Original Article

Prevalence and severity of asthma symptoms in school-age children in the city of Duque de Caxias, Rio de Janeiro, Brazil*

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Background: Asthma is considered the most common chronic childhood disease. However, there have been few studies on the prevalence of asthma in Brazil.

Objective: To assess the prevalence and severity of asthma symptoms in school-age children and adolescents living in the city of Duque de Caxias, located in the greater metropolitan area of Rio de Janeiro.

Method: Cross-sectional transversal study using the International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire. The sample comprised students of 6, 7, 13 and 14 years of age.

Results: One group of 2334 students between the ages of 6 and 7 and another composed of 4040 students between the ages of 13 and 14 were evaluated. The prevalence of wheezing within the last 12 months in the younger children was 27.7%, vs. 19% among the adolescents ($p < 0.0001$). There was a predominance of males in the 6-7 age group (29.9% vs. 25.6%; $p = 0.01$) and of females in the 13-14 age group (21.9% vs. 15.8%; $p < 0.0001$). The proportion of previously diagnosed cases of asthma was similar (approximately 10%) for both age brackets. Wheezing upon physical exertion was more prevalent among the adolescents (21.4% vs. 7.8%; $p < 0.0001$). Symptom severity was higher among female adolescents (severe asthma: 6.6% vs. 4.4%; $p = 0.001$), although no differences among genders were seen in the 6-7 age group.

Conclusion: Asthma prevalence in Duque de Caxias is high, as it is in other Brazilian and Latin American cities. Values are higher in the 6-7 age group, in which symptoms were seen predominantly in males. Among the adolescents, the prevalence and severity of symptoms were higher in females, a recent observation that seems to be a new epidemiological trend of asthma.

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Key words: Asthma. Epidemiology. Severity of illness index. Cross-sectional studies.

* Study carried out in the Universidade Federal do Rio de Janeiro, Rio de Janeiro, RJ

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INTRODUCTION

Asthma is considered the most common chronic childhood disease[1]. It has been estimated that asthma affects from 14 to 15 million people, 4.8 million of which are children, in the USA[2]. Various studies in developed western countries, such as Scotland and England, have shown that the prevalence of asthma has increased 1.5 to 3 times over the past four decades[3-5]. Since such a large an increase over such a short time cannot be explained by genetic factors, this rapid expansion of asthma has been attributed to the action of environmental factors[6].

Epidemiological studies of asthma in Brazil are still limited due to the territorial extension of the country, and the true dimension of the prevalence of the disease in the various regions is still unknown. Wandalsen[7], assessing the incidence of asthma attacks in children in the city of Santo André (in the state of São Paulo), detected a considerable increase during the study period (from 42.3 per 10,000 children in 1975 to 86.2 per 10,000 children in 1984).

Recent data from a study carried out in a few Brazilian cities using the International Study of Asthma and Allergies in Childhood (ISAAC)[8] revealed a mean cumulative prevalence of diagnosed cases of asthma to be 10.8% in the 6- to 7-year-old and 13- to 14-year-old age brackets[9].

To date, there have been few studies of asthma prevalence in the state of Rio de Janeiro, and none of those have used the methodology standardized by the ISAAC[10]. The objective of this study was to assess the prevalence and symptom severity in school-age children living in the city of Duque de Caxias, which is located within the greater metropolitan area of the city of Rio de Janeiro, and to identify any correlations between these findings and variables such as gender, age group and type of school.

METHODS

A cross-sectional transversal study was carried out. The study sample comprised two groups of school children: 6- to 7-year-olds and 13- to 14-year-olds. We used the methodology developed by the ISAAC in order to determine the prevalence of symptoms related to asthma. The study population comprised school children within a specific geographic area, and two distinct age groups were selected: 6- to 7-year-olds and 13- to 14-year-olds. After defining the geographic area of the study, we established the number of schools in the area (a minimum of 10 schools or all schools in areas where there were less than 10 schools), which is necessary to form a representative sample. Of this total number of schools, we randomly selected those in which the study would be carried out, considering each school as a sample unit. The study sample comprised all students within one of the two study age brackets and enrolled in one of the selected schools. The suggested sample size for each age bracket is 3000 students.

The city of Duque de Caxias has a well-developed industrial park, intense traffic and high population density. According to the 2000 census conducted by the *Instituto Brasileiro de Geografia e Estatística* (IBGE, Brazilian Institute of Geography and Statistics), the total number of residents in the city was 770,858, of which 142,922 were children and adolescents enrolled in elementary and middle schools[11]. Our sample comprised 4,064 students between the ages of 13 and 14 and 2,765 students between the ages of 6 and 7, enrolled in 36 public schools and 13 private schools. This proportion was chosen in order to match that found in the general population. The participating schools were selected using random numbers generated by the statistical software program Epi Info 6.

Data collection was based on asthma-related questions in the ISAAC questionnaire, translated into Portuguese and validated by Solé et al.[12]. Data were collected between May and August of 2000. The 13-year-old and 14-year-old students filled out the questionnaires themselves. Parents or guardians filled out the questionnaires for the 6-year-old and 7-year-old students. The Ethics Research Committee of the *Hospital Universitário Clementino Fraga Filho* (Clementino Fraga Filho University Hospital) of the *Universidade Federal do Rio de Janeiro* (Rio de Janeiro Federal University) approved the protocol.

The Epi Info 6 software program was used for the statistical analysis of data. Results were assessed based on the percentage of positive answers for each question. We used the chi-square test for the comparison of results. The level of significance was set at $p < 0.05$. For each case, we calculated the prevalence ratio (PR), which indicates the strength of a correlation between any two given results and the respective 95% confidence interval (CI).

RESULTS

The 13- to 14-year-old age group comprised 4064 students, of which 4040, corresponding to 99.4% of the original sample, filled out the questionnaire correctly.

The number of students in the 6- to 14-year-old age group was of 4533. Of these, 2765 questionnaires were collected, 2334 of which, corresponding to 51.5% of the original sample, were filled out correctly. The total number of students assessed in the study was 6374, and approximately 52% of the students in both age groups were female (Table 1).

Table 2 shows the frequency and gender distribution of positive answers (by age group) for each question on the questionnaire. The percentage for each question was calculated on the basis of the number of questionnaires completed correctly: 4040 for the 13- to 14-year-old age group and 2334 for the 6- to 7-year-old age group. Since negative responses to initial questions precluded answering some of the subsequent questions, frequencies may not total 100%.

The prevalence of a history of wheezing was significantly higher in the 6- to 7-year-old age group ($p < 0.0001$; PR = 1.33; 95% CI: 1.25 – 1.41), with higher prevalence in males ($p = 0.05$; PR = 1.09; 95% CI: 1.00 – 1.19). In the 13- to 14-year-old age group, a history of wheezing was more prevalent in females ($p = 0.0001$; PR = 1.26; 95% CI: 1.16 – 1.38).

TABLE 1

Characteristics of the sample of students selected. Duque de Caxias, 2000 / Rio de Janeiro Federal University

Variables	Age group			
	6 to 7		13 to 14	
	n	%	*n*	%
Total	2334	100	4040	100
Gender				
Male	1117	47.9	1920	47.5
Female	1217	52.1	2120	52.5
Type of school				
Private	345	14.8	800	19.8
Public	1989	85.2	3240	80.2

The prevalence of wheezing within the last 12 months was also higher in the younger children ($p < 0.0001$; PR= 1.46; 95% CI: 1.33 – 1.60). In the same age group, the prevalence of wheezing was higher in males ($p = 0.01$; PR = 1.17; 95% CI: 1.03 – 1.33), whereas it was higher in females among the adolescents ($p < 0.0001$; PR = 1.39; 95% CI: 1.22 – 1.58). Among children of the same gender, the prevalence of wheezing within the last 12 months

TABLE 2

Percentage frequency of responses regarding asthma symptoms in students between the ages of 6 and 7 and in students between the ages of 13 and 14. Duque de Caxias, 2000 / Rio de Janeiro Federal University

Question		Age (years)					
		6 and 7			13 and 14		
	Gender	Male *N*=1117 % (47,9)	Female *N*=1217 %(52,1)	Total *N*=2334 % (100)	Male *N*=1920 % (47,5)	Female *N*=2120 % (52,5)	Total *N*=4040 %(100)
History of wheezing		48,7[a,b]	44,7[b]	46,6	30,8	38,9[a]	35,1
Wheezing in the last 12 months		29,9[a,b]	25,6[b]	27,7	15,8	21,9[a]	19,0
No. of wheezing attacks	none	72,3	76,0	74,2	85,6	79,6	82,5
within the last 12 months	1 - 3	21,6[b]	18,6	20,0	11,6	17,0[a]	14,5
	4 - 12	4,2[b]	4,1[b]	4,2	1,6	2,4	2,0
	+ de 12	1,9	1,2	1,5	1,09	0,94	1,0
Sleep disturbance	Never	80,4	83,1	81,8	93,21	89,8	91,4
(times a week)	< 1x/week	11,2[b]	9,4[b]	10,3	4,3	6,7[a]	5,5
	≥ 1x/week.	8,4[b]	7,4[b]	7,9	2,5	3,5	3,0
Speech limitation		7,2[b]	6,5[b]	6,8	2,8	4,8[a]	3,8
Previous diagnosis of asthma		11,1	9,6	10,3	9,6	10,5	10,0
Wheezing upon physical exertion		8,7	6,9	7,8	18,9[b]	23,6[a,b]	21,4
Dry cough at night		37,3[b]	37,6	37,5	31,8	42,7[a,b]	37,5

[a]aSignificantly higher when comparing genders in the same age group (p < 0.05)
bSignificantly higher when comparing age groups in the same gender (p < 0.05)

was higher in the 6- to 7-year-old age group, both among boys ($p < 0.0001$) and among girls ($p = 0.01$).

Analyzing the number of asthma attacks within the last 12 months, we found that the 6- to 7-year-old age group presented a higher prevalence, both in the "1 to 3 attacks" category ($p < 0.0001$; PR = 1.38; 95% CI: 1.24 – 1.54) and in the "4 to 12 attacks" category ($p < 0.0001$; PR = 2.09; 95% CI: 1.57 – 2.80). However, in the 13- to 14-year-old age group, the prevalence of "1 to 3 attacks" response was higher among females ($p < 0.0001$; PR = 1.46; 95% CI: 1.25 – 1.71). In the "more than 12 attacks within the last 12 months" category, no statistical differences were found between the two age groups.

Sleep disturbance was more prevalent in the 6- to 7-year-old age group, despite the number of times during the week ($p < 0.0001$) and gender ($p < 0.0001$) considered. In the 13- to 14-year-old age group, sleep disturbance with a prevalence of less than once a week was more common in females ($p = 0.001$; PR = 1.55; 95%CI: 1.19 – 2.02).

Limited speech was statistically more significant in the younger age group ($p < 0.0001$; PR = 1.80; 95% CI: 1.45 – 2.23), even when we studied the genders separately. Limited speech was more prevalent in females in the adolescent group ($p = 0.0009$; PR = 1.71; 95% CI: 1.24 – 2.37).

Wheezing upon physical exertion was more prevalent among the adolescents ($p < 0.0001$; PR = 2.75; 95% CI: 2.36 – 3.19), and, within this age group, it was more prevalent in females ($p = 0.0002$; PR = 1.25; 95% CI: 1.11 – 1.41).

DISCUSSION

Among the standardized tools for data collection in epidemiological surveys, questionnaires have been the most widely used due to their ease of use, low cost and good acceptability. In addition, questionnaires are relatively independent of immediate circumstances, such as climatic factors and the incidence of respiratory infections[13].

Although the ISAAC questionnaire is simple, is standardized and has been validated in various international studies, it is not free from possible biases that may influence the results to varying degrees. For example, the questionnaire has been translated into various languages and some languages do not have a word that conveys the idea expressed by the English word "wheezing", and the word chosen may not carry the same meaning as that understood by English-speaking populations. The high prevalence of asthma in English-speaking countries, especially in those where the word "wheezing" is commonly used in medical studies, suggests that there might be some language biases associated with the questionnaire or that those populations are more aware of and know more about the disease. On the other hand, the higher prevalence may be correlated with environmental factors related to the lifestyle of the population in these western countries[14]. High prevalence of asthma has also been observed in Spanish- and Portuguese-speaking countries in South America, which suggests the participation of other factors. In addition, prevalence rates have not been uniformly high among countries that speak the same language. For example, Peru and Costa Rica have prevalence rates higher than those reported in Spain; Brazil has higher rates than does Portugal, and Hong Kong has higher rates than those seen in China[10]. It is also possible that individuals who have are not familiar with asthmatic patients misinterpret other types of sensations or respiratory sounds as wheezing[12].

A source of error to be taken into consideration in our area is the fact that the population commonly referred to the disease as "bronchitis" since, in the popular imagination, the word "asthma" is associated with an extremely severe, stigmatized disease. It is important to emphasize that many physicians continue to use the terms "asthma" and "bronchitis" as synonyms, which makes the correct diagnosis of the disease difficult[15].

Another difficulty is the sensitivity and specificity of symptoms, which are referred to in the questionnaire in order to identify children with specific diseases such as asthma. This can represent a confounding factor since the prevalence of infectious diseases presenting wheezing is high in some countries.

The method of selecting the sample may be another source of error since a sample based on children of 6, 7, 13 and 14 years of age enrolled in school may, due to absenteeism, not be representative of the population of children in these age groups in certain communities. These aspects must be taken into consideration in the assessment of the national and international patterns of the prevalence of asthma symptoms established by ISAAC[14].

In the first phase of the ISAAC, 463,801 students between the ages of 13 and 14 were studied at 155 centers in 56 countries, and 257,800 students between the ages of 6 and 7 years were studied at 91 centers in 38 countries[10]. The return rate for the

questionnaires distributed ranged from 60% to 100%, and it was higher among the adolescents[16]. Low return rates induce errors and are usually inversely correlated to the prevalence of symptoms[17].

In Duque de Caxias, a sample of 4040 students between the ages of 13 and 14 was selected, surpassing the number recommended by the ISAAC. However, we did not reach the target of 3000 students between the ages of 6 and 7 since our sample comprised 2334 children, a value 20% lower than that recommended. According to the criteria established in the ISAAC, a sample size of 3000 children is ideal in order to assess not only the prevalence of symptoms of asthma but also the severity of these symptoms. A sample of 1000 children would be large enough in order to verify the prevalence of symptoms alone[13]. Therefore, the assessment of the severity of symptoms in the younger age group might have suffered some interference due to this smaller sample size.

The return rate for the questionnaires distributed in the 13- to 14-year-old age group was 99.4%. This rate was lower (51.5%) in the younger age group. This might have been due to the fact that, for this age group, the participating schools sent the questionnaires to the parents to be completed and returned, which made direct supervision by the researchers impossible, increasing the number of unreturned questionnaires. Another factor to be considered is the motivation and cooperation of school employees charged with this task. Although the researchers had explained, in detail, the importance of the study and its repercussions for the community, interest in facilitating the study was not apparent in many schools, both public and private.

The return rate for the questionnaires distributed worldwide during the first phase of ISAAC ranged from 60% to 100%, and it was higher among the adolescents[14]. In Brazil, the return rates were 72% and 94% in the 6- to 7-year-old and 13- to 14-year-old age groups, respectively, the city of São Paulo[18], compared to 58% and 92.1%, respectively, in the city of Curitiba, in the state of Paraná[19].

Errors induced by the process of completing the questionnaire may occur if there are wide variations in the return rates and if the participation is correlated with the presence of symptoms (those who have the symptoms are more interested in completing the questionnaire than those who do not). What if the parents who completed and returned the questionnaire were those who were more interested in the subject because their children suffer from respiratory diseases? Or, conversely, those who did not complete the questionnaire were those who are not concerned with this subject because their children do not suffer from respiratory diseases? In this case, we could have had a false increase in the prevalence of respiratory symptoms in the younger age group. The answers to these questions are not to be found in the group of individuals who completed the questionnaire, but in that to which we had no access (our group of "lost cases"). The low return rate in the 6- to 7-year-old age group in Duque de Caxias constitutes one of the limitations of this study.

Approximately 52% of the participants in both age groups were female, which is comparable to that found by other Brazilian authors[18].

The prevalence of a history of wheezing was significantly higher in the 6- to 7-year-old age group, with a higher incidence among the males. In the 13- to 14-year-old age group, a history of wheezing was more prevalent in females. Although the incidence of prior wheezing episodes cannot be used for the diagnosis of active asthma, these results suggested that, in Duque de Caxias, there was a high incidence of respiratory diseases that cause wheezing. Similar results have been reported in São Paulo[18] and Curitiba[19], and such symptoms have always been found to be more prevalent in the 6- to 7-year-old age group.

In Duque de Caxias, The prevalence of wheezing within the last 12 months in the younger group was 27.7%, compared to 19.0% among the adolescents ($p < 0.0001$). Among 13-year-olds and 14-year-olds in other cities, these values ranged from 18.4% (in Curitiba) to 27% (in Salvador, in the state of Bahia), whereas among 6-year-olds and 7-year-olds, the prevalence of wheezing was 21.3% in São Paulo to 27.2% in Recife (in the state of Pernambuco)[10]. The lack of a validation study in each investigated area suggests that these data contain errors[19]. However, various environmental factors may explain differences in the prevalence among the various urban centers in a country of continental dimensions such as Brazil.

The prevalence of a previous diagnosis of asthma was 10.3% in the 6- to 7-year-old age group and 10% in the 13- to 14-year-old age group, lower rates than those reported for wheezing within the last 12 months. These results may indicate medical underdiagnosis of the disease or the use of incorrect terminology (such as "bronchitis") to refer to the disease. Camelo-Nunes et al.[20], comparing the results of bronchoprovocation tests with methacholine in 106 adolescents who reported "wheezing within the last 12 months" with those of

the 103 adolescents who had answered "no" to all questions on the ISAAC questionnaire, reported that the methacholine dose needed to induce a 20% decrease in the forced expiratory volume in one second was significantly lower in the former group than in the latter group. Therefore, the question "wheezing within the last 12 months" would be an appropriate indicator to discriminate asthmatic from nonasthmatic children.

When we compared the genders among adolescents in Duque de Caxias, the prevalence of wheezing within the last 12 months was higher in females. In the younger group, the prevalence was higher in males. These results are similar to those reported by Felizola[21] in the city of Brasília and reproduce the same pattern reported in the worldwide results from the ISAAC[10].

Asthma is more common in boys than in girls. This is probably due to differences in the anatomy of the lower respiratory tract since, for any given lung volume, the lower airways tend to be smaller in males than in females[22]. In addition, some studies have shown that the prevalence of atopy seems to be higher in male children[23,24]. However, in most longitudinal population studies that have addressed this question, persistence of asthma from childhood into adulthood has been found to be more common in females[25]. This shift in predominance from males to females occurs during puberty and is probably related to physical maturation. Other factors associated with the persistence of asthma are family history, environmental exposure and severity of symptoms[26]. An alternative explanation for this finding is related to the fact that, during adolescence, boys tend to underestimate and girls tend to overestimate symptoms[26]. The same pattern of gender-based differences has been reported in other studies in western countries[19,21,27].

In a previous study, the current authors evaluated the relationship between asthma and exposure to environmental pollution[28], comparing the prevalence of asthma among adolescents in Duque de Caxias to that seen among those in Seropédica, another municipality in the state of Rio de Janeiro. The results revealed that the prevalence of asthma in adolescents was directly related to air pollution in the population studied.

When the severity of wheezing was evaluated based on the number of attacks and on the frequency of sleep disturbance, we found that, among 6-year-olds and 7-year-olds, 5.4% reported wheezing within the last 12 months and having had more than 12 asthma attacks, and 28.5% reported wheezing within the last 12 months and sleep disturbance more than once a week. Among the adolescents, these values were 5.2% and 15.8%, respectively (Table 2). These data suggest that, despite the availability of efficacious asthma therapy, asthma has not been properly managed in a great number of school-age children. In developed countries, the severity of the attacks tends to decrease as asthma treatment improves. However, this does not seem to be the case for most of the students in Duque de Caxias, probably due to difficulties in accessing specialized clinics and financial inability to purchase anti-inflammatory medication, as well as to undertreatment of asthma.

Although the prevalence of asthma was higher in 6-year-old and 7-year-old males in Duque de Caxias, there was no significant difference between males and females concerning asthma severity. In contrast, asthma severity and symptom prevalence among adolescents was significantly higher in females. Jenkins et al.[29], in a study of the predictive values for the persistence of asthma into adulthood, concluded that females whose parents are asthmatic and who have severe childhood asthma are at high risk for presenting asthma in adulthood. It is possible that the results obtained in our sample and in recent international studies reflect a similar pattern, in which girls who, in childhood, presented wheezing related to higher disease severity, continued having these symptoms into adolescence, making the prevalence and severity of asthma higher in females. The reasons why asthma severity was higher in female adolescents are unknown, although hormonal changes during puberty, caused either by endogenous alterations or the use of contraceptive pills, have been cited[30,31].

Based on the results of the present study, we can conclude that the prevalence of asthma in school-age children in Duque de Caxias was high (27.7% and 19%, respectively, in the 6- to 7-year-old and 13- to 14-year-old age groups). The prevalence was higher in the younger group, regardless of gender. The frequency of asthma symptoms in the 6- to 7-year-old age group was higher than the national and Latin American means. Among the adolescents, these values were lower than the national mean and higher than the Latin American mean. Asthma was more prevalent in female adolescents. Asthma symptom severity was higher in the 6- to 7-year-old age group, regardless of gender. Among the adolescents, it was significantly higher in females.

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