

Incidence and Characteristics of Adult-Onset Asthma

Xavier Casas,^a Eduard Monsó,^{a,b} Xavier Orpella,^c Ramona Hervás,^a Josep Anton González,^c Elisabeth Arellano,^a Carlos Martínez,^a Gerardo Martínez,^d Àlex Ascosa,^d Jesús Comín,^d Rafael Ruiz,^d Berta Monsó,^e Irma Casas,^f Maria Esteve,^f and Josep Morera^a

^aServei de Pneumologia, Hospital Germans Trias i Pujol, Badalona, Barcelona, Spain

^bCiber de Enfermedades Respiratorias (CibeRes), Bunyola, Mallorca, Spain

^cUnidad de Salud Laboral Barcelonés Nord i Maresme, Badalona, Barcelona, Spain

^dÀreas Bàsiques de Salut del Barcelonés Nord i Maresme, Badalona, Barcelona, Spain

^eUniversitat Pompeu Fabra, Barcelona, Spain

^fServei de Medicina Preventiva, Hospital Germans Trias i Pujol, Badalona, Barcelona, Spain

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; 95% CI, 1.05-29.11) 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.

Key words: Asthma. Adult-onset asthma. Incidence. Occupational asthma. Household cleaning. Course. Chronic asthma. Atopy. Occupation.

Study partly financed by the Catalan Foundation for Pulmonology and the Catalan Society for Pulmonology.

Correspondence: Dr E. Monsó
Servei de Pneumologia, Hospital Germans Trias i Pujol
Ctra. del Canyet, s/n
08916 Badalona, Barcelona, Spain
E-mail: emonso.germanstrias@gencat.cat

Manuscript received July 3, 2007. Accepted for publication February 19, 2008.

Incidencia y características del asma bronquial de inicio en la edad adulta

OBJETIVO: Determinar la incidencia del asma del adulto, junto con las características funcionales e inmunológicas de la enfermedad, sus causas y su evolución.

PACIENTES Y MÉTODOS: Tras la identificación de los habitantes de Barcelona Norte con un primer diagnóstico de asma del adulto, se procedió a la caracterización de la enfermedad por cuestionario, función respiratoria y pruebas cutáneas de alergia. Los pacientes con una ocupación causante de asma, sibilancias durante el trabajo y/o sensibilización a un alérgeno laboral se consideraron afectados de asma relacionada con la ocupación. Los factores de riesgo de cronificación del asma se determinaron por medio de análisis multivariante.

RESULTADOS: En 2 años se identificaron 218 primeros diagnósticos de asma del adulto (población: 68.067 adultos; incidencia anual: 160/100.000). Aceptaron participar en el estudio 152 pacientes (índice de respuesta: 70%), de los que se caracterizó a 140 que referían sibilancias y/o asma bronquial en el último año (92%). Las pruebas cutáneas mostraron atopia en 57 casos (41%). Se diagnosticó asma relacionada con la ocupación en 19 casos (14%), por mamíferos domésticos en 8 (6%), por fármacos en 7 (5%) y por alérgenos ambientales en 44 (31%), siendo la limpieza doméstica la ocupación más frecuentemente asociada a la enfermedad (26%). De los 102 pacientes examinados de nuevo a los 2 años, 70 presentaban asma crónica (69%); la atopia (odds ratio [OR] = 3,39; intervalo de confianza [IC] del 95%, 1,15-9,99) y una ocupación de riesgo cuando se diagnosticó la enfermedad (OR = 5,54; IC del 95%, 1,05-29,11) fueron los factores de cronificación del asma.

CONCLUSIONES: La ocupación del paciente está relacionada con el asma del adulto en algo más de una décima parte de los casos y es un determinante principal de la cronicidad de sus síntomas.

Palabras clave: Asma. Asma del adulto. Incidencia. Asma relacionada con el trabajo. Limpieza doméstica. Evolución. Asma crónica. Atopia. Ocupación.

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 al¹ 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.^{2,3} Ownby et al,⁴ 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,⁵⁻⁸ 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,⁹ confirming the decrease in the incidence of asthma with age.

Only indirect estimates of the incidence of adult-onset asthma¹⁰ are available for the population covered by the present study.¹⁰ 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.¹¹⁻¹³ 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).^{13,14} The occupation of a subject was listed 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 (Spirometrics, Gray, Maine, USA), according to standard techniques.¹⁵ The values obtained were compared with age- and sex-adjusted reference values obtained from a population-based sample of volunteers in the province of Barcelona¹⁶; the results were expressed as 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 ($PC_{20} \leq 16$ mg/mL).¹⁷

Skin allergy tests were done by skin pricks,¹⁸ 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*

TABLE 1
Occupations or Sectors Potentially Associated With Asthma
in the Study Population¹⁴

Domestic cleaner
Industrial cleaner
Hairdresser
Industrial chemist
Baker
Tanner
Welder
Electronics manufacture
Carpenter
Plastics industry
Spray painter
Gardener

farina, *Dermatophagoides pteronyssinus*, 3 pollen mixtures, grass pollen mixtures, cereal pollen mixtures, *Parietaria officinalis*); sensitization to occupational allergens as at least one positive reaction to allergens to which the subject was exposed in his or her workplace (storage mites, flours, latex); and sensitization to domestic mammals as at least one positive reaction to cats or dogs (Leti SA, Barcelona, Spain, and Stallergènes, Antony, France).

Etiologic Diagnosis

Patients with adult-onset asthma in an occupation potentially associated with asthma when the symptoms first occurred were considered as having occupational asthma if they reported wheezing during occupational exposure and/or the skin tests with allergens present in their place of work were positive. The patients with home exposure to cats and/or dogs and specific sensitization to the animal according to skin allergy testing were considered as having asthma due to domestic mammals. The cases of adult-onset asthma were considered drug-related when symptoms appeared during treatment with drugs that may trigger the disease.¹⁹ Finally, patients with no identifiable causal occupational, domestic, or drug exposure whose skin allergy tests showed sensitization to common environmental allergens were considered as having environmental asthma.

Clinical Course

Patients with adult-onset asthma in the study cohort attended a second visit 2 years after the initial diagnosis. They answered the questionnaire used at baseline, with some additional questions on disease severity and treatment, with the aim of determining whether exposure to the presumed causal agent persisted or had been suppressed and of measuring the disease severity 2 years after diagnosis, in accordance with the criteria of the Global Initiative for Asthma (GINA).²⁰

Statistical Analysis

The data were analyzed using the SPSS statistical package (Chicago, Illinois, USA). The results obtained were expressed as absolute numbers and relative frequencies for categorical variables and as means (SD) for continuous variables.

Initially, once all cases of adult-onset asthma diagnosed during the selection period had been identified, the incidence of the disease was determined in the study population using the size of the target population as the denominator. The value obtained was expressed as annual incidence. This identification was followed by comparison of the occupational and domestic exposures in patients with adult-onset asthma and in subjects without any respiratory disease who formed the control group (*t* test and χ^2 test), and by characterization of the cases identified, with determination of lung function and occupational, domestic, and/or environmental allergen sensitization. Whenever possible, an etiologic diagnosis was established based on exposure, symptoms, and sensitization of the patient. Finally, the clinical course of disease was characterized by analyzing the follow-up data for the cohort of patients with adult-onset asthma; also determined were the risk factors for developing chronic disease, that is, presence of wheezing and/or asthma and/or use of bronchodilators 2 years after diagnosis. This was done by a multivariate logistic regression analysis that included all independent variables in the initial univariate analysis ($P < .25$); the results obtained were expressed as the odds ratio (OR) and 95% confidence interval (CI) for each variable. Results of statistical tests with *P* less than .05 were considered statistically significant.

Results

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 \times 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 (χ^2 test, $P = .01$), and a higher proportion of occupations potentially associated with asthma at the time of disease onset (χ^2 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 airway 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

TABLE 2
Respiratory Symptoms and Exposure
in the Study Population^a

	Cases	Controls	P
No. of patients	152	150	–
Sociodemographic data			
Mean age, y	42.5 (16.1)	38.2 (15.4)	.02
Women, n (%)	110 (72.4%)	86 (57.3%)	.01
Smoking habit			
Never smoker	80 (52.6%)	72 (48.0%)	>.25
Current smoker	49 (32.2%)	49 (32.7%)	>.25
Ex-smoker	23 (15.1%)	29 (19.3%)	>.25
Respiratory complaints			
Wheezing in last year	136 (89.5%)	21 (14.0%)	<.01
Asthma attacks in last year ^b	57 (37.5%)	–	–
Wheezing and/or asthma attacks in last year ^b	137 (90.1%)	–	–
Symptoms since more than 1 year ago	13 (8.6%)	–	–
Occupation potentially associated with asthma			
Domestic cleaner	13 (8.5%)	9 (6.0%)	
Industrial cleaner	6 (3.9%)	0 (0.0%)	
Hairdresser	8 (5.3%)	3 (2.0%)	
Industrial chemist	7 (4.6%)	5 (3.3%)	
Baker	3 (2.0%)	4 (2.7%)	
Tanner	1 (0.7%)	0 (0.0%)	
Welder	3 (2.0%)	7 (4.7%)	
Other occupations ^c	7 (4.6%)	3 (2.0%)	
Total	48 (31.6%)	31 (20.7%)	.04
Exposure to domestic mammals			
Cat	18 (11.8%)	18 (12.0%)	
Dog	44 (28.9%)	53 (35.3%)	>.25

^aData are presented as means (SD) or number of patients (%).

^bAsthmatic patients excluded from control population.

^cElectronics, carpentry, plastic, spray painting, gardening.

TABLE 3
Patients With Adult-Onset Asthma and Current Symptoms
(n=140)^a

Lung function	
No consent for test or invalid test	21 (15.0%)
Forced spirometry	
Obstructive respiratory disorder	15 (10.7%)
Only bronchodilator test positive	20 (14.3%)
Obstructive and/or reversibility disorder	35 (25.0%)
Nonspecific bronchial challenge ^b	
No consent for test	35 (25.0%)
Positive	27 (19.3%)
Negative	27 (19.3%)
Sensitization	
Atopy ^c	57 (40.7%)
Environmental allergen	
House dust mites	37 (26.5%)
Pollens	32 (22.8%)
Fungi	4 (2.9%)
Occupational allergen ^d	6 (4.3%)
Domestic mammals	
Cat	18 (12.9%)
Dog	13 (9.3%)

^aAll patients with adult-onset asthma were considered symptomatic if they had reported wheezing and/or asthma in the previous year.

^bTest performed when forced spirometry and bronchodilator test was normal.

^cOne or more positive allergens.

^dFlour, latex, or storage mites.

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, 6; 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 4
Occupational Asthma

Occupation	No.	Wheezing at Work	Specific Sensitization	Occupational Asthma
Domestic cleaner	13	5 (38%)	0 (0%)	5 (38%)
Industrial cleaner	6	0 (0%)	2 (33%) ^b	2 (33%)
Hairdresser	8	3 (37%)	0 (0%)	3 (37%)
Industrial chemist	7	1 (14%)	0 (0%)	1 (14%)
Baker	3	1 (33%)	2 (67%) ^{b,c}	2 (67%)
Tanner	1	0 (0%)	1 (100%) ^b	1 (100%)
Welder	3	2 (67%)	1 (33%) ^d	3 (100%)
Other	7	2 (29%) ^a	0 (0%)	2 (29%)
Occupational exposure	48	14 (29%)	6 (12%)	19 (40%)

^aCarpenter and spray painter.

^bStorage mites.

^cWheat flour.

^dLatex

TABLE 5
Etiology of Adult-Onset Asthma

Exposure	
Occupational	19 (13.6%)
Domestic mammals	8 (5.7%)
Medication	7 (5.0%)
Environmental allergens	49 (35.0%)
Not identified	74 (52.8%)
Total	140 (100%)

TABLE 6
Course of Adult-Onset Asthma (n=102)

Respiratory Complaints	
Wheezing and/or asthma attacks in last year	63 (61.8%)
Daily bronchodilator treatment	33 (32.4%)
Wheezing, asthma, and/or daily treatment ^a	70 (68.6%)
Intermittent ^b	33 (47.2%)
Persistent ^b	37 (36.3%)
Treatment	
None	39 (38.2%)
Short-acting β-adrenergic antagonists	62 (60.8%)
Long-acting β-adrenergic antagonists	15 (14.7%)
Inhaled corticosteroids	28 (27.5%)
Others	9 (8.8%)

^aWheezing and/or asthma in the last year and/or daily bronchodilator treatment.

^bSeverity according to the Global Initiative for Asthma criteria with wheezing and/or asthma in the last year and/or daily bronchodilator treatment.¹⁹

asthma, with atopy and occupation being determining factors for developing chronic symptoms.

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.¹⁰ 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.^{1,21-23} 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,^{2,4} the proportion of new cases in middle-aged adults has remained constant at around 200 cases per 100 000 inhabitants,^{5,7,24} a figure similar to that observed in our study in North Barcelona.⁹

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.²⁵⁻²⁹ 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,³⁰ which is higher in certain types of asthma, such as occupational asthma.³¹ In a study of incidence in the Finnish population, Reijula et al³² estimated that occupational asthma accounted for 5% of new cases of adult-onset asthma, a somewhat lower figure than that reported in our study. This difference may

TABLE 7
Risk Factors for Developing Chronic Disease in Adult-Onset Asthma

	Unadjusted OR (95% CI)	P	Adjusted OR (95% CI)	P
Age	1.02 (0.99-1.05)	.15	1.03 (0.99-1.06)	.11
Sex	0.76 (0.30-1.91)	>.25	—	—
Atopy	2.33 (0.94-5.78)	.07	3.39 (1.15-9.99)	.03
Cause				
Occupational	3.75 (0.80-17.61)	.09	5.54 (1.05-29.11)	.04
Domestic animal	0.91 (0.15-5.24)	>.25	—	—
Medication	1.88 (0.20-17.52)	>.25	—	—
Environmental	1.06 (0.39-2.90)	>.25	—	—

Abbreviations: CI, confidence interval; OR, odds ratio.

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 function⁴⁴ and with reports of worse clinical course in patients with asthma of occupational origin.³¹ Coté et al⁴⁵ 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.

REFERENCES

1. Yunginger JW, Reed CE, O'Connell EJ, Melton J III, O'Fallon MW, Silverstein MD. A community-based study of the epidemiology of asthma: incidence rates, 1964-1983. *Am Rev Respir Dis.* 1992;146:888-94.
2. Larsson L. Incidence of asthma in Swedish teenagers: relation to sex and smoking habits. *Thorax.* 1995;50:260-4.
3. Norrman E, Nystrom L, Jonsson E, Stjernberg N. Prevalence and incidence of asthma and rhinoconjunctivitis in Swedish teenagers. *Allergy.* 1998;53:28-35.
4. Ownby DR, Johnson CC, Peterson EL. Incidence and prevalence of physician-diagnosed asthma in a suburban population of young adults. *Ann Allergy Asthma Immunol.* 1996;77:304-8.
5. McWhorter WP, Polis MA, Kaslow RA. Occurrence, predictors and consequences of adult asthma in NHANES-I and follow-up survey. *Am Rev Respir Dis.* 1989;139:721-4.
6. Lundback B, Ronmark E, Jonsson E, Larsson K, Sandstrom T. Incidence of physician-diagnosed asthma in adults. A real incidence or a result of increased awareness? Report from the Obstructive Lung Disease in Northern Sweden Studies. *Respir Med.* 2001;95:685-92.
7. McDonnell WF, Abbey DE, Nishino N, Lebowitz MD. Long-term ambient ozone concentration and the incidence of asthma in nonsmoking adults: the AHSMOG Study. *Environ Res.* 1999;80:110-21.
8. Toren K, Hermansson BA. Incidence of adult-onset asthma in relation to age, sex, atopy and smoking: a Swedish population-based study of 15813 adults. *Int J Tuberc Lung Dis.* 1999;3:192-7.
9. Bauer BA, Reed CE, Yunginger JW, Wollan PC, Silverstein MD. Incidence and outcomes of asthma in the elderly. A population-based study in Rochester, Minnesota. *Chest.* 1997;111:303-10.
10. Basagaña X, Sunyer J, Zock JP, Kogevinas M, Urrutia I, Maldonado JA, et al. Incidence of asthma and its determinants among adults in Spain. *Am J Respir Crit Care Med.* 2001;164:1133-7.
11. Burney PGJ, Chinn S. Developing a new questionnaire for measuring the prevalence and distribution of asthma. *Chest.* 1987;91:79S-83S.
12. Burney P, Luczynska C, Chinn S, Jarvis D. The European Community Respiratory Health Survey. *Eur Respir J.* 1994;7:954-60.
13. Bernstein LI, Chan-Yeung M, Malo JL, Bernstein DI. Asthma in the workplace. 3rd ed. New York: Taylor and Francis Group; 2006.
14. Orriols Martínez R, Abu Shams KI, Alday Figueroa E, Cruz Cardona MJ, Gladiz Iturre JB, Isidro Montes I, et al. Normativa del asma ocupacional. *Arch Bronconeumol.* 2006;42:457-74.
15. American Thoracic Society. Standardization of spirometry: 1987 update. *Am Rev Respir Dis.* 1987;136:1285-98.

16. Roca J, Sanchis J, Agustí-Vidal A, Segarra F, Navajas D, Rodríguez-Roisin R, et al. Spirometric reference values from a Mediterranean population. *Bull Eur Physiopathol Respir*. 1986;22:217-24.
17. American Thoracic Society Statement. Guidelines for methacholine and exercise challenge testing. *Am J Respir Crit Care Med*. 2000;161:309-29.
18. Pepys J. Types of allergic reaction. *Clin Allergy*. 1973;3:491S-509S.
19. Meeker DP, Wiedemann HP. Drug-induced bronchospasm. *Clin Chest Med*. 1990;11:163-75.
20. Bateman ED, Hurd SS, Barnes PJ, Bousquet J, Drazen JM, Fitzgerald M, et al. Global strategy for asthma management and prevention: GINA executive summary. *Eur Respir J*. 2008;31:143-78.
21. Ross Anderson H, Gupta R, Strachan DP, Limb ES. 50 years of asthma: UK trends from 1955 to 2004. *Thorax*. 2007;62:85-90.
22. Huovinen E, Kaprio J, Laitinen LA, Koskenvuo M. Incidence and prevalence of asthma among adult Finnish men and women of the Finnish twin cohort from 1975 to 1990, and their relation to hay fever and chronic bronchitis. *Chest*. 1999;115:928-36.
23. Urrutia I, Aguirre U, Sunyer J, Plana E, Muniozgueren N, Martínez-Moratalla J, et al. Cambios en la prevalencia de asma en la población española del Estudio de Salud Respiratoria de la Comunidad Europea (EERCS-II). *Arch Bronconeumol*. 2007;43:425-30.
24. Barr RG, Kurth T, Stampfer MJ, Buring JE, Hennekens CH, Gaziano JM. Aspirin and decreased adult-onset asthma. *Am J Respir Crit Care Med*. 2007;175:120-5.
25. Toren K, Balder B, Brisman J, Lindholm N, Lowhagen O, Palmqvist M, et al. The risk of asthma in relation to occupational exposures: a case-control study from a Swedish city. *Eur Respir J*. 1999;13:496-501.
26. American Thoracic Society Statement: occupational contribution to the burden of airway disease. *Am J Respir Crit Care Med*. 2003;167:787-97.
27. Blanc PD, Toren K. How much adult asthma can be attributed to occupational factors? *Am J Med*. 1999;107:580-7.
28. Monso E, Muñoz-Rino F, Izquierdo J, Roca J, Masia N, Rosell A, et al. Occupational asthma in the community: risk factors in a Western Mediterranean population. *Arch Environ Health*. 1998;53:93-8.
29. Timmer S, Rosenman K. Occurrence of occupational asthma. *Chest*. 1993;104:816-20.
30. Jarvholm B, Brisman J, Toren K. The association between epidemiological measures of the occurrence of asthma. *Int J Tuberc Lung Dis*. 1998;2:1029-36.
31. Allard C, Cartier A, Ghezzi H, Malo JL. Occupational asthma due to various agents. Absence of clinical and functional improvement at an interval of four or more years after cessation of exposure. *Chest*. 1989;96:1046-9.
32. Reijula K, Átela T, Klaukka T, Rantanen J. Incidence of occupational asthma and persistent asthma in young adults has increased in Finland. *Chest*. 1996;110:58-61.
33. Karjalainen A, Kurppa K, Virtanen K, Keskinen H, Nordman H. Incidence of occupational asthma by occupation and industry in Finland. *Am J Ind Med*. 2000;37:451-8.
34. Medina-Ramon M, Zock JP, Kogevinas M, Sunyer J, Antó JM. Asthma symptoms in women employed in domestic cleaning: a community based study. *Thorax*. 2003;58:950-4.
35. Meredith S. Reported incidence of occupational asthma in the United Kingdom, 1989-90. *J Epidemiol Community Health*. 1993;47:459-63.
36. Meredith SK, McDonald JC. Work-related respiratory disease in the United Kingdom, 1989-1992: report on the SWORD project. *Occup Med*. 1994;44:183-9.
37. Kogevinas M, Antó JM, Sunyer J, Tobías A, Kromhout H, Burney P. Occupational asthma in Europe and other industrialised areas: a population-based study. *Lancet*. 1999;353:1750-4.
38. Zock JP, Kogevinas M, Sunyer J, Almar E, Muniozgueren N, Payo F, et al. Asthma risk, clearing activities and use of specific clearing products among Spanish indoor cleaners. *Scand J Work Environ Health*. 2001;27:76-81.
39. Zock JP, Kogevinas M, Sunyer J, Jarvis D, Toren K, Antó JM, et al. Asthma characteristics in cleaning workers, workers in other risk jobs and office workers. *Eur Respir J*. 2002;20:679-85.
40. Medina-Ramón M, Zock JP, Kogevinas M, Sunyer J, Basagaña X, Schwartz J, et al. Short-term respiratory effects of cleaning exposures in female domestic cleaners. *Eur Respir J*. 2006;27:1196-203.
41. Settiple GA, Greisner WA III, Settiple RJ. Natural history of asthma: a 23-year followup of collage students. *Ann Allergy Asthma Immunol*. 2000;84:499-503.
42. Frank PI, Hazell ML, Morris JA, Linehan MF, Frank TL. A longitudinal study of changes in respiratory status in young adults, 1993-2001. *Int J Tuberc Lung Dis*. 2007;11:338-43.
43. Vesterinen E, Kaprio J, Koskenvuo M. Prospective study of asthma in relation to smoking habits among 14729 adults. *Thorax*. 1988;43:534-9.
44. Sunyer J, Soriano J, Antó JM, Burgos F, Pereira A, Payo F, et al. Sensitization to individual allergens as risk factors for lower FEV₁ in young adults. *Int J Epidemiol*. 2000;29:125-30.
45. Coté J, Kennedy S, Chan-Yeung M. Outcome of patients with cedar asthma with continuous exposure. *Am Rev Respir Dis*. 1990;141:373-6.
46. Chan-Yeung M, Lam S, Koerner S. Clinical features and natural history of occupational asthma due to western red cedar (*Thuja plicata*). *Am J Med*. 1982;72:411-5.