

Trends in the prevalence of asthma and other allergic diseases in schoolchildren from Cuernavaca, Mexico

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ABSTRACT

Several studies suggest that the prevalence of allergic diseases have increased worldwide in recent years. However, in Mexico, those diseases have not been assessed throughout time. The aim of this study was to determine whether there has been a change in the prevalence of childhood asthma, eczema, and atopic rhinitis in Mexican schoolchildren. Following the methodology recommended by the International Study of Asthma and Allergy in Childhood, we performed two cross-sectional assessments (1995/2002) using a standardized questionnaire-based survey answered by the parents of schoolchildren aged 6–8 years and 11–14 years randomly selected from schools in Cuernavaca, Mexico. The prevalence of asthma diagnosed by a doctor was 5.8% (95% CI, 5.2, 6.4) for 1995 versus 9.1% (95% CI, 8.3, 10.0) for 2002, with a greater prevalence in children aged 6–8 years in 2002 (5.7% versus 9.0%). No significant differences were found over time for wheezing in the last 12 months: 7.7% (95% CI, 7.1, 8.4) in 1995 and 8.0% (95% CI, 7.3, 8.8) in 2002. The prevalence of nasal and eye symptoms without colds was slightly higher in 1995 than it was in 2002: 9.9% (95% CI, 9.1, 10.7) versus 8.2% (95% CI, 7.4, 9.0), respectively. The results suggest an increase in the prevalence of asthma diagnosed by a doctor. However, no difference was observed in the prevalence of wheezing in the last 12 months, which may indicate a possible absence of “epidemic asthma” in the city of Cuernavaca among schoolchildren.

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Key words: Asthma, child, epidemiology, eczema, ISAAC, prevalence, questionnaire, rhinitis, trends, wheezing, world health

There is substantial evidence that the prevalence of asthma and other atopic diseases is increasing worldwide.^{1–3} Although in the last 30 years changes in prevalence have been reported and clearly documented around the world, no studies have been conducted in Mexico that evaluate the trends of prevalence of asthma and other allergic diseases using standardized methodology. The International Study of Asthma and Allergy in Childhood (ISAAC) is a collaborative project between countries that uses validated methodology for describing the prevalence and severity of asthma, allergic rhinitis, and eczema in children worldwide.⁴ The information obtained with this methodology is useful to identify etiologic and temporary changes in these diseases. The goal of our study was to determine the trends of prevalence of asthma, eczema, and allergic rhinitis in schoolchildren in Cuernavaca, a

city in the state of Morelos, in Mexico, at two different time periods (1995 and 2002) and to evaluate whether a change in the prevalence of the aforementioned conditions existed using the ISAAC methodology during both time periods.

MATERIALS AND METHODS

This study was planned taking into account the geographical and climatic conditions of Cuernavaca; therefore, we divided the study area into four strata. With the aid of the Ministry of Public Education (SEP) in Morelos, we obtained information on elementary schools in Cuernavaca and elaborated a framework sample. The proportional assignment of the sample was made according to the size of each stratum. Schools were considered as conglomerates. From a total of 137 elementary schools in the municipality of Cuernavaca, 72 (53%) participated in the study. The sample size was calculated to have enough power to detect variations in the prevalence among cities and in the severity of the studied cases—between 3 and 5%, respectively, according to the ISAAC specifications and considering the multicentral character of the study.

Study Population

A random sample of 7200 schoolchildren aged 6–8 years and 11–14 years was chosen for each study pe-

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riod (1995 and 2002). Approximately 3000 children were available for each study group, plus an additional 20% to prevent losses, as recommended in the ISAAC.⁴ At the end, the total number of first- and sixth-grade registered students was included in the sample. A questionnaire designed according to the criteria established in the ISAAC methodology was used and self-administered by the parents of the participating children after clearly explaining the study and obtaining their signed informed consent form. General social and demographic data and a clinical history were included, in addition to a section on assessing the symptoms associated with asthma, eczema, and allergic rhinitis, followed by another section on assessing the medical diagnoses of these conditions. At the end of the questionnaire, we included some questions related to the frequency and severity of the symptoms to evaluate the seriousness of the conditions studied.

Statistical Analysis

Descriptive data analysis was performed, and current and cumulative prevalences of the conditions were included. A separate analysis was done on the severity of the conditions through medical diagnoses and symptoms. A stratified analysis was conducted by sex, area or strata, and family history of asthma for each age group and for each study period, as well as for the total population. Chi-square tests were used to compare the prevalences with 95% CIs. Data were analyzed with the STATA statistical software 7.0. (release 7.0, STATA Corp., College Station, TX).

RESULTS

A total of 10,803 questionnaires were answered, of which 5565 corresponded to 1995 and 5238 corresponded to 2002. Of that total, 5398 (49.96%) questionnaires corresponded to the group of 6- to 8-year-old children and 5405 (50.04%) corresponded to the group of 11- to 14-year old children. The response rate was 95% for 1995 and 91% for 2002. Table 1 shows detailed characteristics of the study population. We had similar distribution of sexes among participants. In 2002, the mother's schooling increased, as compared with 1995, and in both study periods we had more participation among public schools than among private schools.

The prevalence of wheezing in the last 12 months in the 6- to 8-year-old children was 8.9% (95% CI, 7.9, 10.0) for 1995 versus 8.7% (95% CI, 7.6, 9.9) for 2002. With respect to this age group (6- to 8-year old children), no significant differences were found as to the prevalence of wheezing in the last 12 months between the two study periods. However, for the 11- to 14-year old children, the prevalence was slightly lower for 1995, 6.6% (95% CI, 5.7, 7.5) versus 7.4% (95% CI, 6.4, 8.5) in 2002 ($p > 0.05$; Table 2). As for the prevalence

Table 1 Comparison of social and demographic characteristics of participants in an ISAAC study, in two periods, 1995–2002, Cuernavaca, Mexico

Variable	<i>n</i>	1995 (%)	<i>n</i>	2002 (%)
Sex				
Boys	2731	50.9	2535	48.6
Girls	2833	49.1	2695	51.5
Age				
6–8 yr	2770	50.3	2633	50.3
11–14 ys	2795	49.67	2605	49.7
Mother's schooling				
None	402	7.5	204	4.1
Elementary school	2009	37.3	1283	25.6
Junior high school	1032	19.0	1750	34.9
Senior high school	500	9.2	960	19.12
College/university	1411	26.2	812	16.2
Type of schooling				
Public	55	76.0	56	77.0
Private	17	24.0	16	22.0

according to sex, for 1995, wheezing was slightly more common in 6- to 8-year-old girls than it was in boys in the same age group. For the year 2002, an opposite situation was seen, because the prevalence of wheezing was more common in boys in both age groups (Fig. 1).

Regarding the medical diagnosis of the studied diseases, we found that, the prevalence of asthma by medical diagnosis was 5.8% (95% CI, 5.2, 6.4) for 1995 versus 9.1% (95% CI, 8.3, 10.0) for 2002, with a greater prevalence in children aged 6–8 years in 2002 (5.7% *vs.* 9.0%; Table 2). The overall prevalence of rhinitis by medical diagnosis was 4.9% (95% CI, 4.3%, 5.5%) for 1995 versus 5.9% (95% CI, 5.3%, 6.6%) for 2002; a higher prevalence was observed in the older age group (6.6% versus 5.7%; Table 3). Regarding the prevalence of eczema by medical diagnosis, an increase was found for the year 2002 for both age groups (Table 4).

The prevalence of nasal and eye symptoms without cold in the last 12 months was slightly higher in 1995 (9.9% [95% CI, 6.7, 8.8]) than in 2002 (8.2% [95% CI, 4.9.0]). For the 6- to 8-year old children, the prevalence for 2002 was 9.6% (95% CI, 8.6, 10.7) versus 7.7% (95% CI, 6.7%, 8.8%). In the group of 11- to 14-year-old group, the prevalence for 2002 was 8.6% (95% CI, 7.6, 9.8) versus 10.1% (95% 9.1, 11.3) for 1995 (Table 3). When the prevalence of nasal and eye symptoms was stratified by sex in the group of 6- to 8-year-old children, it was higher in boys than it was in girls for 1995 (Fig. 2), showing the same pattern for 2002. However,

Table 2 Prevalence of asthma by medical diagnosis and symptoms, 1995–2002, Cuernavaca, Mexico

Variable	1995			2002			<i>p</i> Value§
	<i>n</i> *	%	95% CI#	<i>n</i> *	%	95% CI#	
Medically diagnosed asthma¶							
6–8 years old	79	3.0	(2.4, 3.7)	104	4.2	(3.5, 5.1)	0.014
11–14 years old	61	3.6	(3.0, 4.4)	114	4.6	(3.8, 5.5)	0.056
All ages	140	3.3	(2.9, 3.8)	218	4.4	(3.8, 5.0)	0.002
Medically diagnosed asthmatic bronchitis¶							
6–8 years old	94	5.3	(4.5, 6.2)	94	7.9	(6.9, 9.1)	0.002
11–14 years old	109	5.9	(5.1, 6.8)	191	7.9	(6.8, 9.1)	0.028
All ages	203	5.1	(4.6, 5.7)	385	7.9	(7.2, 8.7)	0.000
Medically diagnosed asthma and/or asthmatic bronchitis¶							
6–8 years old	129	5.7	(4.9, 6.6)	222	9.0	(7.9, 10.2)	0.000
11–14 years old	126	5.9	(5.1, 6.8)	230	9.3	(8.2, 10.5)	0.000
All ages	255	5.8	(5.2, 6.4)	452	9.1	(8.3, 10.0)	0.000
Symptoms							
Wheezing ever¶							
6–8 years old	442	23.9	(22.3, 25.5)	453	17.7	(16.3, 19.3)	0.000
11–14 years old	520	19.7	(18.3, 21.2)	433	17.1	(15.6, 18.6)	0.000
All ages	962	21.8	(20.7, 22.9)	886	17.4	(16.4, 18.5)	0.000
Current wheezing							
6–8 years old	147	8.9	(7.9, 10.0)	221	8.7	(7.6, 9.9)	0.789
11–14 years old	184	6.6	(5.7, 7.5)	186	7.4	(6.4, 8.5)	0.236
All ages	331	7.7	(7.1, 8.4)	407	8.0	(7.3, 8.8)	0.551
Coughing after exercising							
6–8 years old	279	17.6	(16.3, 19.0)	624	25.1	(23.4, 26.9)	0.000
11–14 years old	421	11.2	(10.1, 12.4)	480	19.5	(18.0, 21.2)	0.000
All ages	700	14.1	(13.5, 15.3)	1104	22.3	(21.2, 23.5)	0.000
Over three wheezing episodes	302	5.7	(5.1, 6.4)	356	7.1	(6.4, 7.8)	0.002

*Number of children.

#CI₉₅ = 95% CI.§*p* Value estimated using Pearson's chi-square test.

¶Cumulative prevalence.

||Current prevalence.

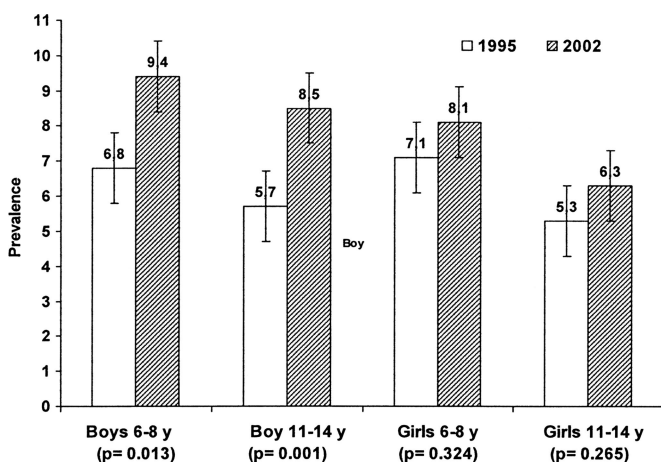


Figure 1. Prevalence of wheezing in the last 12 months according to age group and gender.

when the group of 11- to 14-year-old children was compared by sex, in 1995, the prevalence of those symptoms was more common in girls, and for 2002, it was more common in boys (Fig. 2).

As for the prevalence of eczema by symptoms, the prevalence of eczema in the last 12 months was higher in 1995 than it was in 2002: 10.3% (95% CI, 9.6, 11.1) versus 5.6% (95% CI, 4.9, 6.3; $p < 0.05$), with the same behavior in each age group: 10.1% (95% CI 9.1, 11.3) for 1995 versus 5.8% (95% CI, 4.9, 6.8) for 2002 in the 6- to 8-year-old children and 10.5% (95% CI, 9.5, 11.7) for 1995 versus 5.4% (95% CI, 4.5, 6.3) for 2002 in the 11- to 14-year-old children, respectively (Table 4). We found a slightly lower severity of asthma during 1995, 5.7% (95% CI, 5.1, 6.4) versus 7.1% (95% CI, 6.4, 7.8) for 2002 in both age groups, based on reported having more

Table 3 Prevalence of rhinitis by medical diagnosis and symptoms, 1995–2002, Cuernavaca, Mexico

Variable	1995			2002			<i>p</i> Value§
	<i>n</i> *	%	95% CI#	<i>n</i> *	%	95% CI#	
Medically diagnosed rhinitis¶							
6–8 years old	140	4.0	(3.3, 4.8)	124	5.2	(4.3, 6.2)	0.029
11–14 years old	93	5.7	(4.9, 6.6)	159	6.6	(5.6, 7.7)	0.157
All ages	233	4.9	(4.3, 5.5)	283	5.9	(5.3, 6.6)	0.017
Symptoms							
Variable nasal symptoms without a cold							
6–8 years old	577	24.8	(23.3, 26.4)	550	22.4	(20.7, 24.1)	0.033
11–14 years old	607	23.5	(22.0, 25.1)	503	20.4	(18.8, 22.1)	0.004
All ages	1184	24.2	(23.1, 25.3)	1053	21.4	(20.3, 22.6)	0.000
Nasal and ocular symptoms							
6–8 years old	239	9.6	(8.6, 10.7)	189	7.7	(6.7, 8.8)	0.010
11–14 years old	225	10.1	(9.1, 11.3)	213	8.6	(7.6, 9.8)	0.053
All ages	464	9.9	(9.1, 10.7)	402	8.2	(7.4, 9.0)	0.002
Symptoms according to the severity of rhinitis interference with everyday chores							
Little							
6–8 years old	294	10.9	(9.7, 12.2)	214	8.8	(7.7, 1.0)	0.008
11–14 years old	301	11.6	(10.4, 12.9)	206	8.4	(7.4, 9.6)	0.000
All ages	595	12.2	(10.4, 12.2)	420	8.6	(7.8, 9.5)	0.000
Very much							
6–8 years old	16	0.6	(0.3, 0.9)	19	0.7	(7.5, 1.1)	0.637
11–14 years old	20	0.7	(0.4, 1.1)	17	0.7	(0.4, 1.1)	1.000
All ages	36	0.7	(0.5, 0.9)	36	0.7	(0.5, 1.0)	1.000

*Number of children.

#CI₉₅ = 95% confidence interval.

¶Cumulative prevalence.

§*p* value estimated using Pearson's chi-square test.

||Current prevalence.

than three wheezing episodes in the last 12 months (Table 2).

The severity of rhinitis was established based on the interference with the child's activities for the presence of symptoms in the last 12 months. When the children reported that the symptoms produced low interference with their daily activities, we found a prevalence of 12.2% (95% CI, 10.4, 12.2) for 1995 and 8.6% (95% CI, 7.8, 9.5) for 2002 of current rhinitis. When asked whether this interference was frequent, children gave a similar percentage of positive answers for both periods of the study: 0.7% (95% CI, 0.5, 0.9) for 1995 versus 0.7% (95% CI, 0.5, 1.0) for 2002 (Table 3). Of the participants who reported wheezing in the last 12 months, 41.3% were medically diagnosed with asthma during 2002. In the year 1995, 39.6% of those children with wheezing problems in the last 12 months had been medically diagnosed with asthma.

When assessing the interrelationship between asthma, eczema, and allergic rhinitis, in 2002, we found that 0.2% of the children had the three conditions: 2.2% had asthma and allergic rhinitis, 1.5% had asthma and

eczema, and 1.4% had allergic rhinitis and eczema. In 1995, only five children reported having all three conditions: 0.7% had asthma and allergic rhinitis, 0.2% had asthma and eczema, and 0.7% had allergic rhinitis and eczema.

DISCUSSION

Using the ISAAC methodology, we evaluated and compared, during a 7-year period, the prevalence of asthma and other atopic diseases in schoolchildren from Cuernavaca, Mexico. The prevalence of wheezing in the last 12 months was slightly higher in 2002 than it was in 1995 (8.0% versus 7.7%, respectively), which suggests the absence of an epidemic in Mexico. Our country is among those with the lowest prevalence rates for atopic conditions, especially when compared with countries such as Australia.⁶ On the other hand, the prevalence of allergic rhinitis was similar in 1992 and in 1995, whereas the medical diagnosis of asthma increased significantly between the two periods.

According to our data, the prevalence of asthma symptoms was higher in younger children, especially

Table 4 Prevalence of eczema by medical diagnosis and symptoms, 1995–2002, Cuernavaca, Mexico

Variable	1995			2002			<i>p</i> Value§
	<i>n</i> *	%	95% CI#	<i>n</i> *	%	95% CI#	
Medically diagnosed eczema¶							
6–8 years old	105	3.9	(3.2, 4.7)	146	6.1	(5.2, 7.2)	0.000
11–14 years old	96	4.2	(3.5, 5.0)	168	6.9	(6.0, 8.0)	0.000
All ages	201	4.1	(3.6, 4.6)	314	6.5	(5.8, 7.3)	0.000
Eczema symptoms							
Dry itchy skin spots at any time¶¶							
6–8 years old	413	15.0	(13.8, 16.4)	176	7.3	(6.3, 8.4)	0.000
11–14 years old	375	17.0	(15.6, 18.4)	170	7.0	(6.0, 8.1)	0.000
All ages	788	16.0	(15.1, 17.0)	346	7.2	(6.4, 7.9)	0.000
Dry itchy skin spots in the last 12 mon¶¶							
6–8 years old	253	10.1	(9.1, 11.3)	140	5.8	(4.9, 6.8)	0.000
11–14 years old	244	10.5	(9.5, 11.7)	130	5.4	(4.5, 6.3)	0.000
All ages	497	10.3	(9.6, 11.1)	270	5.6	(4.9, 6.3)	0.000

*Number of children.

#CI₉₅ = 95% confidence interval.

¶Current prevalence.

§*p* Value estimated using Pearson's chi-square test.

¶¶Cumulative prevalence.

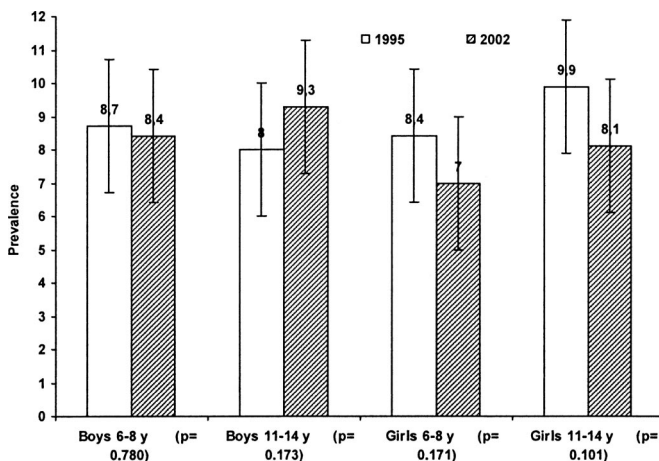


Figure 2. Prevalence of nasal and eye symptoms in the last 12 months according to age group and gender.

in 1995, for both cumulated wheezing and night coughing, and these symptoms were more common in boys than in girls. These results are similar to the results of several studies published in the international literature and conducted in other countries.^{7–14}

Our data suggest an increase in allergic diseases by medical diagnosis in 2002. This could be attributable to a greater access to health care services, improvements in the medical diagnosis of asthma, or a greater knowledge on the part of the population about these diseases during the study period. However, it is probable that diagnostic improvements contribute only in a small proportion to the change of related morbidity.

The increase in asthma diagnosis in 2002 was caused by mainly an increase in the diagnosis of asthmatic bronchitis, which might likely be related to transient wheezing during respiratory infection and not to persistent asthma. This is suggested by the absence of a significant change in the prevalence of wheezing in the last 12 months. When asking about the presence of coughing after exercising, we found that the 2002 prevalence rate for that condition was much higher than that for the first assessment (1995). This result may be indicative of a greater frequency of bronchial hyperactivity and not of an increase in the frequency of the disease. This also could be contributing to an increase in the hospitalization rates for asthma currently reported in our country.^{15,16}

When analyzing the prevalence of the symptoms related to eczema, we found that the prevalence in the last 12 months was lower in 2002. This could be caused by a more specific identification of eczema, because the 2002 survey had photographic illustrations provided to the parents, which were not included in the 1995 survey.

A series of epidemiological studies sustain that life-style changes^{17–19} and environmental changes, both indoors and outdoors, play an important role in the temporary changes of allergic diseases.^{20–22} Among those, the most-highlighted example of those changes is second-hand smoking. We found that the prevalence of second-hand smoking, as well as of smoking during pregnancy, decreased only slightly between 1995 and 2002, from 30 to 28.8%, and from 3.8 to 3.2%, respec-

tively. Although second-hand smoking has been regarded as a strong risk factor for asthma in our country and in several studies performed with the same ISAAC methodology,^{23–28} there is no current and consistent information that allows asserting that the changes in the habit and the frequency of smoking are related to the changes found. Similarly, the environmental and lifestyle conditions in Cuernavaca have not changed significantly in the last few years, which might explain the lack of significant changes observed in our study. In contrast, changes on these conditions have been noted in several countries when an increase in asthma prevalence has been related to them.

The results of this study should be interpreted with caution, because parents of children with an allergic disease could be more likely to participate in the study than parents with healthy children. To evaluate this possibility, we applied a short questionnaire to characterize dropouts of those children not responding during the first stage of the study, and we did not find any significant differences between participants and non-participants for the conditions studied. Similarly, because a self-administered questionnaire was used as part of the study methodology, low grades could have arisen from the subjects completing the survey, because their responses partially depended on the participants' recalling and the interpretation they gave to the question. To reduce that chance, several questions were inserted throughout the survey on symptoms, asked in different ways, and combined with others establishing the definition of the conditions, which increased the validity of the study. In addition, our response rate was 91%, which minimized a potential selection bias. It is also worth noting that in both surveys (1995 and 2002) parents answered the questionnaire for both age groups; therefore, responses might be more reliable. In contrast, the reproducibility of the questionnaire was tested in a subsample of 64 schoolchildren and reached acceptable results (Kappa between 0.74 and 0.90) for the questions assessed²⁹.

In conclusion, our study did not find any important increase in asthma and allergic rhinitis in schoolchildren from Cuernavaca, Mexico, over a 7-year period. However, because lifestyle changes are currently occurring in this country, we should continue assessing the trends of these diseases and we should implement preventive actions to avoid the increase of those conditions as it is observed in many developed countries.

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