Original Article

Seasonal variations in emergency room visits for asthma attacks in Gama, Brazil*

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ABSTRACT

Objective: To quantify the number of asthma attacks treated in the emergency room of a public hospital and to study seasonal fluctuations, taking into consideration the local climate, which is characterized by having only two seasons: a rainy/humid season and a dry season. **Methods:** A retrospective survey was conducted in a community general hospital. A total of 37,642 emergency room consultations related to asthma, bronchitis, pneumonia, upper-airway infection or other respiratory complaints were registered during a two year period. The data from each patient chart were collected for later analysis. **Results:** Among the respiratory conditions treated, asthma (24.4%) was the second most common diagnosis. Most of the asthma consultations (56.6%) involved children below the age of fifteen. Regression analysis revealed a seasonal variation in the number of asthma consultations, which was significantly higher in March ($p = 0.0109$), the low points being in August ($p = 0.0485$) and September ($p = 0.0169$). The correlation between climate and asthma was most significant in relation to changes in humidity, although the effect was delayed by one month ($p = 0.0026$) or two months ($p = 0.0002$). **Conclusion:** Visits to the emergency room for the treatment of asthma attacks were more frequent during the rainy season, increasing at one to two months after the annual increase in humidity and decreasing in the dry season. This positive correlation raises the possibility of a causal relationship with proliferation of house dust mites and molds.

Keywords: Seasons; Status asthamaticus/etiology; Weather; Pyroglyphidae ; Humidity; Emergency service, hospital

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INTRODUCTION

Emergency room visits and hospital admissions for asthma result from exacerbations of the disease, constitute risk factors for death, and are evidence of inadequate therapeutic control. Therefore, reductions in the number of emergency room visits and hospital admissions[1] are among the objectives emphasized in practical guidelines and consensuses on asthma management.

The seasonal exacerbation of asthma is a well-known phenomenon, and various authors have demonstrated a variation in the rate of emergency room visits, hospitalizations, and mortality during certain periods of the year.[2-3] The patterns of the use of emergency services by asthma patients could constitute a better indicator than do the patterns of hospitalization, since the former comprises a larger patient population presenting a broad spectrum of disease severity. Identifying seasonal periodicity can provide elements for researching environmental factors and altered organic responses that provide guidance for the institution of preventive measures.

The objectives of the present study were to quantify asthma-related visits to a public emergency room and to study the seasonal variance in the disease, considering local weather conditions, which are characterized by two distinct seasons, a rainy/humid season and a dry season.

METHODS

This study was conducted in a community hospital with 457 beds, accounting for 98% of the hospital beds in the city of Gama, which is a bedroom community of Brasília. This population nucleus, situated 35 km from the center of Brasília, was home to 133,797 inhabitants with an average per capita income of BR$ 3,427.82 (US$ 1,874.00) in 2000. With an average annual precipitation of 1244.8 mm, the climate is characterized by a rainy season (from October to April) and a dry season (from May to September). The temperature drops from May to August, the average low being 14.6°C.

For the current survey, the data was collected retrospectively for the period of January 1, 1999 to December 31, 2000. Over this two-year period, there were a total of 641,905 visits to the emergency room of the hospital. Out these, 37,642 were for respiratory complaints. Each emergency room file, which contained information such as patient initials, date of birth, gender, residence, date/time of entry, diagnosis, and outcome (emergency room discharge or admission to the hospital) were entered into an Epi-Info database for subsequent analysis. Diagnoses were transcribed on the forms filed by the physicians on duty and were grouped in accordance with the Tenth Revision of the International Classification of Diseases (ICD-10): asthma (J45, J46); acute bronchitis (J20); pneumonia (J12-J18); upper respiratory tract infection (J00-J06 and J11, except acute tonsillitis); other diagnoses. No attempt was made to validate the diagnoses made by the physicians. Climatic data were obtained from the National Meteorological Institute. In the present study, the data were condensed to annual and monthly means.

In the statistical analysis, we used the Pearson linear correlation coefficient to evaluate correlations among variables, calculating the respective p values and confidence intervals. To study the seasonal variance, we initially applied logarithmic transformation to the monthly mean of asthma consultations from 1999 to 2000, which were studied jointly in order to make the series more homogenous. We subsequently applied a multiple linear regression model with twelve independent variables corresponding to the months of January to December.[4] Likewise, seasonal oscillation related to the total number of visits to the emergency room was also researched in such way as to rule out the possibility that the observed variance resulted from the variance in the total number of consultations. To that end, we used the Statistical Analysis System program, version 8.2.

RESULTS

The annual mean and percentage of respiratory conditions treated in the emergency room are both shown in Table 1. Among the diagnoses made, asthma (at 24.4%) was second only to upper respiratory tract infections (at 47.1%).

Of the asthma patients treated, 51.3% were male. The majority of asthma consultations (52.6%) involved children under the age of fifteen, the under-five and five-to-nine brackets accounting for the largest shares (29.4% and 16.7%, respectively). The overall annual rate of asthma treatment was 343 visits/10,000 inhabitants. In the lower age groups,

TABLE 1

Annual means and percentages for respiratory conditions treated in the emergency room

Diagnosis	Annual Mean	Annual percentage
Upper respiratory tract infection	8.879	47.1
Asthma	4.591	24.4
Acute bronchiolitis	2.780	14.6
Pneumonia	1.976	10.4
COPD	230	1.2
Bronchiolitis	164	0.9
Other diagnoses	301	1.6
Total	18.821	100.0

DPOC: doença pulmonar obstrutiva crônica

the rates were even higher (under-five: 977/10,000; five-to-nine: 661/10,000).

The highest percentage of asthma consultations (39.7%) occurred between January and March, compared with 14.7% between July and September. The regression analysis revealed significantly higher concentrations of asthma cases in the month of March and significantly lower concentrations in the months of August and September (p = 0.0109, p = 0.0485 and p = 0.0169, respectively), characterizing a seasonal variance.

The results of the regression analysis regarding the total number of cases treated in the emergency room (for all specialties) also demonstrated a seasonal variance, albeit with differences in the distribution of asthma cases. There were more cases treated in May and June (p = 0.0011 and 0.0263, respectively), and there were fewer cases treated in July and September (p = 0.076 and 0.0047, respectively). No correlation was found between the total number of patients treated and the number of patients treated for asthma.

Total rainfall from January to March was 467.8 mm, compared with 113.5 mm from July to September, and the mean relative humidity was 67.7% and 44.7%, respectively. However, no significant correlation was established between asthma visits and climatic variances (humidity, rainfall, and mean temperature) in accordance with the statistical analysis shown in Table 2. Nevertheless, since the number of asthma consultations began to rise one or two months after the increase in humidity, as shown in Figure 1, we studied the correlation between asthma and relative humidity with a one- to two-month lag. We found a positive, linear, statistically significant correlation, i.e., the higher the relative humidity of the air during the two previous months, the higher the number of asthma-related visits for treatment. We also found a positive, significant correlation between the number of asthma-related emergency room visits and rainfall during the two previous months, as well as between the number of asthma-related emergency room visits and mean temperature during the two previous months (Table 2).

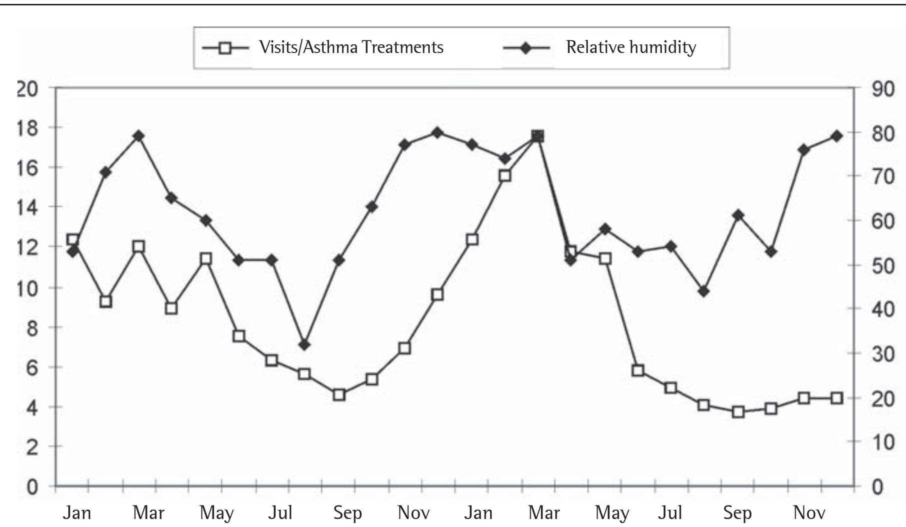

Figure 1 - Percentage variance in the number of asthma consultations in the emergency room and in the relative humidity in the years 1999 and 2000

TABLE 2

Correlations of asthma consultations with meteorological variables and other respiratory conditions treated in the emergency room between 1999 and 2000

Treatment for asthma versus	r	95% CI	p
Relative humidity	0.373	-0.036-0.675	0.0725
Relative humidity at a one-month lag	0.587	0.231-0.805	0.0026
Relative humidity at a two-month lag	0.690	0.378-0.861	0.0002
Rainfall	0.140	-0.279-0.514	0.0725
Rainfall after a one-month lag	0.344	-0.079-0.662	0.1085
Rainfall after a two-month lag	0.573	0.200-0.801	0.0045
Mean Temperature	0.128	-0.291-0.505	0.5558
Mean Temperature after a one-month lag	0.369	-0.051-0.678	0.0835
Mean Temperature after a two-month lag	0.428	0.008-0.720	0.0462
Total consultations in the emergency room	0.248	-0.172-0.592	0.2452

r: correlation coefficient

DISCUSSION

The present study represents the first time that, in the Brazilian medical literature (based on a bibliographic search of the LILACS and SciELO databases), a seasonal variance in the number of emergency room visits for asthma (in children and adults) has been demonstrated. We found that the number of such visits increased significantly in March and reached the lowest points in August and September. There was also a confirmed increase in the number of acute asthma cases from one to two months after the increase in relative humidity and two months after increases in rainfall and mean temperature. The lag between changes in environmental conditions and asthma attacks suggests that this interval is the time required for the concentrations of potential trigger factors, such as dust mites and fungi, to increase.

The validity to these findings could be questioned due to the limitations inherent to using diagnostic data provided by emergency room medical teams. However, potential diagnostic incongruities, including those in younger age brackets, are mitigated by the greater facility of diagnosing an asthma attack than of diagnosing asthma in remission, as well as by the high mean annual number of consultations (4591). Other authors have used a similar methodology, even for evaluating children.[3,5-7]

Fluctuations in the morbidity of asthma have been observed in other countries. In a study conducted in Canada,[5] it was demonstrated that asthma-related emergency room visits peak in the last week of September and remain elevated for the following three weeks. This peak affected children and adults from fifteen to sixty years of age, although no such increase was observed among individuals over the age of sixty. No correlation was found between a higher number of asthma-related visits and levels of nitric dioxide or sulfur dioxide. The authors found it improbable that a specific pollen or the replication of mites was responsible for the event. Therefore, the cause for the peak was not identified.

In the USA, it has been reported that the number of asthma-related visits is higher in autumn than in summer.[6,8] Some authors[8] found that the seasonal patterns produced a similar effect among children who displayed no reaction to the skin test, those who reacted only to domestic allergens, and those who reacted to external environmental allergens. Among the analyzed pollutants, only the seasonal pattern for sulfur dioxide coincided with asthma-related morbidity. Nevertheless, a review of the literature casts doubts on the causal nature of this association. Other authors[7] have observed increased seasonal fluctuations in children under fourteen years of age.

Therefore, according to the results of the studies published to date, no causes for the seasonal variation in asthma attacks have been identified. Among the possible factors involved, viral respiratory infections have been associated with asthma attacks in several studies.[9-12] One study[11] provided support for the hypothesis that upper respiratory tract infections are associated with 80% to 85% of the asthma-related exacerbations in school-age children. A study involving children in Brazil showed that the rhinovirus does not seem to be a trigger for asthma exacerbations.[13]

The relationship between fungi in the environment and asthma has been investigated. The growth of mold in the home can lead to serious respiratory illnesses that require hospitalization.[14] Some authors[15-16] have observed a correlation between fungal spores and asthma exacerbations. Another study showed that ten out of eleven asthma patients who had displayed respiratory arrest had returned positive skin test results for Alternaria alternata, in comparison with only 31% of the control individuals.[17] In another study,[18] involving subjects from five to thirty-four years of age, it was observed that asthma-related deaths were more likely to occur on days when the spore count was higher (1000 spores per m^3). The authors stated that, although deaths resulting from asthma also involve personal or social factors, such as access to medical services, their findings suggest that being exposed to environmental fungi plays an important role in asthma-related mortality and should therefore be taken into consideration when devising preventive strategies.

In a survey conducted in the Federal District,[19] it was observed that, among 1376 subjects examined at a pulmonology clinic, 26% tested positive results for allergen on a skin prick test. Of those, 63% reacted to mite antigens, whereas 22% and 19% reacted to two different mixtures of fungi, and 11% reacted to both cat and dog hair.

It has long been believed that mite allergens have play a major role in triggering asthma symptoms.[20] In the city of Wellington, New Zealand, 76% of recently hospitalized asthma patients tested positive for D. pteronyssinus.[21] Motivated by these findings, another group of authors[22] determined that significantly higher Der p 1 levels are found in homes with older carpets than in those with new carpets or no carpets and with a relative humidity above the average (51%). Others[23] examined dust samples collected monthly from mattresses for a two-and-a-half year period. Live mites were found during the warmer months and in months when the relative humidity was above 50% during at least part of each day. Although the period during which the mite population peaked varied from year to year, the general data indicated that humidity and higher temperatures favor the proliferation of mites. During the period evaluated in the present study, mean relative humidity in the Federal District remained at 67.7% from January to March and at 47.7% from July to September.

We identified other data of medical interest, such as the fact that asthma accounts for one-fourth of all respiratory-related emergency room visits to the community hospital in question, which is located in the central-west region of Brazil. This value was also below 30% in the city of São Paulo[24], well below the 41.3% found in Vancouver, Canada.[5] The annual rate of visits to the emergency room in this study was 343/10,000 inhabitants and therefore almost ten times higher than the number determined for Vancouver (35/10,000). A little over one-half of the asthma-related emergency consultations involved children under the age of fifteen. The lower the age bracket, the higher the rate of visits (977/10,000 for the under-five group and 661/10,000 for the five-to-nine group). These rates are 2.8 and 1.9 times higher than those found for the general population. The rate for the under-five age bracket was only slightly lower than that found in a study of children covered by Medicaid in the USA (1074/10,000 children covered).[6] These numbers indicate that asthma-related morbidity is greater in children, and that underprivileged social groups more often resort to emergency treatment, since they do not have access to outpatient clinic services or appropriate preventive treatment.

In conclusion, our data show that the number of asthma-related emergency visits varies with the seasons, rising one to two months after an increase in the relative humidity and dropping during the drier seasons. It is an accepted fact that inflammation and bronchial hyperresponsiveness render the airways susceptible to various specific agents (allergens) and nonspecific factors (viral infections, cold air, exercise, passive smoking, and pharmacological agents), both of which can cause airway obstruction and asthma symptoms. Therefore, the hypothesis that the proliferation of mites and fungi during the warmer, humid season triggers asthma attacks in our region is plausible. In this case, the adoption of preventive measures and environmental controls can reduce asthma-related morbidity.

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REFERENCES

1. Sociedade Brasileira de Pneumologia e Tisiologia. II Consenso brasileiro no manejo da asma. J Pneumol. 1998;24(4):171-276.
2. Weiss KB. Seasonal trends in US asthma hospitalizations and mortality. JAMA. 1990;263(17):2323-8.
3. Fleming DM, Cross KW, Sunderland R, Ross AM. Comparison of the seasonal patterns of asthma identified in general practitioner episodes, hospital admissions, and deaths. Thorax. 2000;55(8):662-5.
4. Neter J, Wasserman W, Kutner MH. Applied linear regression models (Richard D. Irwin, Inc., Illinois, 1983)
5. Bates DV, Baker-Anderson M, Sizto R. Asthma attack periodicity: a study of hospital emergency visits in Vancouver. Environ Res. 1990;51(1):51-70.
6. Fredrickson DD, Molgaard CA, Dismuke SE, Schukman JS, Walling A. Understanding frequent emergency room use by Medicaid-insured children with asthma: a combined quantitative and qualitative study. J Am Board Fam Pract. 2004;17(2):96-100.
7. Silverman RA, Stevenson L, Hastings HM. Age-related seasonal patterns of emergency department visits for acute asthma in an urban environment. Ann Emerg Med. 2003;42(4):577-86.
8. Gergen PJ, Mitchell H, Lynn H. Understanding the seasonal pattern of childhood asthma: results from the National Cooperative Inner-City Asthma Study (NCICAS). J Pediatr. 2002;141(5):631-6. Comment in: J Pediatr. 2002;141(5):604-5.
9. Nicholson KG, Kent J, Ireland DC. Respiratory viruses and exacerbations of asthma in adults. BMJ. 1993;307(6910): 982-6. Comment in: BMJ. 1994;308(6920):57.
10. Gern JE, Busse WW. Association of rhinovirus infections with asthma. Clin Microbiol Rev. 1999;12(1):9-18.
11. Johnston SL, Pattemore PK, Sanderson G, Smith S, Lampe F, Josephs L, et al. Community study of role of viral infections in exacerbations of asthma in 9-11 year old children. BMJ. 1995;310(6989):1225-9. Comment in: BMJ. 1995;311(7005):629. BMJ. 1995;311(7005):629-30.
12. Fraenkel DJ, Bardin PG, Sanderson G, Lampe F, Johnston SL, Holgate ST. Lower airways inflammation during rhinovirus colds in normal and in asthmatic subjects. Am J Respir Crit Care Med. 1995;151(3 Pt 1):879-86.
13. Câmara AA, Silva JM, Ferriani VP, Tobias KR, Macedo IS, Padovani MA, et al. Risk factors for wheezing in a subtropical environment: role of respiratory viruses and allergen sensitization. J Allergy Clin Immunol 2004;113(3):551-7.
14. Solomon WR. Fungus aerosols arising from cold-mist vaporizers. J Allergy Clin Immunol. 1974;54(4):222-8.
15. Salvaggio J, Seabury J, Schoenhardt FA. New Orleans asthma. V. Relationship between Charity Hospital asthma admission rates, semiquantitative pollen and fungal spore counts, and total particulate aerometric sampling data. J Allergy Clin Immunol. 1971;48(2):96-114.
16. Dales RE, Cakmak S, Burnett RT, Judek S, Coates F, Brook JR. Influence of ambient fungal spores on emergency visits for asthma to a regional children's hospital. Am J Respir Crit Care Med. 2000;162(6):2087-90.
17. O'Hollaren MT, Yunginger JW, Offord KP, Somers MJ, O'Connell EJ, Ballard DJ, et al. Exposure to an aeroallergen as a possible precipitating factor in respiratory arrest in young patients with asthma. N Engl J Med. 1991;324(6):359-63. Comment in: N Engl J Med. 1991;324(6):409-11. N Engl J Med. 1991;325(3):206-8.
18. Targonski PV, Persky VW, Ramekrishnan V. Effect of environmental molds on risk of death from asthma during the pollen season. J Allergy Clin Immunol. 1995;95(5 Pt 1):955-61.
19. Pereira AAF, Valença LM, Restivo PCN. Testes cutâneos alérgicos em doentes respiratórios. Brasília Med. 1997;34 Supl 1:92.
20. Peat JK, Tovey E, Toelle BG, Haby MM, Gray EJ, Mahmic A, et al. House dust mite allergens. A major risk factor for childhood asthma in Australia. Am J Respir Crit Care Med. 1996;153(1):141-6.
21. Fitzharris P, Stone L, Sawyer G. The atopic profile of adult asthmatics admitted to hospital in Wellington, New Zealand [abstract]. J Allergy Clin Immunol. 1996;97:378.
22. Wickens R, Siebers R, Ellis I, Lewis S, Sawyer G, Tohill S, et al. Determinants of house dust mite allergen in homes in Wellington, New Zealand. Clin Exp Allergy. 1997;27(9): 1077-85.
23. Murray AB, Zuk P. The seasonal variation in a population of house dust mites in a North American city. J Allergy Clin Immunol. 1979;64(4):266- 9.
24. Oliveira MA, Bruno VF, Ballini LS, Brito Jardim JR, Fernandes AL. Evaluation of an educational program for asthma control in adults. J Asthma. 1997;34(5):395-403.