

Prevalence of symptoms of asthma, rhinitis and atopic eczema among students between 6 and 7 years of age in the city of Londrina, Brazil*

Prevalência de sintomas de asma, rinite e eczema atópico em escolares de 6 e 7 anos na cidade de Londrina (PR)

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Abstract

Objective: To determine the prevalence of symptoms of asthma, rhinitis and atopic eczema among students between 6 and 7 years of age in the city of Londrina, Brazil. **Methods:** A population-based study using the International Study of Asthma and Allergies in Childhood (ISAAC) standardized questionnaire (asthma, rhinitis and atopic eczema modules), validated for use in Brazil, in public school students between 6 and 7 years of age. **Results:** Of the 3,963 questionnaires retrieved, 3,600 (90.8%) were appropriately completed and were used in the analysis. The prevalence of symptoms of asthma, rhinitis and atopic eczema in the last 12 months was 22.0%, 27.3% and 9.6%, respectively. The prevalence of physician-diagnosed asthma, rhinitis and atopic eczema was 10.4%, 23.4% and 11.4%, respectively. The prevalence of rhinoconjunctivitis and flexural eczema was 13.6% and 6.6%, respectively. Although symptoms of asthma and rhinitis were more common in males than in females, no gender difference was found regarding atopic eczema symptoms. **Conclusions:** The prevalence of symptoms of asthma, rhinitis and atopic eczema in our sample was within the range found at the facilities that participated in phases I and III of the ISAAC in Brazil. The low prevalence of physician-diagnosed asthma suggests that asthma continues to be underdiagnosed.

Keywords: Public health; Epidemiology; Asthma.

Resumo

Objetivo: Determinar a prevalência de sintomas de asma, rinite e eczema atópico em escolares de 6 e 7 anos na cidade de Londrina (PR). **Métodos:** Estudo de prevalência de base populacional, utilizando o questionário padronizado do *International Study of Asthma and Allergies in Childhood* (ISAAC) validado para uso no Brasil (módulos de asma, rinite e eczema atópico) em escolares de 6 e 7 anos de escolas públicas. **Resultados:** Dos 3.963 questionários recuperados, 3.600 (90,8%) estavam completos e foram utilizados na análise. A prevalência de sintomas de asma, rinite e eczema nos últimos 12 meses foi de 22,0%, 27,3% e 9,6%, respectivamente. A prevalência de diagnóstico médico de asma, rinite e eczema atópico foi de 10,4%, 23,4% e 11,4%, respectivamente. A prevalência de rinoconjuntivite e de eczema em local específico foi de 13,6% e 6,6%, respectivamente. Os sintomas de asma e rinite predominaram no sexo masculino, mas não houve diferença nos sintomas de eczema atópico entre os gêneros. **Conclusões:** A prevalência de sintomas de asma, rinite e eczema em nossa amostra está dentro da variação encontrada nos centros brasileiros que participaram das fases I e III do ISAAC. A baixa prevalência de diagnóstico médico de asma sugere que esta ainda é subdiagnosticada.

Descritores: Saúde pública; Epidemiologia; Asma.

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Introduction

The prevalence of allergic diseases in the population has risen, with a consequent increase in direct and indirect costs to society. Worldwide, this has stimulated research aimed at identifying factors associated with these diseases, as well as at estimating their true prevalence and incidence, so that measures to minimize their consequences can be proposed and implemented.

Asthma is a chronic inflammatory disease of the airways that is quite common in children, presenting as recurrent episodes of wheezing, shortness of breath and cough, and can worsen at night or in the morning.⁽¹⁾

Rhinitis is defined as acute or chronic, infectious, allergic or irritative inflammation of the nasal mucosa and is characterized by anterior or posterior rhinorrhea, sneezing, nasal obstruction and nasal pruritus.⁽²⁾ Symptoms begin in childhood or adolescence and persist in adulthood. Rhinitis is the most common allergic disease in the world.⁽³⁾

Atopic eczema, also known as atopic dermatitis, is one of the most common chronic skin diseases in childhood, showing periods of exacerbations and remissions in flexural regions, depending on the age of the child. It is usually associated with other allergic diseases, such as rhinitis and asthma.⁽⁴⁾

Before the 1990s, there had been few studies comparing the prevalence of allergic diseases in different countries. In that decade, some studies were conducted in specific places. One group of authors⁽⁵⁾ reported that, in eastern Germany, there was an increase in the prevalence of atopy, which rose from 19% in 1991 to 27% in 1996, although there were no differences in the prevalence of asthma in the period. Another group of authors⁽⁶⁾ reported that, among students from Aberdeen, Scotland, the prevalence of atopic eczema, which was 5.3% in 1964, increased to 12% in 1989. In Sweden, an increase in the prevalences of asthma, rhinitis and eczema was reported between 1979 and 1991.⁽⁷⁾

Symptom questionnaires are frequently used in epidemiological studies of asthma due to their low-cost and user-friendliness.⁽⁸⁾ Since there is no gold standard for defining asthma in epidemiological studies, one group of authors⁽⁹⁾ defined "active asthma" as wheezing symptoms in the last 12 months, associated with increased bronchial hyperresponsiveness. Those authors

observed that children between 7 and 12 years of age presenting with active asthma had increased hyperresponsiveness, greater variation in airflow and greater frequency of symptoms of asthma and atopy, in addition to using more medication than did those who had bronchial hyperresponsiveness or recent wheezing in isolation.

In the early 1990s, international collaborative studies were conducted in an attempt to standardize data and determine the worldwide prevalence of asthma and respiratory symptoms, regardless of cultural or language differences. To that end, the International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire, which is a simple tool (a written questionnaire and a video questionnaire), was released in order to standardize a method of data collection that could be applied to specific populations anywhere in the world, allowing comparisons of data on the prevalence and severity of asthma, rhinitis and atopic eczema within and among the international facilities participating in the study. Another important issue that this standardized questionnaire came to solve was the monitoring of these diseases over time.^(10,11)

In Brazil, only 7 facilities participated in ISAAC phase I, whereas 21 facilities in 20 cities participated in phase III. Only the written questionnaire was used in Brazil, the asthma, rhinitis and atopic eczema modules having been validated for use in the country.⁽¹²⁻¹⁴⁾

The objective of this study was to determine the (overall and gender-related) prevalence of asthma, rhinitis and atopic eczema among public school students between 6 and 7 years of age in the city of Londrina, Brazil, by applying the ISAAC standardized questionnaire (asthma, rhinitis and atopic eczema modules), validated for use in Brazil.

Methods

A population-based prevalence study was conducted in the city of Londrina, Brazil, between February and December of 2008. Londrina is located in northern Paraná and is one of the most important cities in southern Brazil. The estimated population of Londrina is 500,000 inhabitants, 96.9% of whom live in the urban areas of the city. Its climate is characterized as humid subtropical, with rainfall in all seasons, predominantly in the summer. In general,

temperatures range from 16.4°C to 25.5°C, with hot summers and mild winters, and the mean annual relative humidity is approximately 69%.⁽¹⁵⁾

The study target population consisted of public school students aged from 6 years and 1 day to 7 years, 11 months and 29 days in the city of Londrina, Brazil. This recommended age bracket is early childhood, a phase involving many visits to health care clinics due to asthma.⁽¹⁰⁾ The total number of students in this specific age bracket was 16,320. This information, stratified by region, was obtained from the Londrina Municipal Health Department.⁽¹⁶⁾

The list of the students enrolled in state or municipal public schools at the beginning of the academic year of 2008, together with the addresses of the schools and the permission to apply the questionnaire, was provided by the Municipal Department of Education and by the Regional Center of Education. We selected 38 schools, distributed proportionally among the five regions of the city: northern; southern; eastern; western; and downtown. All children in the established age bracket who were enrolled in these schools were invited to participate in the study.

The study had the participation of the researcher and of eight previously trained interns who were third-, fourth- or fifth-year medical students at the State University at Londrina. The team had regular meetings to standardize procedures and discuss specific problems.

The ISAAC⁽¹¹⁾ standardized questionnaire (asthma, rhinitis and atopic eczema modules) was used. The asthma module comprises eight questions, the rhinitis module comprises six questions, and the atopic eczema module comprises seven questions.

The questionnaire, together with a written informed consent form as well as a letter

Table 1 - Distribution of students who completed questionnaires appropriately in the city of Londrina, Brazil, by region and age.

Region	Age				Total	
	6 years		7 years		n	% ^b
	n	% ^a	n	% ^a		
Downtown	220	36.9	376	63.1	596	16.6
Eastern	266	45.1	324	54.9	590	16.4
Northern	425	43.6	550	56.4	975	27.1
Western	367	45.1	447	54.9	814	22.6
Southern	368	58.9	257	41.1	625	17.4
Total	1646	45.7	1954	54.3	3.600	100

Chi-square test = 64.25; $p < 0.01$. ^aProportion of children by age. ^bOverall proportion of children by region.

explaining the importance of the study and requiring that the legal guardians of the children respond to all of the questions in the three modules of the questionnaire and return it to the school, was sent to parents by the teachers of each class. Within 7 to 10 days, the questionnaires were collected and, when incomplete, they were returned to be completed correctly. Students who were absent and those who did not return the questionnaire were sent another copy.

In order to reduce the possibility of data entry errors, all of the responses in the three modules were tabulated twice by the Epi Info program, version 3.4.3 for Windows, developed by the Centers for Disease Control and Prevention.

Descriptive statistics was used to organize the data in tables. The chi-square test was used to establish differences among proportions, and, when necessary, Fisher's exact test was used. In addition, the gender prevalence ratio and 95% CI were calculated. Values of $p < 0.05$ were considered statistically significant.

The study was approved by the Human Research Ethics Committee of the State University at Londrina.

Table 2 - Proportion of affirmative responses to the questions in the asthma module among students between 6 and 7 years of age in the city of Londrina, Brazil.

Question	Female		Male		Total		PR (95% CI)	p
	n	%	n	%	n	% (95% CI)		
Wheezing ever (n = 3,600)	796	46.0	933	54.0	1.729	48.0 (46.4-49.7)	1.11 (1.04-1.19)	< 0.01
Wheezing in the last 12 months (n = 3,600)	339	42.8	453	57.2	792	22.0 (20.7-23.4)	1.16 (1.08-1.24)	< 0.01
Physician-diagnosed asthma	143	38.3	230	61.7	373	10.4 (9.4-11.4)	1.23 (1.13-1.35)	< 0.01
Wheezing on exertion	93	36.8	160	63.2	253	7.0 (6.2-7.9)	1.26 (1.14-1.3 9)	< 0.01

PR: prevalence ratio.

Table 3 – Proportion of affirmative responses to the questions in the rhinitis module among students between 6 and 7 years of age in the city of Londrina, Brazil.

Question	Female		Male		Total		PR (95% CI)	p
	n	%	n	%	n	% (95% CI)		
Sneezing and rhinorrhea ever	554	44.7	685	55.3	1240	34.5 (32.9-36.0)	1.12 (1.04-1.19)	< 0.01
Sneezing and rhinorrhea in the last 12 months	437	44.4	547	55.6	984	27.3 (25.9-28.8)	1.12 (1.05-1.20)	< 0.01
Ocular symptoms	216	44.1	274	55.9	490	13.6 (12.5-14.8)	1.11 (1.02-1.21)	0.02
Physician-diagnosed rhinitis	385	45.7	458	54.3	843	23.4 (22.0-24.8)	1.08 (1.01-1.16)	0.02

PR: prevalence ratio.

Results

Based on the proportional distribution of children between 6 and 7 years of age by region and on the number of public schools in the city of Londrina, Brazil, 3,963 questionnaires were sent. Of those, 3,600 (90.8%) were appropriately completed, thereby comprising the database. Of the sample as a whole, 45.7% of the students were 6 years old and 54.3% were 7 years old.

No significant gender difference was found between the children aged 6 years and those aged 7 years, 1,837 children being male (51%) and 1,763 being female (49%).

The distribution of students with appropriately completed questionnaires by age and city region is presented in Table 1.

In the present study, the prevalence of wheezing in the last 12 months (“active asthma”) was 22.0%, the prevalence of physician-diagnosed asthma was 10.4%, and the prevalence of wheezing on exertion was 7.0%, all of which more common in boys, as shown in Table 2.

The parents of the students reported that, in the last 12 months, nasal symptoms without the flu (“active rhinitis”) occurred in 27.3% of the children, the prevalence of physician-diagnosed rhinitis was 23.4%, and associated ocular symptoms occurred in 13.6% of the students. These data are shown in Table 3.

Regarding the month of occurrence of rhinitis symptoms, the majority reported a peak period between April and July—427 children (16%) had symptoms in June and 352 (13%) had symptoms in May—whereas in the months of November and December, only 103 (3.9%) and 104 (3.9%), respectively, had symptoms.

Table 4 shows the distribution of affirmative responses to the questions in the atopic eczema module. The prevalence of symptoms in the

last 12 months (“active eczema”) was 9.6%. The prevalence of physician-diagnosed atopic eczema was found to be 11.4%. No significant gender difference was found in the responses.

Discussion

The importance of allergic diseases in childhood and their impact on the health care system have generated epidemiological research seeking to estimate the magnitude of the problem, determining not only the prevalence of these diseases, but also the etiologic factors involved, in order to optimize disease control measures and reduce the associated morbidity and mortality rates.

In order to make it possible to conduct epidemiological studies of any population, regardless of culture, race or socioeconomic condition, written questionnaires (translated to and validated in any language) are ideal tools due to their simplicity, user-friendliness and low-cost, in addition to their good acceptability and reproducibility and the fact that they allow comparisons among distinct populations.^(8,11)

The questionnaire return rate in the present study was 90.8%, which is higher than the mean of 88% reported in a multinational study conducted in Latin America⁽¹⁷⁾ and much higher than the rates of 73.2%, 58% and 51.5%, respectively, reported in studies conducted in the Brazilian cities of Cuiabá,⁽¹⁸⁾ Curitiba⁽¹⁹⁾ and Duque de Caxias.⁽²⁰⁾ Higher return rates translate to more reliable results. Worldwide, the prevalence of wheezing in the last 12 months ranged from 4.1% to 32.1%.⁽²¹⁾ In Latin America,⁽¹⁷⁾ the prevalence is as high and variable as in industrialized countries and developed regions, ranging from 8.6% (Cuernavaca, Mexico) to 32.1% (Costa Rica). In Brazil, this prevalence ranged from 16.1% in the city of Itaboraí to 27.2%

Table 4 – Proportion of affirmative responses to the questions in the atopic eczema module among students between 6 and 7 years of age in the city of Londrina, Brazil.

Question	Female		Male		Total		PR (95% CI)	p
	n	%	n	%	n	% (95% CI)		
Eczema ever	245	47.9	267	52.1	512	14.2 (13.1-15.4)	1.02 (0.93-1.12)	> 0.05
Eczema in the last 12 months	171	49.3	176	50.7	347	9.6 (8.7-10.7)	0.99 (0.89-1.10)	> 0.05
Flexural eczema	115	48.1	124	51.9	239	6.6 (5.9-7.5)	1.01 (0.89-1.15)	> 0.05
Physician-diagnosed atopic eczema	188	45.6	224	54.4	412	11.4 (10.4-12.5)	1.07 (0.97-1.18)	> 0.05

PR: prevalence ratio.

in the city of Recife. In the present study, the prevalence was found to be 22%, which is close to the national average and similar to the 22.9% reported for the city of Curitiba, Brazil.⁽¹⁹⁾ In order to explain the prevalence of asthma in countries with low socioeconomic status, one group of authors⁽¹⁷⁾ considered poverty to be a risk factor rather than a protective factor, contradicting the “hygiene hypothesis”, according to which poor hygiene practices and a large number of people living in the same household are associated with fewer cases of atopy.

In the present study, as in the study conducted in Curitiba,⁽¹⁹⁾ the prevalence of asthma was determined by the criteria set for “probable asthma”: four or more attacks in the last 12 months; or one to three attacks associated with sleep disruption; or even one to three attacks without sleep disruption, but accompanied by nocturnal cough and symptoms on exertion. The prevalence of probable asthma was found to be 16.5% among students between 6 and 7 years of age in the city of Londrina, Brazil, being higher in boys than in girls. This result is similar to the rate of 15.7% reported in the study conducted in the city of Curitiba, Brazil,⁽¹⁹⁾ and higher than the 13.2% reported in the study conducted in the city of Cuiabá, Brazil.⁽¹⁸⁾

In the present study, the prevalence of physician-diagnosed asthma (10.4%) was lower than the prevalence of wheezing in the last 12 months (22.0%), in addition to being similar to the prevalence of previously diagnosed asthma (10.3%) reported in the study conducted in the city of Duque de Caxias, Brazil,⁽²⁰⁾ which confirms underdiagnosis. Underdiagnosis of asthma was also reported in a study conducted in the city of Curitiba, Brazil,⁽¹⁹⁾ the rate being 6.5%, and in a study conducted in the western region of the city of São Paulo, Brazil,⁽²³⁾ the rate being 5.7%.

The explanation for this involves cultural issues, such as the stigma associated with the diagnosis of asthma by family members and physicians, who prefer to use the term “bronchitis”.

The prevalence of nocturnal cough in the last 12 months, without associated infection, was 35.9%, being within the 19.9 to 41.5% range reported in the multinational study conducted in Latin America⁽¹⁷⁾ and similar to the 37.5% reported in the study conducted in the city of Duque de Caxias, Brazil,⁽²⁰⁾ as well as to the 32.4% reported in the study conducted in the city of Curitiba, Brazil.⁽¹⁹⁾ Worldwide, this prevalence varied widely, ranging from 5.9% in Iran to 39.5% in Argentina.⁽²¹⁾ It is possible that other respiratory diseases have been contributing to increasing these values, which makes this a sensitive issue, despite little specific, for the diagnosis of asthma.

With the exception of wheezing-related sleep disturbance, impaired speech and nocturnal dry cough, there was a predominance of affirmative responses to all of the other questions among the boys evaluated in the present study. This can be explained by differences in the anatomy of the lower respiratory tract, since, in boys, the airways are narrower, have greater tone and have lower pulmonary flow.⁽²⁴⁾ Therefore, childhood asthma is more common in boys.⁽²¹⁾

Regarding rhinitis, the prevalence of nasal symptoms in the last 12 months was 27.3%. This rate is within the range found in a study conducted in different cities in Brazil,⁽²⁵⁾ in which the rates ranged from 20.2% in the city of Uberlândia to 33.8% in the city of São Paulo. In phase III of the ISAAC in Brazil,⁽²⁵⁾ the mean prevalence of “acute rhinitis” was 25.7%. Worldwide,⁽²²⁾ this prevalence ranged from 1.5% to 41.8%.

The prevalence of rhinoconjunctivitis found in the present study was 13.6%. In Brazil, the prevalence of rhinoconjunctivitis ranged from 9.8% in the city of Uberlândia to 28.9% in the city of Itabira. Worldwide,⁽²⁶⁾ this prevalence ranged from 0.8% to 14.9%.

Symptoms that affect daily activities, characterizing the severity of rhinitis, were reported by 13.5% of the legal guardians of the students, a rate that is similar to that found in the city of Uberlândia, Brazil.⁽²⁵⁾

The prevalence of physician-diagnosed rhinitis was 23.4%, which is much higher than the rates ranging from 0.8% to 14.9% reported in a worldwide study,⁽²⁶⁾ is also higher than the 9.3% found in the city of Itabira, Brazil,⁽²⁵⁾ and is similar to the rate of 24.4% found in the city of Porto Alegre, Brazil.⁽²⁵⁾

In the city of Londrina, similarly to the findings of a study conducted at facilities in southern and southeastern Brazil,⁽²⁵⁾ the months between April and August were recorded as the peak period of rhinitis symptoms, affecting the daily activities of the children minimally in the vast majority of cases. An exception was found in the western region of the city of São Paulo, where the peak period of nasal symptoms was between September and December.⁽²³⁾

Among allergic diseases, symptoms related to atopic eczema were the least reported by parents, occurring in 9.6% of the students in the last 12 months. In Brazil,⁽²⁷⁾ the prevalence ranged from 7.3% in the city of Salvador to 13% in the cities of Aracaju, Nova Iguaçu and Natal.

The wide range of atopic eczema symptoms found worldwide shows low prevalence rates (< 5%) in China, in Eastern Europe and in Central Asia, whereas in Africa, in the Baltic States and in Northern and Western Europe, prevalence rates exceed 15%.

The prevalence of asthma with flexural eczema in the last 12 months was 6.6%, similar to the rate found in the central southern region of the city of São Paulo, Brazil,⁽²⁸⁾ and lower than the 9.8% found in the city of Recife, Brazil.⁽²⁷⁾ The mean prevalence in Brazil has been shown to range from 5.3% to 13.0%.⁽²⁸⁾ Although this combined criterion translates to chronicity (flexural distribution and recurrence), one group of authors⁽²⁹⁾ advocate that the use of physician-diagnosed atopic eczema in public health would be of greater help because it would allow the

evaluation of a greater number of individuals with symptoms, making it possible to increase the number of diagnoses.

Worldwide, the prevalence of physician-diagnosed atopic eczema ranged from 1.1% in Iran to 18.4% in Sweden.⁽²⁷⁾ In Brazil, it ranged from 7.9% in the city of Santo André to 15.2% in the city of Manaus.⁽²⁸⁾ In the city of Londrina, the rate of 11.6% found for the prevalence of physician-diagnosed atopic eczema is within the national average.

In conclusion, the prevalence of wheezing in the last 12 months was 22.0% in the present study. The analysis of the responses to the question about having ever had asthma revealed that underdiagnosis still occurs (10.4%). The prevalence of rhinitis was 27.3%, whereas the prevalence of rhinoconjunctivitis was 13.6%. Although the prevalence of atopic eczema was 9.6%, it decreased to 6.6% when the combined criterion of flexural eczema symptoms was used. In the present sample, asthma and rhinitis were more common in boys, and no gender difference was found regarding atopic eczema.

References

1. Sociedade Brasileira de Pneumologia e Tisiologia. IV Diretrizes Brasileiras para o Manejo da Asma. *J Bras Pneumol.* 2006;32(Suppl 7):S447-S474.
2. Bousquet J, Khaltaev N, Cruz AA, Denburg J, Fokkens WJ, Togias A, et al. Allergic Rhinitis and its Impact on Asthma (ARIA) 2008 update (in collaboration with the World Health Organization, GA(2)LEN and AllerGen). *Allergy.* 2008;63 Suppl 86:8-160.
3. Li Y, Baudoin T. Prevalence of allergic rhinitis and related diseases. Review. *Acta Clin Croat.* 2004;43:61-6.
4. National Collaborating Centre for Women's and Children's Health (Great Britain); National Institute for Health and Clinical Excellence (Great Britain). *Atopic Eczema in Children: Management of Atopic Eczema in Children from Birth Up to the Age of 12 Years.* London: RCOG Press; 2007.
5. von Mutius E, Weiland SK, Fritzsche C, Duhme H, Keil U. Increasing prevalence of hay fever and atopy among children in Leipzig, East Germany. *Lancet.* 1998;351(9106):862-6.
6. Ninan TK, Russell G. Respiratory symptoms and atopy in Aberdeen schoolchildren: evidence from two surveys 25 years apart. *BMJ.* 1992;304(6831):873-5.
7. Aberg N, Hesselmar B, Aberg B, Eriksson B. Increase of asthma, allergic rhinitis and eczema in Swedish schoolchildren between 1979 and 1991. *Clin Exp Allergy.* 1995;25(9):815-9.
8. Wandalsen NF, Gonzalez C, Wandalsen GF, Solé D. Evaluation of criteria for the diagnosis of asthma using an epidemiological questionnaire. *J Bras Pneumol.* 2009;35(3):199-205.

9. Toelle BG, Peat JK, Salome CM, Mellis CM, Woolcock AJ. Toward a definition of asthma for epidemiology. *Am Rev Respir Dis.* 1992;146(3):633-7.
10. Asher MI, Keil U, Anderson HR, Beasley R, Crane J, Martinez F, et al. International Study of Asthma and Allergies in Childhood (ISAAC): rationale and methods. *Eur Respir J.* 1995;8(3):483-91.
11. International Study of Asthma and Allergies in Childhood (ISAAC). Manual. Auckland/Münster: International Study of Asthma and Allergies in Childhood (ISAAC); 1993.
12. Solé D, Vanna AT, Yamada E, Rizzo MC, Naspitz CK. International Study of Asthma and Allergies in Childhood (ISAAC) written questionnaire: validation of the asthma component among Brazilian children. *J Investig Allergol Clin Immunol.* 1998;8(6):376-82.
13. Vanna AT, Yamada E, Arruda LK, Naspitz CK, Solé D. International Study of Asthma and Allergies in Childhood: validation of the rhinitis symptom questionnaire and prevalence of rhinitis in schoolchildren in São Paulo, Brazil. *Pediatr Allergy Immunol.* 2001;12(2):95-101.
14. Yamada E, Vanna AT, Naspitz CK, Solé D. International Study of Asthma and Allergies in Childhood (ISAAC): validation of the written questionnaire (eczema component) and prevalence of atopic eczema among Brazilian children. *J Investig Allergol Clin Immunol.* 2002;12(1):34-41.
15. Prefeitura Municipal de Londrina [homepage on the Internet]. Londrina: Prefeitura on line [cited 2009 Jan 14]. Available from: <http://www.londrina.pr.gov.br>
16. DATASUS [homepage on the Internet]. Brasília: Ministério da Saúde. [cited 2009 Jan 14]. Available from: <http://www.datasus.gov.br>
17. Mallol J, Solé D, Asher I, Clayton T, Stein R, Soto-Quiroz M. Prevalence of asthma symptoms in Latin America: the International Study of Asthma and Allergies in Childhood (ISAAC). *Pediatr Pulmonol.* 2000;30(6):439-44.
18. Amorim AJ, Daneluzzi JC. Prevalência de asma em escolares. *J Pediatr (Rio J).* 2001;77(3):197-202.
19. Ferrari FP, Rosário Filho NA, Ribas LF, Calfe LG. Prevalência de asma em escolares de Curitiba - projeto ISAAC (International Study of Asthma and Allergies in Childhood). *J Pediatr (Rio J).* 1998;74(4):299-305.
20. Boechat JL, Rios JL, Sant'Anna CC, França AT. Prevalence and severity of asthma symptoms in school-age children in the city of Duque de Caxias, Rio de Janeiro, Brazil. *J Bras Pneumol.* 2005;31(2):111-7.
21. Worldwide variations in the prevalence of asthma symptoms: the International Study of Asthma and Allergies in Childhood (ISAAC). *Eur Respir J.* 1998;12(2):315-35.
22. Solé D, Camelo-Nunes IC. A dimensão do problema da asma e da rinite alérgica no Brasil: prevalência, hospitalizações e mortalidade. *Gaz Med Bahia.* 2008;78 (Suppl 2):3-10.
23. Lima RG, Pastorino AC, Casagrande RR, Sole D, Leone C, Jacob CM. Prevalence of asthma, rhinitis and eczema in 6 - 7 years old students from the western districts of São Paulo City, using the standardized questionnaire of the "International Study of Asthma and Allergies in Childhood" (ISAAC)-phase IIIB. *Clinics (Sao Paulo).* 2007;62(3):225-34.
24. Caracta CF. Gender differences in pulmonary disease. *Mt Sinai J Med.* 2003;70(4):215-24.
25. Solé D, Camelo-Nunes IC, Vana AT, Yamada E, Werneck F, de Freitas LS, et al. Prevalence of rhinitis and related-symptoms in schoolchildren from different cities in Brazil. *Allergol Immunopathol (Madr).* 2004;32(1):7-12.
26. Strachan D, Sibbald B, Weiland S, Ait-Khaled N, Anabwani G, Anderson HR, et al. Worldwide variations in prevalence of symptoms of allergic rhinoconjunctivitis in children: the International Study of Asthma and Allergies in Childhood (ISAAC). *Pediatr Allergy Immunol.* 1997;8(4):161-76.
27. Williams H, Robertson C, Stewart A, Ait-Khaled N, Anabwani G, Anderson R, et al. Worldwide variations in the prevalence of symptoms of atopic eczema in the International Study of Asthma and Allergies in Childhood. *J Allergy Clin Immunol.* 1999;103(1 Pt 1):125-38.
28. Solé D, Camelo-Nunes IC, Wandalsen GF, Mallozi MC, Naspitz CK; Brazilian ISAAC Group. Prevalence of atopic eczema and related symptoms in Brazilian schoolchildren: results from the International Study of Asthma and Allergies in Childhood (ISAAC) phase 3. *J Investig Allergol Clin Immunol.* 2006;16(6):367-76.
29. Camelo-Nunes IC, Wandalsen GF, Melo KC, Naspitz CK, Solé D. Prevalência de eczema atópico e sintomas relacionados entre estudantes. *J Pediatr (Rio J).* 2004;80(1):60-4.

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