

Factors associated with asthma control in a pediatric reference center

Fatores associados ao controle da asma em pacientes pediátricos em centro de referência

Factores asociados al control del asma en pacientes pediátricos en centro de referencia

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ABSTRACT

Objective: To describe the epidemiological and clinical data and factors associated with asthma control of asthmatic patients followed at a pediatric reference center.

Methods: Cross-sectional study including asthmatic outpatients receiving prophylactic medications from the institution. For classification of asthma, steps of treatment and control evaluation, the IV Brazilian Guidelines for the Management of Asthma (2006) were adopted. The presence of other allergies, obesity, immunodeficiency, gastroesophageal reflux and allergic sensitization were evaluated and compared between patients with or without asthma control according to the treatment step, obesity and allergic sensitization.

Results: 300 patients with asthma (1.38M:1F) were included; median age=10.8 years; median age at onset of symptoms=1.0 year. Among parents and/or siblings, 78% reported atopy. Personal history showed other allergic diseases in 292 patients (96% rhinitis, 27% atopic dermatitis, 18% allergic conjunctivitis, 6% food allergy). IgA deficiency was diagnosed in seven cases and IgG2 deficiency in four. Obesity was noted in 34/233 patients (15%) and overweight/obesity were associated with asthma poor control ($p<0.023$). Among 118 patients multisensitized, the frequency of poor asthma

control was greater (22 (19%) cases; $p=0.049$, OR 1.9; 95%CI 1.03-3.50). Among the patients, 180 (60%) were treated according steps 3 and 4; 122 children (45%) were considered controlled and 112 (41%) were partially controlled.

Conclusions: Allergic rhinitis was the allergic disease more associated with asthma. The prevalence of IgA deficiency was 20 times higher than in the general population. Total or partial control of asthma symptoms was obtained in 85% of the cases. Overweight/obesity and multisensitization were associated to poor asthma control.

Key-words: asthma; adolescent; therapeutics; obesity.

RESUMO

Objetivo: Descrever os dados epidemiológicos, clínicos e os fatores associados ao controle da asma em pacientes asmáticos seguidos em um ambulatório pediátrico especializado.

Métodos: Estudo transversal de pacientes asmáticos ambulatoriais, para os quais eram fornecidas medicações profiláticas. A classificação da asma, as etapas de tratamento e a avaliação do controle seguiram a IV Diretrizes Brasileiras para o Manejo da Asma, de 2006. Os fatores avaliados foram: outras alergias, obesidade, imunodeficiências, refluxo

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gastroesofágico e sensibilização alérgica, sendo comparados pacientes com asma controlada ou não com relação à etapa do tratamento, à obesidade e à sensibilização alérgica.

Resultados: Foram analisados 300 pacientes com asma (1,38M:1F), com mediana de idade de 10,8 anos, e de início dos sintomas de 1,0 ano. A atopia estava presente em 78% dos pais e/ou irmãos. Antecedentes pessoais de doenças alérgicas ocorreram em 292 pacientes (96% rinite, 27% dermatite atópica, 18% conjuntivite alérgica, 6% alergia alimentar). Foram diagnosticados sete casos de deficiência de IgA (DIgA) e quatro de IgG2; obesidade em 37/253 (15%), sendo que sobrepeso e obesidade estiveram associados à falta de controle ($p=0,023$). Em 118 pacientes com multissensibilização, predominaram casos não controlados (22 (19%) casos; $p=0,049$; OR 1,9; IC95% 1,03-3,50). Entre os 180 casos (60%) em tratamento nas etapas 3 e 4, 122 (45%) estavam controlados e 112 (41%) parcialmente controlados.

Conclusões: A rinite foi a alergia mais associada à asma e a prevalência de DIgA foi 20 vezes maior do que na população geral. O controle parcial ou total dos sintomas da asma foi obtido em 85% dos casos. Obesidade/sobrepeso e multissensibilização foram associadas à falta de controle da asma.

Palavras-chave: asma; adolescente; terapêutica; obesidade.

RESUMEN

Objetivo: Describir los datos epidemiológicos, clínicos y los factores asociados al control del asma en pacientes asmáticos seguidos en ambulatorio pediátrico especializado.

Métodos: Estudio transversal de pacientes asmáticos ambulatoriales, para los que se suministraban medicaciones profilácticas gratuitamente. La clasificación del asma, las etapas de tratamiento y la evaluación del control siguieron las IV Directrices Brasileñas para el Manejo del Asma, 2006. Los factores evaluados fueron: otras alergias, obesidad, inmunodeficiencias, reflujo gastroesofágico y sensibilización alérgica, siendo comparados pacientes controlados o no respecto a la etapa del tratamiento, obesidad y la sensibilización alérgica.

Resultados: Se analizaron a 300 pacientes con asma (1,38M:1F); mediana de edad de 10,8 años, mediana del inicio de los síntomas de 1,0 año. La atopia estaba presente en el 77,8% de los padres y/o hermanos. Antecedentes personales de enfermedades alérgicas ocurrieron en 292 pacientes (95,6% rinitis, 27% dermatitis atópica, 18,3% conjuntivitis alérgica, 6% alergia alimentar). Se diagnosticaron 7 casos de

deficiencia de IgA (2,3% de DIgA) y 4 de IgG2; obesidad en 37/253 (14,6%), siendo que el sobrepeso y la obesidad estuvieron asociados a la falta de control ($p=0,023$). En 118 pacientes con multissensibilización predominaron casos no controlados (18,6% frente a 9,8%) ($p=0,049$; OR 1,9; IC95% 1,03-3,50). Entre los 180 casos (60,2%) en tratamiento en las etapas 3 y 4, 122 estaban controlados (45,0%) y 112 (41,3%), parcialmente controlados.

Conclusiones: La rinitis fue la alergia más asociada al asma y la prevalencia de DIgA fue 20 veces superior a la población general. El control parcial o total de los síntomas del asma se obtuvo en el 86,3% de los casos. Obesidad/sobrepeso y multissensibilización fueron asociadas a la falta de control del asma.

Palabras clave: asma; adolescente; terapéutica; obesidad; sensibilización.

Introduction

Asthma remains a public health problem worldwide. According to Brazilian data, it represents the third leading cause of hospitalizations, accounting for 1.8% of total admissions between 2008 and 2010, and 60% (1.09%) of these patients are younger than 19 years⁽¹⁾.

Asthma is considered a chronic systemic inflammatory process involving the airway, with clinical variations depending on the interaction between different genes and the environment where the individual lives⁽²⁾. Knowledge about the existence of several asthma phenotypes, with different underlying inflammatory processes, could provide a more specific treatment. However, most centers for asthma treatment in Brazil do not detect the inflammatory process involved. Thus, asthma treatment is most frequently based on clinical control⁽²⁾.

The application of consensus for the classification of control of asthma symptoms proposes steps of increasing therapeutic efficacy and adequate monitoring of sequential treatment to ensure clinical benefits and improved quality of life^(2,3). In a study conducted in 11 Latin American countries, 2,184 adults and children with asthma were interviewed. Only 2.4% of them could be considered as having full control of asthma, and only 6% of patients used inhaled corticosteroids. The factors mentioned by the authors for this low percentage of control included low rates of diagnosis and adequate treatment, lack of monitoring, and improper use of medications for asthma control⁽⁴⁾.

The Allergy and Immunology Unit of Instituto da Criança of the HCFMUSP has developed a line of research on allergic diseases in children and adolescents. The Unit has a specializing outpatient clinic in asthma and rhinitis, where patients are followed up regularly according to the severity and their level of disease control. Patients also receive prophylactic and for the crisis medications on a regular basis e free of payment.

Therefore, the objective of the present article is to describe the profile of the asthmatic patients followed up at a pediatric specializing outpatient clinic in asthma and rhinitis and the factors that may be associated with lack of asthma control. Such knowledge may provide subsidies to new Brazilian studies at Brazilian centers looking for treatment for asthma control and improved quality of life of their patients.

Method

In early 2008, was developed a protocol for a descriptive cross-sectional study on the clinical and laboratory profile of patients treated at the specializing outpatient clinic in asthma of the Allergy and Immunology Unit of Instituto da Criança. Epidemiological data, personal and family history, associated diseases, physical environment, and vaccination schedule were included in the protocol. In addition, information about the onset of asthma symptoms, clinical and therapeutic characteristics, as well as the analysis of pulmonary function tests, laboratory tests, and imaging studies were also part of the protocol. The filling of the protocols was based on the review of medical records containing the data reported by patients and caregivers of all patients with a primary diagnosis of asthma. The present study was approved by the Research Ethics Committee at the HCFMUSP (CAPPesq) as part of the undergraduate research project for medical students at the FMUSP.

We evaluated 313 patients with primary diagnosis of asthma and/or rhinitis who were being followed up at the

outpatient clinic between March and November 2008. Of these, 13 patients were excluded because they were only diagnosed with rhinitis. The final convenience sample included 300 patients.

The diagnosis and classification of asthma severity were established using the Global Strategy for Asthma Management and Prevention, Global Initiative for Asthma (GINA-2006), 2007 updated version, and the 4th Brazilian Guidelines for Asthma Management. Asthma was classified at admission and during protocol filling as intermittent, mild persistent, moderate, or severe. Level of control was divided into: full control, partial control, or uncontrolled. The stages of treatment were also documented^(2,5). Tables 1 and 2 summarize the levels of asthma control and treatment steps. In relation to the steps of treatment, patients receive treatment only for the crisis at stage I, without the need for maintenance medications. At stages II, III, IV and V, maintenance medications are added gradually. The drugs of choice were inhaled corticosteroids at increasing doses, combined or not with long-acting bronchodilators, anti-leukotrienes and other medications, in order to achieve full control of symptoms^(2,5).

Patients' weight and height were measured during the follow-up visits, and their body mass index (BMI) was calculated by dividing the weight by squared height. BMI was classified into percentiles according to age, based on data from the World Health Organization⁽⁶⁾. Considering their BMI, patients were classified as malnourished (BMI below 5%), overweight (BMI above 85%), obese (BMI above 95%), and normal (BMI between 5-85%).

Anemia was defined based on the recommendation of the World Health Organization, which established the hemoglobin level below 11.5g/dL for children between 5 and 12 years old⁽⁷⁾. Presence of eosinophilia was established when the absolute count of eosinophils was higher than 500 cells/ μ L and increased immunoglobulin E (IgE) were

Table 1 - Levels of control of asthmatic patients^(2,5)

PARAMETER	Controlled	Partly Controlled (At least 1 in any week)	Uncontrolled
Daytime symptoms	None or minimal	2 or more / week	3 or more parameters present in any week
Night awakenings	None	at least 1	
Need for rescue medications	None	2 or more per week	
Limitation of activities	None	Present at any time	
PEF or FEV ₁	Normal or near normal	<80% predicted or personal best, if known.	
Exacerbation	None	1 or more per year	

PEF: peak expiratory flow, FEV₁: forced expiratory volume in the first second

Table 2 - Stages of asthma treatment for children older than 5 years according to severity^(2,5)

STAPS OF TREATMENT				
STEP 1	STEP 2	STEP 3	STEP 4	STEP 5
ASTHMA EDUCATION				
ENVIRONMENTAL CONTROL				
Short-acting beta 2* Y/N	Short-acting beta 2* Y/N	Short-acting beta 2* Y/N	Short-acting beta 2* Y/N	Short-acting beta 2* Y/N
Option	Select one of the options below	Select one of the options below	Add 1 or more relative to step 3	Add 1 or more relative to step 4
Preferential Option	Low-dose IC	Low-dose IC + LABA Children <6 years IC moderate dose	Moderate or high dose of IC + LABA	Low-dose oral corticosteroids
Other Options	Leukotriene inhibitors or Chromones	Moderate dose IC Low-dose IC + anti-leukotriene Low-dose IC + theophylline	Leukotriene Inhibitors Theophylline	Anti-IgE

IC: inhaled corticosteroids; LABA: long acting beta agonist; *maximum use 3 to 4 times a day and above this value seek medical advice

considered when their levels were higher than 200IU/mL. The diagnosis of immunodeficiencies, particularly of IgA deficiency and IgG2 subclasses, was according to the criteria proposed by the Pan American Group for Immunodeficiency (PAGID) and the European Society for Immunodeficiencies (ESID)^(8,9).

The immediate hypersensitivity skin test (prick test) was performed in 237 patients. Allergenic extracts, positive control (histamine), and negative control were placed on the volar forearm. A disposable plastic pricker was used to pressure the skin surface. The results were determined by measuring the diameter of the wheal formed twenty minutes later. The test was positive if the wheal was equal to or larger than 3mm in diameter⁽¹⁰⁾. Those patients who were positive to at least three allergens were considered to have multiple allergen sensitization.

For the statistical analysis, the tables included percentage, means and medians, showing standard deviation and 95% confidence interval. The computer program InStat 5.0 was used to calculate the odds ratio (OR) between BMI, IgE values, allergic sensitization, and steps of treatment regarding the control of asthma.

Results

We analyzed 300 medical records of patients diagnosed with asthma (174 males, M: F=1.38). Mean age at protocol filling was 11 years old (median: 10.8 years, ranging from 2.1 years to 20.2 years).

The mean age at the onset of asthma symptoms was 1.7 years (median=1 year, ranging from 0.5 months to 11 years). The mean follow-up period at the outpatient clinic was 3.6 years (median=2.7 years, ranging from 1-20 years).

Regarding the personal history, 17.2% (39/226) received a previous diagnosis of bronchiolitis and 78.5% (205/261) reported at least one episode of pneumonia before the start of follow-up. In terms of birth conditions and neonatal period, 8.8% (20/226) required oxygen therapy, and 14% (32/230) were premature.

A family history of atopy (parents or siblings) was reported by 77.8% (200/257). The prevalence of parent and/or mother with asthma was 35.4% (91/257) and, among siblings, there were 76 cases of asthma (29.5%).

With regard to the conditions of the physical environment at home, smoking (passive or active) was reported in 43.8% of cases (99/226), presence of animals at home in 49.4% (116/235), dust in 60.7% (88/145), and moist in 37.8% (68/180).

We were able to classify the initial severity of asthma in 270 patients. Of these, 15.9% were classified as intermittent, 23.3% as mild persistent, 40.4% as moderate persistent, and 20.4% as severe persistent. Patients were also classified according to the initial and current stage of treatment and the results are shown in Figure 1. With regard to symptom control, 271 patients were evaluated at the conclusion of the protocol, with 45% of them controlled, 41.3% and 13.7% partially controlled and uncontrolled, respectively. The association of asthma with allergic rhinitis

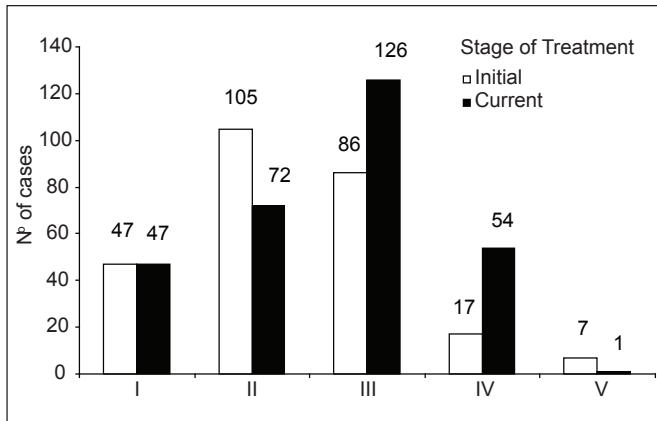


Figure 1 - Initial and current classification of patients regarding the stage of treatment according to the 4th Brazilian Guidelines for Asthma Management, 2006

was found in 95.6% of the 300 patients, atopic dermatitis in 27%, allergic conjunctivitis in 18.3%, and food allergy in 6%. The coexistence of gastroesophageal reflux was only investigated in 70 patients, being diagnosed in 40 of them (57.1%). There were 11 patients with immunodeficiency, seven of them with IgA deficiency (IgAD) and four with IgG2 deficiency.

The analysis of BMI performed in 253 patients showed that 166 (65.6%) were within the normal range, 30 were overweight (11.9%), 37 were obese (14.6%), and 20 were considered malnourished (7.9%). After analyzing the control of asthma in relation to BMI in 231 patients, we found that 11.1% (2/18) of the malnourished patients, 21.4% (6/28) of the overweight, and 21.2% (7/33) of the obese had uncontrolled asthma symptoms. In those patients with a BMI within the normal range, 9.2% (14/152) had uncontrolled symptoms (Table 3). The statistical analysis comparing overweight and obese patients with the remaining patients in relation to the control of asthma symptoms showed a significant difference ($p=0.023$), with a 2.6 times greater risk (OR=2.6, 95%CI 1.17-5.80) for uncontrolled asthma in patients with overweight and/or obesity.

Laboratory tests detected anemia in only 6.5% of cases (18/275). With regard to the absolute number of eosinophils, 48% had eosinophilia and 52% of 300 patients had normal values.

Serum IgE level was analyzed in 266 patients, showing that 84.2% of them had increased values (>200IU/mL), and the percentage of patients with serum IgE>1000IU/mL was 45.1%. There was no difference in terms of the

Table 3 - Distribution of 231 patients with asthma regarding control of asthma symptoms and their BMI

% BMI	Controlled or Partly controlled N (%)	Uncontrolled N (%)
<5	16 (7.9)	2 (6.9)
5-85	138 (68.3)	14 (48.3)
85 to 95	22 (10.9)	6 (20.7)*
>95	26 (12.9)	7 (24.1)*
TOTAL	202 (100.0)	29 (100.0)

* $p=0.023$; OR=2.6; 95%CI 1.17 to 5.80

Table 4 - Distribution of patients according to IgE serum levels and control of symptoms in 246 patients with asthma

Serum IgE IU/l	Total N	Controlled or Partly Controlled N (%)	Uncontrolled N (%)
<200	34	30 (14.1)	4 (12.1)
200-400	33	29 (13.6)	4 (12.1)
400-700	38	34 (16.0)	4 (12.1)
700-1000	28	24 (11.7)	4 (12.1)
1000-2000	49	42 (19.7)	7 (21.2)
> 2000	64	54 (25.4)	10 (30.3)
Total	246	213 (100.0)	33 (100.0)

$p=1$; OR = 1.2; 95%CI 0.39 to 3.62

Table 5 - Distribution of 271 patients with asthma regarding multiple allergen sensitization and asthma control

Prick Test	Uncontrolled Asthma N (%)	Controlled Asthma N (%)	Total
> 3 positive	22 (59.5)*	96 (41.0)	118 (43.5)
≤ 3 positive	15 (40.5)	138 (59.0)	153 (56.5)
Total	37 (100.0)	234 (100.0)	271 (100.0)

* $p=0.049$; OR=1.9; 95%CI 1.03 to 3.50

control of asthma symptoms in relation to serum IgE levels (Table 4).

As for the immediate hypersensitivity skin test (prick test), the most frequent positive allergens were *Dermatophagoides pteronyssinus* (Dpt) with 71.8% (161/224), *Dermatophagoides farinae* (Df) with 67.9% (150/221), and *Blomia tropicalis* (Bt) with 64.9% (146/225). There was less than 20% positivity to other home environment allergens, including cockroaches, dog and cat dander, and fungi. Among the 118 patients who had multiple allergen sensitization (>3 positive prick test), there was a significantly larger number of uncontrolled cases of asthma (18.6% versus 9.8%), $p=0.049$, OR 1.9, 95%CI 1.03-3.50), as shown in Table 5.

Discussion

Asthma is a highly prevalent disease worldwide, showing a tendency to increase in developing countries^(2,3). In a multicenter study using a standardized questionnaire (the International Study of Asthma and Allergies in Childhood - ISAAC), the prevalence of asthma symptoms, rhinitis and eczema in children aged 6-7 years and 13-14 years from different countries could be assessed and compared^(11,12). In Brazil, the rates are high, around 20% for both age groups⁽¹³⁾.

In children under 5 years old, the diagnosis of asthma is complex because it is based primarily on clinical aspects and history data, since it is difficult to perform objective tests in this age group^(2,3). Distinguishing the phenotypes present in this phase, such as recurrent transient wheezing and persistent wheezing⁽¹⁴⁾, is important, but often only the continued observation of these children will determine whether the wheezing is transient and will disappear between 3 and 6 years old. Some risk factors are considered important for this differentiation, including: personal or family history of atopy, eosinophilia and evidence of sensitivity to airborne allergens and/or food^(15,16).

In the first years of life, wheezing is most often related to viral infections of the respiratory tract. Respiratory syncytial virus is the most important agent, affecting up to 70% of children in the first year of life⁽¹⁷⁾. Some studies have shown that hospitalizations for bronchiolitis are an independent risk factor for developing asthma^(18,19), while other studies have suggested a clear epidemiological link between viral infection and the origin of asthma^(20,21). In the present study, 17.2% of patients reported prior history of bronchiolitis and the symptoms began at the mean age of 20 months, which may reflect immaturity of the immune system and also more frequent contact with viral agents.

Among the patients analyzed in the present study, there was a slight prevalence of males. Other studies have also shown higher prevalence of asthma in males in the pediatric age group^(16,22,23). After reviewing several articles, Postma found a higher prevalence of males until puberty, with a reversal of this trend occurring in adulthood and prevalence of women with cases of severe asthma⁽²²⁾.

In 2003, Kuruulaaratchy *et al* presented the results of a 10-year follow-up of 1,456 newborns. Of these, 40.3% (n=417) had wheezing ever in life. Among those patients who had symptoms before 4 years old, 63% were considered to have transient wheezing and 37% had persistent wheezing. Risk factors associated with persistent wheezing

were family history of asthma, recurrent chest infections at 2 years, and positive prick test at age 4⁽²⁴⁾. These data reinforce the importance of having a positive family history as part of a clinical diagnosis of asthma, which occurred in 77.8% of the cases in our sample. Several studies have shown that family history of atopy is an independent risk factor for developing asthma^(15,16,23).

Several studies have suggested a strong association between asthma and smoking in the home environment^(15,16,23). Both maternal smoking during pregnancy and passive smoking in the home environment determine high risk for developing asthma^(15,16,25). This condition of passive smoking was present in 43.8% of our cases, and the families were counseled to reduce exposure to secondhand smoke at home.

Asthma is a disease that may be related to other atopic disorders. Allergic rhinitis is the disease most often associated with asthma. Some authors consider the two diseases as a single inflammatory process of the airway, sharing the same pathophysiology, triggering factors, and environmental risk factors^(26,27). In the present study, rhinitis was associated with asthma in 95.6% of patients. The control of symptoms of rhinitis in asthmatic patients is essential, as this combination may lead to an increased need for medication to control asthma, worsening the quality of life of patients and increasing costs and demand for health care services^(27,28).

Deficiency of IgA and IgG subclasses have been related to atopic diseases such as asthma^(29,30). In the present study, we only performed the immunological evaluation of patients with severe asthma or those with recurrent infections. We found 11 patients with humoral immunodeficiency, seven of them suffering from IgA deficiency with a prevalence of 2.3%, which is quite higher than the rate among Brazilian blood donors and healthy pregnant women, who have a prevalence of 0.1% (1 in 965 donors)⁽³¹⁾. Such datum is easily explained by the fact that immunodeficiencies predispose to allergic diseases, which can often be the clinical expression of the immunodeficiencies. In 2000, the analysis of the immunological profile of 45 asthmatic patients with recurrent nasopharyngitis found 12 (26%) patients with IgA deficiency, two of them below 7 mg/dl and 10 patients with partial deficiency⁽³²⁾.

Many studies have shown that obesity is associated with increased severity of asthma symptoms and larger number of hospitalizations, especially in intensive care units^(16,33). In the present study, we found a significant difference in the control of asthma symptoms in patients with obesity/overweight,

although there was no difference in severity and treatment. In 2007, Carrol *et al*⁽³⁴⁾ conducted a retrospective study comparing obese and non-obese children with asthma at an emergency department. These authors found no difference between the severity of symptoms or the therapy received, but the obese children were more likely to require hospitalization and intensive care during exacerbations. With regard to the interference of overweight and obesity in asthma control, our results were in agreement with the literature, suggesting worsening of the lung function and symptom control in patients with high BMI.

Type I hypersensitivity reactions are involved in the process of respiratory allergies and the main antibody related to this process is IgE. Thus, increase in total and specific IgE has been correlated with the presence of asthma and other atopic diseases^(16,35,36). In 2000, an analysis of 1,219 patients conducted by Beeh *et al* showed that increased serum IgE is a risk factor for asthma regardless of atopy⁽³⁶⁾. Some authors believe that specific IgE is a better marker for atopy than total IgE^(15,16). Sensitization to certain aeroallergens has been described as more related to atopy and allergic diseases such as asthma. Arshad *et al*, in a 4-year prospective study of 981 infants, showed that tests using the four most common allergens (*Dermatophagoides pteronyssinus*, pollen, cat and *A alternata*) were sufficient to detect 94% of atopic children. The authors found that the risk of atopy increased as the number of positive prick tests increased. This same study found that sensitization to *Dermatophagoides pteronyssinus* was a risk factor for asthma⁽³⁷⁾. This coincides with the

data presented in the present study showing that 71.8% of patients were positive for this aeroallergen. Other allergens associated with asthma, such as *D. farinae*, *P. American* and *Canis familiaris*, were less prevalent in our study. Multiple sensitization may be more often associated with asthma and/or rhinitis, as previously described and confirmed in a study involving adolescents in two urban areas in Brazil⁽³⁸⁾.

Several factors may be involved in asthma control. Adherence to treatment, identification and treatment of comorbidities and triggering factors, availability of medications, and education of patients and their families may play a fundamental role in this goal^(2,3). Frequent assessments, with the possibility of continuing discussions about the disease and its comorbidities, inspection of environmental control, and the possibility of receiving medications after each medical visit may have been responsible for the high percentage of patients with controlled and/or partly controlled symptoms in the present study.

The retrospective analysis of medical records of asthmatic patients followed up at a reference center is a limitation for the generalization of the data presented in this article. However, it allowed us to understand the factors that had a positive influence on the control of asthma symptoms and other factors that should be modified so that such control is attained. Such knowledge may be useful in other health care facilities with similar characteristics. Further prospective studies including a systematic analysis of patients with asthma may provide more concrete data on the presence of isolated or combined factors that contribute to asthma control.

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