Original Article

Prevalence of asthma attacks treated in public health facilities in the city of Juiz de Fora, Brazil*

Oscarina da Silva Ezequiel[1], Gilberto Salles Gazeta[2], Nicolau Maues da Serra Freire[2]

Abstract

Objective: To evaluate the prevalence of asthma attacks treated in public health facilities in the city of Juiz de Fora, Brazil from February 1, 2002 to January 31, 2003. **Methods:** This was a cross-sectional study involving monthly analyses performed in order to evaluate the asthma attacks treated. The variables analyzed were patient gender, age, and place of residence, as well as the profile of the visits by age bracket and by the site of the visit. In addition, we attempted to determine whether asthma attacks correlated with temperature or relative humidity. **Results:** A total of 25,243 patients were treated for asthma attacks, accounting for 11.1% of the total number of visits to pediatric clinics and 2.7% of the total number of visits to medical clinics. The mean age of the patients was 11.6 years (median, 4 years), and 52.9% of the patients were male. The analysis of the annual distribution revealed an increase in the number of asthma attacks treated in the months of May (11.5%), June (10.8%), and July (10.9%). Asthma attack presented a strong inverse correlation with temperature (-0.86) and a weak inverse correlation with relative humidity (-0.27). Statistically significant differences, in terms of mean age and gender, were found between patients with asthma attacks treated in emergency rooms and those treated in basic health clinics. The evaluation by age bracket revealed a predominance of males among patients younger than 12 years of age and a predominance of females among those aged 12 or older. **Conclusion:** We found that asthma represents a significant public health problem in this city. Local strategies are urgently needed in order to increase the availability of prophylactic treatment.

Keywords: Asthma/epidemiology; Prevalence; Hospitals; Public; Brazil.

*Study carried out at the Universidade Federal de Juiz de Fora (UFJF, Juiz de Fora Federal University) School of Medicine – Juiz de Fora, Brazil.

1. Adjunct Professor at the Universidade Federal de Juiz de Fora (UFJF, Juiz de Fora Federal University) School of Medicine – Juiz de Fora, Brazil.
2. Researcher at the Instituto Oswaldo Cruz (IOC, Oswaldo Cruz Institute) of the Fundação Oswaldo Cruz (FIOCRUZ, Oswaldo Cruz Foundation) – Rio de Janeiro (RJ) Brazil.
Correspondence to: Oscarina da Silva Ezequiel. Av. Rio Branco, 2.370, sala 1.014, Centro, CEP 36016-310, Juiz de Fora, MG, Brasil.
Phone 55 32 3213-1971. E-mail: oscarina@acessa.com
Submitted: 2/7/05. Accepted, after review: 10/4/06.

Introduction

The significance of asthma as a public health problem has led to the establishment of consensuses for its management. However, despite the fact that 60% of the asthma cases are classified as intermittent or mild persistent and are therefore likely to be treated by clinicians, pediatricians, or family doctors,[1-3] consensus guidelines are, in general, used only by specialists and not by generalist physicians. This fact, in conjunction with the high cost of the drugs used to prevent persistent asthma, (inhaled corticosteroids), results in most of the population in developing countries having no access to preventive treatment for asthma.[3-5] Therefore, there is currently a dichotomy between the increase in knowledge regarding the initial assessment/treatment of asthma and as the fact that it remains the most common chronic disease among children and young adults.[1,6,7]

In recent years, the rates of hospitalization and emergency room visits for asthma have tended to vary in different studies, these variations being quite often associated with interventions in asthma management, such as the implementation of the consensuses, which was carried out in the sample analyzed.[1,8-10]

The seasonal characteristic of asthma can be observed from the increase in hospitalizations, as well as in mortality, at certain times of year, being associated with climatic influences (direct as well as indirect), due to alterations in air pollution and in the concentrations of fungal and mite allergens.[11,12]

The Global Initiative for Asthma (GINA), a World Health Organization project, with the support of various scientific organizations, set the following objectives for 2005: a 50% reduction in the number of deaths from asthma among children; a 25% decrease in the number of hospitalizations for asthma among small children; and a 50% decrease in school absenteeism due to asthma as compared to 2002.[13]

The objective of the present study was to evaluate the prevalence of asthma attacks in patients treated within the Sistema Único de Saúde (SUS, Unified Health Care System), since such knowledge regarding a given geographic area can provide substantial data to make the administrative organizations that are responsible for the health of the population aware of the need to develop programs involving multidisciplinary teams and of the need to properly manage the financial resources for asthma treatment, thereby leading to the achievement of the GINA objectives for 2005.[10,13-15]

Methods

The city of Juiz de Fora, Brazil has, according to information provided by the Brazilian Institute of Geography and Statistics, a population of 456,432 inhabitants.[16] According to the data collected at the principal climatological station at the Federal University of Juiz de Fora, 5th Meteorological District, the climate of the city is characterized by two well-defined seasons: October to April, when there are higher temperatures and heavier rainfalls, and May to September, when temperatures are lower and there is less rainfall. In the period studied, the behavior of the temperature and relative humidity of the air was similar to that of the historical means.

The emergency room visits covered by the SUS are conducted in the Emergency Departments of the East Central and North Central Branches, as well as in the Institute for Children and Adolescents, in the João Penido Regional Hospital, in the Santa Casa de Misericórdia Hospital, and in the Federal University of Juiz de Fora University Hospital.

This was a repeated cross-sectional panel study, carried out from February 1, 2002 to January 31, 2003, involving monthly analyses performed in order to determine the period prevalence of the asthma attacks treated in 24 unidades básicas de saúde (UBSs, basic health clinics; 100% of the clinics where the Family Health Program has been implemented in the city of Juiz de Fora), as well as in all of the SUS emergency rooms in the city. This study design was used because it is a methodology often employed in evaluating the impact of changes (here represented by the exposure to seasonal variations and its direct or indirect influence on the number of asthma attacks treated) on the same dynamic population without, however, necessarily repeating the observations for the same individuals in the monthly evaluations.[17] Since all of the SUS emergency rooms in the city of Juiz de Fora were included in the study, we considered the source population as representative of the population base. In addition, of the 39 urban UBSs and 14 rural UBSs, 24 were included.

The charts of the patients treated in each month were analyzed, and those treated for asthma attacks were selected. Prior to the study outset, the physicians responsible for the treatment in the different sectors received orientation regarding asthma diagnosis according to the Brazilian Consensus on Asthma Management.[18]

The profile of the population studied was analyzed regarding gender, age, place of residence, and the monthly distribution of asthma attacks treated. We evaluated the correlation between the number of asthma attacks treated and the relative humidity of the air, as well as the correlation between the number of asthma attacks and the temperature, for each period studied and in comparison with the historical mean.

The patients treated for asthma attacks were classified into two groups according to the site of the visit, that is, emergency room visits or UBS visits, as well as into distinct age brackets. The chi-square test was used to compare the groups regarding gender, and the Mann-Whitney was used to compare the groups regarding mean age. The level of significance was set at 0.05. Data were analyzed using the Epi Info 6.0 software program.

The total number of SUS medical appointments, of all types, was provided by the Juiz de Fora Department of Health.

The present study was approved by the Ethics in Research Committee of the Oswaldo Cruz Foundation on January 22, 2002 (process no. 153/01).

Results

During the study period, a total of 25,243 patients were treated for asthma attacks in the 24 UBSs and in the SUS emergency rooms. The mean age of the patients was 11.6 ± 17 years (median, 4 years), showing a non-normal distribution curve for the age of the patients treated for asthma. A total of 13,345 (52.9%) of the patients were male, and 11,898 (47.1%) were female.

The monthly distribution of the asthma attacks treated can be analyzed in Table 1, where we can see that there was a predominance of visits in the months of May (2909 patients, 11.5%), June (2726 patients, 10.8%), and July (2758 patients, 10.9%). The correlations between the number of asthma attacks treated and the monthly historical mean temperature and relative humidity of the air were –0.86 and –0.27, respectively, that is, asthma attacks presented a strong inverse correlation with temperature and a weak inverse correlation with relative humidity of the air.

The variable 'patient place of residence' was analyzed by geographic sector, according to the regionalization of the city of Juiz de Fora, and it was possible to see that the greatest number of patients resided in the east and northwest areas, comprising 6726 (26.6%) and 8511 (33.7%) of the patients, respectively (Table 2).

Of the 25,243 patients treated for asthma attacks, 23,500 (93.1%) were treated in emergency rooms, and 1743 (6.9%) were treated in UBS.

Table 1 - Distribution of absolute and relative frequencies of treatments for asthma attacks by month (n = 25,243).

Month/year	Total number of visits		ER visits		UBS visits	
	Absolute frequency (n)	Relative frequency (%)	Absolute frequency (n)	Relative frequency (%)	Absolute frequency (n)	Relative frequency (%)
Feb/02	1221	4.8	1044	4.4	177	10.2
Mar/02	1803	7.1	1640	7.0	163	9.4
Apr/02	2119	8.4	1924	8.2	195	11.2
May/02	2909	11.5	2698	11.5	211	12.1
Jun/02	2726	10.8	2564	10.9	162	9.3
Jul/02	2758	10.9	2600	11.1	158	9.1
Aug/02	2470	9.8	2304	9.8	166	9.5
Sept/02	2230	8.8	2073	8.8	157	9.0
Oct/02	2078	8.2	1948	8.3	130	7.5
Nov/02	1780	7.1	1686	7.2	94	5.3
Dec/02	1674	6.7	1609	6.8	65	3.7
Jan/03	1475	5.9	1410	6.0	65	3.7
Total	25,243	100.0	23,500	100.0	1743	100.0

ER: emergency room; UBS: unidade básica de saúde (basic health clinic).

The mean age of the patients treated in emergency rooms was 11.2 ± 16.7 years (median, 4 years). The comparison of mean age and median age of the patients treated for asthma revealed a non-normal distribution curve. A total of 12,481 (53.1%) of the patients were male, and 11,019 (46.9%) were female.

The analysis of the monthly distribution of emergency room visits for asthma revealed that there was a predominance of visits in the months of May (2698 patients, 11.5%), June (2564 patients, 10.9%), and July (2600 patients, 11.1%) (Table 1). Of the patients treated for asthma attacks, most resided in the east area (6063 patients, 25.8 %) or in the northeast area (7911 patients, 33.7%) (Table 2).

Of the 1743 patients treated for asthma attacks in the 24 UBS, 864 (49.6%) were male and 879 (50.4%) were female. The mean age was 16.7 ± 20.1 years, with a median of 6.3 years, showing a non-normal age distribution curve of the patients treated for asthma attacks. The monthly distribution of visits and the distribution of the variable 'place of residence' by geographic sector are shown in Tables 1 and 2, respectively.

The comparison between emergency room and UBS visits for asthma revealed significant differences between the mean ages of patients (p = 0.000001, Mann-Whitney test), the mean age being higher in the UBSs. There were also significant differences in the distribution of the visits by gender, in which we observed a predominance of males in emergency rooms (p = 0.004; OR = 1.15; 95% CI: 1.04–1.27 – and prevalence ratio [PR] = 1.07; 95% CI: 1.02–1.13, chi-square test).

The patients were distributed into seven age brackets, and 19,607 (77.7%) of the patients were under 12 years of age (Table 3).

In view of the predominance of patients in the up to 12 years age bracket, comprising 19,607 patients, we carried out analyses that were specific for these patients. For this group, the mean age was 3.9 ± 2.7 years. The mode age and the median age were both 3 years, showing a normal age distribution curve of the patients. A total of 11,151 (56.9%) of the patients were male, and 8456 (43.1%) were female.

Table 3 - Distribution of absolute and relative frequencies of treatments for asthma attacks by patient age bracket (n = 25,243).

Age bracket (years)	Absolute frequency (n)	Relative frequency (%)	Accumulated frequency (%)
≥ 6 m < 2 y	5401	21.3	21.4
≥ 2y < 5 y	7717	30.6	52.0
≥ 5y < 12 y	6489	25.7	77.7
≥ 12y < 18 y	728	2.9	80.6
≥ 18y < 45 y	2796	11.1	91.7
≥ 45y < 60 y	1289	5.1	96.8
≥ 60 y	823	3.3	100.0
Total	25,243	100.0	-

m: months; y: years.

Table 2 - Distribution of absolute and relative frequencies of treatments for asthma attacks by place of residence (geographic sector) in the city of Juiz de Fora (n = 25.243).

Geographic sector	Total number of visits		ER visits	UBS visits		Total number of visits
	Absolute frequency (n)	Relative frequency (%)	Absolute frequency (n)	Relative frequency (%)	Absolute frequency (n)	Coefficient by geographic sector (per 1000 inhabitants)
West	1211	4.8	1.210	5.1	1	70.2
Central	2471	9.8	2.459	10.4	12	19.0
South	2527	10.0	2.364	10.1	163	65.9
East	6726	26.6	6.063	25.8	663	69.9
Northwest	8511	33.7	7.911	33.7	600	128.7
North	1015	4.0	1.005	4.3	10	1025.2
Northeast	1899	7.5	1.755	7.5	144	115.2
Southeast	522	2.1	373	1.6	149	71.3
Other cities	361	1.4	360	1.5	1	-
Total	25.243	100.0	23.500	100.0	1.743	-

ER: emergency room; UBS: unidade básica de saúde (basic health clinic).

During the 12 months of data collection, the percentage of emergency room visits for asthma in relation to the total number of visits ranged from 8.3 to 16% for the 6 months to 12 years age bracket and from 1.8 to 3.6% for the over 12 years age bracket, whereas that the overall percentage (for all age brackets) ranged from 5.3 to 9%. Emergency room visits for asthma accounted for 11.1% of the total number of visits for the under 12 years age bracket, 2.7% for the over 12 years age bracket, and 6.6% overall (Table 4).

The comparison of visits by age bracket, considering a group of patients younger than 12 years of age and a group of patients aged 12 or older, revealed that there was a statistically significant difference in gender distribution, with a predominance of males among those under 12 (OR = 2.07; 95% CI: 1.95–2.20 – and PR = 1.46; 95% CI: 1.41–1.51 – p = 0.000001, chi-square test) and a predominance of females among those aged 12 or older (OR = 2.07, 95% CI: 1.95–2.20 – and PR = 1.42; 95% CI: 1.38–1.45 – p = 0.000001, chi-square test).

Discussion

The fact that asthma continues to be a public health problem, despite the number of therapeutic advances made, has given rise to the need to re-evaluate its management, including with respect to clinical diagnosis, since, despite being simple, asthma has very often been underdiagnosed, either due to the reluctance on the part of physicians to do so (since asthma cases are considered airway infections in childhood) or due to confusion with other diagnosis such as chronic obstructive pulmonary disease in elderly patients.[19-21] The difficulty in diagnosing asthma is one of the limitations of our study. Despite the fact that the data were obtained after the wide dissemination of the clinical inclusion and exclusion criteria (established in the II Brazilian Consensus on Asthma Management for a diagnosis of asthma) to the physicians working in public health facilities in the city, this difficulty probably led to underdiagnosis due to information bias.[18]

Despite the difficulties in using the term asthma in the first year of life, we considered 6 months to be the minimum age, since a diagnosis of asthma is dependent on the repetition of episodes of the disease, and since data in the literature show that this is the typical age at onset of the disease.[2,19,22] Patients diagnosed with bronchiolitis were excluded, as were those diagnosed with chronic obstructive pulmonary disease or mucoviscidosis, those whose onset of symptoms occurred in adulthood after a long period of smoking, and those whose airway obstruction was caused by anatomical anomalies or whose airway obstruction was secondary to foreign bodies.[18]

Table 4 - Monthly percentage of emergency room visits for asthma attacks in relation to the total number of visits (n = 23,500).

Month/year	Total number of pediatric visits n	Visits for asthma 6 m – 12 y n (%)	Total number of visits > 12 y n	Visits for asthma > 12 y n (%)	Visits for asthma (total) n (%)
Feb/02	9266	776 (8.4)	9548	268 (2.8)	1044 (5.5)
Mar/02	11,960	1362 (11.4)	11,608	278 (2.4)	1640 (6.9)
Apr/02	13,753	1607 (11.7)	15,935	317 (2.0)	1924 (6.5)
May/02	14,028	2243 (16.0)	16,047	455 (2.8)	2698 (9.0)
Jun/02	14,134	1948 (13.8)	17,110	616 (3.6)	2564 (8.2)
Jul/02	15,937	2069 (13.0)	18,517	531 (2.9)	2600 (7.5)
Aug/02	17,647	1874 (10.6)	18,230	430 (2.3)	2304 (6.4)
Sep/02	15,328	1616 (10.5)	16,834	457 (2.7)	2073 (6.4)
Oct/02	15,122	1425 (9.4)	16,610	523 (3.1)	1948 (6.1)
Nov/02	14,871	1388 (9.3)	16,504	298 (1.8)	1686 (5.4)
Dec/02	12,795	1209 (9.4)	14,869	400 (2.7)	1609 (5.8)
Jan/03	11,641	973 (8.3)	15,130	437 (2.9)	1410 (5.3)
Total	166,482	18,490 (11.1)	186,942	5010 (2.7)	23,500 (6.6)

m: months; y: years.

Racial differences in morbidity and mortality from asthma have been considered noteworthy by some studies, and a predominance among black individuals has been reported.[11,23,24] However, the high miscegenation rates in the city of Juiz de Fora, as well as the results of studies on the epidemiology of asthma, which provide strong evidence that socioeconomic differences have a much greater influence on prevalence than do ethnic differences, led us to consider this variable irrelevant.[24,25]

In 1996, the Brazilian government spent approximately 76 million Brazilian reals on asthma-related hospital admissions, this value corresponding to 2.8% of total annual expense for health care and representing the third greatest SUS expense for a single disease nationwide.[18] Asthma attacks represent uncontrolled disease, resulting in high public health costs, as demonstrated by one group of authors, who estimated the expenditure in the USA to be 295 million dollars in 1990.[26] Those expenses become even more relevant when patients need to seek treatment far from their place of residence or in emergency rooms, which implies higher costs and increased difficulty in monitoring the preventive treatment of the patients.[10]

Therefore, we can attest to the importance of our results for the public health system, since, of the 25,243 patients diagnosed with asthma over the 12-month study period, 23,500 (93.1%) were treated in emergency rooms, and only 1743 (6.9%) were treated in the 24 UBSs. We observed that treatment for asthma attacks is regularly sought in emergency rooms, as reported in the cities of Pelotas (located in the state of Rio Grande do Sul) and Belo Horizonte (located in the state of Minas Gerais).[27,28] The present study was carried out in public institutions in the city of Juiz de Fora, and did not include any private institutions. Although treatment was available, since patients had access to emergency rooms and hospitals, the situation is less than ideal in the sense that those facilities should be responsible for curative treatment and not for preventive treatment.

The ages of patients treated for asthma presented a non-normal distribution curve (median of 4 years), with 52% of patients being younger than 5 years of age and 77.7% being younger than 12 years of age – results that are in accordance with those of other studies that show greater vulnerability in the younger age brackets, which should be given priority in the development of prevention strategies.[10,26,29]

Our results showed a significant difference between the mean age of patients treated in the UBSs (16.7 years) and that of those treated in emergency rooms (11.2 years) ($p = 0.000001$, Mann-Whitney test), as well as a significant gender-related difference in the distribution of the visits, in which we observed a predominance of males among the patients treated in emergency rooms (OR = 1.15; $p = 0.004$). This finding can be explained by the greater prevalence of asthma in young children, who constitute a group that is vulnerable to admissions and exacerbations, and by the fact that males have less access to the UBSs, which are only open during the day, a time when adult patients, especially males, are working.[10,19,26,27]

Similarly to other authors, we found that the prevalence of visits for asthma in males was 1.46-times higher among those younger than 12 years of age, and that the prevalence of visits for asthma in females was 1.42-times higher among those aged 12 or older.[29] In addition to the strength of the association demonstrated by these values, the precision of the study was evidenced by the small confidence intervals.

The seasonal characteristic of the visits for asthma, with a higher frequency in the months of May, June, and July, as well as the correlations between the number of asthma attacks treated and the monthly historical mean temperature and relative humidity of the air ($r = 0.27$, a strong inverse correlation with temperature and a weak inverse correlation with relative humidity of the air), can be explained, according to some authors, by a direct influence of the climate on asthma patients, due to altered pulmonary function, and also an indirect influence, since there is more exposure to certain allergens in homes, which remain closed for longer periods in the winter.[12] The weak correlation with relative humidity of the air is probably due to the fact that relative humidity varies little in the city of Juiz de Fora, since, even on biologically dry days, it remains above 65%.

The analysis of the distribution of patients by place of residence revealed a higher frequency of visits for asthma among patients who lived in the east and northwest areas, which can be explained by the fact that those are areas of high population density. However, the analysis of the coefficient

by geographic sector revealed a greater number of visits for asthma per thousand inhabitants in the northeast, northwest, and north areas, probably due to the fact that these populations live in poor socioeconomic conditions, according to the Brazilian Institute of Geography and Statistics, and are more dependent on the SUS.

According to the II Brazilian Consensus on Asthma Management, asthma is responsible for 5% of the pediatric visits to general emergency rooms, 16% of the visits to pediatric emergency rooms, and 12% of the visits to adult emergency rooms. Our results demonstrated that, during the 12 months of data collection, the percentage of emergency room visits for asthma (in relation to the total number of visits) ranged from 8.3 to 16% for the 6 months to 12 years age bracket and from 1.8 to 3.6% for the over 12 years age bracket, that is, we obtained values similar to those estimated by the II Consensus for young children, but with relatively lower frequencies for adults, which could be explained by the limitation of our study due to the possibility of underdiagnosis among patients in the over 12 years age bracket.[18] Results similar to ours for the adult phase were obtained in a study conducted between 1988 and 1989 in Sidney, Australia, where 3% of the emergency room visits for all age brackets were due to asthma, whereas, in a pediatric hospital, the percentage of visits for asthma was 12.3%.[30]

The lack of prophylactic treatment of asthma implies a high socioeconomic cost and the maintenance of the cycle of asthma-related visits and hospitalizations.[5,14,30] Our results demonstrated that, despite the possibility of the occurrence of information bias due to underdiagnosis, the monthly prevalence of asthma was high, following a seasonal pattern, with a tendency toward increased values in periods of lower temperature and lower relative humidity. In our view and in that of other researchers, some causes related to the fact that emergency rooms are more commonly sought for treatment than are outpatient clinic services could be the severity of the symptoms, as well as the limited access to emergency treatment in the UBS, and the lack of resources in primary care.[23,28,29] Rectifying this situation should be the primary objective of a strategy aimed at increasing the availability of preventive treatment of asthma, and, in order to achieve this objective, it is necessary that health care facilities be reorganized and that drugs for preventing asthma be available in primary care. In addition, it is necessary that patients and their families be included in asthma education programs.

References

1. Evans R, Gergen PJ. Etiology and pathogenic factors in allergy and asthma. In Bierman CW, Pearlman DS, Shapiro GG, Busse WW, editors. Allergy, asthma, and immunology from infancy to adulthood. 3rd ed. New York: W.B. Saunders; 1996. p. 79-88.
2. Sociedade Brasileira de Pneumologia e Tisiologia. III Consenso Brasileiro no manejo da Asma 2002. J Pneumol. 2002; 28(Supl 1):S1-28.
3. Morgenstern GK, Freitas AT, Rosário-Filho NA. Competências do alergista no manejo da asma. Rev Bras Alerg Imunopatol. 1997;20(5):183-4.
4. Kemp JP. Approaches to asthma management: realities and recommendations. Arch Intern Med. 1993;153(7):805-12.
5. Sano F, Sole D, Naspitz CK. Intervenção precoce com corticoterapia inalatória no tratamento da asma. Rev Bras Alerg Imunopatol. 2000;23(3):124-9.
6. Newacheck PW, McManus MA, Fox HB. Prevalence and impact of chronic illness among adolescents. Am J Dis Child. 1991;145(12):1367-73.
7. Camelo-Nunes IC, Wandalsen GF, Melo KC, Naspitz CK, Solé D. Prevalência de asma e de sintomas relacionados entre escolares de São Paulo, Brasil: 1996 a 1999 - Estudo da reatividade brônquica entre adolescentes asmáticos e não asmáticos - International Study of Asthma and Allergies in Childhood (ISAAC). Rev Bras Alerg Imunopatol. 2001;24(3):77-89.
8. Gergen PJ, Weiss KB. Changing patterns of asthma hospitalization among children: 1979 to 1987. JAMA. 1990;264(13):1688-92.
9. Anderson HR. Trends and district variations in the hospital care of childhood asthma: results of a regional study 1970-1985. Thorax. 1990;45(6):431-7.
10. Fischer GB, Camargos PAM. Paediatric asthma management in developing countries. Paediatr Respir Rev. 2002;3(4):285-91.
11. Weiss KB. Seasonal trends in US asthma hopistalizations and mortality. JAMA. 1990;263(17):2323-8.
12. Jamason PF, Kalkstein LS, Gergen PJ. A synoptic evaluation of asthma admissions in New York city. Am J Respir Crit Care Med. 1997;156(6):1781-8.
13. World Health Organization. Global Initiative for Asthma (GINA). Global strategy for asthma management and prevention. Canada; NHLBI/WHO; 2002.
14. Westphal MF, Sampaio MMSC. O valor do tratamento intercrítico da criança asmática e seus aspectos educativos. Pediatria (S. Paulo) 1984;6(3):116-23.
15. Weiss KB, Sullivan SD. Understanding the costs of asthma: the next step. CMAJ. 1996;154(6):841-3.
16. Anuário Estatístico de Juiz de Fora, Ano-base 2000. Juiz de Fora: Templo Gráfica e Editora; 2001.
17. Klein CH, Bloch KV. Estudos seccionais. In: Medronho RA, Carvalho DM, Bloch KV, Luiz RR, Werneck GL, editores. Epidemiologia. São Paulo: Atheneu; 2004. p.125-50.

18. Sociedade Brasileira de Pneumologia e Tisiologia. II Consenso Brasileiro no Manejo da Asma. J Pneumol. 1998;24(4): S173-96.
19. Yunginger JW, Reed CE, O'Connell EJ, Melton LJ 3rd, O'Fallon WM, Silverstein MD. A community-based study of the epidemiology of asthma. Incidence rates, 1964-1983. Am Rev Respir Dis. 1992;146(4):888-94.
20. Massod D, Cheriyan S, Patterson R. Management of asthma in the geriatric population. Gerontology 1996;42(4):183-9.
21. Sociedade Brasileira de Pneumologia e Tisiologia. I Consenso Brasileiro de Doença Pulmonar Obstrutiva Crônica (DPOC). J Pneumol. 2000;26(Supl 1): S1-52.
22. Blair H. Natural history of childhood asthma. 20-year follow-up. Arch Dis Child. 1977;52(8):613-9.
23. Stanford R, McLaughlin T, Okamoto LJ. The cost of asthma in the emergency department and hospital. Am J Respir Crit Care Med. 1999;160(1):211-5.
24. Weitzman M, Gortmaker SL, Sobol AM, Perrin JM. Recent trends in the prevalence and severity of childhood asthma. JAMA. 1992;268(19):2673-7.
25. Homa DM, Mannino DM, Lara M. Asthma mortality in U.S. hispanics of mexican, puerto rican, and cuban heritage, 1990-1995. Am J Respir Crit Care Med. 2000;161(2 Pt 1): 504-9.
26. Weiss KB, Gergen PJ, Hodgson TA. An economic evaluation of asthma in the United States. N Engl J Med. 1992;326(13):862-6.27- Chatkin M, Menezes AMB, Albernaz E, Victora CG, Barros FC. Fatores de risco para consultas em pronto-socorro por crianças asmáticas no Sul do Brasil. Rev Saúde Pública. 2000; 34(5):491-8.
28. Lasmar LMLBF, Fontes MJF, Guerra HL, Jentzsch NS. Perfil da assistência pública à criança e ao adolescente asmáticos. Rev Med Minas Gerais. 2000;10(4):219-31.
29. Zimmermman DR, Allegra JR, Cody RP. The epidemiology of pediatric visits to New Jersey general emergency departments. Pediatr Emerg Care. 1998;14(2):112-5.
30. Mellis CM, Peat JK, Bauman AE, Woolcock AJ. The cost of asthma in New South Wales. Med J Aust. 1991;155(8):522-8.