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Epidemiology of community-acquired pneumonia in adults: a population-based study

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ABSTRACT: In this prospective study, the authors assessed the incidence, aetiology, and outcome of patients with community-acquired pneumonia in the general population.

From December 1993 to November 1995, a study was performed in a mixed residential-industrial urban population of the "Maresme" region in Barcelona, Spain. All subjects ≥14 yrs of age (annual average population size 74,368 inhabitants) with clinically suspected community-acquired pneumonia were registered. All cases were re-evaluated by chest radiographs on the 5th day of illness and at monthly intervals until complete recovery. Urine and blood samples were obtained for culture and antigen detection. When lower respiratory tract secretions were obtained, these were also cultured.

There were 241 patients with community-acquired pneumonia, with an annual incidence rate of 1.62 cases (95% confidence interval, 1.42–1.82) per 1,000 inhabitants. Incidence rates increased by age groups and were higher in males than in females. Of 232 patients with aetiological data, 104 had an identifiable aetiology. A total of 114 pathogens were found (single pathogen 94, two pathogens 10). There were 81 episodes of bacterial infection and 33 of viral infection. The most common pathogens were *Streptococcus pneumoniae*, *Chlamydia pneumoniae*, and influenza A and B viruses. No case of Hantavirus infection was found. The rate of hospital admission was 61.4% with a mean±SD length of 11.7±10.1 days, a mean period of 23.0±14.3 days inactivity, and an overall mortality rate of 5%.

The high rate of hospital admission, prolonged stay in hospital, and long period of inactivity all continue to constitute a social and health care burden of community-acquired pneumonia.

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Community-acquired pneumonia remains a major reason for admission to hospital and a common cause of death in developed countries. Most epidemiological data have been obtained from hospitalized patients with community-acquired pneumonia. A few population-based studies have been reported and little information is available on outpatients treated by family physicians.

According to population-based studies with radiological confirmation, the annual incidence rate of community-acquired pneumonia in adults varies between 2.6–13.4 per 1,000 inhabitants [1–4], with somewhat higher figures in males and at the extreme ages of life. Hospitalization rates ranging between 22% [2] and 51% have been reported with annual mortality rates between 0.1–0.7 per 1,000 inhabitants. In ~50% of pneumonia patients, a causative pathogen is found. *Streptococcus pneumoniae* is recovered in 20–75% of the cases followed by *Mycoplasma pneumoniae* (1–18%), *Chlamydia pneumoniae* (4–19%), and different viruses (2–16%) [5]. *C. pneumoniae*, however, has emerged as a significant pulmonary pathogen in adult pneumonia patients requiring hospitalization. The role played by Hantavirus in hospitalized patients with community-acquired pneumonia is geographically select [6].

In a prospective study of all patients with community-acquired pneumonia in the adult population of the "Maresme" region (Barcelona, Spain), an annual incidence rate of 2.6 cases per 1,000 inhabitants was estimated [4]. The most common cause of pneumonia was *C. pneumoniae* [4]. Some years later, all cases of community-acquired pneumonia in the adult population of the same area were surveyed as a part of a case-control study on risk factors for pneumonia [7]. This study was conducted with the primary aim of providing a comprehensive population-based overview on incidence, aetiology, and outcome of community-acquired pneumonia in the authors' region. The secondary aim was to compare clinical features, aetiology, and patients' outcome with data from a previous study [4].

Materials and methods

Study population

From December 1993 to November 1995, a study was conducted in a mixed residential-industrial urban population of the "Maresme" region at the Mediterranean coast in Barcelona, Spain. Mean maximum and minimum temperatures for the study period were 19.7°C and 11.9°C, respectively. On a daily basis, all subjects >14 yrs of age and living in the area (an annual population size of 74,368 inhabitants) with clinically suspected community-acquired pneumonia were assessed.

All physicians working in public primary health care centres and private clinics of the "Maresme" region participated in the reporting of cases. In the primary health care centres (covering 95.2% of the population), patients were visited first by a general practitioner and then referred to the pneumology specialist who worked at the same centre. Outpatients with a tentative diagnosis of pneumonia visited at private centres were referred to public hospitals for the confirmation of diagnosis. A total of 65 patients with community-acquired pneumonia were diagnosed at nine primary health care centres and six patients at private clinics (Centro de Atención Primaria (primary health care centre; CAP) of Arenys, n=14; CAP of Canet de Mar and Sant Pol de Mar, n=7; CAP Cirera-Molins (Mataró), n=12; CAP Ronda Cerdanya (Mataró), n=10; CAP Ronda Prin (Mataró), n=10; CAP Caldes d'Estrac, n=1; CAP Argentona, n=8; CAP Dosrius, n=1; and private clinics, n=6). Moreover, patients living in the "Maresme" region who sought medical care directly from the emergency services of three public reference hospitals in the area (Hospital Germans Trias i Pujol, n=6; Hospital Sant Jaume de Calella, n=49; and Hospital de Mataró, n=99) and two private hospitals outside the area (Hospital de Barcelona, n=9; and Hospital del Sagrat Cor, n=7) were also included. Once these patients had been attended to at the hospital they were referred to the corresponding primary health care centre for subsequent follow-up. In order to improve the reporting cases, periodic meetings and weekly telephone contact were held with all patients and physicians.

Predefined criteria for case registration were based on acute lower respiratory tract infection for which antibiotics had been prescribed in association with the appearance of previously unrecorded focal signs on physical examination of the chest [2] and new radiological findings suggestive of pneumonic infiltrate, which was required for all suspected cases. Patients with aspiration pneumonia (witnessed aspiration with respiratory symptoms or oral content of aspiration) or active pulmonary tuberculosis, and patients coming from nursing homes or having been discharged from hospital <7 days before the onset of symptoms were excluded.

Criteria for clinical suspicion of acute lower respiratory tract infection included the presence of three or more of the following manifestations: cough with or without sputum production, dyspnoea and/or wheezing, pleuritic chest pain or abdominal pain, fever, headache, pneumonic consolidation on auscultation of the chest, sweating, arthromyalgias, dysphagia, and coryza. For clinically atypical community-acquired pneumonia, one or more of the following criteria were considered: sweating, arthromyalgias, dysphagia, and coryza that required antibiotic prescription or persisted ≥5 days without antibiotics. In elderly patients, the possibility of pneumonia was also considered in the presence of prostration and/or anorexia and/or confusion or disorientation. In all cases in which criteria for clinical suspicion were met, a chest radiograph was ordered. Patients with doubtful initial radiographic images of community-acquired pneumonia were tentatively included in the study and then excluded or definitively included according to clinical evolution and subsequent roentgenographic findings. For the purpose of this study, all cases of community-acquired pneumonia were re-evaluated by chest roentgenograms on the 5th day of illness and at monthly intervals until complete recovery. In 51 (17.5%) of the 292 patients initially included in the study, the diagnosis was not confirmed because of clinical evolution and chest radiograph images not consistent with community-acquired pneumonia. The reason for exclusion was bronchiectasis in 12 patients, nonpneumonic respiratory infection in nine, pleural synechiae in nine, lung cancer in seven, atelectasis in five, pulmonary tuberculosis in three, aspiration pneumonia in two, lung abscess in one, chronic organized pneumonia in one, acute pulmonary oedema in one, and chronic vasculitis in one.

Medical history of all studied cases was obtained by personal interview administered by trained physicians or nurses at home or at the end of hospital stay. In addition, the patient's medical record was reviewed in order to collect the following information: clinical data and radiological findings; initial and successive antibiotic regimens; admission to hospital or to the intensive care unit (ICU); mortality (due to respiratory insufficiency, septic shock, multiorgan failure, or other causes); number of days to clinical healing (disappearance of all clinical symptoms); and number of days to return to normal daily activities (days to return to work in employed patients).

In patients with fever ≥38°C two blood cultures were drawn. When lower respiratory tract secretions (via fibreoptic bronchoscopy, bronchoalveolar lavage, plugged double catheter) or pleural fluid samples were obtained, these were cultured too. Paired serology, at the moment of diagnosis and within the 4–6th week were also collected. Sera were tested for evidence of complement fixing antibodies to influenza A and B; parainfluenza 1, 2, and 3; adenovirus; respiratory syncytial virus; *Chlamydia psittaci*; *Coxiella burnetii*, and *M. pneumoniae*. The indirect fluorescent antibody technique was used for detecting immunoglobulin (Ig)G against *Legionella pneumophila* serogroups 1–6. Sera were tested for IgG antibodies by an enzyme linked immunosorbent assay (ELISA) using Hantavirus antigens (Puumala and Hantaan strains) bound directly to a microtitre plate. The indirect microimmunofluorescence antibody technique was used for detecting IgG and IgM against *C. pneumoniae*. When varicella pneumonia was suspected, testing for antibodies was performed by standard complement-fixation technique.

Urine samples were also collected and frozen at -30°C to perform the following tests in one batch towards the end of the study: test for pneumococcal polysaccharide capsular antigen and *Haemophilus influenzae* type B capsular antigen. In order to minimize possible nonspecific reactions, all urine samples were heated at 100°C for 3 min. Urine samples were centrifuged at 2,000×*g* for 10 min and tests for antigen performed in both concentrated and unconcentrated urine ~20-fold by means of a disposable ultrafilter

(Minicon-B15 concentrator; Amicon, Beverly, MA, USA). *H. influenzae* type B capsular antigen was detected in urine with a commercially available latex kit (Bactigen; Wampole Laboratories, Cranbury, NJ, USA) according to the manufacturer's instructions. Pneumococcal polysaccharide capsular antigen was detected in urine by counterimmunoelectrophoresis (CIE) with pneumococcal Omniserum (Statens Serum Institut, Copenhagen, Denmark). Some urine samples were also tested for *L. pneumophila* serogroup 1 antigen by ELISA.

Microbiological testing was always performed prior to the administration of antibiotics. An aetiological diagnosis was based on: 1) blood cultures yielding a bacterial or fungal pathogen (in the absence of an apparent extrapulmonary focus); 2) pleural fluid culture yielding a bacterial pathogen; 3) seroconversion, *i.e.*, a 4-fold rise in IgG-titres for *C. pneumoniae* (IgG ≥1:512), C. psittaci (IgG ≥1:64), *L. pneumophila* (IgG ≥1:128), *C. burnetti* (IgG ≥1:80), and respiratory viruses (influenza virus A and B, parainfluenza virus 1–3, respiratory syncytial (RS)-virus, adenovirus,); 4) single elevated IgM-titre for *C. pneumoniae* ≥1:32, *C. burnetti* ≥1:80, and *M. pneumoniae*; 5) a positive urinary antigen for *S. pneumoniae* polysaccharide capsular antigen, *H. influenzae* type B capsular antigen, and *L. pneumophila* serogroup 1 antigen; 6) bronchoalveolar lavage cultures yielding $\geq 10^4$ colony-forming unit (CFU) per millilitre, or protected specimen brush cultures yielding $\geq 10^3$ CFU·mL^{-1}.

Statistical analysis

The statistical analyses were mostly descriptive. Presentation of results were based on annual cumulative incidence rate with 95% confidence intervals (CI) stratified by age, sex, and year season. Population sizes were calculated using the municipal data of the national census of 1991 and 1996. From the increment population observed among these 2 yrs the authors calculated the annual age and sex specific growth at each municipality (1.6% overall); applying this growth to the population of 1991 it allowed an estimate of the study population at each age and sex specific group from 1993–1995. For those areas where not all the municipal population was included in the study, the number of inhabitants was calculated from administrative data on the covered population at each participating primary care centre in 1995. The Fisher's exact test and one-way analysis of variance were used to assess differences in antimicrobial treatment between ambulatory and hospitalized patients and outcome variables according to the aetiology of pneumonia.

Results

The study population consisted of 241 patients with community-acquired pneumonia with an annual incidence rate of 1.62 cases (95% CI 1.42–1.82) per 1,000 inhabitants. There were 140 males with mean±SD age of 55±21 yrs and 101 females with a mean age of 51±21 yrs. Specific annual incidence rates by age and sex throughout the study period are shown in figure 1. Incidence rates showed a tendency to increase by age groups (from 1.12–3.16 per 1,000 inhabitants) and were higher in males than in females. In relation to seasonal distribution (fig. 2), higher incidence rates occurred in winter (2.21 per 1,000 inhabitants) as compared with autumn (1.59 per 1,000 inhabitants), spring (1.24 per 1,000 inhabitants), and summer (1.45 per 1,000 inhabitants).

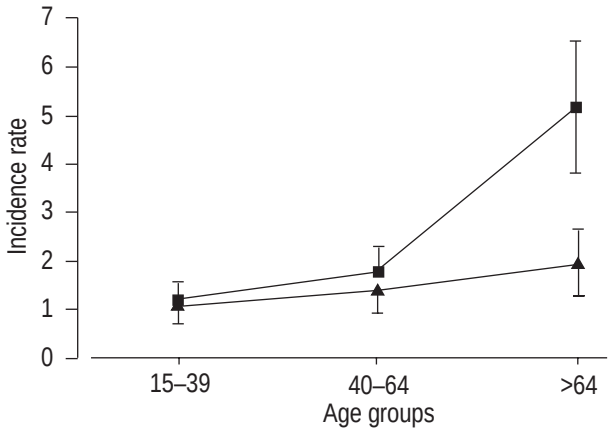

Fig. 1. – Annual incidence rate of community-acquired pneumonia per 100 inhabitants by age and sex groups. ■: males; ▲: females. Data are presented as the incidence rate and its 95% confidence interval.

In 91.1% of patients, pneumonia was unilobar. A total of 8.9% of patients had pleural effusion and 17.4% were afebrile at the time of diagnosis. Regular cigarette smokers represented 27.8% of the patients and 12.4% had a history of alcohol consumption (>80 g·day^{-1} for males and >40 g·day^{-1} for females). Underlying diseases included chronic bronchitis in 64 patients, diabetes mellitus in 35, cardiopathy in 18, immunosuppression in 17, asthma in 14, chronic liver disease in 13, and neoplasm in six.

Of the 232 patients with aetiological evaluation, 104 (44.8%) had an identifiable aetiology. A total of 114 pathogens were identified, a single pathogen in 94 patients and two pathogens in 10 (table 1). Serological tests were carried out in 210 patients and identified the causative organism in 74 (*C. pneumoniae*, 22; influenza A and B, 19; *M. pneumoniae*, nine; *C. burnetti*, five; *L. pneumophila*, five; parainfluenza, five; RS virus five; adenovirus, three; and varicella virus, one). None of the sera tested positive for Hantavirus. Blood cultures were performed

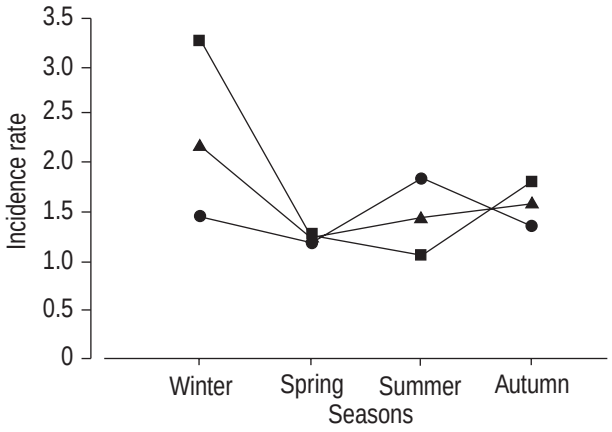

Fig. 2. – Annual incidence rate of community-acquired pneumonia per 1,000 inhabitants. ●: 1994; ■: 1995; ▲: total. Data are presented as mean values.

Table 1. – Distribution of the 114 causative pathogens of community-acquired pneumonia in 104 patients by diagnostic tests*

Pathogen	No. pathogens	Serological tests	Blood culture	Urine antigen	PF culture	BAL and PDC
Streptococcus pneumoniae	27		6/162	24/176	2/22	
Chlamydia pneumoniae	22	22/210				
Influenza A	12	12/210				
Mycoplasma pneumoniae	9	9/210				
Influenza B	7	7/210				
Pneumocistis carinii	7					7/8
Coxiella burnetii	5	5/210				
Legionella pneumophilia	5	5/210		1/30		
Parainfluenza virus	5	5/210				
Respiratory syncytial virus	5	5/210				
Adenovirus	3	3/210				
Varicella virus	1	1/1				
Haemophilus influenzae	1			1/176		
Streptococcus pyogenes	1		1/162			
Streptococcus milleri	1				1/22	
Bordetella bronchiseptica	1					1/8
Pseudomonas aeruginosa	1		1/162			
Serratia marcescens	1		1/162			
Hantavirus	0	0/149				

*: Results are expressed as number of patients with positive results/total number of patients submitted to that diagnostic test. PF: pleural fluid; BAL: bronchoalveolar lavage; PDC: plugged double catheter. Dual pathogens in 10 patients: *Streptococcus pneumoniae* in association with influenza A virus (n=3), *Chlamydia pneumoniae* (n=1), respiratory syncytial virus (n=1), parainfluenza virus (n=1), and *Mycoplasma pneumoniae* (n=1); *Chlamydia pneumoniae* and adenovirus (n=1); *Coxiella burnetti* and influenza A virus (n=1); and *Pneumocistis carinii* and *Bordetella bronchiseptica* (n=1).

on 162 patients and identified a causative organism in nine (5.6%). Urine CIE was performed on 176 patients and identified a causative organism in 25 (14.2%). Urine ELISA was performed on 30 patients and only one of them was positive for *L. pneumophila*, which also showed a positive serological test. Pleural fluid cultures were performed in 22 patients and identified the causative organism in three (13.6%). Finally, the microbiological analysis of bronchoalveolar lavage and plugged double catheter was carried out in eight patients and identified the causative organism in seven (87.5%).

In relation to the 114 causative organisms recovered, there were 81 (71.1%) episodes of bacterial infection and 33 (28.9%) of viral infection. In relation to the 104 patients in whom a causative organism was identified, 71 (68.3%) patients had bacterial pneumonia (three of them as dual bacterial infection), 26 (25.0%) had viral pneumonia, and seven (6.7%) both. *S. pneumoniae* and *C. pneumoniae* were the most common pathogens and accounted for 27 and 22 cases, respectively, followed by influenza A in 12, and *M. pneumoniae* in nine.

The antibiotics initially prescribed according to the type of consultation, *i.e.*, reference hospital or primary health care centre are shown in table 2. The antibiotics most commonly given were macrolides, predominantly prescribed in the outpatient setting, followed by second-generation cephalosporins, third-generation cephalosporins, and penicillins, predominantly given to hospitalized patients. A total of 23.8% of patients (most of them hospitalized) received two classes of antimicrobials, in general a combination of macrolides and β-lactams. None of the six blood culture isolates positive for *S. pneumoniae* were penicillin-resistant.

A total of 148 (61.4%) patients were admitted to the hospital. All of them fulfilled the hospitalization criteria of FINE *et al.* [8], with a mean hospital stay of 11.7±10.1 days (table 3). Twenty-one (8.7%) patients were admitted to ICU due to the presence of one or more of the following criteria: respiratory rate of >30 breaths·min^{-1}; oxygen tension in arterial blood (P_{a,O_2})/inspiratory oxygen fraction (F_{I,O_2}) index <250; need for mechanical ventilation; bilateral or multilobar pulmonary infiltrates; rapidly expanding infiltrates; shock; need for vasopressors; oliguria; or acute renal failure. In relation to differences in aetiology between outpatients and inpatients, of the 81 episodes of bacterial infections, 44 occurred in inpatients and 37 in outpatients, and of the 33 episodes of viral infection, 21 occurred in inpatients and 12 in outpatients (table 3).

The mean time from diagnosis to the disappearance of clinical symptoms was 5.4±5.9 days, whereas the mean

Table 2. – Distribution of patients by initial antibiotic treatment according to place of prescription*

	Inpatients n	Outpatients n	Total n
Macrolides	17 (11.7)†	76 (84.4)	96 (39.6)
≥2 types of antibiotics‡	55 (37.9)†	1 (1.1)	56 (23.8)
2nd generation cephalosporins	37 (25.5)†	8 (8.9)	45 (19.2)
3rd generation cephalosporins	21 (14.5)†	1 (1.1)	22 (9.4)
Penicillins	8 (5.5)	4 (4.4)	12 (5.1)
Other	7 (4.8)†	0 (0.0)	7 (3.0)
Total	145 (100.0)	90 (100.0)	235 (100.0)

Data are presented as absolute numbers with percentages in parentheses. *: Information not available in six patients; †: p< 0.0001 between inpatients and outpatients; ‡: combination of macrolides and β-lactams in 52 of the 56 patients.

Table 3. – Clinical outcome of patients with community-acquired pneumoniae according to causative pathogen

	Outpatients		Hospital admission		Days of hospital stay	ICU admission		Mortality		Days to clinical healing	Days to return to daily activity	Years of age
	n	%	n	%	x±SD	n	%	n	%	x±SD	x±SD	x±SD
Bacterial	27	38.0	44	62.0	15.4±15.8	5	7.0	5	7.0	5.3±5.9	25.0±18.0	50.5±21.6
Viral	5	19.2	21	80.8†	9.5±6.2	5	19.2	2	7.7	4.8±3.6	23.1±10.2	53.2±21.6
Bacterial and viral	1	14.3	6	85.7†	12.0±5.2	1	14.3	-	-	6.6±6.3	30.0±19.7	67.3±18.7
Unknown	60	43.8	77	56.2	10.2±6.1	10	7.3	5	3.7	5.6±6.2	21.5±12.4	54.3±20.2
Total	93	38.6	148	61.4	11.7±10.1	21	8.7	12	5.0	5.4±5.9	23.0±14.3	53.4±20.8

*: p=0.04 as compared with viral pneumonia; †: p=0.06 as compared with bacterial pneumonia.

time to return to daily activities was 23.0±14.3 days. The control chest radiograph film taken at day 35 after diagnosis showed complete resolution in 87.3% of patients. The remaining patients were assessed at monthly intervals but none of them had a bronchoscopy. Of all the study patients, 135 worked at home or did not have employment at the time of diagnosis of community-acquired pneumonia and 106 were employed. For the employed patients, the mean time of absence from work was 22.9±13.3 days; that is, 9.8% were at work within 1 week, 22.1% within 2 weeks, 41.5% within 1 month, and 25.6% were absent for >1 month. The time to clinical healing and the time to return to daily activities were 1.9 and 5.8 days longer respectively in hospitalized than in nonhospitalized patients (p=0.02 and p=0.004, respectively). However, the time absent from work was 25.2±14.7 days for inpatients and 21.2±12.1 days for outpatients (p=0.15).

A total of 12 patients died, with an overall modality rate of 5.0% (95% CI, 2.0–8.0%). All but three patients died in the ICU. Causative pathogens were identified in six of the 12 patients who died. These were influenza A (n=2), *Pseudomonas aeruginosa* (n=1), *Serratia marcescens* (n=1), *S. pneumoniae* (n=1), and *Streptococcus pyogenes* (n=1). Clinical outcome in relation to microbiological diagnosis is shown in table 3. Analysis of different endpoints showed a higher rate of hospital admission for patients with viral aetiology as compared with bacterial and unknown cause (p=0.06) but a longer hospitalization period for patients with bacterial pneumonia as compared with viral (p=0.04). Time to clinical healing and to return to daily activities was longer in patients with mixed (bacterial and viral) pneumonia than in the other subgroups.

Discussion

Although community-acquired pneumonia had a relatively low annual incidence rate, a high rate of hospital admission, a prolonged stay in hospital, and a long period of inactivity in relation to this condition was found. The authors have examined the incidence, aetiology, and clinical outcome of this disease in the adult population of the "Maresme" region in Barcelona, Spain. Between April 1990 and March 1991, the same study was carried out in the same geographical area with similar purposes. In both population-based studies, similar methods and microbiological techniques for the aetiological diagnosis of pneumonia were used. Although studies have been published in the literature in which different periods of time are evaluated, none were actually population-based since they were carried out in patients admitted to the hospital [9] or comparisons with inpatient populations were made [2, 10].

In the present study, the estimated annual incidence rate was 1.62 cases per 1,000 inhabitants. In the USA, an incidence of community-acquired pneumonia of 15 episodes for every 1,000 persons per year has been reported [11]. This figure, however, was obtained from the US National Health Survey's population sample interview, all ages were included, and no roentgenographic confirmation of pneumonia was required. In European population-based studies, a lower incidence of community-acquired pneumonia has been reported, such as 5 per 1,000 persons between 15–79 yrs of age in England [12], and 9 per 1,000 inhabitants >14 yrs of age in Finland [3]. In Spain, Santos de Unamuno *et al.* [13] reported an incidence rate of 1.8 per 1,000 inhabitants >14 yrs of age. In a previous study, an incidence rate of 2.6 per 1,000 persons >13 yrs of age was found [4]. The incident rate of the present study seems to be lower than those already published, although it closely resembles the Spanish estimates. The current population-based study enables the inclusion of all suspected pneumonia cases registered by physicians through a prospective case-identification system. Although broad criteria of clinical suspicion were adopted, it is possible that several cases with mild symptoms were missed simply because no chest radiography was ordered. In addition to these broad clinical criteria, the authors followed rigorous diagnostic procedures that required systematic chest roentgenograms at the initial consultation, on the 5th day of illness, and 1 month later to confirm the diagnosis. Patients in whom complete resolution was not recorded in the control chest radiographic film taken at day 35 after diagnosis were followed at monthly intervals until complete recovery. If this diagnostic approach would not had been followed, 51 (17.5%) patients would have been wrongly included in the study. Disagreement between initial and final diagnoses in patients with community-acquired pneumonia has also been reported by others, from 7.7–21.5% in patients admitted to the hospital [14, 15], or about 11% in population-based studies [2, 4].

The incidence of community-acquired pneumonia is higher in elderly than in young adults [3, 16]. This period of life is characterized by the occurrence of chronic and debilitating conditions, which tend to be more frequent in males and have been found to be a major risk factor for

community-acquired pneumonia [7]. Similar trends in the incidence rates stratified by age and sex were found in the Finnish population-based study [3]. The incidence rate of pneumonia also varied annually and in the authors′ Mediterranean climate, winter (2.21) and autumn (1.59) had the highest rates.

The cause of pneumonia was established in 44.8% of patients in the present study and in 44% in a previous study [4]. It should be noted that the authors′ diagnostic criteria were restrictive since bacteriological examination of sputum was not assessed, nor were invasive diagnostic procedures carried out systematically. This approach implicated a failure to detect the true incidence of *H. influenza*, *S. aureus*, Gram-negative bacteria, and *P. aeruginosa* and an overestimation of viral and "atypical" bacterial pathogens determined by serology. However, because paired serum samples were required for seroconversion, the presence of viruses during the pneumonia episode was ensured either as a causative agent or as secondary to an undetected concurrent bacterial infection.

S. pneumoniae and *C. pneumoniae* were the most frequently diagnosed causative pathogens in the authors′ geographical area. This finding consistent with results of a previous study [4]. The importance of both pathogens has also been stressed in other recent studies [15, 17, 18]. Although *C. pneumoniae* infection together with other pathogens has been reported [15, 17–19], the current authors only found this association in two patients (8.7%), in one case with *S. pneumoniae* and in another with adenovirus.

A marked increase was found in the number of cases of community-acquired pneumonia caused by respiratory virus, from 10.9% in a previous survey [4] to 25.0% in the present study, due to a greater prevalence of influenza viruses. Although in seven patients viral and bacterial aetiologies coexisted, 26 (25%) patients had a viral aetiology alone; 21 of these patients required admission to the hospital, five of them to the ICU with two deaths. These findings may raise doubts about the single viral aetiology in these patients. The pathogenetic role of respiratory syncytial virus in adult patients with normal immune response is unknown [20]. In the five patients with this aetiology, the respiratory syncytial virus acted as copathogen in one and was the sole cause of the pneumonia in four.

In 9.6% of the patients the presence of a double pathogen as cause of pneumonia was observed, and 70% of them were due to bacterial and viral aetiologies. In a previous study these percentages were 17.4% and 75%, respectively, which are similar to those reported by others [21, 22]. Although the group of mixed pneumonia had a higher mortality rate [23], the authors could not confirm this finding possibly because of the small number of deaths with microbiological confirmation of the causative pathogen.

Pulmonary involvement caused by Hantavirus has been reported in North America [24]. In patients hospitalized with community-acquired pneumonia, Hantavirus serologies have been examined by Auwaerter *et al.* [6], although seroprevalence did not show recent infection in any case. In the general Spanish population, a seroprevalence of 2.2% has been estimated [25]. In the present study, however, no case of Hantavirus infection was documented.

According to these findings >50% of patients with community-acquired pneumonia were admitted to the hospital. In the USA, ~15% of pneumonia cases required hospitalization [26, 27]. Hospitalization rates in European countries range between 22% in a study carried out in England [12] and 48% in Finland [3]. In a previous study, 50% of patients with community-acquired pneumonia were admitted to hospital [4]. It has been shown that using similar diagnostic criteria, the number of patients admitted to hospital varies largely by geographic area [2, 3]. In the present study, the high rate of hospital admission (61.4%) may be explained by the characteristics of the "Maresme" region where the study was conducted, particularly in relation to easy accessibility to the reference hospital so that many patients sought medical care directly from the emergency service of the hospital rather than being visited by a primary care physician. In a recent study carried out in Majorca, 63% of patients who were initially visited at the hospital were admitted as compared with 11% of those who were initially attended at primary care centres [13]. The mean length of hospital stay was 11.7 days, which is longer than an average of 7 days in the study of Fine *et al.* [28] in which four American hospitals participated. Factors related to clinical practice, the patients′ age, or the presence of underlying conditions (*e.g.*, number of human immunodeficiency virus (HIV)-infected patients) may account for the differences. On the other hand, the severity of community-acquired pneumonia is reflected by the fact that 8.7% patients required admission to the ICU.

The greater prevalence of *C. pneumoniae* in patients who met clinical criteria of chronic bronchitis is important. *C. pneumoniae* was the causative pathogen in 16% of patients with chronic bronchitis as compared with 8% in patients without this disease. On the other hand, 45% of patients with community-acquired pneumonia caused by *C. pneumoniae* fulfilled a clinical diagnosis of chronic bronchitis and empirical treatment consisted of β-lactams (68%) and macrolides (32%) [14, 15, 29]. All patients showed a favourable clinical course, which confirms the benign nature of infection by this pathogen [30]. Symptoms generally disappeared in 5 days, (7.6 days when the infection was caused by *S. pneumoniae* and 5.7 days for *C. pneumoniae*) This contrasted with the number of days to return to daily activities, which were 20.2 in the first case and 25.3 in the second.

The mortality rate was 5%, which is close to that observed in three European studies (1–5%) [2, 4]. In population surveys carried out in the USA, the mortality rate reached 24.1 per 100,000 inhabitants, in fifth place after cardiovascular, neoplastic, cerebrovascular, and chronic bronchitis for largest mortality rate [26].

This study has provided information on aetiology and characteristics of community-acquired pneumonia. A low incidence was shown (1.62 cases per 1,000 inhabitants), although important between-year variation was noticed. *Streptococcus pneumoniae* and *Chlamydia pneumoniae* were relevant causative pathogens. A considerable proportion of patients had viral pneumonia. The high rate of hospital admission (61.4%) with a mean length of hospital stay of 11.7 days, a period of 23.0 days inactivity and an overall mortality rate of 5%, are social and health care burdens of community-acquired pneumonia.

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