Incidence and Characteristics of Adult-Onset Asthma

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OBJECTIVE: To determine the incidence of adult-onset asthma, along with lung function and immunologic characteristics, causes, and clinical course of the disease.

PATIENTS AND METHODS: After identifying incident cases of asthma among adult residents of the district of North Barcelona, Spain, we proceeded to characterize the disease using a questionnaire, lung function tests, and skin allergy tests. Patients with an occupation associated with asthma, wheezing at work, and/or sensitization to workplace allergens were considered as having occupational asthma. The risk factors for developing chronic asthma were determined by multivariate analysis.

RESULTS: In the 2-year study period, 218 incident cases of adult-onset asthma were identified (in a population of 68,067 adults, corresponding to an annual incidence of 160 per 100,000 per year). In total, 152 patients agreed to participate in the study (response rate, 70%); 140 reported wheezing and/or asthma in the last year (92%). The skin tests showed atopy in 57 cases (41%). Occupational asthma was diagnosed in 19 cases (14%). Domestic mammals were identified as causal agents in 8 patients (6%), drugs in 7 (5%), and environmental allergens in 44 (31%). Household cleaning was the occupation most frequently associated with the disease (26%). Of the 102 patients examined again after 2 years, 70 had chronic asthma (69%). Atopy (odds ratio [OR], 3.39; 95% confidence interval [CI], 1.15-9.99) and risk occupation when the disease was diagnosed (OR, 5.54; confidence interval [CI] del 95%, 1.15-9.99) were the factors associated with development of chronic disease.

CONCLUSIONS: Occupation was related to adult-onset asthma in a little over 10% of the cases and was the main determinant of the development of chronic symptoms.


Introduction

The incidence of asthma in the general population has been assessed less often than its prevalence due to the added difficulty of implementing the cohort studies required...
to provide such data. Studies in different populations have reported incidence rates that vary widely (between 100 and 1000 new cases per 100 000 inhabitants) according to the mean age of the population studied, with the highest incidences reported in the youngest populations. In a cohort study that began in 1964 in Minnesota in the United States of America, Yunginger et al. found an annual asthma incidence of 284/100 000 in the general population, with lower incidences in younger adults. Higher incidences have been repeatedly observed in those under 18 years, with annual rates ranging from 800 to 1200 new cases per 100 000 inhabitants in some population-based samples. Ownby et al., in an incidence study conducted in Detroit in the United States of America, identified 340 new asthma cases per year for every 100 000 inhabitants in a population of young adults, and observed that the incidence was clearly higher in those under 30 years of age (530/100 000 per year) than in older patients (150/100 000 per year). Studies focusing on the adult population in different regions have reported annual incidences between 100 and 500 new cases per 100 000 inhabitants, although when the incidence of asthma in elderly subjects has been studied, the rates have been reported to be less than 100 cases per 100 000 per year, confirming the decrease in the incidence of asthma with age.

Only indirect estimates of the incidence of adult-onset asthma are available for the population covered by the present study. Our aim was to determine the incidence of asthma in the adult population in the district of North Barcelona, Spain, along with lung function and immunologic characteristics, causes, and clinical course of the disease.

**Patients and Methods**

**Study Design and Population**

From January 2002 through December 2003, we identified all patients with a first diagnosis of adult-onset asthma in North Barcelona, Spain. This population-based sample was used to form a cohort that was followed for 2 years after diagnosis. Adult residents of North Barcelona living in health districts that agreed to participate in the study (Mongat-Tiana, 10 910 inhabitants; Apenins-Montigalà, 16 226 inhabitants; La Salut, 28 431 inhabitants; Morera-Pomar, 12 520 inhabitants; total, 68 067 adult inhabitants) made up the population-based target sample of the study.

**Methods**

During the 2-year patient selection period, all adults diagnosed with asthma by a physician of the participating health districts were identified using the records of each district and chart review. Adult-onset asthma was considered present when no previous diagnosis of asthma was found in the districts’ records. The lack of a previous diagnosis was confirmed by a telephone call to the patient. These patients were then asked to answer a telephone survey containing questions about respiratory symptoms and exposure. Those who agreed formed the study group. We also established a control group of patients without respiratory disease from the first adults to attend the clinics in the participating health districts in each month during the selection period. This group had the same number of patients as the adult-onset asthma group for that month. The charts of these subjects were reviewed and those with a previous diagnosis of asthma at some point were excluded from the analysis. Those who were finally included in the control group were asked to answer the same telephone survey as those with asthma.

**Disease Characterization**

All patients who reported current symptoms, that is, those who affirmed that they had wheezing and/or asthma in the past year in the questionnaire, were offered the opportunity to undergo lung function testing and sensitization tests after signing an informed consent. These patients answered a questionnaire in person, underwent lung function tests and allergy tests, and formed the cohort that was followed for 2 years.

The questionnaire answered in person for the characterization study had questions on sociodemographic data, smoking habit, respiratory symptoms, occupation, domestic pets, and medication used, and had been previously validated. Working for more than 6 months in an occupation listed as a potential cause of asthma was considered a situation of occupational risk for this disease (Table 1). The occupation of a subject was classified as domestic cleaning when his or her work took place in people’s homes and as industrial cleaning when it was done in companies or institutions.

Lung function tests and skin allergy tests were done for all patients whose asthma had been characterized. Forced vital capacity and forced expiratory volume in 1 second were measured by spirometry with reversibility testing in the morning with a dry spirometer using standard techniques. The values obtained were compared with age- and sex-adjusted reference values obtained from a population-based sample of volunteers in the province of Barcelona; the results were expressed as a percentage of predicted. Spirometry measurements were followed by a salbutamol reversibility test. Patients with forced spirometry values in normal range and reversibility of less than 12% compared to baseline after bronchodilator administration were offered, after signed informed consent, a nonspecific bronchial challenge test according to standard techniques. The result was considered positive when a decrease equal to or greater than 20% of baseline occurred with any of the concentrations used during the procedure (PC20 ≤16 mg/mL). Skin allergy tests were done by skin pricks, using histamine phosphate (1/200 mg/mL) as positive control and diluent (50% glycerin) as negative control. The maximum wheal diameter was measured 15 minutes after applying the allergenic extract, and the reaction was considered positive when the diameter was 3 mm or more, provided no reaction to diluent occurred and the patient showed a positive reaction to histamine. Sensitization to environmental allergens was defined as obtaining at least one positive reaction to 6 common allergens (Dermatophagoides pteronyssinus, Dermatophagoides farinae, cat dander, dog dander, cockroach allergen Blattella germanica, and Aspergillus fumigatus).
Incidence and Exposure in Adult-Onset Asthma

From the medical records of the participating health districts, we identified 379 adults who sought attention for asthma in the 2-year study period. Chart review and telephone contact with the patients revealed that this was the first diagnosis in 218 cases. The annual incidence of adult-onset asthma in North Barcelona was therefore 160/100 000 adults (218 cases/68 067 adults × 2 years).

Of the 218 patients identified with adult-onset disease, 152 agreed to answer the study questionnaire (response rate, 69.7%). The answers were compared with those of the same questionnaire administered to the 150 control subjects who were free of respiratory disease. The patients with adult-onset asthma had a somewhat higher mean age than subjects in the control group (t test, P=.02), a greater proportion of women (χ² test, P=.01), and a higher proportion of occupations potentially associated with asthma at the time of disease onset (χ² test, P=.04) (Table 2).

Disease Characterization

One hundred and forty patients with adult-onset asthma and current symptoms, that is, those who reported wheezing and/or asthma in the previous year (92.1% of all patients) agreed to undergo testing to characterize their asthma. Of these, an acceptable forced spirometry test was carried out in 119 (85.0%), 35 of whom (29.4%) showed an obstructive and/or reversible pattern. A nonspecific bronchial challenge test was offered to the remaining 84 patients; 54 (64.3%) accepted, 27 of whom showed airflow hyperresponsiveness (Table 3). The skin allergy tests revealed atopy in 57/140 study participants (40.7%); the subjects were mainly sensitized to house dust mites (26.5%) and/or pollens (22.8%). Positive tests showing sensitization to workplace allergens (4.3%) and cats (12.9%) and dogs (9.3%) were also common (Table 3).

Etiology

The asthma characterization study showed that 14 of the 48 symptomatic patients with an occupation potentially associated with asthma at the time of onset of symptoms reported wheezing at work (29.0%). The occupations in which this association was found most often were domestic cleaning (n=5), hairdressing (n=3), and welding (n=2). In 6 of these patients, the skin allergy tests for allergens present in the workplace showed specific sensitization to storage mites in 2 industrial cleaners, a baker, and a tanner; to wheat flour in a baker; and to latex in a welder who used latex gloves (12.5%). Occupational asthma was diagnosed in 19 of the 140 patients with adult-onset asthma who, in addition to being in a risk occupation at the time of onset of symptoms, reported wheezing at work and/or were sensitized to an allergen present in the workplace (13.6%) (Tables 4 and 5).

Domestic cleaning was considered the cause of adult-onset asthma in 5/140 symptomatic patients (3.6%) and was the risk occupation that was most frequently associated
with the disease (5/19 cases of occupational asthma, 26.3%) (Table 4). Lung function testing detected airway hyperresponsiveness in all cases of asthma related to domestic cleaning (positive bronchodilator reversibility test, 2; positive nonspecific bronchial challenge test, 3), although forced spirometry only showed obstructive disease in 1 of these cases.

Of the 140 symptomatic patients with adult-onset asthma, 53 had domestic mammals at home (17 cats and 39 dogs). Of these, 8 showed sensitization to specific allergens in the skin allergy tests (cat, 2; dog, 6) (5.7%), thereby confirming diagnosis of asthma due to exposure to domestic mammals. In the 7 patients whose onset of symptoms coincided with administration of a particular drug (nonsteroidal anti-inflammatory drug, β-blocker, 1), the drug was considered to be the causal agent (5.0%). Of the remaining symptomatic patients with adult-onset asthma, the skin allergy tests with environmental allergens were positive for one or more allergens in 44 cases (domestic house mites, 23; pollens, 21; fungi, 3), and in these cases, environmental asthma was diagnosed (31.4%) (Table 4).

**Clinical Course**

Of the 140 patients with adult-onset asthma who were symptomatic when included in the cohort, 16 left North Barcelona to live elsewhere during follow-up and so they were excluded from the analysis. One hundred and two of the remaining 124 patients agreed to repeat the questionnaire on respiratory symptoms, exposure, and treatment 2 years after diagnosis (82.2%). In the follow-up questionnaire, 70 patients reported wheezing and/or asthma and/or daily bronchodilator treatment in the previous year, and so they were considered sufferers of chronic asthma (68.6%). Thirty-seven of them had clinical characteristics of persistent asthma according to GINA criteria (36.3%) (Table 6). At the end of the 2-year follow-up period, although 11 of 16 patients diagnosed with occupational asthma no longer worked in the occupation that caused their disease (68.7%), the respiratory symptoms persisted in 9 of them (81.8%).

Four of the 6 patients with asthma caused by domestic mammals no longer had the animals in their home (66.7%), and 3 still had asthma symptoms (75.0%). Analysis of the factors for development of chronic symptoms showed that both atopy (OR=3.39; 95% CI, 1.15-9.99) and working in a risk occupation during the diagnostic period (OR=5.54; 95% CI, 1.05-29.11) were statistically significant risk factors for the persistence of symptoms 2 years after disease onset (Table 7).

**Discussion**

According to the present study, the annual incidence of adult-onset asthma in North Barcelona was 160/100 000 inhabitants and a tenth of these cases corresponded to occupational asthma. In two-thirds of the patients with adult-onset asthma, the respiratory symptoms had become chronic, and half showed characteristics of persistent

<table>
<thead>
<tr>
<th>TABLE 2</th>
<th>Respiratory Symptoms and Exposure in the Study Populationa</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cases</td>
</tr>
<tr>
<td>No. of patients</td>
<td>152</td>
</tr>
<tr>
<td>Sociodemographic data</td>
<td></td>
</tr>
<tr>
<td>Mean age, y</td>
<td>42.5 (16.1)</td>
</tr>
<tr>
<td>Women, n (%)</td>
<td>110 (72.4%)</td>
</tr>
<tr>
<td>Smoking habit</td>
<td></td>
</tr>
<tr>
<td>Never smoker</td>
<td>80 (52.6%)</td>
</tr>
<tr>
<td>Current smoker</td>
<td>49 (32.2%)</td>
</tr>
<tr>
<td>Ex-smoker</td>
<td>23 (15.1%)</td>
</tr>
<tr>
<td>Respiratory complaints</td>
<td></td>
</tr>
<tr>
<td>Wheezing in last year</td>
<td>136 (89.5%)</td>
</tr>
<tr>
<td>Asthma attacks in last yearb</td>
<td>57 (37.5%)</td>
</tr>
<tr>
<td>Wheezing and/or asthma attacks in last yearb</td>
<td>137 (90.1%)</td>
</tr>
<tr>
<td>Symptoms since more than 1 year ago</td>
<td>13 (8.6%)</td>
</tr>
<tr>
<td>Occupation potentially associated with asthma</td>
<td></td>
</tr>
<tr>
<td>Domestic cleaner</td>
<td>13 (8.5%)</td>
</tr>
<tr>
<td>Industrial cleaner</td>
<td>6 (3.9%)</td>
</tr>
<tr>
<td>Hairdresser</td>
<td>8 (5.3%)</td>
</tr>
<tr>
<td>Industrial chemist</td>
<td>7 (4.6%)</td>
</tr>
<tr>
<td>Baker</td>
<td>3 (2.0%)</td>
</tr>
<tr>
<td>Tanner</td>
<td>1 (0.7%)</td>
</tr>
<tr>
<td>Welder</td>
<td>3 (2.0%)</td>
</tr>
<tr>
<td>Other occupationsc</td>
<td>7 (4.6%)</td>
</tr>
<tr>
<td>Total</td>
<td>48 (31.6%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TABLE 3</th>
<th>Patients With Adult-Onset Asthma and Current Symptoms (n=140)a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lung function</td>
<td>No consent for test or invalid test</td>
</tr>
<tr>
<td>Forced spirometry</td>
<td>Obstructive respiratory disorder</td>
</tr>
<tr>
<td>Only bronchodilator test positive</td>
<td>20 (14.3%)</td>
</tr>
<tr>
<td>Obstructive and/or reversibility disorder</td>
<td>35 (25.0%)</td>
</tr>
<tr>
<td>Nonspecific bronchial challengeb</td>
<td>No consent for test</td>
</tr>
<tr>
<td>Positive</td>
<td>27 (19.3%)</td>
</tr>
<tr>
<td>Negative</td>
<td>27 (19.3%)</td>
</tr>
<tr>
<td>Sensitization</td>
<td>Atopyc</td>
</tr>
<tr>
<td>Environmental allergen</td>
<td>House dust mites</td>
</tr>
<tr>
<td>Pollens</td>
<td>32 (22.8%)</td>
</tr>
<tr>
<td>Fungi</td>
<td>4 (2.9%)</td>
</tr>
<tr>
<td>Occupational allergen</td>
<td>6 (4.3%)</td>
</tr>
<tr>
<td>Domestic mammals</td>
<td>Cat</td>
</tr>
<tr>
<td>Dog</td>
<td>13 (9.3%)</td>
</tr>
</tbody>
</table>

aData are presented as means (SD) or number of patients (%).
bAsthmatic patients excluded from control population.
cElectronics, carpentry, plastic, spray painting, gardening.
The incidence of adult-onset asthma observed in our study (160/100 000 adults) is somewhat lower than the figure of 553/100 000 estimated for Spain using data from the European Asthma Study for the population aged between 20 and 44 years, that is, younger than the population we studied in North Barcelona. In industrialized countries, the incidence of asthma increased in the second half of the 20th century, driven by an increase among younger individuals, although this was not accompanied by a significant increase in the number of new cases diagnosed in adults. Thus, even with incidences of asthma of 300 to 800 cases per 100 000 inhabitants in recent studies that included high proportions of young people, the proportion of new cases in middle-aged adults has remained constant at around 200 cases per 100 000 inhabitants, a figure similar to that observed in our study in North Barcelona.

A link was found between the patient’s occupation and the disease in slightly more than one-tenth of the incident cases in adults we identified in the district of North Barcelona. This proportion is similar to the 10% to 15% estimated in asthma prevalence studies conducted in different regions. However, the percentage corresponding to occupational asthma in prevalence studies may be greater than that obtained in cohort studies designed to measure incidence, as the prevalence figures do not depend just on the incidence of asthma in the study population but also on its persistence. Thus, even with incidences of asthma of 300 to 800 cases per 100 000 inhabitants in recent studies that included high proportions of young people, the proportion of new cases in middle-aged adults has remained constant at around 200 cases per 100 000 inhabitants, a figure similar to that observed in our study in North Barcelona.

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be due to methodological differences but it can most likely be attributed to different occupational profiles in the populations studied,\(^{33}\) that is, there is a higher incidence when occupations closely linked to the disease are more common in a given region. The data obtained in our study support the second explanation, as domestic cleaning, an occupation considered to be associated with asthma, was a common occupation in the district of North Barcelona, both among patients affected by adult-onset asthma (8.5\%) and in the control group (6.0\%). In a recent study conducted in the district of South Barcelona, a high percentage—over 5\%—of the active population worked in cleaning.\(^{34}\) This percentage is much higher than the estimated percentage in Great Britain (<1\%).\(^{35,36}\)

In our study, domestic cleaning was associated with asthma in approximately 4\% of the cases and was the risk occupation that was most frequently associated with the disease. In all cases, airway hyperresponsiveness was detected in the lung function tests. Working as a cleaner had been identified as a risk factor for asthma in the recent European Asthma Study.\(^{37}\) In Great Britain, the incidence of asthma among cleaners was estimated to be 1 per 100.\(^{35}\) The importance of domestic cleaning in the etiology of adult-onset asthma in Spain is highlighted in a recent study in which the type of work was identified as a strong risk factor for adult-onset asthma, with an OR of 3.3 (95\% CI, 1.9–5.8).\(^{38}\) In our study, we only identified 2 cases of asthma related to industrial cleaning, by detecting sensitization to allergens present in the workplace, indicating that this type of work is less important in the etiology of adult-onset asthma in Spain, in agreement with previous population-based epidemiological studies in which industrial cleaning was not associated with the appearance of a significant number of cases of adult-onset asthma.\(^{34}\) This difference between the incidence of asthma in domestic and industrial cleaners might be explained by the fact that the number of cases of asthma observed among domestic cleaners in Barcelona can probably be attributed to the use of specific chemicals in the homes that can trigger disease without the mediation of immunoglobulin E, as suggested by recent studies.\(^{38,40}\)

Approximately 70\% of the patients diagnosed with adult-onset asthma in our study reported wheezing or asthma and/or required daily treatment 2 years after initial diagnosis. This percentage is higher than that observed in young populations, in which more than half the patients diagnosed are asymptomatic several years after onset,\(^{41,42}\) but similar to that reported in other studies of subjects with a similar age range to that of the sample of the present study.\(^{43}\) In our study, atopy and occupation were factors related to symptoms becoming chronic 2 years after diagnosis. This observation coincides with previous studies that have linked atopy with impaired lung function\(^{44}\) and with reports of worse clinical course in patients with asthma of occupational origin.\(^{45}\) Coté et al\(^{46}\) observed not only a worsening of symptoms in workers who were exposed to the causal agent in their workplace, but also persistence of symptoms in half of those affected who were no longer in that occupation. In these patients, the duration of exposure to the causal agent after the onset of symptoms was a main determinant for developing chronic disease.\(^{46}\) This highlights the need for early diagnosis and withdrawal from exposure in cases where asthma is diagnosed as occupational.

In conclusion, with the present study, we were able to determine that the annual incidence of adult-onset asthma in North Barcelona is 160/100 000 inhabitants. The occupation of the patient is the cause of the disease in slightly more than one-tenth of cases, a higher proportion than that observed in other European countries. This observation can be attributed in part to the high percentage of domestic cleaners among the workforce. This occupation was the one most frequently associated with the disease in our study and may be considered the cause in around 4\% of the cases of adult-onset asthma identified. In two-thirds of the patients studied, respiratory symptoms persisted 2 years after diagnosis, and an occupational origin was identified as one of the main risk factors for developing chronic disease. The importance of the occupation of the patient, both in the etiology and persistence of symptoms of adult-onset asthma, demands that the type of work of the patient should be determined in detail when the disease is first diagnosed in adults.

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