

## Prevalence and risk factors for asthma in schoolchildren in southern Brazil

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### Abstract

**Objective:** To study the prevalence and risk factors for asthma in a cohort of 494 children born in 1993 and followed up to the age of 6 years in Pelotas, state of Rio Grande do Sul, Brazil.

**Methods:** A standardized and validated asthma questionnaire, based on the International Study of Asthma and Allergies in Childhood (ISAAC), was applied. Other information was also collected about socioeconomic background, genetic, nutritional, gestational and allergic factors, and previous infectious episodes.

**Results:** The prevalence of asthma found in this study was 12.8% (95%CI: 10-15.9%). In the multivariate analysis, risk factors such as non-white skin color (RR = 1.9 95%CI: 1.1-3.3%), family history of asthma (RR = 2.8 95%CI: 1.5-5.1), allergic rhinitis in children (RR = 2.6 95%CI: 1.5-4.4) and maternal smoking during pregnancy (RR = 1.7 95%CI: 1-2.9) were associated with asthma.

**Conclusion:** Childhood asthma is highly prevalent in Pelotas, and it is a serious public health problem. Therefore, specific programs should be developed for its control.

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### Introduction

Asthma is the most prevalent chronic disease among children, and constitutes a serious public health problem. Many studies have shown an increase in the prevalence, morbidity, and mortality of asthma in several countries in the last decades.<sup>1,2</sup>

In a Latin American study, the cumulative asthma prevalence found in children at 6-7 years of life ranged between 4.1 and 26.9% and that of wheezing in the past 12 months varied from 8.6 to 32.1%. These findings indicate that the prevalence of asthma and its symptoms is as high as that observed in industrialized countries.<sup>3</sup>

In Brazil, there is a paucity of population-based studies on asthma prevalence in children. A study carried out with school-aged children in some Brazilian cities (Porto Alegre, São Paulo, Curitiba, Salvador, Recife, Itabira and Uberlândia), which took part in the International Study of Asthma and Allergies in Childhood (ISAAC), revealed a cumulative prevalence of diagnosed asthma of 7.3% for boys and of 4.9% for girls aged 6-7 years and of 9.8 and 10.2%, respectively, for those aged 13-14 years. By looking at the data separately, we may see that the prevalence ranged from 4.8% in Itabira to 21.9% in Porto Alegre, in those individuals aged 13-14 years.<sup>4-7</sup> A cross-sectional study done with schoolchildren in Rio de Janeiro showed a prevalence of 21.7% for asthma according to the criteria of the questionnaire used (modified ATS-DLD-78 C).<sup>8</sup>

Childhood asthma is a multicausal disease that has been associated with genetic, environmental, gestational and socioeconomic factors, among others, in several studies with children and adolescents.<sup>9,10</sup>

Standardized questionnaires have been used as the major tool to determine asthma prevalence in the

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population. The ISAAC is an initiative to establish a standardized methodology and to allow for international comparisons, producing new hypotheses and investigating the existing ones.<sup>11</sup>

Asthma certainly causes a strong impact on children, on their families and on society. Notably, there is a large number of children being treated at emergency services, with frequent need for hospitalization. As a result, there is a big problem for the children (absenteeism from school), for the parents (absenteeism from work), and for the health system (elevated costs).

It is of paramount importance that asthma prevalence and its risk factors be determined so as to plan measures for its control and for the reduction of the morbidity and mortality associated with it.

The present study aimed to investigate the prevalence of risk factors for asthma in a cohort of children born in 1993, at 6 years of life, in Pelotas, state of Rio Grande do Sul, Brazil.

## Methods

This study was conducted in Pelotas, a medium-sized town in southern Brazil. A total of 532 children aged between 6 and 7 years participated in the study. These children were originally participants in a longitudinal study with 5,304 children born in Pelotas,<sup>13</sup> followed up since birth, with the aim to assess the influence of social and biological factors on children's health, growth and development. The children were followed up at 6, 12 and 48 months of life; 96.8, 93.4 and 93.4% of the children could be found. The current study consisted of a systematic sample of 10% of that cohort, which allowed investigating exposures between 7.5 to 9%, with an 80% power and significance level of 0.05, and a relative risk of 2.

For the current study, a precoded standardized questionnaire was applied to the mothers between June and September 2000 by especially trained interviewers. The questions about asthma symptoms were based on a questionnaire used by the ISAAC.<sup>14</sup> The term "bronchitis" was used together with "asthma" due to its wide use in the study population.

The variables used to determine asthma prevalence and symptoms were the following:

- Current asthma: physician-diagnosed asthma in the last year;
- Cumulative asthma: physician-diagnosed asthma since birth;
- Current wheezing: occurrence of wheezing episode in the last year;
- Cumulative wheezing: wheezing ever;
- Number of current wheezing episodes greater than 4;
- Sleep-disturbing wheezing once a week;
- Wheezing after physical exercise;
- Speech-limiting wheezing; and
- Nocturnal cough.

Biological variables (gender and skin color), hereditary variables (familial asthma and/or allergy) and socioeconomic variables (family income and maternal level of education) were analyzed. The following environmental factors were assessed: smoking in the household and overcrowding. History of allergic rhinitis in the child and eczema in the first year of life were also investigated. All of the variables mentioned above were collected during follow-up at 6 years of life, in 2000. Information about maternal and gestational factors (smoking during pregnancy, maternal age and preterm birth) was collected in 1993, as well as about nutritional factors, which included birth weight and breastfeeding and occurrence of bronchiolitis in the first year, which represented previous infectious events.

Current asthma was the major outcome. Pearson's chi-squared test was used for analyzing the association between each variable and the outcome, whereas the trend test was used for linear association. The joint effect of independent variables on outcome was assessed using Poisson regression, based on a hierarchical model. A significance level of 0.05 was chosen for the exclusion or maintenance of variables in the model.

## Results

92.5% of the proposed sample was studied, with a total of 38 (7.5%) losses, most of which were due to changes of address. The final sample included 494 children, approximately 10% of the original cohort.

Most children were white (74.7%) and 52.8% were female. Fifty-nine percent of the families to which these children belong earned up to three minimum wages (minimum wage at the time = R\$ 130,00 or 75 dollars).

The prevalence of current physician-diagnosed asthma corresponded to 12.8% (95%CI: 10-15.9%) and that of cumulative asthma amounted to 31%, i.e., 153 of 494 children had been diagnosed with asthma by a physician at least once since their birth and, 63 had this diagnosis in the last year. With regard to asthma symptoms, 16.8% of the children had wheezing episodes in the last year, 42.1% had wheezing ever, 7.9% had wheezing after exercise, and nearly 4% of the children had more than four wheezing episodes in the last year (Table 1).

In the bivariate analysis, current asthma was significantly correlated with non-white skin color, familial asthma, smoking during pregnancy and allergic rhinitis in the child (Table 2).

After the multivariate analysis, the risk factors for asthma identified in the present study were the following: non-white color, which showed a risk almost twice as high (RR = 1.9), even after socioeconomic factors were controlled; family history of asthma and allergic rhinitis in the child, which showed the highest relative risks with a slight decrease after controlling for confounding variables, and, smoking during pregnancy, which revealed to be associated in the significance threshold (Table 3).

**Table 1** - Prevalence of symptoms and diagnosis of asthma in the cohort children born in 1993 and followed up to the age of 6 years in Pelotas, state of Rio Grande do Sul, Brazil. Pelotas (RS)

	n (494)	Prevalence (%)
Current physician-diagnosed asthma	63	12.8
Cumulative physician-diagnosed asthma	153	31.0
Current wheezing (in the last 12 months)	83	16.8
Cumulative wheezing (ever)	208	42.1
Number of wheezing crisis > 4 in the last 12 months	18	3.64
Sleep disturbed by wheezing	46	9.3
Wheezing after exercise	39	7.9
Speech affected by wheezing	13	2.6
Nocturnal cough	129	26.1

## Discussion

As this was a cross-sectional study, one should bear some limitations of this type of study design in mind, such as the recall bias. To minimize this limitation, the questions used in this study about the major outcomes were restricted to the last year and the outcome referred to physician-diagnosed asthma. The prevalence of current asthma and current wheezing was similar, which may indicate that the prevalence of asthma was not overestimated in this study.

The prevalence of current asthma found in this cohort corresponded to 12.8%. Using the same methodology, at four years of life, an 18.4%<sup>10</sup> prevalence had been observed, which demonstrates a significant reduction ( $p = 0.005$ ) in the prevalence of asthma among these children at 4 to 6 years of life. The occurrence of wheezing in the last year was also lower at 6 years, showing that, if asthma was underdiagnosed in these children, it was not responsible for the decrease in the prevalence, since symptoms were alleviated. Werneck et al. also found a higher prevalence of asthma and its symptoms in the youngest children of the samples analyzed in Minas Gerais.<sup>5</sup>

Of the countries which participated in the ISAAC, Brazil showed high prevalence of asthma among children aged 13-14 years, and this was also the case of New Zealand, Australia, Canada, the United Kingdom, Peru, the United States and the Islamic Republic of Iran. The Brazilian cities that took part in this study were Curitiba, Porto Alegre, Recife, Salvador, Itabora, Uberlândia and São Paulo, with the prevalence of cumulative asthma ranging from 4.8% in Itabora to 21.9% in Porto Alegre, in those aged 13-14 years, and from 4.7 to 20.7% in those aged 6-7 years.<sup>5,6,15,16</sup> In the study conducted in Pelotas, the prevalence of cumulative asthma amounted to 31%, which was higher than that observed in other studies, including Porto Alegre, which is located in the same state.

A larger number of children had current wheezing (16.8%) than those diagnosed with asthma, which may indicate underdiagnosis of asthma in these children,

leading to mismanagement, and increasing morbidity and mortality due to asthma. Lack of diagnosis and of proper management of childhood asthma has been highlighted by several studies on morbidity caused by asthma.<sup>12,17</sup> In Switzerland, Kühni & Sennhauser<sup>18</sup> concluded that asthma was underdiagnosed and undertreated; children diagnosed as asthmatic would most likely receive treatment than other children with the same symptoms, but without having been diagnosed with asthma by a physician. Ehrlich et al.<sup>19</sup> also found a large difference between the prevalence of asthma symptoms and the diagnosis of asthma in children aged 7/8 years in Cape Town; children who showed a combination of asthma symptoms and diagnosis of asthma had a higher chance of receiving regular treatment for the disease than children with symptoms, but without the medical diagnosis.

The present study found a risk for asthma 64% higher among non-white children compared to white ones, after adjustment for socioeconomic factors. A similar result was described by Schwartz et al.,<sup>20</sup> when they analyzed data related to the Second National Health and Nutrition Examination Survey, where black skin color had an odds ratio of 1.7 (95%CI 1.2-2.1), after being adjusted. A study conducted in Michigan, with adolescents from a homogeneous socioeconomic background, found a higher prevalence of asthma among dark-skinned individuals, controlling for gender and maternal level of education, concluding that the findings were consistent with the hypothesis that biological differences play a crucial role in the development of asthma.<sup>21</sup>

Maternal history of asthma was also a risk factor in a case-control study with Afro-American children living in a poor neighborhood in the United States.<sup>22</sup> Ehrlich et al.,<sup>23</sup> in a study with children aged between 7 and 9 years living in Cape Town, detected maternal asthma and history of allergy (eczema, rhinitis) in the child, as predictors of asthma.

**Table 2** - Distribution of variables studied and their association with asthma in the cohort children born in 1993 and followed up to the age of 6 years in Pelotas, state of Rio Grande do Sul, Brazil. Pelotas (RS)

Variable	n (%)	% asthma	Raw RR (CI 95%)	p value
<b>Sex</b>				p = 0.38
Female	261 (52.8)	11.5	1	
Male	233 (47.2)	14.3	1.2 (0.8-2)	
<b>Skin-color</b>				p = 0.02
Caucasian	369 (74.7)	10.8	1	
Non-caucasian	125 (25.3)	20	1.9 (1.1-3.3)	
<b>Family history of asthma</b>				p = 0.000
No	238 (48.2)	6.3	1	
Yes	256 (51.8)	18.8	3 (1.7-5.3)	
<b>Family income</b>				p = 0.15
> 10 mw	37 (7.57)	13.5	1	
6.1 a 10 mw	37 (7.57)	5.4	0.4 (0.8-2.1)	
3.1 a 6 mw	126 (25.8)	12.7	0.9 (0.3-2.6)	
1.1 a 3 mw	191 (39.1)	10.5	0.8 (0.3-2.1)	
< 1 mw	98 (20)	20.4	1.5 (0.6-4)	
<b>Level of education</b>				p = 0.5
≥ 9 years	110 (22.4)	10.0	1	
5-8 years	219 (44.6)	12.8	1.3 (0.6-2.6)	
0-4 years	162 (33.0)	14.8	1.5 (0.7-3)	
<b>Smoking during pregnancy</b>				p = 0.058
No	323 (65.4)	10.5	1	
Yes	171 (34.6)	16.9	1.6 (1-2.6)	
<b>Maternal age</b>				p = 0.67
20 or more	424 (85.8)	12.5	1	
Less than 20	70 (14.2)	14.3	1.1 (0.6-2.3)	
<b>Gestational age</b>				p = 0.27
37 ou mais semanas	402 (82.7)	12.2	1	
< 37 semanas	84 (17.3)	16.7	1.6 (0.9-2.5)	
<b>Smoking mother</b>				p = 0.06
No	325 (65.8)	10.8	1	
Yes	168 (34.2)	16.7	1.6 (0.9-2.5)	
<b>n of people living at the same home</b>				p = 0.10
Up to three people	243 (49.2)	10.3	1	
Four people or more	251 (50.8)	15.1	1.5 (0.9-2.4)	
<b>Sleep with the child</b>				p = 0.66
1 person or none	221 (44.7)	11.3	1	
2 people	138 (27.9)	14.5	1.3 (0.7-2.3)	
3 or more people	135 (27.3)	13.3	1.2 (0.6-2.2)	
<b>Low birth weight</b>				p = 0.65
No	341 (69.2)	12.3	1	
Yes	152 (30.8)	13.8	1.1 (0.7-1.9)	
<b>Maternal breastfeeding</b>				p = 0.66
≥ 9 months	146 (29.8)	15.1	1	
4-8.9 months	95 (19.4)	9.5	0.6 (0.3-1.4)	
1-3.9 months	155 (31.6)	12.9	0.9 (0.5-1.6)	
< 1 months	94 (19.2)	12.8	0.9 (0.4-1.7)	
<b>Allergic rhinitis</b>				p = 0.000
No	368 (74.5)	8.7	1	
Yes	126 (25.5)	24.6	2.8 (1.7-4.6)	
<b>Eczema</b>				p = 0.10
No	399 (80.8)	11.5	1	
Yes	95 (19.2)	17.9	1.6 (0.9-2.7)	
<b>Bronchiolitis up to 1 year</b>				p = 0.54
No	468 (95.3)	13.0	1	
Yes	23 (4.7)	8.7	0.7 (0.2-2.7)	
	494 (100)			

mw = minimum wage.

**Table 3 -** Multivariate analysis of variables studied and their association with asthma. Pelotas, RS, Brazil

Variable	Raw RR (CI 95%)		Adjusted RR (CI 95%)	
<b>Skin-color</b>		p = 0.02		p = 0.03
Caucasian	1		1	
Non-Caucasian	1.9 (1.1-3.3)		1.9 (1.1-3.3)	
<b>Family history of asthma</b>		p = 0.000		p = 0.001
No	1		1	
Yes	3 (1.7-5.3)		2.8 (1.5-5.1)	
<b>Smoking during pregnancy</b>		p = 0.06		p = 0.059
No	1		1	
Yes	1.6 (1-2.6)		1.7 (1-2.9)	
<b>Allergic rhinitis</b>		p = 0.000		p = 0.001
No	1		1	
Yes	2.8 (1.7-4.6)		2.6 (1.5-4.4)	

Inheritance plays a key role in asthma; therefore, occurrence of asthma among parents is an important predictor of asthma in their children. Litonjua et al.<sup>24</sup> observed that the chance of having one asthmatic child was three times greater in the families in which one parent was asthmatic and six times higher when both parents were asthmatic, than in families in which only one parent had inhalant allergy, but did not have asthma. In the present study, family history of asthma was investigated by considering mother, father and siblings. A risk for asthma 2.8 higher was associated with this variable.

There was an association between maternal smoking during pregnancy and occurrence of asthma in school-aged children in a study conducted in Chicago.<sup>25</sup> Several studies<sup>26,27</sup> have shown an association between asthma and maternal smoking; in the present study, there was a stronger association with smoking during pregnancy, a variable that was kept in the model after control for confounding variables, in opposition to maternal smoking in the household.

No association was observed between asthma and the overcrowding variable in this visit, neither at 4 years (12), which is not consistent with the hypothesis of hygiene that has been demonstrated in several studies.<sup>28,29</sup> As to the occurrence of bronchiolitis in the first year of life, which was identified as risk factor for asthma in this same cohort at four years of life (12), was not associated with the outcome in the current study. Respiratory syncytial virus infection (RSV) has been strongly associated with the occurrence of wheezing and asthma in children.<sup>30</sup>

Since the analyzed sample is representative, we may extrapolate the results of this study to the population in this age group, and we may conclude that childhood asthma has a high prevalence in Pelotas, constituting a public health problem, and as such, proper measures should be taken for its control.

## References

- Dales RE, Raizenne M, el-Saadany S, Brook J, Burnett R. Prevalence of childhood asthma across Canada. *Int J Epidemiol.* 1994;23:775-81.
- Sears MR. Epidemiology of childhood asthma. *Lancet.* 1997;350:1015-20.
- Mallol J, Sole D, Asher I, Clayton T, Stein R, Soto-Quiroz M. Prevalence of asthma symptoms in Latin America: the International Study of Asthma and Allergies in Childhood (ISAAC). *Pediatr Pulmonol.* 2000;30:439-44.
- Worldwide variations in the prevalence of asthma symptoms: the International Study of Asthma and Allergies in Childhood (ISAAC). *Eur Respir J.* 1998;12:315-35.
- Werneck G, Ruiz S, Hart R, White M, Romieu I. Prevalence of asthma and other childhood allergies in Brazilian schoolchildren. *J Asthma.* 1999;36:677-90.
- De Britto MC, Bezerra PG, Ferreira OS, Maranhao IC, Trigueiro GA. Asthma prevalence in schoolchildren in a city in north-east Brazil. *Ann Trop Paediatr.* 2000;20:95-100.
- Sole D, Yamada E, Vana AT, Werneck G, Solano de Freitas L, Sologuren MJ, et al. International Study of Asthma and Allergies in Childhood (ISAAC): prevalence of asthma and asthma-related symptoms among Brazilian schoolchildren. *J Investig Allergol Clin Immunol.* 2001;11:123-8.
- Teldeschi AL, Sant'anna CC, Aires VL. [Prevalence of respiratory symptoms and clinical conditions and associated asthma in schoolchildren in Rio de Janeiro, Brazil]. *Rev Assoc Med Bras.* 2002;48:54-9.
- Joseph CL, Ownby DR, Peterson EL, Johnson CC. Does low birth weight help to explain the increased prevalence of asthma among African-Americans? *Ann Allergy Asthma Immunol.* 2002;88:507-12.
- Chatkin MN, Menezes AM, Victora CG, Barros FC. High prevalence of asthma in preschool children in Southern Brazil: a population-based study. *Pediatr Pulmonol.* 2003;35:296-301.
- Beasley R, Ellwood P, Asher I. International patterns of the prevalence of pediatric asthma the ISAAC program. *Pediatr Clin North Am.* 2003;50:539-53.
- Chatkin MN, Menezes AM, Albernaz E, Victora CG, Barros FC. [Asthmatic children's risk factors for emergency room visits, Brazil]. *Rev Saude Publica.* 2000;34:491-8.
- Victora CG. Estudo longitudinal da população materno-infantil da região urbana do sul do Brasil, 1993: aspectos metodológicos e resultados preliminares. *Rev Saude Publica.* 1996;30:34-5.
- Sole D, Vana AT, Yamada E, Rizzo M, Naspietz CK. International Study of Asthma and Allergies in Childhood (ISAAC) written questionnaire: validation of the asthma component among Brazilian children. *J Investig Allergol Clin Immunol.* 1998;8:376-82.

15. The International Study of Asthma and Allergies in Childhood Steering Committee. Worldwide variation in prevalence of symptoms of asthma, allergic rhinoconjunctivitis, and atopic eczema: ISAAC. *Lancet*. 1998;351:1225-32.
16. Sole D, Yamada E, Vana AT, Costa-Carvalho BT, Naspitz CK. Prevalence of asthma and related symptoms in school-age children in Sao Paulo, Brazil—International Study of Asthma and Allergies in Children (ISAAC). *J Asthma*. 1999;36:205-12.
17. Friday GA, Khine H, Lin M, Caliguiri LA. Profile of children requiring emergency treatment for asthma. *Ann Allergy Asthma Immunol*. 1997;78:221-4.
18. Kühni CE, Sennhauser FH. The Yentl syndrome en childhood asthma: risk factors for undertreatment in Swiss children. *Pediatr Pulmonol*. 1995;19:156-60.
19. Ehrlich RI, Du Toit D, Jordaan E, Volmink JA, Weinberg EG, Zwarenstein M. Prevalence and reliability of asthma symptoms in primary school children in Cape Town. *Int J Epidemiol*. 1995;24:1138-45.
20. Schwartz HJ, Gold DR, Dockery DW, Weiss ST, Speizer FE. Predictors of asthma and persistent wheeze in a national sample of children in the United States. *Am Rev Respir Dis*. 1990;142:555-62.
21. Nelson DA, Johnson CC, Divine GW, Strauchman C, Joseph CL, Ownby DR. Ethnic differences in the prevalence of asthma in middle class children. *Ann Allergy Asthma Immunol*. 1997;78:21-6.
22. Oliveti JF, Kercksmar CM, Redline S. Pre- and perinatal risk factors for asthma in inner city African-American children. *Am J Epidemiol*. 1996;143:570-7.
23. Ehrlich RI, Toit DD, Jordaan E, Zwarenstein M, Potter P, Volmink JA, et al. Risk factors for childhood asthma and wheezing. *Am J Respir Crit Care Med*. 1996;154:681-8.
24. Litonjua AA, Carey VJ, Burge HA. Parental history and the risk for childhood asthma. Does mother confer more risk than father? *Am J Respir Crit Care Med*. 1998;158:176-81.
25. Hu FB, Persky V, Flay BR, Zelli A, Cooksey J, Richardson J. Prevalence of asthma and wheezing in public schoolchildren: association with maternal smoking during pregnancy. *Ann Allergy Asthma Immunol*. 1997;79:80-4.
26. Cook DG, Strachan DP. Health effects of passive smoking. 3. Parental smoking and prevalence of respiratory symptoms and asthma in school age children. *Thorax*. 1997;52:1081-94.
27. Larsson ML, Frisk M, Hallstrom J, Kiviloog J, Lundback B. Environmental tobacco smoke exposure during childhood is associated with increased prevalence of asthma in adults. *Chest*. 2001;120:711-7.
28. Cardoso MR, Cousens SN, Siqueira LF, Alves FM, D'Angelo LA. Crowding: risk factor or protective factor for lower respiratory disease in young children? *BMC Public Health*. 2004;4:19.
29. da Costa Lima R, Victora CG, Menezes AM, Barros FC. Do risk factors for childhood infections and malnutrition protect against asthma? A study of Brazilian male adolescents. *Am J Public Health*. 2003;93:1858-64.
30. Sigurs N, Bjarnason R, Sigurbergsson F, Kjellman B. Respiratory syncytial virus bronchiolitis in infancy is an important risk factor for asthma and allergy at age 7. *Am J Respir Crit Care Med*. 2000;161:1501-7.

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