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**ORIGINAL ARTICLE**

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## *Prevalence of asthma in school-age children*

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### **Abstract**

**Objective:** to assess the prevalence of asthma symptoms and of asthma in children due to the high frequency of pediatrics patients with symptoms suggestive of the disease and to the lack of data regarding prevalence of asthma in this population.

**Methods:** we carried out a cross-sectional study with 2,735 school-age children aged 6-7 years and 3,509 adolescents aged 13-14 years selected by random sampling. Data were collected between 1998 and 1999 using a translated version of the questionnaire of the International Study of Asthma and Allergies in Children, which has been previously tested and approved. Guardians were responsible for answering the questionnaire of younger children, whereas adolescents answered their own, in classroom. The data were computed and analyzed using EPI-info software.

**Results:** the response rates for questionnaires were 73.2% (6-7-years old) and 94% (13-14 years old). The prevalence of symptoms in children and adolescents were, respectively: wheezing ever 46.7% and 44.3% ( $P<0.05$ ); wheezing in the last 12 months 22.7% and 21.2%; speech limited due to wheezing 4.7% and 4.0%; wheezing following exercise 6.3% and 18.2% ( $P<0.05$ ); nighttime cough in the last 12 months 38.5% and 45.8% ( $P<0.05$ ); asthma (bronchitis) ever 28.2% and 26.4% ( $P=0.11$ ).

**Conclusions:** the prevalence of asthma symptoms and of asthma of the two groups are among the highest results ever reported in Brazil; these results were compatible with those of high prevalence results reported worldwide using ISAAC questionnaires. The high prevalence of symptoms suggests a high prevalence of the disease, which makes asthma an important problem for public health in the region.

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### **Introduction**

Asthma is the most common chronic disease in childhood. Studies carried out in different countries suggest that the prevalence<sup>1-3</sup> and the rate of hospitalization<sup>4-6</sup> for children and adolescents are increasing despite the considerable advancements made in understanding the disease and the development of effective medication. The economical<sup>7,8</sup> and social consequences of the disease are important, contributing to overburden healthcare services and giving rise to a public healthcare problem.<sup>7</sup>

The International Study of Asthma and Allergies in Childhood (ISAAC) was created with the general objective of maximizing the value of epidemiological research on asthma and other allergic diseases in childhood, and of facilitating international cooperation. The ISAAC suggests a single research method, the ISAAC protocol, based on written questionnaires and video. The protocol studies children in two age groups, aged 6 to 7 and 13 to 14 years.<sup>9</sup>

Some of the specific objectives of the ISAAC protocol are: 1) to describe the prevalence and severity of asthma, rhinitis, and eczema in children who live in different locations and establish a comparison of intra- and inter-country differences; 2) to set baseline measures for future tendencies in prevalence and severity of these diseases; 3) to develop a structure for future etiologic research on genetic and

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environmental factors, lifestyle, and medical care related to these diseases.<sup>9</sup>

In Brazil, the ISAAC protocol was carried out in seven cities. With the exception of the city of Salvador, school-age children between the ages of 6 to 7 and 13 to 14 years were studied. The results obtained in these cities for children and adolescents were, respectively: São Paulo 6.1% and 10.0%; Curitiba 6.6% and 8.6%; Porto Alegre 16.8% and 21.9%; Recife 20.7% and 21.0%; Uberlândia 5.4% and 15.1%; Itabira 4.7% and 4.8%; and Salvador 12.6%.<sup>1</sup>

In the city of Cuiabá, state capital of Mato Grosso, there are no data on the prevalence of asthma or its symptoms. We used the research method proposed by the International Study of Asthma and Allergies in Childhood (ISAAC)<sup>9</sup> to determine the prevalence of asthma symptoms and of its diagnosis.

### Patients and Methods

We obtained, from The State and City Departments of Education, an official list of public and private schools in the city of Cuiabá that also indicated their location - north, south, east, and west - within the city. The data provided did not include the number of enrolled students according to age and sex, only the total number of students enrolled according to grade and school.

We prepared a list separating public and private schools into zones, number of students enrolled according to grade, and total number of students enrolled. Next, schools were selected according to systematic random sampling, not proportional to size (each school was given a single number) after stratification according to the following variables: type (public or private), zone (north, south, east, or west), grades with enrolled students in each school (1st through 4th grade, 1st through 8th grade, or 5th through 8th grade), total enrolled students per school (< 250, 250 to 499, 500 to 749, 750 to 999, 1,000 to 1,449, and 1,500 or more).

The objective of the stratification was to increase the probability of obtaining a sample more representative of the diversity of schools, in an attempt to proportionally include public and private institutions reducing, thus, the possibility of obtaining a "poor" sample by mere chance. As a result, the sample included approximately 34% of the public schools (16 in the east, 10 in the west, 11 in the north, and 10 in the south zone), and 18% of the private schools (4 in the east, 4 in the west, 3 in the north, and 1 in the south zone). All students aged 6 to 7 and 13 to 14 years and enrolled in the selected schools were included in the study.

The sample size according to ISAAC protocol recommendations was calculated considering severe atopic disease rather than the prevalence of the disease itself. The sample for the detection of differences in the severity of asthma was larger than that for the detection of differences in prevalence, since severe asthma is less common. Consequently, a population sample of 3,000 children was established in order to carry out these studies. We carried

out a cross-sectional study in which we assessed 2,735 children aged 6 to 7 years and 3,509 adolescents aged 13 to 14 years.

In Brazil, the translation and back translation of the ISAAC questionnaire were done without any important alterations. A review of the questionnaire by a committee was not required, and pre-testing as well as validation were considered appropriate.<sup>10</sup>

The term bronchitis was used as a synonym for asthma in order to allow for a better understanding by the responders, since the latter is not a commonly used word. We posited the following question: "Have you ever suffered from asthma or bronchitis?". In order to minimize the bias that might originate from the use of the word asthma, we used the term "probable asthma" for the cumulative frequency of answers in order to indicate the diagnosis of asthma with greater precision. Thus, school children who answered that they had four or more episodes during the past twelve months, or one to three episodes involving sleep problems, night cough, or wheezing after physical exercises probably had asthma.<sup>10</sup>

We avoided collection of data during the months in which the air is more polluted in the city. The children took their questionnaires home so that their parents or guardians would answer them. The adolescents, in turn, answered their own questionnaires in class under the supervision of the researcher. Those who were absent from class on that day were given another opportunity to answer the questionnaire. We considered valid all questionnaires that were correctly filled out.

The data were entered into EPI-info software and, under no circumstances, were they altered. For the statistical analysis, we used the chi-square test<sup>11</sup> and the chi-squared distribution based on a 2xN contingency table.<sup>12</sup> Null hypothesis rejection was set at 0.05 or 5% and significant values were marked with an asterisk.

The study was approved by the Ethics Committee of the Hospital das Clínicas - teaching hospital of the Universidade de São Paulo School of Medicine. We also obtained permission to carry out the study from the school principals. The adolescents themselves or the parents or guardians of children aged 6 to 7 years also consented to the participation in the study.

### Results

The questionnaire return rate was 73.2% (6 to 7-year-old subjects) and 94% (13 to 14-year-old subjects). The prevalence of asthma symptoms in children and adolescents is shown in Table 1. As to the presence of "wheezing ever", considering age group, there was no significant difference in children aged 6 to 7 years; however, among adolescents, wheezing was more frequent in girls ( $\chi^2 = 6.01$  and P less than or equal to 0.05). According to sex, wheezing was more frequent in boys aged 6 to 7 years old than in adolescents ( $\chi^2 = 15.97$  and P less than or equal to 0.05).

The presence of “wheezing in the past twelve months” in the lower age group, was more frequent in boys than in girls ( $\chi^2 = 15.92$  and P less than or equal to 0.05), whereas in the upper age group, the difference was not significant. In terms of sex, the presence of wheezing in the past twelve months was more frequent in boys aged 6 to 7 years than in those aged 13 to 14 years ( $\chi^2 = 15.97$  and P less than or equal to 0.05).

The previous history of asthma (bronchitis), in terms of age group, was significantly higher in boys in both groups. In terms of sex, it was more frequent in boys aged 6 to 7 years than in those aged 13 to 14 years ( $X^2 = 4.39$  and P less than or equal to 0.05).

The presence of “wheezing after physical exercises in the past twelve months” did not show differences according to sex of children aged 6 to 7 years; in adolescents, however, it was more frequent among boys ( $\chi^2 = 5.70$  and P less than or equal to 0.05). This symptom was reported with more frequency in adolescents than in children aged 6 to 7 years (P less than or equal to 0.05).

Dry cough at night was more frequently reported by boys aged 6 to 7 years old ( $\chi^2 = 8.71$  and P less than or equal to 0.05) and female adolescents ( $\chi^2 = 8.83$  and P less than or equal to 0.05). According to sex, it was more frequent in female adolescents than in girls aged 6 to 7 years ( $\chi^2 = 49.89$  and P less than or equal to 0.05). There was no significant difference between boys.

The assessment of the question “speech disorders in the past twelve months” did not show significant differences between the two age groups; according to sex, however, it was more frequent in boys aged 6 to 7 years than in those aged 13 to 14 years ( $\chi^2 = 7.51$  and P less than or equal to 0.05).

Reports of “sleep problems in the past twelve months” were statistically more frequent in boys than in girls aged 6 to 7 years ( $\chi^2 = 4.39$  and P less than or equal to 0.05). There was no significant difference between adolescent boys and girls.

The number of wheezing episodes in the past twelve months was higher in boys than in girls aged 6 to 7 years (P less than or equal to 0.05), but there was no significant difference between boys and girls aged 13 to 14 years. Boys aged 6 to 7 years had more wheezing episodes in the past twelve months than those aged 13 to 14 years (P less than or equal to 0.05).

Considering the classification of “Probable Asthma”, a prevalence rate of 13.2% was found in individuals aged 6 to 7 years, which was significantly higher in males (15.90%) as compared to females (10.6%). The prevalence rate was of 12.0% for subjects aged 13 to 14 years, and of 11.5%, and 12.5%, respectively, for boys and girls in that same age group; this difference was not significant. The prevalence rate was higher in boys aged 6 to 7 years than in those aged 13 to 14 years; there was no significant difference between girls.

## Discussion

The response rate, which ranged between 60% and 100%, was comparable to that of other studies that used the ISAAC questionnaire. The response rate was also higher among adolescents.<sup>12-17</sup> The questionnaire return rate among children aged 6-7 years could have been higher. Factors associated with the parents or guardians may be generally related to the low return rate. These factors include low schooling, unawareness of the existence of the questionnaire because children did not hand it in, lack of interest in participating in the study, absence of advantages in returning the questionnaire.

A response rate around 90% is considered sufficient to avoid any deviation caused by nonresponders.<sup>18</sup> Considering that the comparison with other studies, carried out in different countries and with the same method, indicated comparable rates with our study, it is possible that the response rate did not affect our analyses.

**Table 1 -** Distribution of the answers to the asthma-related questionnaire in the two age groups studied, according to sex, and in %

	6 – 7 years		13 – 14 years	
	M	F	M	F
Wheezing ever	48.0	45.9	42.0	46.0*
Wheezing episodes in the past 12 months	26.0*	19.7	20.2	22.1
Asthma (bronchitis) ever	32.0*	24.8	28.1*	25.0
Wheezing after physical exercises in the past 12 months	7.1	5.5	20.0*	16.8
Dry cough at night in the past 12 months	41.2*	35.8	43.0	48.1*
Speech disorders in the past 12 months	5.6	4.0	3.4	4.5
Sleep problems in the past 12 months	16.7*	11.4	7.8	8.4
Asthma attacks in the past 12 months	23.5*	17.2	18.3	20.1

\*p ≤ 0.05

We observed a high prevalence of wheezing ever among children in this study, which was above the maximum limit described in the international literature (Table 3). However, the rates obtained in Brazil in the cities of São Paulo, Porto Alegre, Uberlândia, and Recife (Table 2) were also above this limit, thus in agreement with our findings. In Latin America, the data obtained in Brazil are similar to those found in San José, Panama, the highest rate ever described.<sup>10</sup>

We observed that, in adolescents, the cumulative prevalence of wheezing episodes was between the average and maximum limit reported in the international literature. When compared to data from Brazil, it was between the values obtained in the cities of São Paulo, Porto Alegre, Uberlândia, Salvador, Curitiba, Recife, and Itabira (Table 2).

Our results indicated that the prevalence of wheezing episodes in the past twelve months was slightly above the average value described in the international literature. When compared to data from Brazil, the rates were similar to those obtained in other cities, with the exception of Itabira, where rates were much lower. In Latin America, the highest rates for children aged 6-7 years were described in the city of San José, Panama, with the second-to-highest being the Brazilian rates; the Brazilian rates for adolescents, however, were the highest (Salvador, 27.1%) with Panama in second (23.7%).

The lowest rates in both children and adolescent groups were obtained in Mexico (8.5% and 6.5%, respectively).<sup>10</sup>

In other countries, the prevalence of wheezing in the past twelve months varied a lot according to the studied age group.<sup>19-23</sup> It is well-known that airway infection is the main triggering factor of wheezing; in this sense, when the presence of wheezing is evaluated in the absence of infection, this prevalence shows great reduction.<sup>24</sup> Consequently, responders may understand that wheezing corresponds to any chest noise; however, it is also important to remember that there is a high frequency of virus-induced asthma episodes.

Assessing the severity of asthma through epidemiological studies is not an easy task, since they quantify the problem in an indirect manner<sup>19,20,25,26</sup> evaluating the number of asthma attacks, and sleep and speech disorders in the past twelve months. In our study, the number of episodes observed in both age groups is similar to that found in most Brazilian cities (Table 2).

It is necessary to improve the treatment of asthmatic patients, and to take educational and control measures in the locations with high rates of positive answers to the questionnaire, since these responses suggest increased severity of asthma. Therefore, if proper action is taken, it is possible to improve the quality of life of patients.

**Table 2 -** Variation of asthma prevalence and related symptoms in children aged 6-7 years and in adolescents aged 13-14 years, in some Brazilian cities where the ISAAC questionnaire was used

	S. Paulo	P. Alegre	Recife	Curitiba	Itabira	Uberlândia	Cuiabá
<b>Wheezing ever</b>							
6-7 years	49.2	46.8	44.4	41.8	42.1	45.9	47.6
13-14 years	54.5	46.9	39.0	40.4	35.4	46.9	44.3
<b>Wheezing episodes in the past 12 months</b>							
6-7 years	21.3	23.5	27.4	22.9	16.1	20.2	22.7
13-14 years	23.3	24.7	19.7	18.4	9.6	21.1	21.2
<b>Asthma ever</b>							
6-7 years	6.1	16.8	20.7	6.6	4.7	5.4	28.2*
13-14 years	10.0	21.9	21.0	8.6	4.8	15.1	26.4*
<b>Wheezing after physical exercises in the past 12 months</b>							
6-7 years	5.5	7.0	13.3	9.3	6.7	6.0	6.3
13-14 years	20.5	29.0	20.6	19.8	4.2	20.9	18.2
<b>Dry cough at night in the past 12 months</b>							
6-7 years	34.2	33.6	35.1	32.4	23.8	36.1	38.5
13-14 years	33.0	39.1	31.0	30.1	19.4	39.0	45.8
<b>Speech disorders in the past 12 months</b>							
6-7 years	2.3	4.1	9.8	5.7	9.5	3.8	4.7
13-14 years	5.7	5.7	4.8	4.6	6.5	5.5	4.0
<b>Sleep problems in the past 12 months</b>							
6-7 years	13.0	16.4	23.6	14.6	10.6	14.0	13.7
13-14 years	12.0	15.1	13.1	9.1	6.7	13.4	8.2
<b>Asthma attacks in the past 12 months</b>							
6-7 years	20.6	21.8	27.0	21.6	16.0	19.3	20.2
13-14 years	24.6	25.4	20.0	17.7	9.4	22.2	19.2

Modified Solé method, 1998<sup>10</sup>

\* bronchitis as a synonym for asthma

**Table 3 -** World variation of positive answers to asthma-related questions, using the ISAAC questionnaire, in two age groups

Question	children aged 6-7 years			adolescents aged 13-14 years		
	Minimum	average	maximum	Minimum	average	maximum
Wheezing ever	2.3%	22.6%	43.2%	2.3%	23.8%	52.9%
Wheezing episodes in the past 12 months	1.6%	11.7%	27.2%	1.9%	14.2%	35.3%
1 or + attacks in the past 12 months	2.2%	11.1%	30.5%	1.9%	14.2%	34.1%
Sleep problems in the past 12 months	1.5%	6.5%	26.4%	0.8%	6.7%	16.3%
Speech disorders in the past 12 months	0.4%	2.3%	11.3%	0.7%	3.9%	10.6%
Wheezing after physical exercises in the past 12 months	1.0%	6.6%	19.2%	1.0%	21.9%	47.1%
Dry cough at night in the past 12 months	5.0%	18.5%	38.3%	2.1%	21.9%	47.1%
Asthma ever	1.3%	11.0%	30.8%	1.8%	11.7%	30.2%

Solé, 1998<sup>10</sup>

Wheezing after physical exercises were more frequent among adolescents and male subjects. These results were similar to those of most Brazilian cities (Table 2). Also, these results are in agreement with most results obtained in Latin America, with the exception of Punta Arenas, Chile, where wheezing after physical exercises was more prevalent among children.<sup>10</sup> By comparing the results obtained in our study with those of studies carried out in other countries, we observed that our results are close to the average values described (Table 3).

Dry cough at night is an important sign of asthma, especially in the absence of airway infection. We observed a high frequency of dry cough in both groups. This suggests that responders probably misunderstood the question considering that the results obtained in Brazil and Latin America were higher than those reported elsewhere. The misinterpretation of the question was probably caused by not excluding the alternative "presence of infection", which is difficult to be detected by responders unless they sought medical care or they can recall a past episode. When compared to the diagnosis of asthma (bronchitis), the prevalence of dry cough drops to 17% in children aged 6 to 7 years and to 14.5% in adolescents.

The prevalence of asthma observed in the present study, in both age groups, was higher than that found in other Brazilian cities (Table 2); however, these results cannot be compared due to the use of bronchitis as a synonym for asthma in our study. Moreover, in our study, the diagnosis probably included all wheezing disorders manifest in both age groups, which responders probably mistook as asthma. Nevertheless, the prevalence of symptoms was high, which suggests a high prevalence for the disease as well.

Several studies have used other measurements, in addition to the written questionnaires, with the objective of improving sensitivity and specificity. We did not use any additional measurement. However, we observed that with the use of the classification of "probable asthma", the prevalence rates of both groups showed a significant

reduction and were similar to those obtained in other Brazilian cities, such as Curitiba (6-7 years = 15.7%, 13-14 years = 11.6%), and São Paulo (6-7 years = 13.2%, 13-14 years = 13.7%). This definition is based on the presence of symptoms in the past twelve months, which represents the current prevalence of asthma, whereas the assessment of the diagnosis of asthma (bronchitis) ever represents the cumulative prevalence, which may partially explain the falls in prevalence rates.

In São Paulo, by using a global point score system associated with the ISAAC questionnaire, the prevalence of asthma presented by the point score was two or threefold higher than that of the questionnaire. This suggests that the use of the ISAAC questionnaire alone may lead to subdiagnosis, either due to the lack of diagnostic criteria - often replaced with other terms such as bronchitis, allergic bronchitis, and asthmatic bronchitis - or due to nonacceptance of the questionnaire,<sup>10</sup> which corroborates the use of a synonym in this study. This may lead to delayed diagnosis of the disease.<sup>27</sup> The high rates may also suggest overdiagnosis including false positive results.

The preliminary results of the ISAAC questionnaire (Table 3) confirmed the previous observation of substantial variation in the prevalence of asthma and wheezing. The discrepancies in the prevalence of asthma found in several countries may be a result of the exposure to different risk factors, of different diagnostic criteria, and of an increase in the incidence of allergic diseases, in addition to ethnic and geographical variations.<sup>27-30</sup>

However, the assessment of the differences between studies has to be carefully made if based on written questionnaires with different translations. But the differences in prevalence rates that would result from the differences in language cannot be accountable for the marked discrepancy between countries. Hopefully, the completion of the ISAAC project will help obtaining information in relation to environment, lifestyle, and genetic factors in order to better understand the variations observed.

## Conclusions

The prevalence rates of asthma symptoms observed in both groups using the ISAAC questionnaire are among the highest rates reported in Brazil. These rates were also comparable to the highest rates reported worldwide with the questionnaire. The high prevalence of symptoms suggests a high prevalence of the disease. The prevalence rate obtained with the "probable asthma" classification, in both age groups, was similar to that observed in other Brazilian cities in which this method was used; consequently, we conclude that asthma is also an important public healthcare problem in our region.

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