

International Study of Asthma and Allergies in Childhood (ISAAC): Prevalence of Asthma and Asthma-Related Symptoms Among Brazilian Schoolchildren

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Summary. We have studied the prevalence of asthma and its symptoms using a standard written questionnaire (WQ) designed for the International Study of Asthma and Allergies in Children (ISAAC). The WQ (questions 1 through 8 related to asthma) was applied to 13,604 children aged 6–7 years from six Brazilian cities: Porto Alegre (South, $N = 2,976$), Curitiba (South, $N = 1,664$), São Paulo (Southeast, $N = 3,005$), Uberlândia (Southeast, $N = 3,002$), Itabira (Southeast, $N = 1,551$) and Recife (Northeast, $N = 1,406$). At the age of 13–14 years the WQ was applied to 20,554 schoolchildren living in Porto Alegre (South, $N = 3,198$), Curitiba (South, $N = 3,008$), São Paulo (Southeast, $N = 3,008$), Uberlândia (Southeast, $N = 3,001$), Itabira (Southeast, $N = 2,134$), Salvador (Northeast, $N = 3,119$) and Recife (Northeast, $N = 3,086$). The parents of the younger children answered the WQ, whereas the adolescents answered the questionnaire themselves. The response rates were 72% and 93% for the 6–7-year-old children and for the 13–14-year-old children, respectively. There was a slight predominance of male children in the population studied. In the group of 6–7-year-olds, the prevalence of physician diagnosed asthma was 7.3% for boys and 4.9% for girls: in the group of 13–14-year-olds the rates were 9.8% and 10.2%, respectively. Asthma severity was similar for both age groups, and wheezing following exercise was more frequent among the adolescents. In keeping with studies from other parts of the world, comparison between reported symptoms and diagnosed asthma revealed a significantly lower frequency of diagnosed asthma, suggesting that in the study population, asthma is underdiagnosed.

Key words: asthma, prevalence, ISAAC, epidemiology

Introduction

Asthma is the most common chronic disease in childhood. It is heterogeneous, with multiple trigger agents, potentially serious and with frequency and severity increasing in several parts of the world. The lack of a definition that is accepted broadly in epidemic studies and the absence of an objective measure capable of being applied to children, with high sensitivity and specificity, have been hindering demonstration of such an increase. Many studies to document it have used different methods of evaluation and studied different populations, hindering the interpretation and the comparison of the results [1].

It is important to point out that reliable epidemiological studies were available, and changes in a determined period of time, as well as geographical differences in asthma prevalence, could be monitored [2].

The majority of studies on asthma occurrence refer to its prevalence, obtained once, and in small population groups. These studies evaluate the relationship between asthma and other variables, as they present in a defined population and time [3]. Application of a similar method, for the same population on a different occasion, or for a different population, is essential to allow the follow-up and comparison of observed prevalence [2, 4–6].

The International Study of Asthma and Allergies in Childhood (ISAAC) was conceived to maximize the value of epidemiologic studies in asthma and allergic diseases, establishing a standardized method that would facilitate international collaboration [7, 8]. This study has specific points: (a) to describe prevalence and severity of asthma, rhinitis and eczema in children inhabiting different centers and to accomplish comparisons between them and their countries; (b) to obtain basal measures to advise on future tendencies in the prevalence and severity of those diseases; (c) to provide a structure for etiological studies in genetics, life-style, medical care, and atmospheric pollution that may affect these diseases [7, 8].

In Brazil, few epidemiological asthma studies have been done, and these have used different methods. That contributes to the ignorance of the real importance of asthma in different areas of the country, and make difficult the planning and execution of programs involved in asthma prevention. We studied the prevalence of asthma and asthma-related symptoms in schoolchildren living in different Brazilian cities, using the self-administered ISAAC standardized written questionnaire (WQ) validated for Portuguese (Brazilian culture) [9].

Patients and Method

Seven centers from seven Brazilian cities (Northeast, Southeast and South areas of the country) participated in this study. The schoolchildren were selected as standardized by the ISAAC protocol [7, 8]. The data of involved schools were obtained by the respective City Education Secretary. After the sample definition, ISAAC WQ was filled in by the parents or guardians for the 6–7-year-old children and by the adolescents themselves.

The ISAAC WQ was applied to 13,604 schoolchildren aged from 6 to 7 years as follows: Porto Alegre (South; $N = 2,976$), Curitiba (South; $N = 1,664$), São Paulo (Southeast; $N = 3,005$), Uberlândia (Southeast; $N = 3,002$), Itabira (Southeast; $N = 1,551$) and Recife (Northeast; $N = 1,406$). In the age group of 13–14-year-olds 20,554 schoolchildren participated: Porto Alegre (South; $N = 3,198$), Curitiba (South; $N = 3,008$), São Paulo (Southeast; $N = 3,008$), Uberlândia (Southeast; $N = 3,001$), Itabira (Southeast; $N = 2,134$), Salvador (Northeast; $N = 3,119$) and Recife (Northeast; $N = 3,086$). The data obtained were transcribed for a database (Epi-Info) supplied by ISAACs coordinators.

The frequency of positive answers to each question was analyzed according to the age group. These data were analyzed by the chi-square test and partition, and the level for rejection of the null hypothesis was 5%.

Results

The return of filled ISAAC WQ varied between 72% and 100% for the 6–7 year-old schoolchildren, and from 93% to 98% for the adolescents. The frequencies of affirmative answers for each question of the ISAAC WQ are presented in Tables 1 and 2.

The prevalence of wheezing in the last 12 months for 6–7-year-old schoolchildren (Table 1) oscillated between 16.1% in Itabira and 27.2% in Recife. This was significantly higher than in other cities (Table 1). Having had four or more asthma attacks in the last 12 months varied between 3.0% in Uberlândia and 8.4% in Recife. This was significantly higher than observed in other cities (Table 1). The prevalence of children who have had more than one night per week with sleep disturbance due to asthma attacks in the last 12 months, ranged from 3.8% in São Paulo to 10.2% in Recife. In Recife, again, it was significantly higher than in other cities (Table 1).

The prevalence of limitation of speech due to asthma attacks in the last 12 months varied between 2.3% in São Paulo and 9.8% in Recife. Regarding

Table 1. Affirmative responses (%) to the ISAAC's written asthma questionnaire by 6–7-year-old school children from different cities in Brazil

Question	City						Total (N=13,604)	Chi-square*
	Porto Alegre [a] (N=2,976)	Curitiba [b] (N=1,664)	São Paulo [c] (N=3,005)	Uberlândia [d] (N=3,002)	Itabira [e] (N=1,151)	Recife [f] (N=1,406)		
1 – Wheeze ever	46.8	41.8	49.2	45.9	42.1	44.4	43.7	c > a, d, f > b, e
2 – Wheeze last 12 months	23.5	22.9	21.3	20.2	16.1	27.2	20.9	f > a, b > c, d > e
3 – Attacks last 12 months								
1 to 3	17.7	16.4	16.5	16.3	9.9	18.6	15.5	
4 to 12	4.0	4.5	3.6	2.5	4.2	6.5	3.8	f > a, b, e > c > d
more than 12	1.1	0.7	0.5	0.5	1.9	1.9	0.9	
4 – Sleep disturbed by wheeze								
Less than 1 time/week	10.6	8.7	9.2	9.5	4.5	13.4	9.3	
More than 1 time/week	5.8	5.9	3.8	4.5	6.1	10.2	5.4	f > a, b, e > c, d
5 – Speech limited by wheeze	4.1	5.7	2.3	3.8	9.5	9.8	4.8	e, f > b > c > a, d
6 – Asthma ever	16.8	6.6	6.1	5.4	4.7	6.6	8.1	a > b, c, d, e, f
7 – Wheeze with exercise	7.0	9.3	5.5	6.0	6.7	13.3	7.2	f > b > a, e > c, d
8 – Cough at night	33.6	32.4	34.2	36.1	23.8	35.1	32.5	a, b, c, d, f > e

* $p < 0.05$

this question, the prevalence was significantly higher in Recife and Itabira (9.5%) (Table 1). The frequency of wheeze with exercise in the last 12 months varied from 5.5% in São Paulo to 13.3% in Recife, where it was significantly higher than in other Brazilian cities (Table 1). The report of night cough oscillated between 23.8% in Itabira and 36.1% in Uberlândia, where this was significantly higher than the observed in other cities (Table 1). The prevalence of physician diagnosed asthma varied between 4.7% in Itabira and 16.8% in Porto Alegre. This was significantly higher than was observed in the remaining cities (Table 1).

Regarding adolescents, wheezing in the last 12 months oscillated between 9.6% in Itabira and 27.1% in Salvador, where it was significantly higher than in the other cities (Table 2). The prevalence of adolescents who have had four or more asthma attacks in the last year varied from 2.4% in Uberlândia to 6.0% in Salvador, and in this city the prevalence

was significantly higher than in the other cities (Table 2). However, sleep disturbance more than once a week by asthma attacks was significantly higher in Recife (4.6%) and Porto Alegre (4.5%) compared to the other centers (Table 2). The prevalence of speech disturbance by asthma attacks in the last 12 months were similar in all cities and varied from 4.6% (Curitiba) to 6.5% (Itabira). The prevalence of wheeze by exercise was higher between the adolescents. It oscillated between 4.2% in Itabira and 29.0% in Porto Alegre. It was significantly higher in Porto Alegre and Salvador (27.6%) than in the others. The prevalence of night cough was significantly elevated in Porto Alegre (39.1%) and Recife (31.0%) in comparison to the other cities (Table 2). The prevalence of physician diagnosed asthma oscillated between 4.8% in Itabira and 21.9% in Porto Alegre. It was significantly higher in Porto Alegre and Salvador (21.0%) when compared to the others (Table 2).

Table 2. Affirmative responses (%) to the ISAAC's written asthma questionnaire by 13–14-year-old school children from different cities in Brazil

Question	City							Total (N=20,554)	Chi-square*
	Porto Alegre [a] (N=3,198)	Curitiba [b] (N=3,008)	São Paulo [c] (N=3,008)	Uberlân- dia [d] (N=3,001)	Itabira [e] (N=2,134)	Salvador [f] (N=3,119)	Recife [g] (N=3,086)		
1 – Wheeze ever	46.9	40.4	45.4	46.9	35.4	44.4	39.0	43.0	a, c, d, f > b, g, > e
2 – Wheeze last 12 months	24.7	18.4	23.3	21.1	9.6	27.1	19.7	21.1	f > a, c > d > b, g > e
3 – Attacks last 12 months									
1 to 3	20.9	14.3	20.2	19.8	6.4	20.8	16.2	17.5	
4 to 12	3.5	2.7	3.3	1.7	2.3	3.9	2.7	2.9	f > d > a, c > b, e, g
more than 12	1.0	0.7	1.1	0.7	0.7	2.1	1.1	1.1	
4 – Sleep disturbed by wheeze									
Less than 1 time/week	10.6	6.4	8.5	10.0	2.9	6.6	8.5	7.9	
More than 1 time/week	4.5	2.7	3.5	3.4	3.8	3.0	4.6	3.6	a, g > b, c, d, e, f
5 – Speech limited by wheeze	5.7	4.6	5.7	5.5	6.5	5.4	4.8	5.4	n.s.
6 – Asthma ever	21.9	8.6	10.0	15.1	4.8	12.6	21.0	13.9	a, g > d > f > b, c > e
7 – Wheeze with exercise	29.0	19.8	20.5	20.9	4.2	27.6	20.6	21.2	a, f > b, c, d, g > e
8 – Cough at night	39.1	30.1	33.0	39.0	19.4	29.7	31.0	32.2	a, d > c > b, f, g > e

* $p < 0.05$ n.s. = not significant

Discussion

The ISAAC protocol was conceived to evaluate the prevalence of asthma and allergic diseases in childhood, in different parts of the world, using a standardized method to make the comparisons more reliable. The self-administered ISAAC WQ is easy to understand and independent of an interviewer, a frequent cause of error during the application of the WQ [8].

There were 366,106 adolescents interviewed in ISAAC phase I. They were from 119 centers of 45 countries (Europe, Asia, Africa, North America, South America, and Oceania). In the age of 6–7 years, 208,723 students were interviewed. They were from 74 centers in 34 countries [10]. The percentage of returned WQ varied between 60% and 100%, being higher in the adolescents [8]. In general, low WQ return indexes are associated inversely with errors in

the prevalence of symptoms [11]. In this study we observed satisfactory index of WQ return.

The preliminary analysis of ISAAC's data showed, with regard to the cumulative prevalence of doctor diagnosed asthma, that there was a variation from 1.3% to 30.8% for children aged 6–7 years and from 1.8% to 30.2% for adolescents [8]. The lowest values were documented in the Republic of Georgia and Estonia and the highest in Australia [12–28]. Similar results were observed considering wheeze in the last year; it oscillated from 1.6% to 27.2% for the children aged 6–7 years and from 1.9% to 34.1% for adolescents, [8, 12–28].

Brazil is a country with continental dimensions, whose total area of 8.5 million square kilometers is cut in the north by the equator and in the southeast by the Tropic of Capricorn. Its climate varies according to the area. In the north, northeast and center-west areas, the climate is tropical with dry and lin-

gering summer and rainy winter. In the southeast and south areas the climate is temperate, and seasons are more well defined as we go to south.

In 1996, there were 157,070,163 inhabitants living in Brazil, 49.3% of them were male, 57.0% living in the southeast and south regions, and 30.0% of them were younger than 14 years. The Brazilian cities in the ISAAC study were state capitals, except Itabira and Uberlândia, and two of them were coastal (Recife and Salvador). The populations of each city are: 1.5 million in Recife, 2.2 million in Salvador, 0.44 million in Uberlândia, 9.8 million in São Paulo, 1.5 million in Curitiba, 1.3 million in Porto Alegre, and 95,000 in Itabira.

Although the per capita gross domestic product is around US \$4,000, the income distribution is not even. Twenty-eight percent of our population don't earn half of a minimum salary monthly, and most of them live in the periphery of the big cities of the north, northeast (Recife = 30.1%, Salvador = 28.6%), and center-west areas. In the southeast (Minas Gerais = 26.9%, São Paulo = 9.1%) and South (Curitiba = 7.2%, Porto Alegre = 11.8%) they are lesser. These data corroborate to 37.5 as the infantile mortality rates in the first year of life per 1,000 born alive with the following distribution: Recife = 62.5; Salvador = 52.5; Itabira and Uberlândia = 26.5; São Paulo = 23.9; Curitiba = 29.0 and in Porto Alegre = 21.6.

As mentioned before, we observed the highest prevalence and severity of asthma in both age periods in Recife. However, analyzing the data from the city of Itabira, we verified that, despite asthma symptoms and physician diagnosed asthma being lower in children aged 6–7 years, the number of acute attacks, sleep disturbances, and limitation of speech reinforces the higher severity of asthma in that city (Table 1).

Itabira is located in a mountainous area, in the state of Minas Gerais (southeast). It has a tropical mountain climate characterized by dry winters and long summers. There are extraction and mineral processing industries in this area. The extraction and mining process liberate particulate material, producing a red dust that spreads over the whole city [29].

Among adolescents, wheezing in the last 12 months and having had four or more asthma attacks in the last year were significantly higher in Salvador. However, when we evaluate the prevalence of sleep disturbance, it was significantly higher in Porto Alegre and Recife. The same was observed with doctor diagnosed asthma. The severity of asthma-related symptoms was not higher in Itabira (Table 2).

The Brazilian population made up of a mixture of people. Discovered and colonized by the Portuguese, during our colony history, we also suffered invasions by the French and Dutch. There was African slave

immigration, and after the First World War other people immigrated here: Spanish, Italian and Japanese, among so many others. Analyzing the data obtained in other Portuguese speaking countries, we observed that our results were approximately twice as high as those observed in Cabo Verde, Madeira, and Macau [30]. In comparison to the data obtained in Latin America, our results were in the usual average [31].

This first international study, of great magnitude, allowed us to apply a standardized and validated instrument to establish the prevalence of asthma in schoolchildren of different Brazilian populations (mean prevalence of 11.6%), though other studies are still necessary to understand the observed differences and to permit more effective preventive measures to be adopted.

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