

# Prevalence and Severity of Asthma, Rhinitis, and Atopic Eczema in 13- to 14-Year-Old Schoolchildren from Southern Brazil

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## Abstract

The objective of this study was to investigate the prevalence and severity of asthma, rhinitis, and atopic eczema in schoolchildren from southern Brazil. A cross-sectional study was carried out with the International Study of Asthma and Allergies in Childhood phase III written questionnaire. The questionnaire was self-applied by 2,948 randomly selected schoolchildren aged 13 to 14 years. The lifetime prevalence rates of symptoms were as follows: wheezing, 40.8%; rhinitis, 40.7%; eczema, 13.6%; self-reported asthma, 14.6%; rhinitis, 31.4%; eczema, 13.4%. Rhinitis was reported by 55% of adolescents with current asthma (60% females vs 46.9% males). Girls 13 to 14 years of age had higher prevalence rates of asthma, rhinitis, and eczema than boys had. Atopic eczema was reported by 42.7% of girls and 31.4% of boys with asthma. The prevalence rates were statistically significant for symptoms of asthma, rhinitis, and atopic eczema in females. However, there were no statistically significant differences between the sexes in regard to reported asthma and bronchospasm induced by exercise.

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Asthma is the most common chronic disease in childhood.<sup>1</sup> Recent studies suggest that its prevalence is increasing in children and adolescents, as are hospitalization rates for this condition, despite

considerable advances in knowledge and the development of efficient medications.<sup>2-4</sup> Asthma has important repercussions, both economic and social, contributing to the overloading of health services.<sup>5,6</sup>

Several hypotheses have been suggested to explain this increase, such as better recognition of the disease, an increasing number of doctors, and environmental factors (namely, changes in lifestyle and urbanization in industrialized countries). It may also be explained by differences between research methods, which implies that epidemiologic studies on asthma need be standardized for temporal and international comparisons.

In 1992, aiming to maximize the value of epidemiologic investigations of asthma and other allergic diseases in childhood and to make international collaboration easier, the International Study of Asthma and Allergies in Childhood (ISAAC) proposed a single method for research.<sup>7</sup>

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Phase I of ISAAC showed that Brazil occupies eighth place in prevalence, having a mean prevalence of 20% for current asthma. For ages 13 to 14 years, the prevalence rate varies from 4.8 to 27.1%.<sup>8</sup>

The aim of this study was to investigate the prevalence of asthma, rhinitis, and atopic eczema and to investigate the relationship between rhinitis and eczema with severe asthma in school-aged adolescents living in the city of Passo Fundo in southern Brazil, an agricultural region, as part of an ISAAC phase III project.

## Materials and Methods

This study was carried out in Passo Fundo, a city located in the state of Rio Grande do Sul (latitude 28°S and longitude 52°04'W), which shares borders with Uruguay and Argentina. The majority of the population (88.8%) is Caucasian, descendants of settlers from Portugal as well as immigrants from Italy, Germany, and other European countries. The total population consists of 182,233 inhabitants, and the annual per capita gross product is approximately \$4,000 (US). The climate is temperate, and the region has the characteristics of a humid subtropical region with well-distributed rainfall.

The study was a cross-sectional survey of schoolchildren aged 13 to 14 years. The students were selected from children who attended the public and private schools of Passo Fundo. Information regarding the number of schools and students was obtained from the records at the Secretariat of Education. In the year 2002, 5,932 students in this age group were enrolled in public and private schools, distributed among a total of 80 schools. It was determined that schools with 50 or more enrolled students within this age group would be assessed, according to the ISAAC protocol. A total of 46 such schools were identified. From these, 26 schools were chosen by systematic randomized sampling, resulting in a sample of 3,200 students.

### Questionnaire

The instrument used in this study was the ISAAC project pattern written questionnaire (WQ). In Brazil, the questionnaires were translated into Por-

tuguese and validated.<sup>9-11</sup> The only alteration in the questionnaire was a modification of the question on seasonal rhinitis, formulated as "Have you ever had allergic rhinitis," instead of "Have you ever had hay fever," as in the original English version, because the term "hay fever" as a synonym for seasonal allergic rhinitis is little known in Brazil.<sup>10</sup>

WQs were distributed in classrooms and filled out by the adolescents under researchers' supervision from May to September, 2002 (autumn and winter). For absent students, another opportunity was given at a later time. Every WQ that was correctly filled out was considered valid.

### Ethical Approval and Consent

The study was approved by the Ethical Committee and Research of the Hospital das Clínicas de Porto Alegre, Faculty of Medicine, Federal University of Rio Grande do Sul.

Permission for developing the survey in the classrooms was given by the school principals, and consent for participation was provided by parents and by the adolescents themselves.

### Statistical Analysis and Power Calculation

Collected data were entered into a database in double-entry *EPI Info* version 6.04, provided by the ISAAC coordinators. Statistical analysis was performed with *EPI Info* version 6.04D. Non-parametric tests (Pearson's chi-square test was used for trends), odds ratio (OR), and 95% confidence interval (95% CI) were used to measure the association force among variables, and a *p* value of < .05% was considered to be significant.

With a sample of 3,000 subjects, the power to detect the difference in the 1-year prevalence of wheezing and severe asthma between two centers would be 99% and 90%, respectively, at the 1% level of significance.<sup>7</sup>

### Definitions

In the present study, we defined subjects by the following criteria. Individuals were defined as having had a severe attack of asthma if they answered

**Table 1 Self-Reported Prevalence of Asthma, Rhinitis, and Eczema and Their Related Symptoms in 13- to 14-Year-Old Schoolchildren**

| <i>Symptom*</i>                        | <i>Girls (%)</i><br>( <i>n</i> = 1,513) | <i>Boys (%)</i><br>( <i>n</i> = 1,435) | <i>All (%)</i><br>( <i>n</i> = 2,948) | <i>OR</i><br>(95% <i>CI</i> ) | <i>p Value</i> |
|--|---|--|---------------------------------------|-------------------------------|----------------|
| <b>Asthma</b>                          |   |  |                                       |                               |                |
| Ever wheezed                           | 43.6                                    | 37.8                                   | 40.8 <sup>†</sup>                     | 1.27 (1.09–1.48)              | < .01          |
| Wheeze in the past year                | 23.1                                    | 17.7                                   | 20.5 <sup>†</sup>                     | 1.40 (1.16–1.69)              | < .001         |
| Wheezing with exercise last year       | 22.9                                    | 20.1                                   | 21.5                                  | 1.18 (0.98–1.41)              | > .05          |
| Persistent cough last year             | 47.1                                    | 31.3                                   | 39.4 <sup>†</sup>                     | 1.96 (1.68–2.29)              | < .001         |
| Ever had asthma                        | 13.5                                    | 15.7                                   | 14.60                                 | 0.83 (0.67–1.03)              | > .05          |
| <b>Rhinitis</b>                        |   |  |                                       |                               |                |
| Ever had rhinitis                      | 47.1                                    | 34.0                                   | 40.7 <sup>†</sup>                     | 1.72 (1.48–2.01)              | < .001         |
| Rhinitis in the past year              | 35.2                                    | 23.6                                   | 29.5 <sup>†</sup>                     | 1.76 (1.49–2.08)              | < .001         |
| Associated itchy eye in the past year  | 20.8                                    | 10.7                                   | 15.9 <sup>†</sup>                     | 2.20 (1.78–2.74)              | < .001         |
| Ever had allergic rhinitis             | 36.5                                    | 26.1                                   | 31.4 <sup>†</sup>                     | 1.63 (1.39–1.92)              | < .001         |
| <b>Eczema</b>                          |   |  |                                       |                               |                |
| Chronic rash ever                      | 15.7                                    | 11.4                                   | 13.6 <sup>†</sup>                     | 1.44 (1.15–1.80)              | < .001         |
| Chronic rash in the past year          | 10.5                                    | 6.7                                    | 8.6 <sup>†</sup>                      | 1.64 (1.24–2.16)              | < .001         |
| Chronic rash with typical distribution | 6.3                                     | 3.6                                    | 5 <sup>†</sup>                        | 1.84 (1.28–2.65)              | < .001         |
| Ever had eczema                        | 15.3                                    | 11.4                                   | 13.4 <sup>†</sup>                     | 1.40 (1.12–1.74)              | < .01          |

CI = confidence interval; *n* = population size; OR = odds ratio.

\*From written questionnaire.

<sup>†</sup>Indicates significance between girls and boys.

affirmatively to the question, “In the last 12 months, has wheezing ever been severe enough to limit your speech to only one or two words at a time between breaths?” Individuals were defined as having severe asthma if they answered affirmatively to questions asking if they (1) had more than 12 attacks of wheezing in the last year, (2) had disturbed sleep due to wheezing one or more nights per week, (3) had wheezing severe enough to limit their speech to only one or two words between breaths, and (4) had wheezing during or after exercise.

## Results

The questionnaires were answered by students in the classroom, and immediately returned. A total of 3,161 questionnaires were distributed. Of the 3,048 that were returned, 2,948 (93.2%) were correctly filled out. Of the respondents, 51.3% were female and 48.7% were male; 55.5% were 13 years of age and 44.5% were 14 years of age.

Tables 1 and 2 respectively show the prevalence and severity of asthma, rhinitis, and eczema. The prevalence rate was significantly higher for females than for males ( $p < .05$ ). “Ever wheezed” and “ever had rhinitis” were the most common affirmative responses, these symptoms respectively having a lifetime prevalence of 43.6% and 47.1% in females and 37.8% and 34.0% in males.

Females also responded affirmatively more often than males to having had wheezing in the previous 12 months, nocturnal coughing without respiratory infection, symptoms of rhinitis in the previous 12 months, and symptoms of rhinoconjunctivitis ( $p < .001$ ). Females also presented with more attacks of severe asthma than did males (OR, 2.05; 95% CI, 1.40–2.99;  $p < .001$ ). Regarding the questions on “asthma diagnosed by the doctor” and “wheezing during or after exercise,” there was no statistically significant difference between the sexes. Symptoms of eczema were also more frequent among female adolescents ( $p < .001$ ). Affirmative and concomitant answers

**Table 2 Prevalence of Reported Symptoms Indicating Severity of Asthma, Rhinitis, and Eczema**

| <i>Symptom</i>                       | <i>Girls (%)</i><br>(n = 1,513) | <i>Boys (%)</i><br>(n = 1,435) | <i>All (%)</i><br>(n = 2,948) | <i>p Value</i> |
|--------------------------------------|---------------------------------|--------------------------------|-------------------------------|----------------|
| <b>Wheeze in past year</b>           |                                 |                                |                               |                |
| Number of wheezing episodes          |                                 |                                |                               |                |
| 1–3                                  | 22.5*                           | 16.8                           | 19.7                          | < .01          |
| 4–12                                 | 1.3                             | 1.7                            | 1.5                           | > .05          |
| > 12                                 | 0.1                             | 0.6                            | 0.3                           | < .01          |
| Awoken by wheeze                     |                                 |                                |                               |                |
| < 1 time each week                   | 10.9                            | 8.9                            | 9.9                           |                |
| ≥ 1 time each week                   | 4.8*                            | 2.6                            | 3.8                           | < .01          |
| Limitation of speech during wheezing | 6.3                             | 3.2                            | 4.8                           | < .0001        |
| <b>Rhinitis in past year</b>         |                                 |                                |                               |                |
| Interference with daily activity     |                                 |                                |                               |                |
| Little                               | 18.2*                           | 11.9                           | 15.1                          | < .01          |
| Moderate                             | 3.8*                            | 2.4                            | 3.2                           | < .05          |
| Severe                               | 2*                              | 0.8                            | 1.4                           | < .01          |
| <b>Rashes in past year</b>           |                                 |                                |                               |                |
| Persistent rash without clearing     | 7.5*                            | 4.8                            | 6.2                           | .003           |
| Kept awake by rash                   |                                 |                                |                               |                |
| < 1 time each week                   | 3.4*                            | 2.4                            | 2.9                           | > .05          |
| ≥ 1 time each week                   | 1.9*                            | 0.7                            | 1.3                           | < .01          |

n = size of sample.

\*Indicates significance between girls and boys.

for asthma, rhinitis, and atopic eczema were given by 2.1% of the adolescents. Approximately 55% of the subjects with current asthma reported having current rhinitis (64% females, compared to 63% males). Of the subjects who had current asthma, 36% had associated allergic rhinoconjunctivitis (68% females, compared to 32% males). Approximately 10% of the subjects with current asthma had atopic eczema (72% females, compared to 28% males).

Symptoms of current rhinitis and atopic eczema were significantly associated with symptoms of current asthma as well as with severe attacks of asthma (OR for current asthma, 3.84; 95% CI, 2.67–5.52;  $p < .0001$ ) (OR for atopic eczema, 4.0; 95% CI, 2.62–6.13;  $p < .0001$ ).

## Discussion

In epidemiologic surveys that use WQs for obtaining study data, it is important to reach a total num-

ber of respondents that is close to the estimated population because nonrespondents may generate errors.<sup>12</sup> It is accepted that a rate of response of about 90% is required to avoid such deviations in data.<sup>7</sup> In this study, we observed a rate of about 93.2%, comparable to other studies in which the ISAAC protocol was used.

In the present study, there was a predominance of symptoms of asthma, rhinitis, and atopic eczema in girls. Recent studies indicate that the predominance observed for male preadolescents generally decreases at the end of adolescence,<sup>13</sup> resulting in an inversion of the proportions between the sexes.<sup>14,15</sup> One possible explanation for this is that boys in this age group might tend to underestimate their symptoms whereas girls in this age group might tend to overestimate symptoms.<sup>15</sup> Anatomic<sup>16</sup> and hormonal factors characteristic of puberty (especially the increase of estradiol levels)<sup>17</sup> might also explain this change.

The number of wheezing attacks in the past 12 months is the most important item in defining

cases of asthma because a characteristic of the disease is repeated episodes of wheezing. Children with four or more wheezing attacks in a year have a greater probability of being asthmatic.<sup>18</sup> In our study, the 12-month prevalence of wheezing (current asthma) for these children was 20.5%. Approximately 90% of the adolescents with symptoms of current asthma reported one to three wheezing attacks. One in 10 reported having four or more wheezing attacks per year. One-fifth of those who wheezed reported having had frequent sleep disturbances one or more times per week. About one-fourth of the adolescents who wheezed reported having limitations of speech during wheezing attacks. These results are similar to those observed by Shamssain and Shamsain, in England.<sup>19</sup>

Epidemiologic studies consistently show that asthma and rhinitis are frequently associated in the same patient.<sup>20,21</sup> For adolescents aged 13 to 14 years, the ISAAC protocol showed a 3.4% prevalence of association between asthma and allergic rhinitis, with a variation of 0.5 to 40.0%.<sup>22</sup> In this study, approximately 55% of the adolescents with symptoms of current asthma had current rhinitis. On the other hand, 36.9% of the subjects with current asthma reported symptoms of rhinoconjunctivitis. This is confirmation that asthma seems to be more frequently associated with perennial rhinitis than with seasonal rhinitis.<sup>23</sup> Of the adolescents with current rhinitis plus current asthma, 75% had severe asthma (OR, 7.23; 95% CI, 1.78–34.09;  $p = .0016$ ), indicating that among asthmatic patients, the presence of rhinitis is a risk factor for severe asthma.

Atopic eczema predicts the development of asthma and allergic rhinitis, being the “entrance point” for subsequent allergic diseases.<sup>24</sup> Approximately 80% of children with atopic eczema eventually may develop rhinitis or asthma, suggesting a common systemic relation between respiratory allergy and atopic eczema.<sup>25</sup> In this study, the data show that 25% of the adolescents with atopic eczema had more acute attacks of asthma (OR, 4.01; 95% CI, 2.62–6.13; relative risk [RR], 2.51–5.12;  $p < .0001$ ) than they had severe asthma (OR, 3.55;  $p = .078$ ).

The association of asthma, rhinitis, and eczema concomitantly is a reality. Austin and colleagues,

using the criteria of the ISAAC protocol in a study involving 27,507 children aged 12 to 14 years, verified that 4% of the children reported associated symptoms of asthma, rhinitis, and eczema.<sup>26</sup> Shamssain and Shamsain, assessing 3,000 adolescents aged 13 to 14 years in Sunderland, England, verified the concomitance of asthma, rhinitis, and eczema in 5.1% of subjects.<sup>19</sup> Data in the present study showed that 2.1% of the adolescents presented concomitantly with asthma, rhinitis, and eczema; these values were below those found in the studies conducted in England. When our data are compared with those of other centers at a similar latitude in Latin America, it is observed that there is a higher prevalence of asthma symptoms in Passo Fundo<sup>27</sup> (Table 3).

Regarding the limitations of the study, the first is the fact that a self-reported questionnaire may be subject to recall bias, and the study did not include any objective tests such as bronchial hyperresponsiveness (BHR) testing or exercise challenge. However, previous work showed that in an English-speaking population, the ISAAC WQ has reasonable sensitivity and specificity for BHR.<sup>28</sup> In Brazil, Camelo-Nunes and colleagues, by constructive validation of BHR by methacholine testing, showed that the questionnaire option “wheezing in the past 12 months” is the one that has the best discriminatory power in the screening of asthmatic and nonasthmatic patients.<sup>29</sup>

A second limitation of this study was the absence of questions on possible risk factors such as diet, socioeconomic conditions,<sup>8</sup> family history of atopy, passive or active smoking, the presence of pets, the mother’s education level, and exposure to pesticides<sup>30</sup> and/or insecticides<sup>31</sup> (all of which, being important for epidemiologic studies of asthma and allergic diseases, will be objects of a subsequent study). In addition, using a questionnaire did not allow us to generate data on skin test reactivity to inhalant allergens.

## Conclusions

The prevalence rate of asthma in the study population was close to the Brazilian mean but greater than that of several centres in Latin America that

Table 3 Prevalence of Asthma Symptoms among 52,549 Children Aged 13 to 14 Years, from 17 Latin American Centres

| Center           | Degrees Latitude | N      | WHEZEV (%) | WHEZ12 (%) | AWAKE12 (%) | SPEECH12 (%) | ASTHMAEV (%) | EXWHEZ12 (%) | COUGH12 (%) |
|------------------|------------------|--------|------------|------------|-------------|--------------|--------------|--------------|-------------|
| Cuernavaca       | 18°57'N          | 3,102  | 18.1       | 6.6        | 4.4         | 2.4          | 5.5          | 4.0          | 13.6        |
| Costa Rica       | 9°56'N           | 3,200  | 37.6       | 23.7       | 15.2        | 10.1         | 18.5         | 24.2         | 31.1        |
| David, Panamá    | 8°26'N           | 2,885  | 31.3       | 17.6       | 14.6        | 6.7          | 16.9         | 14.6         | 21.7        |
| Recife           | 8°06'S           | 3,086  | 39.0       | 19.7       | 13.0        | 4.8          | 20.9         | 20.5         | 30.9        |
| Lima             | 12°03'S          | 3,158  | 48.6       | 26.0       | 14.1        | 6.9          | 28.0         | 35.9         | 33.6        |
| Salvador         | 12°58'S          | 3,162  | 44.3       | 27.0       | 9.6         | 5.4          | 12.5         | 27.6         | 29.6        |
| São Paulo        | 23°32'S          | 3,007  | 45.4       | 23.3       | 12.0        | 2.7          | 10.0         | 20.5         | 33.0        |
| Assunción        | 25°15'S          | 2,966  | 39.9       | 19.4       | 10.2        | 5.2          | 12.2         | 15.3         | 31.3        |
| Curitiba         | 25°24'S          | 3,004  | 40.4       | 18.4       | 9.1         | 4.6          | 8.6          | 19.8         | 30.1        |
| Porto Alegre     | 30°04'S          | 3,195  | 47.0       | 24.7       | 15.2        | 5.7          | 21.9         | 29.0         | 39.2        |
| Rosario          | 33°00'S          | 3,008  | 23.9       | 11.8       | 7.6         | 4.4          | 7.9          | 16.5         | 41.9        |
| South Santiago   | 33°27'S          | 3,051  | 27.8       | 11.1       | 7.0         | 4.9          | 11.5         | 25.3         | 32.8        |
| Central Santiago | 33°30'S          | 2,944  | 32.3       | 11.7       | 5.3         | 2.0          | 12.4         | 15.0         | 23.1        |
| Buenos Aires     | 34°40'S          | 2,996  | 19.5       | 9.9        | 6.2         | 3.1          | 6.6          | 13.8         | 36.2        |
| Montevideo       | 34°55'S          | 3,072  | 31.2       | 19.0       | 9.8         | 5.1          | 15.3         | 18.4         | 28.1        |
| Valdivia         | 39°48'S          | 3,231  | 22.8       | 11.5       | 5.0         | 2.2          | 11.9         | 18.0         | 16.2        |
| Puntas Arenas    | 53°09'S          | 3,482  | 21.9       | 6.8        | 3.9         | 1.3          | 7.3          | 6.3          | 15.5        |
| Mean             | —                | 52,549 | 33.6       | 16.9       | 9.5         | 4.5          | 13.4         | 19.1         | 28.6        |
| Passo Fundo      | 28°15'S          | 2,948  | 40.8       | 20.5       | 13.7        | 4.8          | 14.6         | 21.5         | 39.4        |

Adapted from Mallo J et al.<sup>32</sup>

ASTHMAEV = asthma ever; AWAKE12 = sleep disturbance from wheeze, 1 or more times a week in the last 12 months; COUGH12 = dry cough at night in the last 12 months; EXWHEZ12 = wheeze with exercise in the last 12 months; N = size of population; SPEECH12 = wheeze severe enough to limit speech in the 12 months; WHEZEV = wheeze ever; WHEZ12 = wheeze in the last 12 months.



took part in the ISAAC project. Between the sexes, there were no statistically significant differences in regard to diagnosed asthma and exercise-induced bronchospasm; however, there was a predominance of females over males in regard to other symptoms of asthma, rhinitis, and atopic eczema. It was also found that there was a strong association between rhinitis and severe asthma in adolescents; the same was true for atopic eczema and severe attacks of asthma.

Future investigations are needed to confirm these findings, as well as to investigate possible etiologic factors.

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