ORIGINAL ARTICLE

Acute respiratory admissions in Thessaloniki, Greece: 14-year follow-up

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Abstract

Background: Acute exacerbations of respiratory diseases are a common cause of hospitalization among infants and children.

Aim: To assess the epidemiological characteristics of asthma, bronchiolitis and croup among hospitalized children in Thessaloniki, from 1990 to 2003 included.

Methods: Data from the patient registry with discharge diagnosis "asthma", "bronchiolitis" and "croup" were analyzed retrospectively, in five Paediatric Departments of Thessaloniki. Age and sex of the patients, as well as the month of admission were taken into consideration.

Results: A total of 8762 admissions of children (aged 3 months - 14 years) with the diagnosis of "asthma", "bronchiolitis" and "croup", were identified. Sex distribution was 65.86% males (64.86% bronchiolitis, 65.26% asthma and 70.31% croup). Asthma admissions decreased by 53.65%, croup admissions decreased by 4.73%, while bronchiolitis admissions increased by 25.03%, during the study period. A clear seasonal variation was found in all the three diseases, with the lowest incidence during summer months. Moreover there were two peaks for asthma (one during spring and a second during autumn), one peak for bronchiolitis (during winter – early spring) and one peak for croup (during autumn).

Conclusions: Paediatric asthma and croup admissions have declined during the last 14 years, in contrast with bronchiolitis admissions, which showed an increased tendency. More frequent use of inhaled steroids and induction of asthma education programs may have contributed to decreasing asthma admission rates. Hippokratia 2009; 13 (4): 242-246

Key words: asthma, bronchiolitis, croup, children, hospital admissions

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Asthma is a common chronic illness of childhood and one of the most frequent causes of hospitalization. During the past 10 years, the prevalence of current asthma among schoolchildren in Greece has almost tripled from 4% up to 11%[1,2]. Similar observations have been reported from other countries in the past[3-5] with a subsequent increase in hospital admissions[6-8], a tendency that was reversed in more recent studies[9-12].

The reasons for a possible change in asthma admissions are not entirely clear. The declining trend could probably be explained by an improvement in the management of asthma, based on more liberal use of inhaled steroids[13,14], more efficient inhalation devices and education of patients and their families[15].

Bronchiolitis is one of the major causes for hospital admission in infants under the age of one year, with epidemics having a peak between January and March each year[16]. Rates of hospitalization among infants with bronchiolitis show an increasing trend[17,18]. However, treatment practice has not changed during the last decade.

Viral croup (laryngo-tracheo-bronchitis) is a common childhood illness with a peak incidence of 60 per 1000 child –years in those aged between one and two years. Prior to the introduction of steroid therapy, intubation was necessary in approximately 2% of hospitalized children, while this rate has dramatically decreased with the induction of nebulized adrenaline and steroids[19].

The purpose of our study was to investigate the hospitalization trends for asthma, bronchiolitis and croup in Thessaloniki, during the period 1990 - 2003 included and to compare it with previous reports in Greece.

Methods

Thessaloniki, the "capital" of Northern Greece, is the second largest city in Greece, with over one million inhabitants. The inpatient Paediatric Services are provided by five Paediatric Departments, which were included in the study. All of them used the same criteria for the diagnosis of asthma and brochiolitis during the study period.

Data from the patients' discharge notes were analyzed retrospectively, during the period 1990-2003. We exam-

ined three causes of hospitalization based on the discharge diagnosis: asthma, bronchiolitis and croup. Age and sex of children under 14 years of age, as well as month of admission were taken into consideration. The study period included a change from the ninth revision of the International Classification of Diseases (ICD-9) to the tenth revision (ICD-10) in 1997. A diagnosis of asthma comprised the following codes in 1990-96 (ICD-9): 493A, 493B, 493X while in 1997-2003 (ICD-10) they were J45 and J46. The corresponding codes for bronchiolitis were 466, 490, 491C and 491X in 1990-96 and J20-J21 in 1997-2003 and croup 464E before 1997 and J05.0 after 1996. Asthma patients were divided in three groups according to age i.e.: 2-4 years, 5-8 years and 9-14 years.

Statistical methods

The number of children hospitalized for the detected respiratory illness was related to the total number of children living in Thessaloniki, for the corresponding age group (number of admissions per 1,000 children). The estimated population for each year of the study period was obtained from the National Statistical Service of Greece. Statistical analysis of trends was performed by linear regression analysis with a 95% CI (confidence interval) using SPSS v.11.0 for Windows (SPSS, Chicago, Illinois, USA).

Finally, data from the National Department of Drug Statistics were used to assess the sales of inhaled steroids in Northern Greece, during the study period. These data were correlated with asthma admissions, using the Pearson Correlation.

Table 1: Hospitalizations for asthma, bronchiolitis and croup in Thessaloniki.

Year of admission	Asthma	Bronchiolitis	Croup
1990	266	293	143
1991	263	248	161
1992	276	326	75
1993	271	249	190
1994	276	289	80
1995	214	296	107
1996	206	316	68
1997	211	264	90
1998	206	335	47
1999	162	333	102
2000	141	435	51
2001	121	350	85
2002	126	371	52
2003	141	422	104

Results

A total of 8,762 patients with a discharge diagnosis of asthma, viral croup and bronchiolitis were identified (Table 1).

Bronchiolitis was diagnosed in 4,527 children (51.67%), asthma in 2,880 (32.88%) and croup in 1,355 children (15.47%). Boys' admission rates were higher than girls' (65.86% vs. 34.14%) as a total and for each individual disease (65.26% for asthma, 64.86% for bronchiolitis and 70.31% for croup respectively).

The median age of children (SD) was 4.02 (6.14) years at the beginning of the study, diminishing to 2.78 (5.62) by the final year.

The frequency of acute respiratory admissions during the period 1990-2003 is shown in Figure 1. Asthma admissions decreased by 53.65% ($r=0.87$; $p<0.0001$) and croup admissions decreased by 4.73% ($r=0.28$; $p=0.05$). Bronchiolitis admissions showed an increase by 25.03% ($r=0.68$; $p<0.001$).

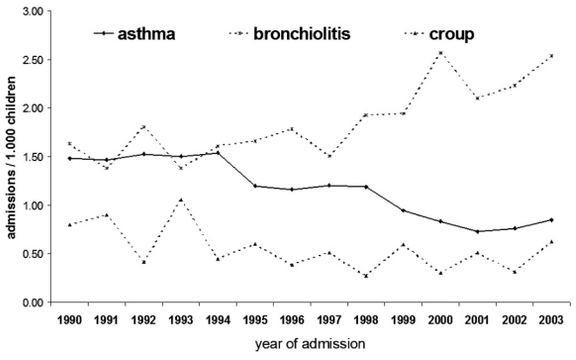

Figure 1: Trends in asthma, bronchiolitis and croup admissions 1990-2003.

The seasonal variation of admissions during the study period is shown in Figure 2, with the lowest during summer for all three conditions. Moreover there were two peaks for asthma (one during spring and a higher one during autumn), one peak for bronchiolitis (winter – early spring) and one peak for croup (autumn).

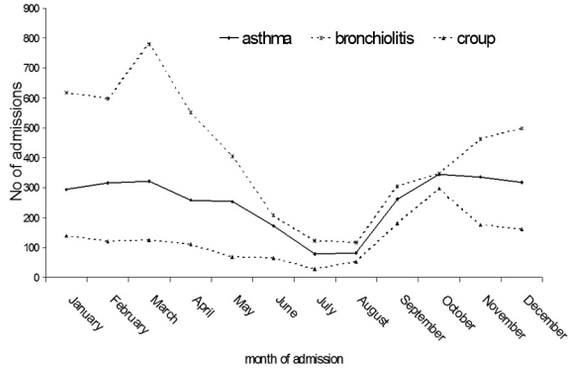

Figure 2: Seasonal variation of asthma, bronchiolitis and croup.

Figure 3 shows the age distribution for asthma cases. Asthma admissions in the under-five rears group accounted for almost 55% of the total asthma cases. We found a significant decrease of asthma hospital admissions during time in all three age groups with predominance of the younger group (52.21% in the 2-4 year- group, 39.58% in the 5-9 year- group and 23.78% in the 10-14 year- group), ($p<0.001$).

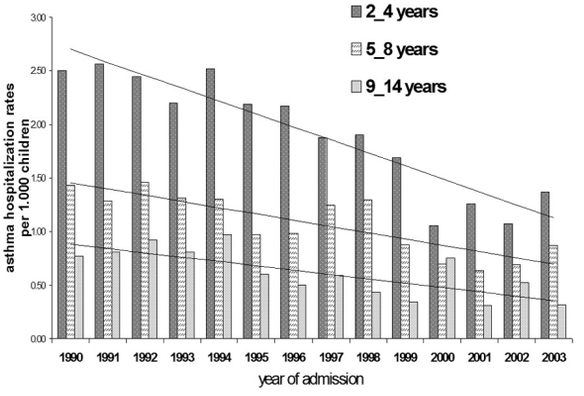

Figure 3: Age distribution of hospital admissions in children with asthma. Hospitalization rates for asthma by age group.

Data from the National Department of Drug Statistics showed an increase of sales of inhaled steroids by 151.4% during the decade 1994-2003 (Figure 4). Comparison between sales of inhaled steroids and hospital admissions showed a strong negative correlation ($p=0.003$, $r=0.836$).

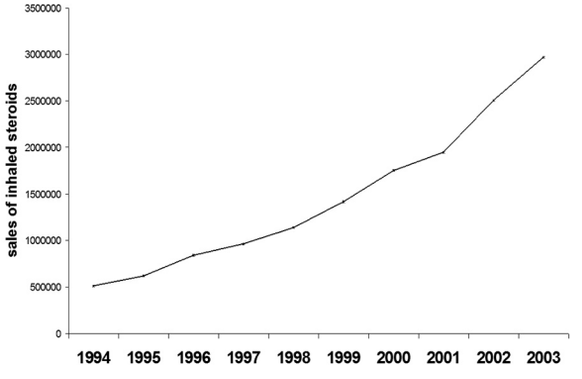

Figure 4: Sales of inhaled steroids in Northern Greece.

Discussion

It is well known that asthma prevalence has increased worldwide in the developed world[3-5] and this is true for the Greek population as well[1,2]. However, despite previous reports for a concomitant increase in hospital admissions of children with acute asthma[6-8,] recent reports show a decrease in hospitalization rates[9-12].

In the study of Priftis et al, an increase in hospital admissions in Athens region was found during 1978-1988[20]. Another similar study in USA (1985-1994) showed that hospitalization rates increased 3.8% per annum[6]. A similar study in Finland (1976-1995) showed an increase in hospital admissions rate by 2.8%, particularly among the younger age- group[10]. An upward trend for hospitalization has been reported from a study in New Zealand, during 1976-1981[7]. Changes in disease severity, different admission criteria, and over use of sympathomimetics were considered as possible factors for this increase.

More recent studies, however, show a decrease in hospitalization rates. A study in Scotland (1981-1997) showed that hospital admissions for asthma, after an initial rise between 1980 and 1990, showed a decline[11]. A similar study from the UK (1980-2002) confirmed a steady upward trend from 1980 to 1993 followed by a downward trend until 1999[12]. Another similar study from Finland (1988-1997) showed a decline in admissions in all but the youngest children[10]. In this study the decline was attributed to the reduction of readmissions. A downward trend of hospitalization for asthma in children below four years of age has been reported in Canada and Scotland[11,22].

The present study is the first Greek study showing a decrease in asthma admission rates in Thessaloniki area, during the period 1990-2003. The overall downtrend was 53.65% with a significant decrease in all age groups: by 52.21% in the 2-4 year group, by 39.58% in children 5-8 years and by 23.78% in children 10-14 years ($p<0.001$).

Considering that asthma prevalence among Greek children has increased form 1.5% in 1978 to 10.8% in 2002 the decline in hospital admissions could be explained by a radical change in asthma management[1,2]. Asthma care is related to both better drug treatment and better education. It is well known that no new drugs have been developed for asthma during the last decade. However, better inhalation devices for children have been introduced in the market, which may have improved delivery and drug deposition to the lung[14,23].

Early intervention with effective anti-inflammatory treatment probably alters the natural course of the disease by facilitating the long-term maintenance of lung function[23]. Inhaled steroids improve asthma control and reduce the need for hospitalization[24,26]. Asthma treatment has changed in Greece during the last decade from the conservative use of inhaled steroids to the more liberal administration even among the younger age group. Sales of inhaled steroids have increased by 151.4% in Northern Greece, during the decade 1994-2004[27]. It seems that this increase has contributed to the significant decrease in hospitalization rates.

"Asthma schools", which include asthma education programs and self-management plans for acute asthma exacerbations have resulted in reduction of asthma morbidity and subsequently in reduction of health care expenses[23,28]. It has been shown that "asthma schools" contribute to better asthma control and a decrease in asthma admissions[29]. Inhaled drugs, if they are not taken properly, are ineffective. Avoidance of triggering factors,

like smoking, are crucial in reducing asthma exacerbations. "Asthma schools" for children and their parents have been introduced in the region of Thessaloniki since 1993 and may have resulted in the positive contribution to asthma self management, change of the "corticophobia concept" and better use of inhalation devices[30].

In contrast with the results of other studies we found a greater decrease in asthma hospitalization rates among the younger age group, i.e. 52.21%, vs. 39.58% and 23.78% among older children[10]. An explanation of this finding could be the change of our diagnostic criteria, with more cases of viral wheeze being diagnosed as bronchiolitis and not asthma. This could also be one of the reasons for the increasing trend of bronchiolitis admissions in recent years.

Seasonal patterns in asthma admissions to hospital are well recognized[31,32]. A clear seasonal variation was observed in all the three conditions in our study with a significant decrease during summer when the virus load is low. Moreover there are two peaks for asthma (one during spring and a higher peak during autumn), one peak for bronchiolitis during winter– early spring (January-April) and one peak for croup during autumn (September- November).

In our study, bronchiolitis admissions have increased by 25.03%, a finding, which is similar to that of other recent studies. Data from the USA National Registry revealed that hospital admissions for bronchiolitis doubled between 1980 and 1996, while admissions for other lower respiratory tract diseases remained stable[33]. A substantial increase in hospitalization rates for bronchiolitis but no change in asthma hospitalizations during the period 1991- 1999 was also observed in Netherlands among children aged 0-4 years[34]. Asthma admission rates in children aged less than one year leveled off, while bronchiolitis admissions increased among Swedish children from 1987 to 2000[35]. A theoretical explanation of these findings could be the increase in responsiveness to viral infections among young children[36]. Moreover, the increasing trend of bronchiolitis hospitalization may be attributed to the fact that asthma and wheezing bronchitis or bronchiolitis are partly overlapping entities in this age group and could be considered as a limitation of the study.

Our study shows that viral croup admissions have decreased by 4.73%. This finding could be partially due to the change in the management of croup during the last decade, i.e.: use of nebulized adrenaline and inhaled steroids[19].

In summary, our study provides a new perspective on asthma, bronchiolitis and croup epidemiology, in Northern Greece. The reduction of hospitalizations of childhood asthma, which has occurred concomitantly with an increasing prevalence of the disease, is probably explained by more frequent use of inhaled steroids together with better education of parents and patients for self-management of this condition.

Competing interests: none declared

References

1. Anthrakopoulos M, Karatza A, Liolios E, et al. Prevalence of asthma among schoolchildren in Patras, Greece: three surveys over 20 years. Thorax. 2001; 56: 569-571.
2. Hatziagorou E, Papadopoulou A, Gratziou C, et al. Prevalence of asthma, rhinitis and atopic eczema among children in Athens and Thessaloniki, Greece. (ISAAC, International study of asthma and allergies in childhood). 12th Annual ERS Congress. Eur Respir J. 2002; 20 (Suppl 38): P316.
3. Akinbami LJ, Schoendorf KC. Trends in childhod asthma: prevalence, health care utilization and mortality. Pediatrics. 2002; 110: 315-322.
4. Burr ML, Butland BK, Kng SA, et al. Changes in asthma prevalence: two surveys 15 years aprt. Arch Dis Child. 1989; 64: 1452-1456.
5. Burney BGJ, Chinn S, Rona RJ. Has the prevalence of asthma increased in children? Evidence from the national study of health and growth 1973-86. Br Med J. 1990; 300: 1306-1310.
6. Goodman DC, Stucel TA, Chang C. Trend in pediatric asthma hospitalization rates: regional and socioeconomic differences. Pediatrics. 1998; 101: 208-213.
7. Mitchell EA, Dawson KP. Why are hospital admissions of children with acute asthma increasing? Eur Respir J. 1989; 2: 470-472.
8. Centers for Disease Control and Prevention. Childhood asthma hospitalizations- King Country, Washington, 1987-1998. MMWR. 2000; 49: 929-933.
9. Wennergren G, Kristjansson S, Strannegard IL. Decrease in hospitalization for treatment of childhood asthma with increase of anti- inflammatory treatment, despite an increase in the prevalence of asthma. J Allergy Clin Immunol. 1996: 97: 742-748.
10. Korhonen K, Reijonen TM, Malmstrom K, et al. Hospitalization trends for pediatric asthma in eastern Finland: a 10 yr survey. Eur Respir J. 2002; 19: 1035-1039.
11. Morrison DS, Mc Loone P. Changing patterns of hospital admission for asthma. Thorax. 2001; 56: 587-690.
12. Lung and asthma information Agency. Ethnic variations in lower respiratory disease. Factsheet. 2001/4.
13. British Thoracic Society. Guidelines on the management of asthma, Thorax. 2003; 58 (Suppl1): P126.
14. GINA Report, Global Strategy for Asthma Management and Prevention; 2006. http://www.ginasthma.org
15. Wolf FM, Guevara JP, Grum CM,et al. Educational interventions for asthma in children. The Cochrane Library. 2003; Issue 1.
16. Henderson FW, Clyde WA, Collier Am, et al. The etiologic and epidemiologic spectrum of bronchiolitis in pediatric practice. J Pediatr. 1979; 195: 183.
17. Shay DK, Holman RC, Newman RD Bronchiolitis-associated hospitalizations among US children, 1980-1996. JAMA. 1999; 20; 282: 1440-1446.
18. Leader S, Kohlhase K Respiratory syncytial virus-coded pediatric hospitalizations, 1997 to 1999. Pediatr Infect Dis J. 2002; 21: 629-632.
19. Macdonald WB, Geelhoed GC. Management of childhood croup Thorax. 1997; 52: 757-759.
20. Priftis K, Anagnostakis J, Harokopos E, et al. Time trends and seasonal variation in hospital admissions for childhood asthma in the Athens region of Greece. 1978-1988. Thorax. 1993; 48: 1168-1169.
21. Sunderland R S, Fleming D M. Continuing decline in acute asthma episodes in the community. Arch Dis Child. 2004; 89: 282-285.
22. Crighton EJ, Mamdani MM, Upshur RE. A population based time series analysis of asthma hospitalizations in Ontario, Canada: 1988 to 2000. BMC Health Serv Res. 2001; 1:7.
23. Mellis CM, Peat JK, Woolkcock AJ. The cost of asthma- can it be reduced? Pharmaco Economics. 1993; 3: 205-219.

24. Gertham UG, Herzman P, Johnsson B, Boman G. Impact of inhaled corticosteroids on acute asthma hospitalisation in Sweden 1978 to 1991. Med Care. 1996; 34: 1188-1198.
25. Blais L, Ernst P, Boibin J, et al. Inhaled corticosteroids and the prevention of readmission to hospital for asthma. Am J Respir Crit Care Med.1998; 158: 126-132.
26. Suissa S, Ernst P. Use of anti-inflammatory therapy and asthma mortality in Japan. Eur Respir J. 2003; 21: 101-104.
27. IMS-Market Share, Greek Health Pharmaceutical Market Data. 2005.
28. Clarton J, Clarton G, Brromfield J, et al. Evaluation of peak flow and symptoms only self-management plans for control of asthma in general practice. Br Med J. 1990; 301: 1355-1359.
29. Haahtela T, Klaukka T, Koskela K, et al. Asthma program in Finland: a community problem needs community solutions. Thorax. 2001; 56: 806-814.
30. Tsanakas J, French D, Gratziou C, et al. Asthma schools in childhood asthma control in Greece. Allergy. 2000; 55 (Suppl 65): P124.
31. Harju T, Keistinen T T, Kirela S L. Seasonal variation in childhood asthma hospitalizations in Filand, 1972-1992. Eur J Pediatr. 1997; 156: 436-439.
32. Fleming D M, Cross KW, Sunderland R, et al. Comparison of the seasonal patterns of asthma identified in general practitioner episodes, hospital admissions and deaths. Thorax. 2000; 55: 662-665.
33. Shay DK, Holman RC, Newman RD, et al. Bronchiolitis – associated hospitalizations among US children, 1980- 1996. JAMA. 1999; 282: 1440-1446.
34. Van Woensel JB, van Aalderen WM, Kneyber MC, et al. Bronchiolitis hospitalizations in the Netherlands from 1991 to 1999. Arch Dis Child. 2002; 86: 370-371.
35. Bjor O, Braback L. A retrospective population based trend analysis on hospital admissions for lower respiratory illness among Swedish children from 1987 to 2000. BMC Public Health. 2003; 3: 22-30.
36. Kuchni CE, Davis A, Brooke AM, et al. Are all wheezing disorders in very young (preschool) children increasing in prevalence? Lancet. 2001; 357: 1821-1825.