Original Article

Prevalence of asthma among adolescents in the city of Santa Maria, in the state of Rio Grande do Sul, Brazil. International Study of Asthma and Allergies in Childhood (ISAAC) Project*

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Background: Asthma is the most common chronic disease among adolescents.

Objective: To determine the prevalence of asthma and asthma-related symptoms using the International Study of Asthma and Allergies in Childhood (ISAAC) protocol to evaluate adolescents in the city of Santa Maria, located in the state of Rio Grande do Sul, Brazil.

Method: A cross-sectional study evaluating 3066 schoolchildren from 13 to 14 years of age, selected by random sampling, as indicated in the ISAAC protocol. Data were collected from March to June of 2003 using the standardized ISAAC questionnaire, which was completed by the adolescents in the classroom and under the supervision of the researchers.

Results: A total of 3066 valid questionnaires (95.5%) were collected. Among the asthma-related symptoms evaluated, the following prevalences were determined: history of wheezing: 42.1%; wheezing within the last 12 months: 16.7%; four or more wheezing attacks within the last 12 months: 1.9%; sleep disturbance on one or more nights a week within the last 12 months: 3.8%; impaired speech within the last 12 months: 3.8%; history of asthma: 14.9%; wheezing after exercise within the last 12 months: 19%; dry cough at night within the last 12 months: 32.4%. Values were significantly higher among females.

Conclusion: The prevalence of asthma-related symptoms among adolescents living in the city of Santa Maria was high, predominantly among the females. However, the rate was comparable to the international average and was lower than those observed in larger metropolitan areas in Brazil. These findings underscore the need for regional studies in order to better understand the prevalence of asthma in Brazil.

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INTRODUCTION

Asthma is the most common chronic disease in children and adolescents. As a consequence, it generates high social and economic costs[1-3]. Research conducted in different localities suggests that the frequency and severity of asthma among children and adolescents is increasing[1-7]. It has been demonstrated that there is a wide range in the prevalence of asthma in different regions in the world[2,3]. Recent studies report a rate of less than 1% in developing countries and over 25% in developed countries[8]. Studies employing similar methods have clearly demonstrated this increase[9].

Significant differences in the prevalence of asthma among several ethnic groups, as well as between rural and urban populations, have been presented[10-13]. Research indicates that the prevalence of asthma is lower in rural municipalities with agricultural economies, such as Campos Gerais, in the state of Minas Gerais, where asthma incidence is only 6%, and higher in megacities such as São Paulo, in the state of São Paulo (23.3%) and Salvador, in the state of Bahia (27.1%)[10]. It is believed that the western life style, urbanization and increased population density contribute to the elevated rates of asthma prevalence. The problem is thought to be compounded by environmental factors and the high atmospheric contamination indices seen in developed regions[10,11,14,15].

The definition of asthma based only on symptoms has been the method used by various epidemiological studies and is justifiable when it is not possible to carry out pulmonary function tests or assess variation by trigger factors or treatment in large populations[16]. Various studies on asthma have utilized written questionnaires (WQs) because they offer advantages over other methods such as the bronchial provocation tests and exercise tests in the identification of asthma in a large numbers of individuals[16,17]. Such WQs are widely accepted, cheap, easily applied and do not require special equipment[16,17]. They are reasonably independent of immediate circumstances such as time of year, atmospheric temperature, humidity, upper airway infections and current treatment, which may affect the results of the provocation tests. They are also easily standardized, especially when self-administered[16,17].

In Latin America, as well as in other developing regions, there was until recently no reliable data that would allow comparisons to be drawn regarding the prevalence of asthma[18]. The International Study of Asthma and Allergies in Childhood (ISAAC) protocol proposed a single method of investigation that maximized the value of epidemiological studies of asthma and other allergic diseases in childhood, as well as making international collaboration possible[19]. A multicentric study, the ISAAC has been carried out in 56 countries and has shown a variability of 1.6% to 36.8% in the incidence of active asthma. Brazil was ranked eighth, with an mean prevalence of 20%[20]. In the 13 to 14 year age bracket, the prevalence of active asthma (wheezing within the last year) has been found to range from 4.8% to 27.1%[21,22].

In Brazil, the true dimensions of asthma in the various regions of the country remain unknown. This fact makes it difficult to plan and carry out programs aimed at prevention[23]. In addition, the few existing studies have been restricted to large centers, mainly capital cities. Little population-based research has been carried out to determine the prevalence of asthma in school children in smaller urban centers. The objective of this study was to use the ISAAC protocol to determine the prevalence of asthma-related symptoms in urban adolescents (aged 13 to 14) residing in Santa Maria, a city located in the central region of the state of Rio Grande do Sul.

METHODS

In studies of asthma prevalence, data have been collected using various methodologies, differing mainly in the collection instruments employed. This has compromised the external validity of the research and the comparability with similar studies. These difficulties motivated a group of researchers to devise the ISAAC, an internationally standardized WQ, so that it would be possible to make future comparisons among countries. The data collected for this study has been steadily growing through contributions from various countries.

This was a population-based cross-sectional study involving urban schoolchildren from 13 to 14 years of age residing in the city of Santa Maria, located in the central region of the state of Rio Grande do Sul. According to the latest census, the city has an estimated population of 243,611 people, 94.8% of whom live in the urban areas[19]. The city has few industries, and its economy is mainly service-based, agriculture being the second most important economic activity.

The schoolchildren were identified from data provided by the Oitava Secretaria de Educação do Estado do Rio Grande do Sul (Eighth Secretary of Education of the state of Rio Grande do Sul) and by the Secretaria Municipal de Educação de Santa Maria (Santa Maria Municipal Secretary of Education), according to the 2002 School Census[21]. The city was divided into five geographic zones, and 45 schools were selected. The total presumed number of students in this age bracket was 4120[21]. The schools were selected by systematic random sampling, not proportionally by size (each school received a single number), after stratification of the following variables: type of school (public or private), zone (north, south, east, west or center), and grade (seventh or eighth). At the end of this process, 3210 adolescents had been randomly selected.

During the March 2003 to June 2003 (fall/winter) period, the WQs were distributed in the classrooms and completed by the adolescents themselves under the supervision of the researchers. Students who were absent on the day the WQs were distributed were given another opportunity on a subsequent date. All completed WQs were considered valid.

Data from the WQs were transcribed and analyzed using the EPI Info and SPSS programs. In the statistical analysis, the frequencies of the variables (95% confidence intervals) were determined, including the total sample and the sample stratified by gender. The chi-square test was utilized in order to analyze the differences between genders. The level of significance required to reject the null hypothesis was set at 5%.

The study was approved by the Comissão de Ensino, Pesquisa e Extensão (Learning, Research and Extension Commission) and by the Comitê de Ética de Assuntos Humanos (Ethics Committee for Human Issues) of the Universidade Federal de Santa Maria (Federal University at Santa Maria). The authorization to carry out the research was given by the directors or coordinators of the schools, and the adolescents themselves gave verbal informed consent.

RESULTS

Of the 3227 WQs distributed, 3066 were considered complete (95.5%). Table 1 shows the general characteristics of the adolescents questioned about the frequency of asthma-related symptoms.

The total sample was 3066 students (1487 males and 1579 females). When stratified by age, 1797 were 13 years old, and 1269 were 14. Most of the students were in the seventh or eighth grade. Of the total number of students selected, 2395 came from public schools and 671 from private schools. A total of 807 adolescents came from the central region, 393 from the north region, 454 from the south region, 729 from the east region and 683 from the west region.

Table 2 presents the frequencies of affirmative answers to the various questions in the asthma module of the WQ, including the stratification by gender (total sample and by gender). The average prevalence of a history of wheezing was 42.1% and was significantly higher among the girls (45.8% vs. 38.1%; $p < 0.05$). The prevalence of wheezing within the last year was 16.7% and was also significantly higher among the girls (18.2% vs. 15.1%; $p < 0.05$).

TABLE 1

General characteristics of the adolescents interviewed regarding the frequency of asthma-related symptoms in Santa Maria (Rio Grande do Sul) in 2003

Variable	*n*	%
Gender		
Males	1487	48.5
Females	1579	51.5
Total	3066	100
Age groups		
13-year-olds	1797	58.6
14-year-olds	1269	41.4
Total	3066	100
School grade		
Fifth	132	4.3
Sixth	229	7.5
Seventh	1416	46.2
Eighth	1289	42.0
Total	3066	100
Schools		
Public	2395	78.1
Private	671	21.9
Total	3066	100
Region		
Center	807	26.3
North	393	12.8
South	454	14.8
East	729	23.8
West	683	22.3
Total	3066	100

TABLE 2

Affirmative answers (%) on the International Study of Asthma and Allergies in Childhood written questionnaire, asthma module, by gender, among adolescents of 13 to 14 years of age in Santa Maria (Rio Grande do Sul) in 2003

Question	Male	Female	Total	
	No = 1,487	No = 1,579	No = 3,066	CI 95%
History of wheezing	38.1	45.8*	42.1	(39.6 - 43.2)
Wheezing within the last 12 months	15.1	18.2*	16.7	(15.2 - 17.9)
Four or more attacks	1.9	1.9	1.9	(1.1 - 2.0)
History of sleep dysfunction	3.0	4.3*	3.8	(3.1 - 4.5)
Impaired speech	2.8	4.6*	3.8	(3.0 - 4.3)
History of asthma	14.5	15.1	14.9	(13.9 - 16.5)
Wheezing after exertion	16.6	21.1*	19.0	(17.5 - 20.3)
Dry cough at night	25.8	38.6*	32.4	(30.0 - 32.9)

* chi-square test, $p < 0.05$

Having had more than four acute wheezing attacks was reported by 1.9% of the schoolchildren, regardless of gender. Sleep dysfunction caused by acute exacerbation was reported by 3.8%, with significantly higher values among the girls (4.3% vs. 3.0%; p < 0.05). Impaired speech due to acute exacerbation was reported by 3.8% of the students and was also predominant among the girls (4.6% vs. 2.8%; p < 0.05).

Physician-diagnosed asthma (history of asthma) was reported by 14.9% of the schoolchildren, regardless of their gender. Wheezing after exertion was reported by 19% of the adolescents and was predominant among the girls (21.1% vs. 16.6%; p < 0.05). Dry cough at night in the absence of flu or respiratory infection was reported by 32.4% of the schoolchildren and was significantly predominant among the girls (38.6% vs. 25.8%; p < 0.05).

DISCUSSION

In epidemiological studies utilizing WQs[16], it is important to control the collection of the WQs since unaccounted-for WQs will compromise the validity of the studies. In the present study, we determined that 95.5% of the adolescents involved completed the WQ. This number is above the average (92%) observed in schoolchildren of the same age bracket in the first phase of the ISAAC[1].

The city of Santa Maria is located in the central region of the state of Rio Grande do Sul. According to the latest census, the city has an estimated population of 243,611 people, 94.8% of whom live in the urban areas[19]. The city has few industries, and its economy is mainly service-based, the agricultural sector being the second most important economic activity. The region presents a subtropical climate with an annual average temperature of 19.2°C (mean variation, 10.5°C), and a relative humidity of 80% (range, 32% to 100%)[21]. In localities where seasons are well defined, the ISAAC protocol recommends that the study not be performed during the pollen season[22]. This is due to the fact that the prevalence of allergic rhinoconjunctivitis (hay fever) is higher during the pollen season[23]. However, the most severe asthma-related symptoms are reported during winter[24]. The present study was carried out during the fall and winter. Nevertheless, the prevalence of more severe asthma was not higher than that observed in Brazilian localities presenting tropical climates[25].

Similarly to what has been documented by other researchers, we observed a predominance of active asthma, asthma of higher severity, exercise-induced bronchospasm and night cough among the females (Table 2). In a longitudinal study, it was documented that, until puberty, the predominance of asthma among boys decreased gradually, whereas the incidence of new cases increased significantly among females. Solé et al.[26] reported that night cough in the absence of a cold was more common among girls of 13 and 14 years of age. In 1999, Camelo-Nunes et al.[27] observed a higher prevalence of impaired speech caused by wheezing and dry cough at night among teenage females. The same has been reported regarding the severity of the disease. Among asthmatic young adults, asthma is

more prevalent among females than males by a ratio of 1:1.5, and higher rates of hospital admission, morbidity, and symptom severity have been observed among females[28]. Although hormonal differences were reported to be responsible for the differences in severity observed between the sexes as early as the 1960s[28], to date, the differences between genders have not been clarified.

Comparative analysis of the prevalence of active asthma found in the present study with that reported for other centers at a similar latitude (either in Brazil or in other South American countries) participating in the first phase of the ISAAC, revealed the 16.7% prevalence in Santa Maria was lower than those found in the cities of São Paulo (23.3%), Curitiba (in the state of Paraná; 18.4%), Uberlândia (in the state of Minas Gerais; 21.1%) and Duque de Caxias (in the state of Rio de Janeiro; 19%), and higher than those found in Santiago, Chile (11.7%), Buenos Aires, Argentina (9.9%) and Itabira (in the state of Minas Gerais; 9.6%)[13]. These data belie the importance of atmospheric pollution as an asthma-inducing agent, once it is heavy in Santiago, elevated in Buenos Aires[13] and almost nonexistent in Santa Maria. The same was documented with regard to the questions that assess the severity of asthma. According to Mallol et al.(18) the remarkable existing differences among the countries of Latin America and, within each, regarding their socioeconomic, cultural and environmental conditions, probably contribute to these variations of prevalence. The high prevalence of asthma symptoms in Santa Maria, a city with little industry whose predominant economic activity is in the area of services, when compared to cities known for their high level of air pollution, such as Santiago and Buenos Aires, is in accordance with the findings of studies that suggest there is no causal relationship between atmospheric pollution and the prevalence of asthma in children[13].

However, the indices obtained in Santa Maria are lower than those found in Porto Alegre (also in the state of Rio Grande do Sul; 24.7%)[25]. Over one million people live in Porto Alegre and its main economic activity is related to providing services and industrial production. The two cities are of predominantly European colonization, have a population of higher than average socioeconomic level, good medical treatment and lifestyles very similar to those of the large urban capitals of the western world, partly explaining the similarity observed with the findings of other authors[13,29]. There are no differences between the two cities with regard to their ethnic composition, climate and geography. However, urbanization and the consequent differences in eating habits and lifestyle may be considered populational risk factors for an increase in the prevalence of asthma.

The prevalence of asthma observed approximates the world average[16]. Explanations for the wide international variation in the prevalence of asthma have been based on ecological analyses, utilizing the data collected in phase 1 the ISAAC project. These studies have found weak protective effects of vegetables in the diet, immunizations and tuberculosis, as well as a positive correlation with economic development but not with climate[30].

In conclusion, the prevalence of asthma (and asthma-related symptoms) in urban schoolchildren of the city of Santa Maria was found to be elevated, predominantly among girls. This prevalence was comparable to global averages but lower than that found in most Brazilian and Latin American capitals, demonstrating the need for further studies related to risk factors for these populations.

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