Artigo original

Epidemiology of Asthma

Epidemiologia da Asma

Joan B Soriano[1], Hisbello da Silva Campos[2]

RESUMO

Quando comparadas às principais causas globais de doença e morte, as doenças respiratórias recebem menos atenção e financiamento. Particularmente na asma, todos os indicadores epidemiológicos sinalizam um grande e crescente problema de saúde pública.

Estima-se que 300 milhões de pessoas em todo o mundo sejam asmáticas e que 180.000 mortes anuais sejam causadas por asma. No Brasil, o estudo ISAAC identificou áreas com altas prevalências de asma, similares às do norte da Europa e da Oceania. Enquanto um estudo de mortalidade concluiu que a asma é responsável por mais de 2.000 mortes anuais no Brasil, ou seja, cerca de 6 por dia, com uma grande variação regional, outro estudo sobre morbidade quantificou cerca de mil hospitalizações diárias, representando um custo de R$100 milhões anuais para o Sistema Único de Saúde.

Pode-se concluir que, face às mudanças demográficas nas populações, no estilo de vida e à epidemia tabágica, a asma continuará sendo um peso crescente em vários países do mundo, incluindo o Brasil.

Descritores: Asma/economia; Asma/epidemiologia; Asma/mortalidade; Asma/prevenção & controle; Brasil.

ABSTRACT

Respiratory diseases in general receive little attention and funding in comparison with other major causes of morbidity and mortality. For asthma in particular, all epidemiological indicators suggest a huge and growing burden.

It is estimated that, worldwide, 300 million people suffer from asthma and that there are about 180,000 asthma-related deaths annually. In Brazil, the ISAAC surveys identified areas in which the prevalence of asthma is high, similar to that observed for Northern Europe and Oceania. Mortality studies have shown that, in Brazil, there are more than 2,000 asthma-related deaths per year, or approximately 6 per day, with considerable regional variability, whereas morbidity studies have demonstrated that there are approximately 1,000 hospital admissions for asthma every day, at an annual cost of 100 million Brazilian reals to the Brazilian Unified Health Care System.

We conclude that, as a result of changing demographics, lifestyle changes, and the smoking epidemic, the burden of asthma is and will be growing, worldwide and in Brazil.

Keywords: Asthma/economics; Asthma/epidemiology; Asthma/mortality; Asthma/prevention & control; Brazil.

1. Epidemiology and Clinical Research Program, Fundación Caubet-Cimera Illes Balears International Centre for Advanced Respiratory Medicine, Mallorca, Illes Balears, Spain.
2. Instituto Fernandes Figueira, Fundação Oswaldo Cruz (FIOCRUZ), Rio de Janeiro, Brazil.
The authors declare that they do not have any potential conflict of interest.

Correspondence to: Hisbello da Silva Campos. Rua do Catete, 311, sala 708. CEP: 22220-001. Rio de Janeiro, RJ, Brasil. Tel. 55 21 2285-3230.
E-mail: hisbello@globo.com.

INTRODUCTION

Asthma is a serious health problem that affects people of all backgrounds and all ages. According to data published in the World Report on Asthma in 2004, an estimated 300 million people suffer from asthma (1). That estimate was later endorsed by the World Health Organization and the Global Alliance against Chronic Respiratory Diseases (2,3). Therefore, among respiratory diseases, asthma is only surpassed by rhinitis, from which 400 million suffer (Table 1). Taken together, chronic respiratory diseases affect approximately 1.15 billion (16.4%) of the 7 billion people in the world.

Table 1 - Estimated prevalence of chronic respiratory diseases worldwide.

Condition	Number of Individuals affected
Asthma	300 million
Chronic obstructive pulmonary disease	210 million
Rhinitis (excluding asthma)	400 million
Sleep-disordered breathing	100 million
Other	50 million
Total	1.15 billion

Source: Beasley (1).

In 2009, the Global Initiative for Asthma reported that the overall prevalence of asthma (in children and adults) was between 1% and 18%, depending on the country, with considerable heterogeneity when broken down by age, gender, and region. The report also identified a recent reduction in asthma prevalence among adolescents in 13-14 year age bracket living in North America or Western Europe, in contrast to what was reported for countries in which the prevalence of asthma had previously been lower (4,5). However, the overall proportion of children and adolescents with asthma increased, probably because of improvements in diagnostic techniques (1).

The asthma burden can be assessed in terms of prevalence, mortality, morbidity, and costs. Although incidence rates can be also considered, given the lifelong duration of asthma and the fact that the onset of asthma symptoms can occur at any age, the incidence rate is a less reliable metric by which to assess the epidemiology of asthma. Therefore, in this review, we briefly summarize the available data on the prevalence, mortality, morbidity, and costs of asthma.

PREVALENCE

Whatever the disease, prevalence estimates depend on the definition that is used for diagnosis. The asthma prevalence data currently available are the result of two major international epidemiological studies initiated in the early 1990s: the European Community Respiratory Health Survey (ECRHS), which studied the prevalence of asthma in young adults (6), and the International Study of Asthma and Allergies in Children (ISAAC), which analyzed the pediatric population (7).

After the first wave of data (for 1993 and 1994) had been analyzed (8), the ECRHS reported that the average prevalence of asthma among individuals between 20 and 44 years of age, across 22 countries, was 4.5%. It also showed that the prevalence rates were highly variable among different geographical areas (6). Subsequent ECRHS reports examined the population by age bracket and showed that there was a generational increase in asthma prevalence, an increase that was highly variable among countries (9), as can be seen in Figure 1. A reassessment of the cohort of young adults who had participated in the ECRHS (5-11 years after the initial assessment) showed an increase in the number of patients treated with medication to control their asthma, without an increase in the number of patients with asthma symptoms (10). This raised two hypotheses: either treatments had become more effective and were being used more widely; or more patients were being diagnosed with mild asthma.

In the first phase of the ISAAC study, conducted in 19 countries in 1994, it was found that the prevalence of asthma symptoms was higher in children and adolescents (14 years of age or younger) than in adults (7). In addition, the prevalence varied greatly among countries, from 2% in Indonesia to 32% in the United States. There was a good correlation between the ISAAC data and the ECRHS data, for the various countries (6,7). It is of note that, within the 17 countries evaluated in both studies, there was a strong correlation between the phase I ISAAC data and the phase I ECRHS in terms of the prevalence of "wheeze in the last 12 months", the former explaining 64% and 74% of the variation of the latter at the country level and at the facility level, respectively. There was also generally good agreement between the two surveys in terms of the international patterns observed for self-reported asthma (74% at the country level and 36% at the facility level), self-reported asthma before age 14 yrs (64 and 26%, respectively), hay fever (61 and 73%, respectively), and eczema (41 and 50%, respectively). Therefore, although there were differences in the absolute levels of prevalence observed in the two surveys, there was good overall agreement between the ECRHS and the ISAAC (11).

By integrating ECRHS and ISAAC data, together with other local studies and estimates (12), the geographic distribution of asthma can be depicted (Figure 2). As can be seen in Figure 2, there are still many regions of the world, particularly in Africa and Asia, for which there are no data. It can be also seen that the prevalence of asthma is highest (≥ 10%) not only in Australia, New Zealand, Western Europe,

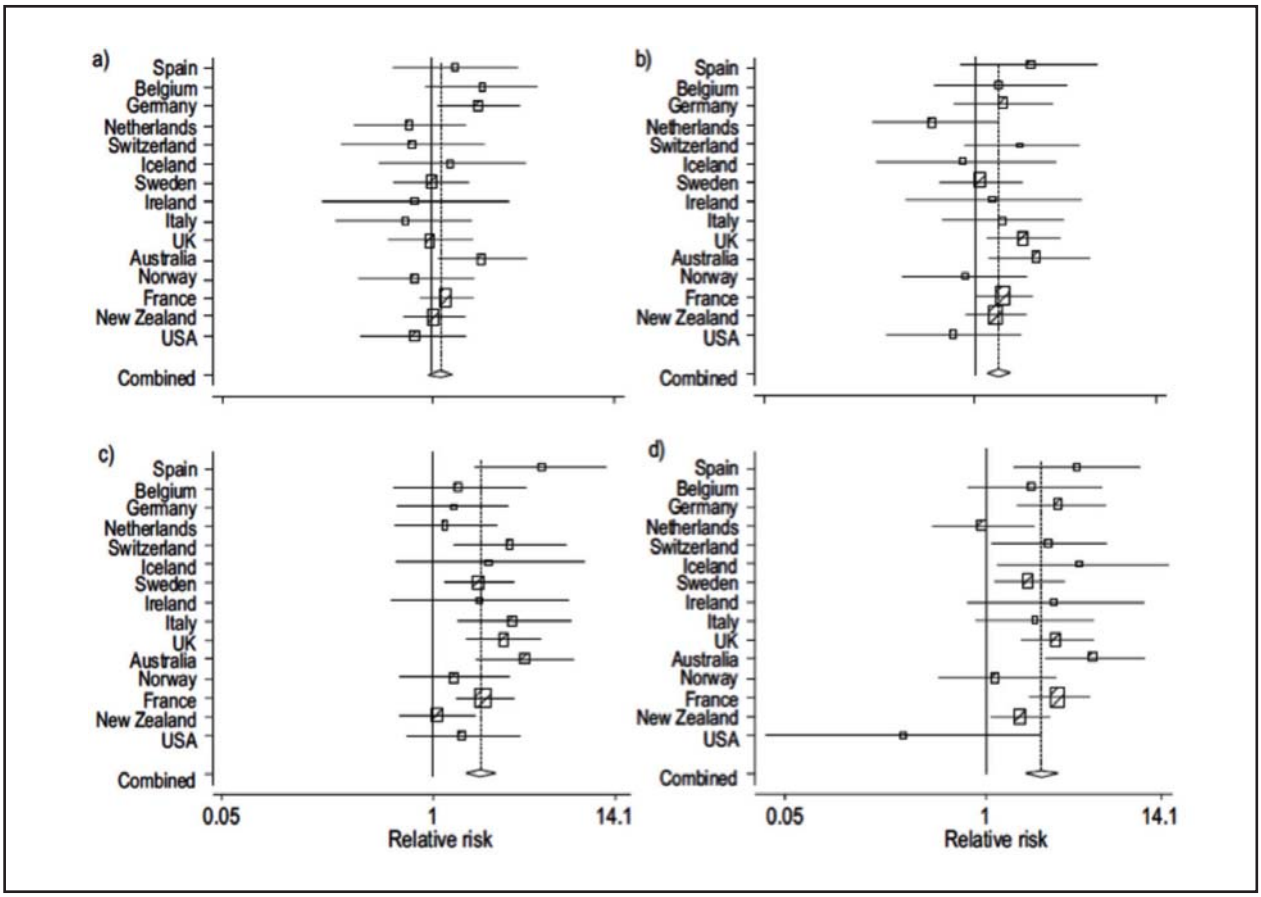

Figure 1 - Generational increase in the prevalence of asthma according to the ECRHS.

Source: Sunyer et al. (9).

Note: The relative risks and respective 95% confidence intervals are presented for each asthma cohort with respect to the baseline cohort (i.e., those born between 1946 and 1950) by country, and the relative risk combo. a) 1951-1955 cohort; b) 1956-1960 cohort; c) 1961-1965 cohort; and d) ≥ 1966 cohort. Countries are ranked according to the prevalence of asthma adjusted for age and sex in the 1946-1950 cohort: 2.2% in Spain; 3.5% in Belgium; 4.6% in Germany; 6.0% in the Netherlands; 6.1% in Switzerland; 7.8% in Iceland; 8.0% in Sweden; 8.2% in Ireland; 9.7% in Italy; 10.0% in the UK; 11.0% in Australia; 11.0% in Norway; 12.5% in France; 19.8% in New Zealand; and 20.2% in the U.S. The box size is inversely proportional to the variation of relative risk. The horizontal lines represent 95% confidence intervals.

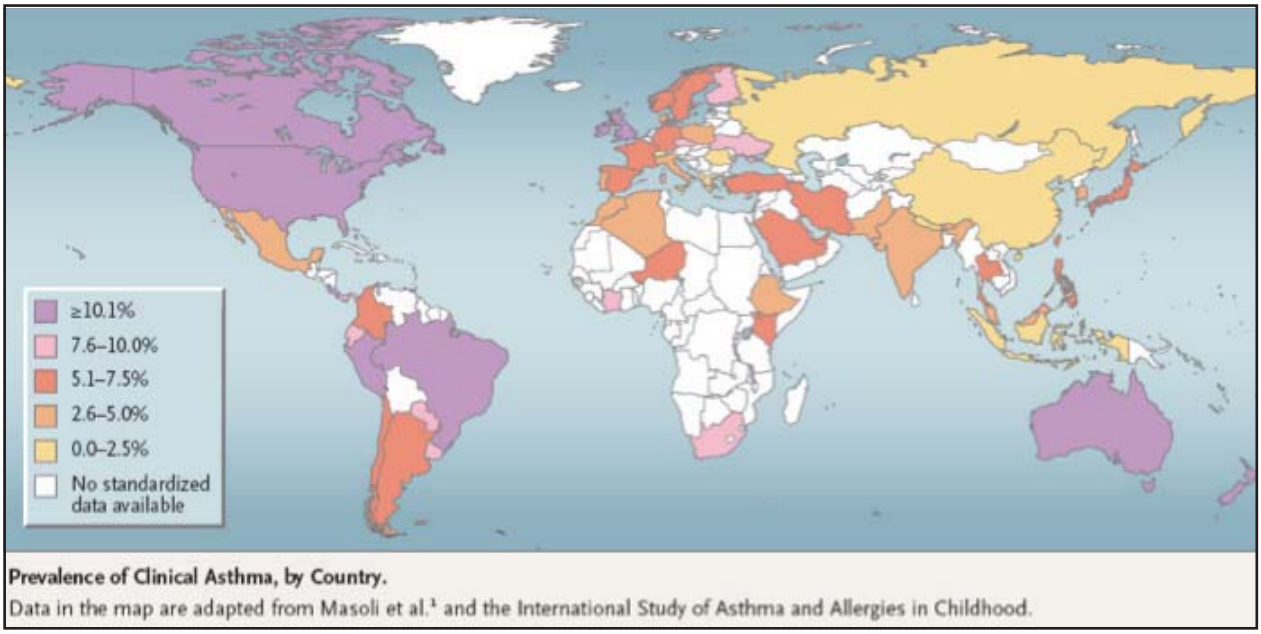

Figure 2 - Geographic distribution of asthma prevalence, where data are available.

Source: Mantzouranis (12).

North America and other English-speaking countries but also in Brazil and some other countries. In fact, the ISAAC showed that Brazil was within the top quartile for asthma prevalence, ranking slightly below Peru and Costa Rica, whereas it ranked slightly above Paraguay and Uruguay (Figure 3).

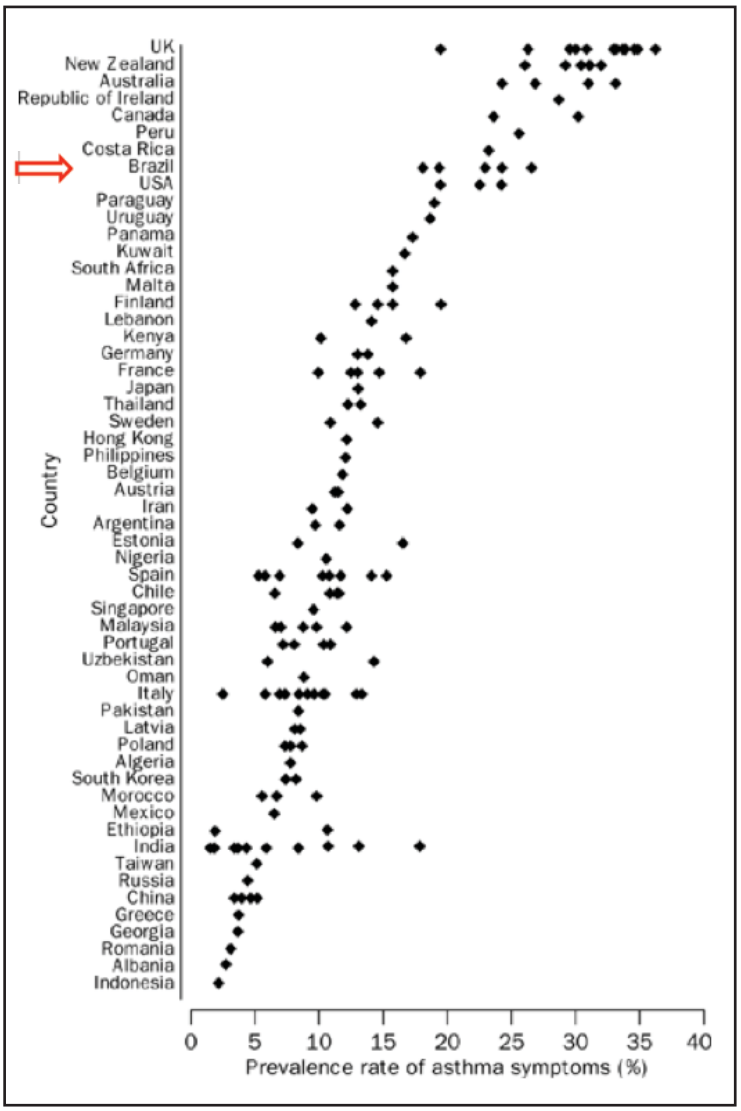

Figure 3 - ISAAC symptoms data
Source: ISAAC (7).

MORTALITY

The true number of asthma-related deaths is difficult to determine, particularly among adults and the elderly, even among those who die in the hospital. In addition, death from asthma is becoming a rare event. Accordingly, asthma mortality data have to be always interpreted with caution. However, although in absolute numbers they are relatively rare events, most fatal or near-fatal episodes could be prevented. It is estimated there are approximately 180,000 deaths annually due to asthma. The report published by Global Initiative for Asthma in 2004 stated that one in every 250 deaths worldwide is attributable to asthma (1). However, since the late 1980s, there has been a widespread and progressive decline in the asthma mortality rate, which fell to 0.23 per 100,000 population in the 2004-2005 period, with an average reduction of 63% between 1985 and 2005 (13).

Recently, asthma mortality in Brazil was revisited (14). Data were collected from the Brazilian National Mortality Database for two periods: 1980-1995, when the tenth revision of the International Classification of Diseases (ICD-9) code 493 was used; and 1996-2006, when the ICD-10 codes J45 and J46 were used. It was reported that during the 1980-2006 period, asthma was responsible for an average of 2,118 deaths per year in Brazil, or approximately 6 per day, with considerable regional variability (Figure 4). The overall asthma mortality rate was 1.5 per 100,000 habitants, and there were slightly more deaths among females than among males (1.7/100,000 vs. 1.3/100,000). For the period as a whole (1980-2006), the asthma mortality rate trended downward by 0.2% per year. Of all asthma-related deaths 16% occurred among children under 5 years of age and 58% occurred among individuals 55 years of age or older (Table 2). The fact that a high proportion of all asthma-related deaths (72%) occurred at health care clinics might indicate that there is a lack of efficient ambulatory care for the asthmatic population.

MORBIDITY AND COSTS

Morbidity assessment includes physician visits, emergency room visits, and hospital admissions. Because of the high prevalence of asthma and of the associated morbidity, together with the fact that most asthma patients live for many years with a chronic condition that does not reduce their life expectancy, therefore requiring drug treatment, as well as scheduled and unscheduled care, there is a significant economic burden associated with asthma. In developed countries, asthma care is thought to account for 1-2% of the total public health care budget (15).

In Brazil, there is a lack of national data on asthma morbidity. A recent report investigated hospital admissions during the 1998-2008 period (16). Data were obtained from the database of the Information Technology Department of the Brazilian Sistema Único de Saúde (SUS, Unified Health Care System), which includes all public (SUS-funded) hospitals. During the period studied, the ICD-10 codes J45 (asthma) and J46 (status asthmaticus)

were employed. The report concluded that asthma was responsible for 328,620 hospital admissions per year (900/day), corresponding to 177.4 such admissions per 100,000 population, being slightly higher among females. In most cases, the J45 diagnostic classification was used as the indication for hospitalization (88% vs. 12% for the J46 classification). Over the period studied, there was a downward trend of 5% per year (Figure 5) and hospital mortality rates were low (0.3%). Between 1998 and 2008, the annual average SUS expenditures related to hospital admissions for asthma, in Brazilian reals (R$), was R$103.5 million, having increased by 7% per year over the period. The highest hospitalization rate was among children under 5 years of age, followed by individuals 55 years of age or older, the latter possibly indicative of cases of chronic obstructive pulmonary disease misdiagnosed as asthma. In that same report (16), it was concluded that exacerbations of asthma resulted in approximately 1,000 hospital admissions per day during the period studied, at an annual cost to the SUS of R$100 million. The number of hospital admissions and the cost remained relatively stable over the period under study.

Table 2 - Asthma mortality rates (per 100,000 population) by age bracket. Brazil, 1980-2006.

	Age bracket (years)									
Year	< 1	1-4	5-14	15-24	25-34	35-44	45-54	55-64	65-74	≥ 75
1980	7.94	2.43	0.22	0.22	0.51	1.08	2.02	6.32	12.23	28.23
1981			0.14	0.23	0.54	0.86	2.07	4.81	10.97	23.49
1982			0.16	0.22	0.52	0.98	2.01	4.96	10.35	21.78
1983			0.18	0.23	0.46	0.95	1.97	4.77	10.73	24.36
1984			0.16	0.25	0.50	0.80	1.95	3.78	9.21	20.33
1985			0.15	0.24	0.41	0.65	1.69	3.67	8.17	21.30
1986			0.17	0.19	0.39	0.90	1.99	4.26	9.47	19.06
1987			0.16	0.19	0.44	0.84	1.54	3.14	6.79	17.60
1988			0.16	0.17	0.34	0.64	1.76	3.30	8.37	19.35
1989			0.17	0.25	0.45	0.84	1.44	3.27	7.25	17.36
1990			0.14	0.21	0.37	0.73	1.66	3.53	8.17	19.88
1991	3.81	1.37	0.13	0.15	0.27	0.67	1.39	3.05	7.18	15.83
1992			0.19	0.21	0.34	0.67	1.50	3.87	7.49	18.62
1993	3.83	1.34	0.14	0.21	0.41	0.90	1.81	4.42	9.61	20.39
1994	3.62	1.51	0.25	0.22	0.37	0.90	2.14	3.91	9.58	19.76
1995	3.99	1.38	0.18	0.22	0.47	1.02	1.91	4.93	9.52	21.63
1996	2.57	0.97	0.16	0.24	0.40	0.69	1.75	4.06	8.62	17.95
1997	3.07	1.12	0.11	0.24	0.42	0.77	1.77	3.97	8.60	19.76
1998	2.31	1.04	0.11	0.17	0.36	0.88	1.88	4.05	8.34	20.16
1999	1.54	1.03	0.14	0.24	0.40	0.80	1.75	3.77	8.71	21.12
2000	1.96	0.88	0.14	0.14	0.32	0.71	1.48	3.16	7.67	17.91
2001	2.05	0.84	0.15	0.13	0.30	0.64	1.54	3.36	7.54	16.82
2002	1.75	0.78	0.09	0.16	0.31	0.61	1.24	3.15	6.66	16.70
2003	1.91	0.79	0.08	0.15	0.31	0.67	1.53	2.80	6.69	16.77
2004	1.24	0.59	0.09	0.13	0.32	0.57	1.44	3.44	6.23	18.26
2005	1.46	0.63	0.10	0.17	0.30	0.67	1.36	2.99	5.65	17.93
2006	1.41	0.61	0.12	0.13	0.38	0.77	1.69	3.15	7.48	23.26
Average	2.34	0.96	0.15	0.20	0.39	0.78	1.71	3.85	8.42	19.84

Source: Campos (14).

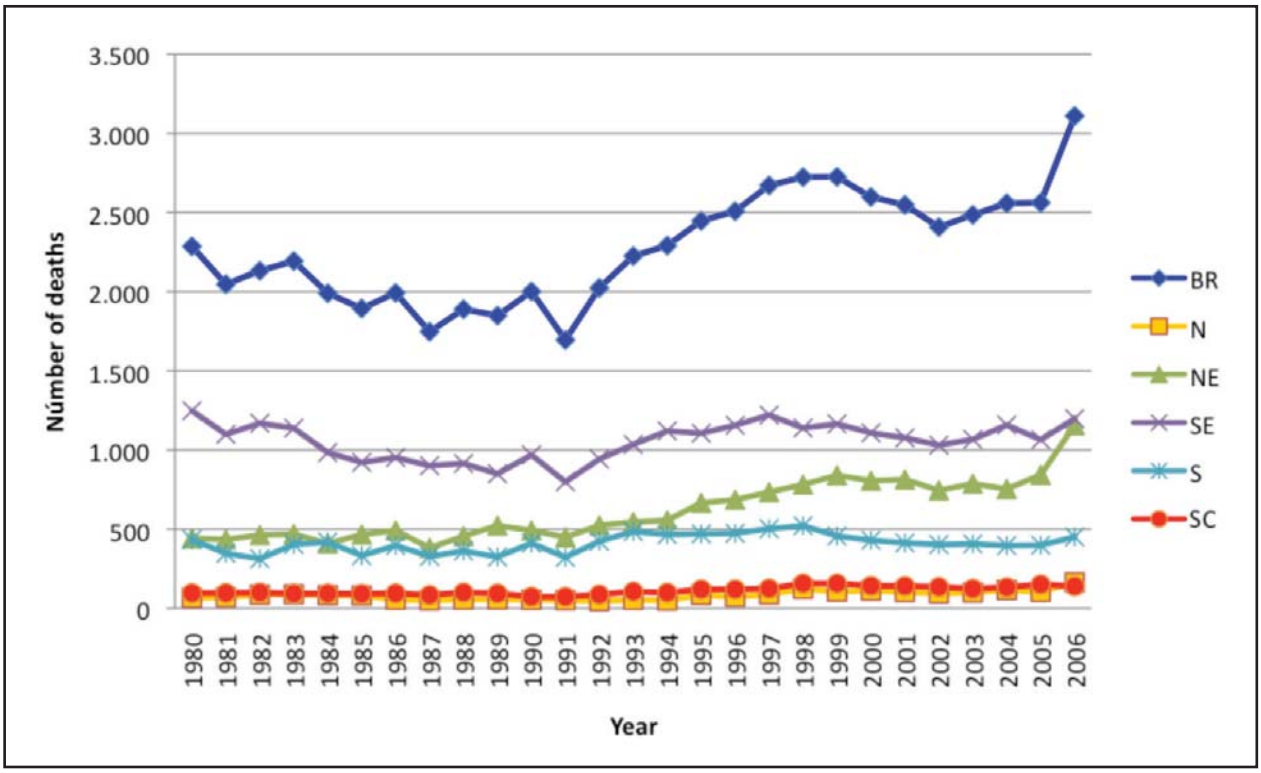

Figure 4 - Total annual number of asthma deaths by region. Brazil, 1980-2006.

BR: Brazil (nationwide); N: north; NE: northeast; SE: southeast; S: south; SC: south-central.
Source: Campos (14).

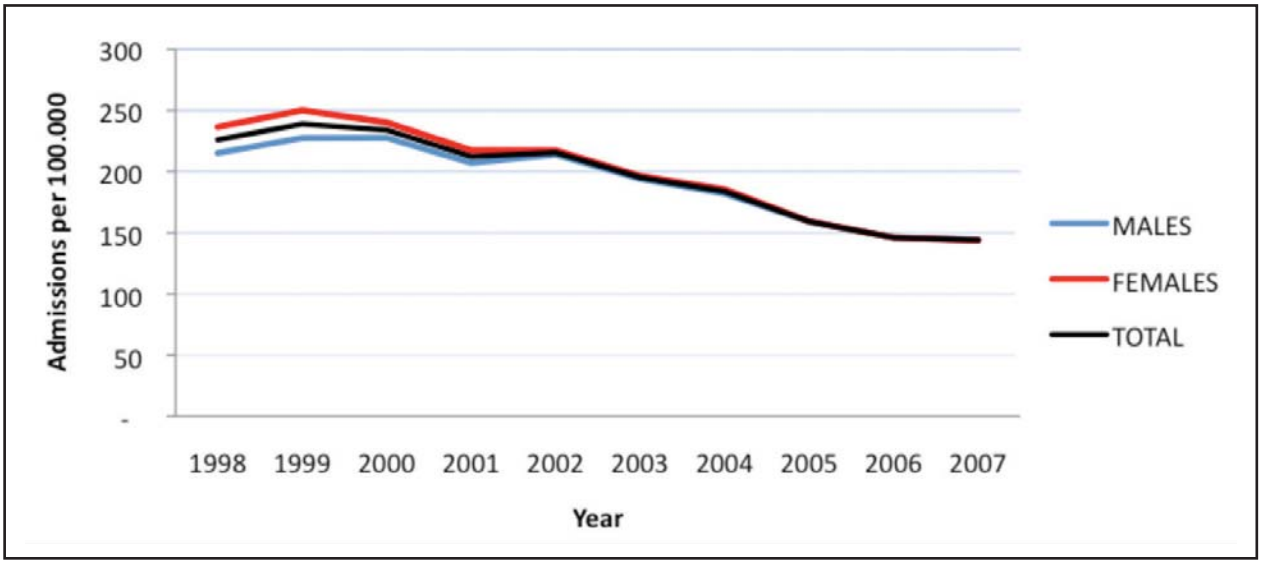

Figure 5 - Trends in asthma-related admissions to SUS-funded hospitals, by gender. Brazil, 1998-2007.

Source: National Institutes of Health (16).

INFERENCES AND FUTURE TRENDS

The many causes of asthma can be classified as host risk factors (most of them non-modifiable, such as genetic predisposition, atopy, airway hyperresponsiveness, gender, and ethnicity) or environmental risk factors (most of which are modifiable). Environmental risk factors can be further subdivided into susceptibility factors (indoor/outdoor allergens, occupational sensitizers, tobacco smoke, air pollution, respiratory infections, parasitic infections, socioeconomic status, overcrowding in homes, diet, drugs, and obesity) and precipitating factors (indoor/outdoor allergens, air pollutants, respiratory infections, exercise-induced hyperventilation, meteorological changes, pollutants such as sulfur dioxide, foods/food additives, drugs, high levels of expressed emotion at home, smoking in the home, and irritants). Such a myriad of risk factors produces multiple, varying effects in individuals and populations, thus making asthma a complex disease.

A number of hypotheses have been proposed in order to explain the worldwide increase in the prevalence of asthma: the hygiene hypothesis (17), which suggests that there is an inverse association between increased exposure to other children during childhood and allergen sensitization; the westernization hypothesis (18), which posits that exposure to new types of foods can trigger asthma; and the lesser-known physiological hypothesis (19), in which obesity, a sedentary lifestyle, and a lack of aerobic activity are though to predispose children to asthma. The last merits further consideration, given that an "indoor" lifestyle includes at least three elements related to the development of asthma: greater exposure to indoor allergens, the potential for overeating, and the lack of physical activity. One can argue that obesity itself increases lung inflammation. However, we could also argue that the lack of physical activity (particularly that involved in normal outdoor play) has removed a form of protection that previously acted to control wheezing. All three of these hypotheses are applicable, at least in part, to the current situation in Brazil, as well as in many other countries, in Latin America and elsewhere. Should we expect an asthma epidemic in Brazil? The change to a more westernized lifestyle, including diet changes, less time spent outdoors, and architectural modifications of houses (including double-glazing, more carpeting, central heating, and air conditioning, and therefore less home ventilation and more recirculation of dust and allergens) has been relatively swift in Brazil. In addition, asthmogenic factors at the population level, such as urban overcrowding, smaller family sizes, universal vaccination, reductions in the numbers of parasites, exposure to pets, smoking, and the abovementioned more sedentary lifestyle have become more predominant. Therefore, all signs point to the possibility that the already high asthma prevalence rates reported in the ISAAC and other studies conducted in Brazil are set to increase in the near future. To quantify the asthma problem and to allocate health resources to tackle the individual and population burden, with the objective of minimizing the impact of chronic respiratory disease, close monitoring of epidemiological trends is warranted. Interventions aimed at reducing the underdiagnosis and undertreatment of asthma should be coupled with those aimed at reducing misdiagnosis and overtreatment. Learning and applying lessons from countries where the problem of asthma was pronounced might be considered (20), with an action program focused on the dissemination of new knowledge, especially in the primary care sphere. The focus might be on screening symptomatic children and adults, as well as on treatment with anti-inflammatory drugs from the outset. For example, such a program in Finland reported that, over a 10-year period (21), there was a 54% reduction in the number of days spent in the hospital, at the national level, as well as a 36% reduction in the annual per-patient costs (21). Not only was the incidence of asthma-related death near zero but even hospital admissions for asthma were nearly abolished in the country. Similar asthma projects and programs have been implemented in Argentina, Australia, China, Japan, Mexico, the Philippines, Russia, South Africa, and Turkey. A recent panel discussion identified low rates of dissemination and implementation of national and international treatment guidelines, low levels of continuing medical education and training of primary health care professionals, as well as limited access to and distribution of inhaled corticosteroids, all of which are considered major barriers to the overall success of a national asthma management program. In the less developed asthma programs, under-recognition and undertreatment further limited the success of the programs. Evidence from well-established national asthma management programs suggests that establishment of a successful program entails a logical progression through specific developmental stages, starting with the endorsement and commitment of politicians and stakeholders, followed by epidemiological evaluation, evaluation of the disease burden, and evaluation of access to care and best treatment practices, as well as the optimization of care and maintenance therapy for individual patients (22).

FINAL CONSIDERATIONS

In conclusion, asthma is and will be a huge and growing burden worldwide. This is no less true in Brazil, where changing demographics, lifestyle changes, and the smoking epidemic continue be significant risk factors for asthma.

REFERÊNCIAS

1. Beasley R. The Global Burden of Asthma Report, Global Initiative for Asthma (GINA). Available at: http://www.ginasthma.org 2004.
2. Bousquet J, Khaltaev N. Global surveillance, prevention and control of Chronic Respiratory Diseases. A comprehensive approach. www.who.int/gard/publications/GARD%20Book%202007.pdf Date last updated: 2007.
3. Bousquet J, Kiley J, Bateman ED, Viegi G, Cruz AA, Khaltaev N, Aït Khaled N, Baena-Cagnani CE, Barreto ML, Billo N, Canonica GW, Carlsen KH, Chavannes N, Chuchalin A, Drazen J, Fabbri LM, Gerbase MW, Humbert M, Joos G, Masjedi MR, Makino S, Rabe K, To T, Zhi L. Prioritised research agenda for prevention and control of chronic respiratory diseases. Eur Respir J 2010;36:995-1001.
4. Global Initiative for Asthma. Global strategy for management and prevention. NHLBI/WHO workshop report 2009. Disponible en http://www.ginasthma.com.
5. Akinbami LJ, Schoendorf KC. Trends in childhood asthma: prevalence, health care utilization, and mortality.

Pediatrics 2002;110:315-322.
6. European Community Respiratory Health Survey. Variations in the prevalence of respiratory symptoms, self-reported asthma attacks, and use of asthma medication in the European Community respiratory health survey (ECRHS). Eur Respir J 1996;9:687-695.
7. The international study of asthma and allergies in childhood (ISAAC) steering committee. Worldwide variations in the prevalence of asthma symptoms: the international study of asthma and allergies in childhood (ISAAC). Eur Respir J 1998;12:315-335.
8. European Community Respiratory Health Survey. Variations in the prevalence of respiratory symptoms, self-reported asthma attacks, and use of asthma medication in the European Community respiratory health survey (ECRHS). Eur Respir J 1996;9:687-695.
9. Sunyer J, Antó JM, Tobias A, Burney P. Generational increase of self-reported first attack of asthma in fifteen industrialized countries. European Community Respiratory Health Study (ECRHS). Eur Respir J 1999;14:885-91.
10. Chinn S, Jarvis D, Burney P, Luczynska C, Ackermann-Liebrich U, Anto JM et al. Increase in diagnosed asthma but not in symptoms in the European Community respiratory health survey. Thorax 2004;59:646-651.
11. Pearce N, Sunyer J, Cheng S, Chinn S, Björkstén B, Burr M, Keil U, Anderson HR, Burney P. Comparison of asthma prevalence in the ISAAC and the ECRHS. ISAAC Steering Committee and the European Community Respiratory Health Survey. International Study of Asthma and Allergies in Childhood. Eur Respir J 2000;16:420-6.
12. Mantzouranis EC. Taking your child's breath away--the extension of asthma's global reach. N Engl J Med. 2008 Mar 20;358(12):1211-3.
13. Wijesinghe M, Weatherall M, Perrin K, Crane J, Beasley R. International trends in asthma mortality rates in the 5- to 34-year age group: a call for closer surveillance. Chest. 2009;135(4):1045-9.
14. Campos HS. Asthma mortality in Brazil, 1980-2006.
15. National Institutes of Health. Global strategy for asthma management and prevention. Publication No. 02-3659. Bethesda, MD: National Heart, Lung and Blood Institute; 2002.
16. Campos HS. Asthma as a cause of hospitalization in public hospitals. Brazil, 1998-2008.
17. Strachan DP. Family size, infection and atopy: the first decade of the 'hygiene hypothesis'. Thorax 2000; 55(Suppl 1): S2–S10.
18. Von Mutius E. Prevalence of asthma and atopy in two areas of West and East Germany. Am J Respir Crit Care Med 1994;149:358-364
19. Crater SE, Platts-Mills TAE. Searching for the cause of the increase in asthma. Curr Opin Pediatr 1998.
20. Haahtela T, Klaukka T, Koskela K, Erhola M, Laitinen LA; Working Group of the Asthma Programme in Finland 1994-2004. Asthma programme in Finland: a community problem needs community solutions. Thorax 2001;56:806-14.
21. Haahtela T, Tuomisto LE, Pietinalho A, Klaukka T, Erhola M, Kaila M, Nieminen MM, Kontula E, Laitinen LA. A 10 year asthma programme in Finland: major change for the better. Thorax 2006;61:663-70.
22. Lalloo UG, Walters RD, Adachi M, de Guia T, Emelyanov A, Fritscher CC, Hong J, Jimenez C, King GG, Lin J, Loaiza A, Nadeau G, Neffen H, Sekerel BE, Yorgancioğlu A, Zar HJ. Asthma programmes in diverse regions of the world: challenges, successes and lessons learnt. Int J Tuberc Lung Dis 2011;15:1574-87.