ORIGINAL ARTICLE

High Prevalence of Asthma and Allergic Diseases in Children Aged 6 and 7 Years From the Canary Islands: The International Study of Asthma and Allergies in Childhood

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Abstract

Objective: To investigate the prevalence of bronchial asthma and allergic diseases in schoolchildren from the Canary Islands, Spain.
Methods: Cross-sectional study following the methodology of ISAAC (International Study of Asthma and Allergies in Childhood), which uses standardized and validated questionnaires. The study participants were children aged between 6 and 7 years attending schools in Las Palmas de Gran Canaria, Canary Islands, Spain.
Results: Of the 3108 questionnaires distributed, 1883 were answered, and 1871 were evaluable (60.6%). Gender distribution was similar (51.8% boys vs 48.2% girls). Current prevalence of asthma was 18.4% (95% confidence interval [CI], 16.7-20.2), rhinitis 40.3% (95% CI, 38-42.3), and atopic dermatitis 35.8% (95% CI, 33.6-37.9). The highest prevalence of rhinitis was recorded during the autumn months ($P<.005$). Asthma was more frequent in boys than in girls ($P<.05$), but there were no statistical differences for the other allergic diseases.
Conclusions: The prevalence of asthma and allergic diseases in children aged 6-7 years in the Canary Islands is higher than in other areas of Spain where the ISAAC study has been performed. Male gender is an important risk factor in children, especially for asthma symptoms.

Key words: Prevalence. Children. Asthma. Rhinitis. Dermatitis. Canary Islands.

Resumen

Objetivo: Investigar la prevalencia de asma bronquial y enfermedades alérgicas en escolares de las Islas Canarias (España).
Métodos: Estudio epidemiológico transversal realizado siguiendo la metodología del ISAAC (Internacional Study of Asthma and Allergies in Childhood), que se basa en la utilización de cuestionarios estandarizados y validados. Los sujetos de estudio fueron niños y niñas de 6 y 7 años pertenecientes a colegios de Las Palmas de Gran Canaria (Islas Canarias).
Resultados: De los 3108 cuestionarios repartidos, se contestaron 1883, de los cuales 1871 fueron evaluables (60.6%). La distribución por sexos fue similar (51.8% niños vs. 48. 2% niñas). La prevalencia de asma fue del 18.4% (IC 95%; 16.7-20.2); rinitis 40.3% (IC95%: 38-42.3) y dermatitis atópica 35.8% (IC95%: 33.6-37.9). Los meses otoñales fueron los que registraron la mayor prevalencia de rinitis ($P<0.005$). El asma fue más frecuente en niños que en niñas ($P<0.05$), mientras que para el resto de enfermedades alérgicas no se apreciaron diferencias estadísticas.
Conclusiones: La prevalencia de asma y enfermedades alérgicas en niños de 6-7 años que viven en las Islas Canarias es mayor que en otros centros de España donde el estudio ISAAC se ha realizado. El sexo masculino es un importante factor de riesgo en los niños, especialmente en lo que se refiere a los síntomas del asma.

Palabras clave: Prevalencia. Niños. Asma. Rinitis. Dermatitis. Islas Canarias.

Introduction

Bronchial asthma affects around 300 million people throughout the world [1,2]. It is the most common chronic disease in children in developed countries and requires a considerable amount of health and social resources, as it is a heavy burden both for patients and their families and for society [3]. Over the past 20 years, the morbidity and prevalence of asthma have increased in different parts of the world [4], alongside other allergic diseases, such as rhinitis and atopic dermatitis, which are also very common in childhood. However, this trend seems to have stabilized in recent years [5].

Asthma has a worldwide distribution, and its expression varies between countries and even between different areas of the same country [6]. Thus, in the nineties, the International Study of Asthma and Allergies in Childhood (ISAAC) was designed to compare the prevalence of asthma and allergic diseases in different parts of the world [7]. It was the first international multicenter study to assess the prevalence and severity of these conditions in 2 age groups (6-7 years and 13-14 years) using standardized validated questionnaires. The results of Phase I revealed widely varying prevalence of asthma between countries and between different centers in the same country [8], thus indicating the possible influence of environmental factors. In Phase II, studies were conducted in a smaller number of selected centers using more specific questionnaires and functional tests (eg, skin prick test for atopy, bronchial responsiveness to hypertonic saline) to investigate the hypothesis that had emerged from Phase I. Finally, Phase III was designed to examine variations in the time trends of asthma and allergic diseases around the world, and to assess their relationship with environmental data.

In Spain, the ISAAC study has been conducted in centers such as Barcelona, Madrid, Pamplona, and Valencia, with considerable differences in the prevalence of asthma and allergic diseases [9,10]. The singular geographical and environmental characteristics of the Canary Islands make it interesting to investigate the current state of allergic diseases in this area in order to make comparisons with centers on the Spanish mainland.

The aim of this population-based study was to determine the prevalence of asthma, allergic rhinitis, and atopic dermatitis in children from the Canary Islands following the standardized ISAAC methodology.

Methods

Study Participants

The study population comprised children aged 6 and 7 years attending schools located in the urban area of Las Palmas de Gran Canaria, Canary Islands, Spain. This city was chosen because it is the most populated in the Canary Islands, and so that a high response rate could be obtained.

Methodology

We carried out a cross-sectional study to determine the prevalence of asthma and allergic diseases following the validated ISAAC methodology. Data were collected using written questionnaires.

In the first phase, the research team sent a letter to all school principals explaining the objectives of the study and inviting them to participate. We then held personal interviews with those principals who were interested, in order to expand on the preliminary information and explain the contents of the questionnaire. Once the principals gave their approval, questionnaires were sent to those schools that agreed to participate. Teachers distributed questionnaires to children along with a letter for their parents, who completed them voluntarily and anonymously.

Sample Size

A desirable minimum sample size of 1649 completed questionnaires was calculated to be necessary to detect differences of 3% compared with the other cities in which the same study has been performed, assuming a 95% confidence interval and a statistical power of 80%.

Variables

The main variables were prevalence of asthma, rhinitis, and atopic dermatitis, which were estimated based on answers to symptom-related issues (eg, wheezing, nocturnal cough, skin spots, itching).

The independent variables corresponded to sociodemographic characteristics (gender, race, place of birth, or family size). Environmental factors (eg, home equipment, parental smoking, and pets) were also considered.

Data Analysis

Completed questionnaires were scanned and exported to SPSS version 15. Comparisons by gender were performed using the χ^2 test. Ninety-five percent confidence intervals were estimated using the EPITABLE module from EPIINFO version 6.3.

Results

The study was conducted between September 2005 and January 2007, during the school year (September-June). We contacted a total of 79 schools, 38 of which agreed to participate. The total number of children aged 6 and 7 years in the participating schools was 3108, from whom we received 1883 questionnaires, 1871 of which were evaluable. The participation rate was 60.6%, and the gender distribution was 51.8% boys and 48.2% girls.

The prevalence of bronchial asthma, allergic diseases, and related conditions is shown in Tables 1, 2, and 3. The results are stratified by gender and overall. A high percentage of children (46.8%) reported wheezing ever, which in the ISAAC study is considered representative of the cumulative prevalence of asthma. However, only 18.4% presented wheezing in the last year (current prevalence of asthma). Asthma was severe in a small percentage of children (2.8%), in whom the symptoms interfered with speech.

As for rhinitis, 40.3% of respondents had experienced it in the last 12 months, with the highest prevalence in October, November, and December. Rhinoconjunctivitis was present in 23.4% of the population.

Table 1. Prevalence of Asthma Symptoms

Symptom	Boys, % (95% CI)	Girls, % (95% CI)	Overall, % (95% CI)
Wheezing ever	51.4 (48.3-54.6)	41.9 (38.7-45.1)	46.8 (44.6-49.1)
Wheezing in the last 12 months	21.2 (18.6-23.7)	15.5 (13.2-17.9)	18.4 (16.7-20.2)
Number of wheezing episodes in the last 12 months:			
None	78.5 (76-81.1)	84.3 (81.9-86.6)	81.3 (79.5-83.1)
1-3	16.2 (13.9-18.5)	12.1 (10-14.2)	14.2 (12.6-15.8)
4-12	4.2 (3-5.5)	3.4 (2.3-4.6)	3.8 (3-4.7)
More than 12	1 (0.4-1.7)	0.2 (0.1-0.5)	0.6 (0.3-1)
Sleep disturbance due to wheezing during the last 12 months:			
Never	85.9 (83.7-88.1)	89.2 (87.2-91.3)	87.5 (86-89)
Less than 1 night per week	9.5 (7-11.4)	7.9 (6.1-9.6)	8.7 (7.4-10)
One or more nights per week	4.6 (3.3-6)	2.9 (1.8-4)	3.8 (2.9-4.7)
Wheezing that has limited speech in the last 12 months	3.2 (2.1-4.3)	2.4 (1.4-3.5)	2.8 2.1-3.6)
Asthma ever	11.7 (9.6-13.7)	9.2 (7.3-11.1)	10.5 (9.1-11.9)
Wheezing associated with exercise in the last 12 months	10.5 (8.6-12.5)	7.1 (5.4-8.8)	8.9 (7.6-10.2)
Nocturnal dry cough in the last 12 months	38.9 (35.8-42)	33.5 (30.4-36.6)	36.3 (34.1-38.5)

Abbreviation: CI, confidence interval.

Table 2. Prevalence of Allergic Rhinitis

Symptom	Boys, % (95% CI)	Girls, % (95% CI)	Overall, % (95% CI)
Rhinitis ever	37.5 (34.4-40.5)	31.2 (28.1-34.1)	34.4 (32.3-36.6)
Rhinitis in the last 12 months	42.9 (39.8-46.1)	37.4 (34.2-40.5)	40.3 (38-42.3)
Rhinoconjunctivitis in the last 12 months	25.1 (22.4-27.8)	21.5 (19.9-24.2)	23.4 (21.4-25.3)
Limitation of daily activity in the last 12 months:			
Never	19.9 (17.4-22.4)	17.3 (14.9-19.8)	18.7 (16.9-20.4)
Occasionally	76.5 (73.8-79.1)	80.4 (77.8-83)	78.4 (76.5-80.2)
Sometimes	2.7 (1.7-3.7)	1.7 (0.8-2.5)	2.2 (1.5-2.6)
Often	0.9 (0.3-1.6)	0.7 (0.1-1.2)	0.8 (0.4-1.2)
Nasal allergy ever	22.4 (19.8-25)	18.7 (16.2-21.3)	20.6 (18.8-22.5)

Abbreviation: CI, confidence interval.

Table 3. Prevalence of Atopic Dermatitis

Symptom	Boys, % (95% CI)	Girls, % (95% CI)	Overall, % (95% CI)
Rash ever	15.1 (12.8-17.3)	15 (12.7-17.3)	15.1 (13.4-16.7)
Rash in the last 12 months	13 (10.9-15.1)	11.4 (9.3-13.5)	12.3 (10.8-13.7)
Rash on specific parts of the body (eg, elbows, knees)	12.5 (10.4-14.6)	10.9 (8.8-12.9)	11.7 (10.3-13.2)
Age when rash first appeared:			
Before 2 years	6.3 (4.8-7.8)	4.1 (2.8-5.4)	5.3 (4.3-6.3)
2-4 years old	4.1 (2.9-5.4)	4.3 (3-5.7)	4.2 (3.3-5.1)
5 years or more	3.7 (2.5-4.9)	5 (3.6-6.4)	4.3 (3.4-5.3)
Rash that has disappeared in the last 12 months	10.5 (8.6-12.5)	9.9 (7.9-11.8)	10.2 (8.9-11.6)
Sleep disturbance due to rash in the last 12 months:			
Never in the last 12 months	10.7 (8.8-12.7)	10.6 (8.6-12.7)	10.7 (9.3-12.1)
Less than 1 night a week	87.8 (85.8-89.9)	88 (86-90.2)	87.9 (86.4-89.4)
One or 2 nights a week	1.4 (0.7-2.2)	1.3 (0.6-2)	1.4 (0.9-1.9)
Atopic dermatitis[a]	36.4 (33.4-39.5)	35 (32-38.2)	35.8 (33.6-37.9)

Abbreviation: CI, confidence interval.
[a] Diagnosed by a doctor.

Dermatitis was found in 15.1% of children, who reported red spots on the skin accompanied by itching (rash); 12.3% of these occurred in the last year. With regard to age at onset, most boys had experienced rash before they were 2 years old, but most girls experienced it for the first time when they were 5 years or older. The high prevalence of clinically diagnosed atopic dermatitis (35.8%) is remarkable.

Finally, in most variables, prevalence was higher in boys, but differences were only statistically significant in asthma-related symptoms.

Discussion

Limitations of the Study

Questionnaires are a useful tool to establish the prevalence of bronchial asthma, because they enable investigators to reach people easily, require no special equipment, and are independent of circumstances such as season or other conditions that could alter concomitant tests [11].

Their drawbacks include lack of sensitivity and specificity, and a marked subjectivity, because information is collected from the perspective of the participant. This can lead to problems arising from variability in the perception of symptoms, unavoidable self-selection and memory bias, and differences in diagnostic practice [12]. Moreover, the educational level of parents is important for understanding the questions and may condition the answers [10].

Response Rate

The response rate in our study was lower than in other centers in Spain where the same study had previously been carried out [13]. Most centers had a participation of 70%-80%, whereas ours was about 60%. This low participation could be due to fear or mistrust regarding the implications of the study, lack of parental motivation, length of the questionnaire, or difficulty in understanding questions with medical terms. However, the number of respondents in absolute terms (1883) was higher than the desirable minimum sample size to detect differences (1649); therefore, we can assume that the results are comparable with those of other studies.

From our point of view, greater institutional support and use of information material aimed at tutors, parents, and children could have increased the participation rate and, therefore,

would make it possible to perform future analyses with a higher statistical power.

Prevalence of Bronchial Asthma

The results of our study show that the prevalence of asthma is very high among children in the Canary Islands (Table 1). If we compare them with data from the global ISAAC [14], or with those from other centers in Spain [9], we can conclude that the current prevalence of asthma in the Canary Islands is higher than in many other Spanish cities and almost twice the overall prevalence in Spain (Table 4).

Table 4. Current Prevalence of Asthma (Age Group, 6-7 Years)

Center	% (95% CI)
Spain overall[a]	9.9 (9.6-10.3)
A Coruña[a]	12.9 (11.7-14.2)
Asturias[a]	11.5 (10.4-12.7)
Barcelona[a]	8.5 (7.5-9.5)
Bilbao[a]	12.2 (11.0-13.4)
Cartagena[a]	11.1 (9.9-12.3)
Castellón[a]	8.3 (7.5-9.2)
Madrid[a]	9.4 (8.3-10.7)
Pamplona[a]	7.1 (6.2-8.0)
San Sebastián[a]	8.6 (6.9-10.6)
Valencia[a]	9.3 (8.3-10.3)
Las Palmas de Gran Canaria[b]	18.4 (16.7-20.2)

Abbreviation: CI, confidence interval.
[a] Carvajal-Urueña [9]
[b] $P<.001$

These differences may be attributed to the strong influence that environmental factors have on the development of asthma [15]. In this respect, the singular climatic conditions of the Canary Islands can promote the emergence of symptoms. First, the high humidity and stable warm temperatures provide ideal conditions for mites and molds, which are very common allergens for asthma and rhinoconjunctivitis in children. This evidence is also supported by a recent study that examined the prevalence of asthma symptoms in 2 different geoclimatic zones in Spain, namely, the coast and plateau, by considering their relative humidity and temperature range [16]. The results showed that asthma was more frequent in coastal areas with milder climates, and that the increase in annual relative humidity was a significant risk factor. This fact seems to be related to a larger mite load in these areas, as has been observed in other studies [17,18].

On the other hand, the proximity to the Sahara Desert means that our region is affected by an unusual meteorological phenomenon known as "calima," which consists of dry and dusty winds from Africa. Clinical experience shows that these conditions worsen the symptoms of people suffering from respiratory diseases such as bronchial asthma.

Nevertheless, the influence of climatic conditions seems less important than the indoor environment. For instance, double-glazed windows seem to protect against allergic diseases such as rhinoconjunctivitis or atopic eczema, as they reduce exposure to dust and molds [19].

Some pollens cause respiratory allergic diseases, such as rhinitis or asthma. In the Canary Islands, pollen and spore counts are lower than in other areas of Spain, with the exception of *Artemisia*, one of the most allergenic types, which caused pollinosis in 64.5% of patients in a study performed in Tenerife [20].

Other than allergens, respiratory viral infections may also play a role in the the high prevalence of asthma observed in the Canary Islands. Respiratory syncytial virus and other viruses that could be responsible for asthma exacerbations depend on a certain degree of humidity for their infectivity [21]. Again, the humid climate of the Canary Islands would be very favorable for these organisms.

Finally, our study found that the percentage of children who reported having experienced wheezing in the last 12 months was higher than those who said they had experienced asthma at some time (18.4% vs 10.5%), which, according to some authors, could indicate that this disease is underdiagnosed [22].

Table 5. Prevalence of Rhinitis in Different Centers in Spain (Age Group, 6-7 Years)

Center	Rhinitis Ever		Rhinitis Last 12 Months	
	Boys, %	Girls, %	Boys, %	Girls, %
Asturias[a]	29.6	24.4	25	19.5
Barcelona[a]	17.4	13.3	12.6	9
Bilbao[a]	26.6	21	22.7	17.7
Cartagena[a]	22.5	20.1	18.4	15.7
Castellón[a]	20.9	17.5	15.6	13
Madrid[a]	29.5	27.8	24.7	21.8
Pamplona[a]	18.8	15.5	14.6	13.7
Valencia[a]	18.4	22.6	14.8	17.8
Las Palmas de Gran Canaria	37.5	31.2	42.9	37.4

[a] Arnedo-Pena [10].

Prevalence of Rhinitis

As with asthma, the prevalence of current and accumulated rhinitis is much higher in our population than in most areas of Spain (Table 5). As for asthma, allergens that frequently cause rhinitis (mites, molds, pollens) find a propitious environment due to the climatic conditions of the Canary Islands.

Likewise, the fact that the prevalence of nasal allergy is much lower than the prevalence of nasal symptoms (20.6% vs 34.4%) also suggests that allergic rhinitis is underdiagnosed [23]. This may have several causes, such as seasonality of symptoms, poor perception of the severity of symptoms, and even lack of referral to a specialist [24,25]. It is important to emphasize that, despite the high prevalence of rhinitis, only 2% or less acknowledged that it interfered with their daily activity, which seems to indicate a low perception of these symptoms, as the severe effect of rhinitis on quality of life is well known [26,27].

Period of Highest Prevalence of Rhinitis

According to the results of our study, the period of highest prevalence of rhinitis was autumn ($P<.005$). These data are consistent with the overall results [28], and do not seem to be influenced by the months prior to data collection, as was the case in other studies [29], because our study took place during every month of the school year.

Some authors have reported differences in levels of pollen and dust mites as a possible justification for seasonal variation between centers [10].

Prevalence of Dermatitis

We found that the prevalence of clinically diagnosed atopic dermatitis was very high in our study population, reaching an overall prevalence of 35.8% (Table 3). However, severe atopic dermatitis that would alter sleep at least once a week was only present in 1.4% of the study population.

A recent study carried out in Spain to document the possible influence of meteorological conditions on the prevalence of atopic dermatitis [30] showed that there was a positive association with precipitation and humidity, so that the highest prevalence was found in the Atlantic area. In contrast, temperature and the number of hours of sunlight may explain a lower rate of this disease in other places, such as the Mediterranean coast.

If we analyze the climatic conditions of the Canary Islands (high humidity, low precipitation, mild temperatures, and a large number of hours of sunlight), we could expect the prevalence to be similar to that of the Mediterranean region, but in fact it was even higher than that of the Atlantic area (Table 6). Therefore, apart from climatic factors, local conditions (food allergens, dietary patterns, genetic susceptibility) may be associated with the pathogenesis of atopic dermatitis.

Prevalence According to Sex

We found that the prevalence of cumulative and current asthma was significantly higher in boys ($P<.05$) (Table 1). Other studies have also found [31] a higher prevalence of symptoms of asthma in boys than in girls, although the underlying causes are unknown. Therefore, it appears that male gender might be considered a risk factor for the development of asthma in childhood [2]. Before the age of 14, prevalence in boys is almost twice that in girls [32]. As age increases, differences between genders lessen, and prevalence is even higher in girls. The reasons are unclear, although it has been suggested that the size of the lungs, smaller at birth in boys, but larger in adult men, can influence the development of asthma [33]. Furthermore, parents of boys seem to have a greater tendency to report symptoms than do those of girls [34].

In contrast, gender differences in the prevalence of rhinitis and dermatitis symptoms were not statistically significant; however, once again, the frequencies for boys were higher in most of the variables evaluated.

Conclusions

The prevalence of asthma and allergic diseases in children aged 6-7 years who live in the Canary Islands is higher than in the other centers of Spain where the ISAAC study has been carried out. Male gender is an important risk factor in children, especially for asthma symptoms.

Differences in prevalence obtained in several studies may indicate exposure to different risk factors, as well as variable ethnic, environmental, and socioeconomic conditions,

Table 6. Prevalence of Atopic Dermatitis in Different Areas of Spain (Age Group, 6-7 Years)

	Mediterranean	Continental	Atlantic	Canary Islands
Prevalence of clinically diagnosed atopic dermatitis, %	28.3	31.2	32.9	35.8
Climatic parameters				
Mean annual temperature, ºC	16.8	14.1	13.5	20.7
Mean annual precipitation, mm	469	386	1126	134
Mean relative humidity, %	69	59	75	68
Mean annual number of hours of sunlight	2593	2658	1830	2805

[a] Morales Suárez-Varela [30].

heterogeneous diagnostic criteria, or a real increase in the prevalence of allergic diseases. The methodology of the ISAAC study combines a large sample size and uniformity in age, and reinforces the validity of our study so that it can be compared with those from other geographical areas. Therefore, differences detected in the prevalence of asthma and allergic diseases seem to correspond with the current situation of these diseases. In any case, it would be interesting to analyze in greater detail the differential factors present in the Canary Islands and their contribution to the pathogenesis of these diseases.

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