 9,506 (95.06%) were considered eligible. We obtained 7,132 (75.03%) responses. The prevalence of the different symptoms was wheezing 25.3%, nocturnal thoracic tightness 18.0%, awakened by an attack of shortness of breath 13.1%, attack of nocturnal coughing 33.3%, attack of asthma 4.3%, current asthma treatment 6.2%, and nasal allergies 18.0%. Women and smokers showed a significantly higher prevalence of asthma symptoms. No significant difference in symptoms was found between subjects whose ancestors were of Canarian origin and those with ancestors born outside the Canaries. As has been observed on other islands (Great Britain and New Zealand), asthma is common in individuals from 20 to 44 years of age in the Canaries. We hypothesize that climatic conditions play an important role in the prevalence of asthma symptoms.

Keywords asthma symptoms, prevalence, epidemiology, climate

INTRODUCTION

A large number of reports exist, which show that the prevalence of asthma has increased in children and adults over the last 30 years (1–3). However, the prevalence of this condition varies considerably throughout the world (4). A high rate of asthma has been found in Great Britain, the United States, Australia, and New Zealand, and an intermediate or low rate has been reported in Northern, Southern, and Central Europe (5). The reasons for this difference are not clear. Several hypotheses have been put forward to explain these discrepancies (4). The main ones are those that relate the increase of asthma to the presence of allergens (e.g., house dust mite, cat, and grass pollen), pollution and environmental tobacco smoke, affluence, diet, and hygiene (4). None of the hypotheses, neither separate nor jointly, explain the surprising worldwide variation in the prevalence of asthma.

The great number of asthmatic patients attending the emergency departments of hospitals and outpatient clinics suggest that asthma is a prevalent disease in the Canary Islands. We hypothesize that genetics and environmental factors (climate and allergen exposure) could be important determinants to explain this high prevalence of asthma. The climate of the Canaries is temperate with high absolute humidity during the whole year, which favors the growth of

house dust mites. There are studies that report high concentrations of house dust mite antigens along with a considerable sensitization of the Canary Islands population to this allergen (6, 7). Consequently, we conducted a study to assess the prevalence of asthma and to obtain baseline measurements for future trends in this disease. The phase 1 questionnaire of the European Community Respiratory Health Survey (ECRHS) was used to carry out the investigation (8). We added two questions on smoking and ancestors' birthplace to this short questionnaire to study the asthma prevalence more precisely. In this article, we report the results of this survey, which represent the first data on asthma-related symptoms in the Canary Islands.

MATERIALS AND METHODS

This investigation was based on data taken from the 1996 Canarian population study. The Canary Islands have 1,493,784 inhabitants of whom 85% live on Gran Canaria Island (665,150 inhabitants) and on the island of Tenerife (623,823 inhabitants). Because the population of the Canary Islands is mainly of European origin, and taking into account the criteria of the ECRHS, the size of the sample population was calculated by assuming that the prevalence of asthma symptoms in Europe was approximately 5%. Moreover, to assess possible differences between the north (predominantly an urban area) and south (mostly a rural area) in both islands, the size of the sample was increased to a total of 10,000 inhabitants.

A one-page questionnaire was mailed to 5000 subjects aged between 20 and 44 years on each of the main islands: Gran Canaria and Tenerife. Subjects were chosen at random

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TABLE 1.—Principal characteristics of the study population for each island and the total.

	Gran Canaria Island (%)	Tenerife Island (%)	Total (%)
<i>Age (yr)</i>			
20–24	17.7	16.3	17.0
25–29	23.4	22.1	22.8
30–34	22.4	22.5	22.4
35–39	19.7	20.7	20.2
40–44	16.7	18.4	17.5
<i>Gender</i>			
Man	49.7	47.8	48.8
Woman	50.3	52.2	51.2
<i>Smoking</i>			
Non-smoker	49.7	51.2	48.6
Smoker	53.7	48.8	51.4
<i>Canarian ancestors</i>			
Yes	77.0	77.5	77.2
No	23.0	22.5	22.8

from the 1996 population study. Sex distribution was approximately 50% men and 50% women in both islands. The questionnaire consisted of 12 questions. Ten of them were the same as the Spanish version of the ECHRS questionnaire (9). Two questions were added on smoking and on the birthplace of the subjects' ancestors. The text of the questionnaire is given in the Appendix. This questionnaire was sent up to three times if there was no response. This was followed by a telephone call and a home visit if necessary. The subjects who were either the wrong age, had moved out of the islands, or had died were considered non-eligible. Non-responders were those who refused to answer the questionnaire and those who could not be reached after three mailings, at least two telephone calls, and a home visit.

Data on temperature and humidity employed in this investigation were obtained from the Spanish Institute of Meteorology (10).

Statistical analysis of the prevalence of asthma-related symptoms was carried out for both islands. Chi-squared and odds ratio (OD) with 95% of confidence interval (CI) analysis were performed to estimate the risk of asthma-related symptoms associated with sex, age, smoking habit, islands, and Canarian ancestors. The relative contribution of the evaluated risk factors to the likelihood of having asthma was examined through multiple logistic regression.

TABLE 3.—Prevalence rates of asthma symptoms, smoking habit, and the existence of Canarian ancestors.

Questions	Total		
	n	Prevalence (%)	95% CI
Wheezing in the last 12 months	1749	25.3	24.4–26.4
With associated breathlessness	960	13.9	13.1–14.7
Without a cold	1078	15.6	14.7–16.4
Awakened with feeling of chest tightness	1242	18.0	17.1–18.9
Woken by attack of breathlessness	899	13.1	12.2–13.8
Woken by coughing	2301	33.3	32.2–34.5
Asthma attack	297	4.3	3.8–4.8
Current asthma medication	431	6.2	5.6–6.8
Nasal allergy	1235	18.0	17.1–18.8
Smoking	3545	51.4	50.2–52.6
Ancestor born outside the Canary Islands	1567	22.8	21.8–23.7

Asthma was defined as in the ECRHS survey: having answered yes to question 3 (woken by shortness of breath), to question 5 (attack of asthma), or to question 6 (current asthma medication). The analyses were carried out by using SPSS, and a *p* value < 0.05 was considered significant.

RESULTS

Of the 10,000 people selected for the study 9,506 (95.1%) were considered eligible. Non-eligible subjects were those who had died (*n* = 16), had moved out of the islands (*n* = 239), or were of the wrong age (*n* = 240). The questionnaire was answered by 7160 (75.3%) people. Of those who responded, 55% sent in the questionnaire, 41% were contacted by telephone, and 4% were visited at home. The group of non-responders was made up of 2346 (24.6%) subjects. Of these, 65% could not be located because their address and telephone number were incorrect; the remaining 35% did not want to participate in the survey.

The characteristics of the study population (gender, age groups, smoking habit, and Canarian ancestors) for each of the islands and the total are depicted in Table 1.

Data on quarterly means of temperature, relative and absolute humidities for Tenerife, the Island of Gran Canaria and the Spanish locations where the ECRHS was carried out are displayed in Table 2. This information represents an

TABLE 2.—Quarterly means of temperature, relative and absolute humidities for Tenerife, Gran Canaria, and the Spanish locations where the ECRHS was carried out.

Locations	First quarter			Second quarter			Third quarter			Fourth quarter		
	T (°C)	RH (%)	AH (g/kg)	T (°C)	RH (%)	AH (g/kg)	T (°C)	RH (%)	AH (g/kg)	T (°C)	RH (%)	AH (g/kg)
Barcelona	10.0	71.6	5.4	16.4	72.0	8.3	22.6	71.3	12.1	13.2	73.0	7.0
Albacete	6.8	70.3	4.3	15.5	56.3	5.3	22.7	52.6	5.3	9.5	76.0	5.4
Huelva	12.9	70.3	6.5	19.0	61.3	8.2	24.8	55.3	10.7	15.7	75.0	8.5
Oviedo	8.9	75.3	5.5	13.3	78.6	7.4	18.1	80.0	10.3	11.2	77.6	6.5
Galdakao	9.8	70.6	5.4	14.8	71.3	7.4	19.7	73.3	10.4	12.1	73.0	6.4
Tenerife	18.8	64.6	8.8	20.5	68.3	10.5	24.3	68.6	13.3	20.8	67.0	10.5
Gran Canaria	17.7	66.6	8.0	20.2	67.0	9.1	23.9	68.3	11.8	20.8	69.6	10.8

T: mean temperature; RH: relative humidity; AH: absolute humidity.

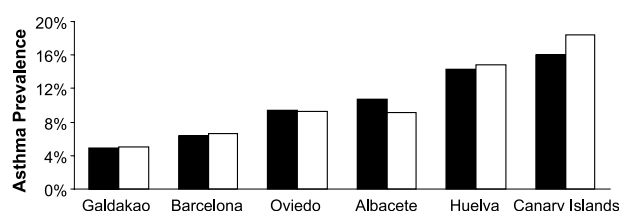


FIGURE 1.—Asthma prevalence for women (white) and men (black) of the five Spanish locations where the ECRHS was carried out and the Canary Islands survey.

average of meteorological records over a 30-year period (1971–2000).

The prevalence rates of asthma-related symptoms with 95% CI for the whole study population are shown in Table 3. Except for question 1 (wheezing in the last 12 months), women had significantly higher rates for all reported symptoms than men. We did not find significant differences in asthma symptoms in relation to age, except in the 40- to 44-year age group, where a higher prevalence was observed for question 2 (awakened with feeling of chest tightness) and question 3 (awakened by attack of breathlessness). We also observed a trend of a decrease in the frequency with increasing age for question 5 (asthma attack), question 6 (asthma medication), and question 7 (nasal allergy). The difference in the prevalence of symptoms between the north and south regions in both islands was not significant. The prevalence rates of asthma-related symptoms were significantly higher in the Island of Gran Canaria than Tenerife. Subjects who smoked had significantly higher prevalence rates of symptoms except for the questions related to asthma attacks in the last 12 months and asthma treatment. Nasal allergy was significantly more prevalent in the non-smoker group.

We did not find significant differences in prevalence between subjects whose grandparents and parents were

born in the Canary Islands and those who had ancestors born outside the Canary Islands except for question 1 (wheezing in the last 12 months), question 1.1 (wheezing in the last 12 months without a cold), and question 4 (awakened by an attack of coughing in the last 12 months). However, a multiple logistic regression analysis disclosed that the existence of wheezing and cough was associated with the smoking habit. Once this confounding effect was controlled, no significant difference was found between subjects with Canarian ancestors and those who had non-Canarian ancestors.

The overall prevalence of asthma (as defined by the ECRHS: woken by shortness of breath, attack of asthma or current medication for asthma) was 17.2% (95% CI, 16.3–18.1), in women 18.3% (95% CI, 17.0–19.6), and in men 16% (95% CI, 14.8–17.2). The prevalence of asthma on the island of Gran Canaria was 18.5% (95% CI, 17.2–19.8) and 15.6% (95% CI, 14.3–16.9) on the island of Tenerife. In Figure 1, the prevalence of asthma by sex in the Canaries and the other places in Spain where the ECRHS was carried out is shown.

The association between risk factors (gender, age, smoking, island, and Canarian ancestors) and asthma (defined as above) is displayed in Table 4. A significant association was found between asthma and women, smoking, or the fact of being from Gran Canaria Island.

DISCUSSION

Using the same methodology used in the ECRHS, this study shows that the prevalence of asthma-related symptoms is high in the Canary Islands. This prevalence is notably higher than that observed in the majority of European countries (5, 9). In particular, in relation to Spain, we found a higher prevalence for all asthma-related symptoms than that reported in the Spanish ECRHS. It seems that these differences between the Mainland and the Canary Islands cannot be explained by genetic factors. On

TABLE 4.—Association between asthma (as defined by the ECRHS: woken by shortness of breath, attack of asthma or current medication for asthma) and risk factors.

	Non-asthmatics n = 5929 (82.8%) (%)	Asthmatics n = 1231 (17.2%) (%)	p	Odds ratio	95% CI
<i>Age (yr)</i>					
20–24	82.9	17.1	Reference		
25–29	83.2	16.8	n.s		
30–34	84.7	15.3	n.s		
35–39	82.6	17.4	n.s		
40–44	80.2	19.8	n.s		
<i>Gender</i>					
Man	84.1	15.9	0.006	1.195	1.053 1.355
Woman	81.6	18.4			
<i>Smoking</i>					
Non-smoker	84.6	15.4	< 0.001	1.267	1.116 1.438
Smoker	81.3	18.7			
<i>Canarian ancestors</i>					
Yes	83.3	16.7	0.180	n.s	
No	81.8	18.2			
<i>Island</i>					
Gran Canaria	81.5	18.5	0.002	1.224	1.079 1.391
Tenerife	84.4	15.6			

n.s: nonsignificant.

the one hand, the population of the Canaries is predominantly of Mediterranean origin and, therefore, similar to the rest of the Spanish people. Although there were a few immigrants to the Canary Islands between the 16th and the 20th century from other parts of Europe and Africa, the population remained relatively stable until the decade of the 1960s; since then, the contact with the mainland has multiplied. Moreover, the fact that in our study we did not find significant differences between those subjects whose parents and grandparents were born in the Islands from those whose ancestors were not from the Canaries suggests that genetic factors are not the principal cause that explain our epidemiological findings. On the other hand, although the genetic hypothesis is appropriate to explain a high prevalence of asthma in certain ethnic groups with a marked incidence of inbreeding, as is the case of the Island of Tristán da Cunha (11), in the majority of studies its influence is difficult to demonstrate, given the great complexity of the inheritance factors related to asthma (4).

In view of this situation with two populations genetically homogeneous, other possible hypotheses must be considered to explain our findings. Because a time lag exists of approximately 9 years between the ECRHS and the completion of our investigation, we could also speculate that the high prevalence of symptoms reflects a general increase of asthma incidence in Europe. Although recent studies reported no significant changes in the prevalence of asthma in the nineties (12, 13), other investigations pointed to a continuing growth in the asthma incidence during the last decade, which seems not to be explained by a greater increase in diagnosed asthma (14, 15). Therefore, it is not possible at this time to confirm any general trend, and more studies are required to assess possible changes in asthma prevalence.

This high prevalence could also be a reflection of the within-country asthma variability. Both the ECRHS and the International Study of Asthma and Allergies in Childhood (ISAAC) showed that prevalence rates in different locations could significantly vary in some countries but not in others. Concerning the ECRHS, the variability observed in the United Kingdom for the category of diagnosed asthma (i.e., the answer "yes" to the questions "having had an attack of asthma in last 12 months" or "being treated for asthma") range from 7.5% in Norwich to 8.4% in Cambridge (5). In contrast, in Spain a greater variability was found for the same questions, ranging from 2.1% in Galdakao to 6.3% in Huelva (5). In the ISAAC, for one question, the 12-month prevalence of wheezing, a similar situation was observed, with higher variations in Spain or Italy than in the United Kingdom or France (16). Although the variability within-country could in part contribute to the high prevalence in the Canary Islands, we think that this sole explanation cannot account for the results of our study because the Islands are more than 2000 km away from the mainland.

The existence of an affluent society is another factor to be taken into consideration to interpret our results (4). Several studies (16, 17) have clearly demonstrated that the prevalence of asthma is higher in industrialized societies than in developing countries. Living in rural areas and

having a large family size seem to protect against asthma (18, 19). However, like the rest of Spain, the distribution of the population in the Canaries is mainly urban, sharing the lifestyle of Western societies (few offspring, exposure to pollution, and processed food). Therefore, other possible explanations should be taken into account, which we think are basically related to climatic factors and exoallergenicity. The Canary Islands have a temperate climate year-round, with elevated absolute humidity, which is the most important factor that intervenes in the growth of dust mites. The optimum level of absolute humidity that house dust mites need to grow should be equal or greater to 7 g/kg of dried air (20). This figure is usually much higher in the Canaries throughout the year. In fact, two studies carried out on the islands of Gran Canaria and Tenerife demonstrated that the concentration of house dust mites was particularly elevated (7, 21), and in one report from Tenerife it was established that the sensitization to dust mites among the population was very high (6), being notably greater than on the mainland (22). Whether dust mites are the cause of the development of asthma or just give rise to a worsening of symptoms is a debatable point; however, in those areas of the world, which generally correspond to islands or regions close to the sea, where high concentrations of dust mites exist, asthma is a widespread condition (23, 24).

The importance of the role of climate in relation to asthma symptoms has been stressed by a recent investigation based on ECRHS data. The authors suggest that the high prevalence of asthma observed in English-speaking countries could be related to an oceanic climate (25). In these countries, a high indoor or outdoor absolute humidity has also been reported, which helps to explain the high concentration of, and an elevated sensitization to, house dust mites (23, 24, 26). This environmental situation is similar to the Canaries and different from the rest of Spain. It has been shown that seasonal variations can influence the concentration of house dust mites and that these changes have an effect on airway hyperresponsiveness in patients with asthma (27). We think that the difference between the Canaries and the mainland lies in the fact that the levels of absolute humidity remain stable throughout the year, keeping the population of house dust mites high and constant, unlike the other places in Spain where the ECRHS was carried out. Although not all the year above 7 g/kg, Huelva, a southern city next to the Atlantic Ocean, has also high absolute humidity levels, which could help to explain the observed high asthma prevalence.

In conclusion, the prevalence of asthma-related symptoms in the Canaries is one of the highest in Europe and similar to those observed on other islands (New Zealand and Great Britain) with climatic conditions that favor the growth of house dust mites. The observed differences in asthma-related symptoms between the Canary Islands and the rest of Spain, it seems cannot be explained through genetics or by the presence of a specific lifestyle. We suggest that allergens and climatic factors could account for our findings, although hypotheses such as an increasing asthma prevalence or the within-country variability cannot be completely ruled out.

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SCREENING QUESTIONNAIRE

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 at any time 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?
11. Do you smoke or have you smoked for 1 year or more (at least 1 cigarette daily or a cigar weekly)?
IF "NO" GO TO QUESTION 12, IF "YES":
11.1 Have you ever stopped smoking (at least more than a month ago)?
12. Were any of your parents or grandparents born outside of the Canary Islands?

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