

Factors Associated With Allergic Rhinitis in Children From Northern Mexico City

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■ Abstract

Background: The International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire allows users to find factors associated with allergic diseases, but thus far most of the studies on risk factors for allergic diseases have been devoted to asthma and not to rhinitis.

Objective: To determine the main factors associated with symptoms of allergic rhinitis and rhinoconjunctivitis in school children and adolescents in northern Mexico City.

Patients and Methods: A cross sectional, multicenter survey was conducted in northern Mexico City, in children aged 6-7 and 13-14 years. The survey instrument was the Phase Three B ISAAC questionnaire, which was validated and standardized in Spanish.

Results: There were 4106 6-7-year-olds and 6576 13-14-year-olds. The total prevalence of diagnosis of allergic rhinitis was 4.6%. The prevalence of cumulative and current symptoms of rhinitis was considered high (>29%), but the prevalence of the diagnosis of allergic rhinitis was considered low (ranging from 3.4% to 5.6%). The prevalence of symptoms of rhinitis with conjunctivitis had intermediate values (ranging from 20.3% to 30.2%). Cumulative symptoms of allergic rhinitis, current symptoms of allergic rhinitis, and rhinoconjunctivitis were related to symptoms of current or cumulative asthma, symptoms of current or cumulative atopic eczema, and current use of paracetamol (odds ratio > 1, $P < .05$).

Conclusion: The present results support the concept of rhinitis and asthma as common chronic respiratory diseases, and this study also found a relation between paracetamol use and rhinitis in children.

Key words: Rhinitis. Asthma. ISAAC. Survey. Paracetamol. Mexico.

■ Resumen

Antecedentes: El cuestionario del Estudio Internacional de Asma y Alergias en la Infancia (The International Study of Asthma and Allergies in Childhood, ISAAC) permite a los usuarios encontrar los factores asociados con las enfermedades alérgicas, sin embargo la mayoría de los estudios de factores de riesgo para enfermedades alérgicas se han dedicado al asma y no a la rinitis.

Objetivo: Determinar los principales factores asociados con los síntomas de la rinitis y la rinoconjuntivitis alérgicas en niños y adolescentes escolares en el norte de la Ciudad de México.

Pacientes y Métodos: Una encuesta de corte multicéntrico fue conducida en el norte de la Ciudad de México, en niños de 6-7 años y de 13-14 años. El instrumento de la encuesta fue el cuestionario de ISAAC fase 3b, el cual fue validado y estandarizado en español.

Resultados: Se incluyeron en el estudio 4.106 niños de 6-7-años y 6.576 de 13-14 años. La prevalencia total del diagnóstico de rinitis alérgica fue de 4.6%. La prevalencia de síntomas de rinitis acumulada y actual fue considerada alta (> 29%), pero la prevalencia del diagnóstico de rinitis alérgica fue considerada baja (con rango de 3,4% a 5,6%). La prevalencia de síntomas de rinitis con conjuntivitis tuvo valores intermedios (con rango de 20,3% a 30,2%). Los síntomas de rinitis alérgica acumulada, los síntomas de rinitis alérgica actual y rinoconjuntivitis estuvieron relacionados con síntomas de asma actual o acumulada, síntomas de dermatitis atópica actual o acumulada y al uso de acetaminofen actual (razón de momios > 1, $P < 0,05$).

Discusión: Los presentes resultados apoyan el concepto de la rinitis como enfermedades respiratorias crónicas en común, y este estudio también encontró una relación entre el uso de paracetamol y rinitis en niños.

Palabras clave: Rinitis. Asma. ISAAC. Encuesta. Paracetamol. México.

Introduction

The International Study of Asthma and Allergies in Childhood (ISAAC) [1,2] and the European Community Respiratory Health Survey [3] in adults have produced an extensive amount of data on the prevalence of asthma and allergic rhinitis worldwide. In the ISAAC cohort which collected data from 721 601 children worldwide, the prevalence of rhinitis symptoms in children ranged from 1.4% to 28.9%. For asthma, the prevalence ranged from 1.6% to 36.8% and, for atopic eczema, from 0.3% and 20.5%.

In Europe, 65% of adults with allergy have allergic rhinitis, 27% have asthma, 22% have skin allergy and 13% have food allergy. One child on 4 is allergic in Europe. For the adults, prevalence rates of asthma range from 5% to 10%. From 1 to 15% of European children are asthmatic. The National Health Interview Survey, a population-based interview survey in the United States of America (USA), reported in 1996, that 5.5% of US residents or almost 14.5 million people have asthma [4]. Surveys done in the USA have found that the prevalence of rhinitis has doubled in a period of 15 years [5]. Some countries have determined the prevalence of allergic diseases in specific geographic regions. The first systematic surveys were conducted in Adelaide, Sydney (Australia), West Sussex (England), Bochum (Germany) and Wellington (New Zealand) to investigate the prevalence of allergic diseases as well as the severity of asthma in children [6]. Based on these efforts, ISAAC was created in 1991 to encourage epidemiological research into allergic diseases, particularly asthma, using a standard methodology in order to facilitate international cooperation. ISAAC studies are conducted using a questionnaire on clinical history and symptoms of asthma, rhinitis, and atopic eczema as well as on respondents' social and ecological environments.

ISAAC has been divided into three phases: Phase One was designed to evaluate the prevalence of allergic diseases and severity of asthma. Phase Two investigates possible etiological factors, and Phase Three was designed to determine any change in the prevalence of allergic diseases and asthma severity using a questionnaire similar to Phase One, including questions regarding the environment. When a study center conducts a Phase Three survey without a previous Phase One study, the survey is referred to as Phase Three B [7].

In Cuernavaca, Mexico, previous surveys that partly followed the ISAAC methodology found a prevalence of 4.9% (95% confidence interval [CI], 4.3-5.3) for diagnosis of allergic rhinitis, 24.2% (95% CI, 23.3-25.3) for nasal symptoms without a cold, and 9.9% (95% CI, 9.1-10.7) for rhinoconjunctivitis [8]. In Ciudad Juarez [9], the prevalence of nasal symptoms without a cold and rhinoconjunctivitis were 28% (95% CI, 28-30) and 16.6% (95% CI, 15.6-17.5), respectively.

Based on the ecological data in the ISAAC questionnaire, it should be possible to find allergic-disease-associated factors that may be important in gaining a better understanding of the etiology of such diseases [10-12], and in implementing intervention strategies. Unfortunately, most of the studies on risk factors for allergic diseases are devoted to asthma and not rhinitis [13-16]. The aim of the present study was to determine the main factors associated with allergic rhinitis

and rhinoconjunctivitis in school children and adolescents in northern Mexico City.

Methods

Survey Population

According to ISAAC specifications [7], the calculated sample size was 3000 subjects for both the 6-7-year-old and 13-14-year-old groups. The sampling units for these groups were elementary and secondary schools, respectively. The number of schools to be included was based on the school population in the first and second grades of elementary and high schools, which were randomly selected in the four participating city precincts (Miguel Hidalgo, Azcapotzalco, Gustavo A Madero, and Venustiano Carranza). A total of 50 elementary and 27 high schools were sampled, and the response rates for the children from the schools was 91% and 99%, respectively. The aim and procedures of the survey were explained to the participants and their parents, and both signed the informed consent form. The Ethics and Research Committees of the Hospital Infantil de México Federico Gómez approved the survey protocol, which was carried out from September 2002 to January 2005. The ISAAC questionnaire used corresponds to Phase Three B of the ISAAC project, which includes the determination of the prevalence of symptoms of asthma, allergic rhinitis and atopic eczema, as well as the identification of environmental factors. The ISAAC coordinator for Latin America provided the Spanish version of the questionnaire [17].

Outcome measures

The main outcome variables used in the study were the presence of symptoms of rhinitis without a cold ever (cumulative prevalence) or in the last 12 months (current prevalence), and the prevalence of allergic rhinitis diagnosis, as well as symptoms of rhinoconjunctivitis. In the ISAAC Phase Three survey protocol there are specific questions regarding each of these variables.

Statistical Analysis

Data in the case report forms were entered twice into a digital database. Inconsistencies were checked against the original case forms, and outliers were checked and corrected in the same way. To detect those variables most probably related to an increase or decrease ($P \leq .10$) in the risk of symptoms of cumulative and current rhinitis, χ^2 tests for categorical variables corrected using the Fisher exact test were performed. The impacts of the possible associated factors and their relation to environmental variables were analyzed with a logistic regression analysis based on prevalence-adjusted odds ratios (ORs), using the forward conditional method to obtain models that explained the risk of each kind of symptom of rhinitis. All the analyses were performed using SPSS 8.0 software (SPSS Inc, Chicago, USA).

Table 1. Demographic Data and Prevalence of Current-Cumulative Symptoms and Medical Diagnosis of Allergic Rhinitis in Children From Northern Mexico City, 2002-2005

Variable	Age Group 6-7-year olds			Age group 13-14-year-olds		
	Boys	Girls	Total	Boys	Girls	Total
No.	2098	2008	4106	3243	3333	6576
Weight (kg±SD)	25.6±6.1	24.9±5.8	25.5±5.9	53.7±11.2	51.0±9.1	52.35±10.1
Height (cm±SD)	122.2±8.0	121.5±8.1	121.8±8.0	158.9±10.7	154.9±8.1	156.9±9.4
Rhinitis symptoms ever (cumulative prevalence)*	55 (52.8-57.1)	52.0 (49.8-54.2)	53.5 (51.3-55.6)	40.2 (38.5-41.9)	42.2 (40.6-43.9)	41.2 (39.5-42.9)
Rhinitis symptoms in the last 12 months (current prevalence)*	47.7 (45.5-49.9)	43.5 (41.3-45.7)	45.6 (43.4-47.8)	29.5 (27.9-31.1)	34.4 (32.7-36)†	31.9 (30.3-33.5)
Medical diagnosis of allergic rhinitis*	5.4 (4.4-6.4)	3.8 (2.9-4.6)	4.6 (3.65-5.5)	3.4 (2.8-4.1)	5.6 (4.8-6.4)†	4.5 (3.8-5.25)
Ocular + nasal symptoms*	20.4 (18.5-22.2)	20.3 (18.5-22.0)	20.3 (18.5-22.2)	23.8 (22.1-25.4)	30.2 (28.4-32.0)†	27.0 (25.2-28.7)
Symptoms of asthma ever*	21.5 (19.7-23.3)	17.1 (15.5-18.8)†	19.4 (18.2-20.6)	15.9 (14.6-17.1)	18.0 (16.7-19.3)	16.9 (16.0-17.8)
Symptoms of asthma in the last 12 months*	7.7 (6.6-8.9)	6.9 (5.8-8.1)	7.3 (6.5-8.2)	8.8 (7.8-9.8)	11.1 (10.0-12.1)†	9.9 (9.2-10.7)
Symptoms of Atopic dermatitis ever*	13.3 (11.9-14.8)	12.3 (10.9-13.8)	12.8 (11.8-13.9)	7.8 (6.9-8.7)	13.0 (11.8-14.1)†	10.4 (9.7-11.2)
Symptoms of Atopic dermatitis in the last 12 months*	10.8 (9.5-12.2)	9.8 (8.5-11.1)	10.3 (9.4-11.3)	6.5 (5.7-7.4)	10.7 (9.6-11.7)†	8.6 (7.9-9.3)
Paracetamol use in the first year of life*	48.1 (46.0-50.3)	47.2 (45.0-49.4)	47.6 (45.5-49.8)			
Antibiotic use in the first year of life*	65.0 (63.0-67.1)	60.7 (58.5-62.9)†	62.8 (60.7-65.0)			
Breast fed*	85.2 (83.7-86.8)	82.5 (80.9-84.2)	83.8 (82.3-85.5)			
Maternal smoking during first year of life*	10.6 (9.3-11.9)	10.7 (9.3-12.0)	10.6 (9.3-11.9)			

* Frequency (95% confidence interval)

† $P < .05$ between genders by χ^2

Table 2. Variables in the Logistic Regression Models*

Cumulative Symptoms of Rhinitis 6-7 Year-Old Group					
	OR	95% CI Upper Limit	95% CI Lower Limit	<i>r</i>	<i>P</i>
Wheezing ever	1.946	2.448	1.546	0.087	.000
Wheezing in the last 12 months	2.410	3.605	1.611	0.064	.000
Itchy rash at any time	1.814	2.337	1.408	0.069	.000
Daily hours watching TV	1.512	1.748	1.308	0.085	.000
Paracetamol use in the last 12 months	1.365	1.605	1.160	0.055	.000
Antibiotic use in the first year of life	1.581	2.184	1.145	0.038	.005
Contact with farm animals during the first year of life	0.905	0.951	0.860	-0.057	.000
Number of younger siblings	0.952	0.991	0.914	-0.031	.016
Number of smokers at home	1.946	2.448	1.546	0.087	.000
Current Symptoms of Rhinitis 6-7 Year-Old Group					
	OR	95% CI Upper Limit	95% CI Lower Limit	<i>r</i>	<i>P</i>
Wheezing ever	1.946	2.448	1.546	0.087	.000
Wheezing in the last 12 months	2.410	3.605	1.611	0.064	.000
Itchy rash in the last 12 months	1.814	2.337	1.408	0.069	.000
Paracetamol use in the last 12 months	1.512	1.748	1.308	0.085	.000
Antibiotic use in the first year of life	1.365	1.605	1.160	0.055	.000
Contact with farm animals during the first year of life	1.581	2.184	1.145	0.038	.005
Number of younger siblings	0.905	0.951	0.860	-0.057	.000
Number of smokers at home	0.952	0.991	0.914	-0.031	.016
Current Symptoms of Rhinoconjunctivitis 6-7 Year-Old Group					
	OR	95% CI Upper Limit	95% CI Lower Limit	<i>r</i>	<i>P</i>
Wheezing ever	1.876	2.458	1.432	0.085	.000
Wheezing in the last 12 months	2.007	2.908	1.385	0.067	.000
Itchy rash in the last 12 months	2.126	2.797	1.616	0.102	.000
Paracetamol use in the last 12 months	1.893	2.298	1.559	0.123	.000
Antibiotic use in the first year of life	1.364	1.717	1.083	0.044	.008
Contact with farm animals during the first year of life	2.180	3.105	1.530	0.080	.000
Number of younger siblings	0.932	0.995	0.873	-0.031	.035
Cumulative Symptoms of Rhinitis 13-14 Year-Old Group					
	OR	95% CI Upper Limit	95% CI Lower Limit	<i>r</i>	<i>P</i>
Wheezing ever	2.377	2.738	2.063	0.132	.000
Itchy rash at any time	2.259	2.703	1.888	0.098	.000
Paracetamol use in the last 12 months	1.257	1.358	1.164	0.063	.000
Smoking father	1.135	1.268	1.016	0.019	.025
Smoke ever	1.182	1.320	1.059	0.029	.003

Table 2 continues in the next page.

Table 2 (continued). Variables in the Logistic Regression Models*

Current Symptoms of Rhinitis 13-14 Year-Old Group					
	OR	95% CI Upper Limit	95% CI Lower Limit	<i>r</i>	<i>P</i>
Wheezing ever	2.330	2.772	1.959	0.117	.000
Asthma diagnosis ever	1.313	1.684	1.024	0.020	.032
Itchy rash at any time	1.286	2.762	1.891	0.104	.000
Daily hours watching TV	1.113	1.195	1.037	0.032	.003
Paracetamol use in the last 12 months	1.308	1.427	1.198	0.072	.000
Primary education of the mother	0.833	0.970	0.716	-0.023	.018
Smoking father	1.186	1.344	1.046	0.028	.008
Number of younger siblings	0.944	0.989	0.900	-0.025	.015
Current Symptoms of Rhinoconjunctivitis 13-14 Year-Old Group					
	OR	95% CI Upper Limit	95% CI Lower Limit	<i>r</i>	<i>P</i>
Sex	1.261	1.460	1.089	0.040	.002
Wheezing ever	1.477	1.807	1.207	0.051	.000
Asthma diagnosis ever	1.327	1.757	1.003	0.020	.048
Itchy rash in the last 12 months	2.219	2.785	1.768	0.097	.000
Daily hours watching TV	0.832	0.909	0.761	-0.055	.000
Paracetamol use in the last 12 months	1.154	1.282	1.039	0.033	.007
Primary education on the mother	0.761	0.947	0.611	-0.029	.014
Secondary education of the mother	0.781	0.913	0.669	-0.040	.002
Contact with cat in the last 12 months	1.220	1.447	1.029	0.026	.022
Born by cesarean section	1.232	1.444	1.050	0.031	.010
Smoke ever	1.274	1.502	1.081	0.036	.004
Currently smoking	1.461	1.891	1.129	0.036	.004
Smokers at home	0.490	0.594	0.405	-0.103	.000
Number of older siblings	0.944	0.985	0.904	-0.033	.008
Number of smokers at home	1.371	1.487	1.264	0.107	.000

* OR indicates odds ratio; CI, confidence interval.

Results

A total of 11380 patients were candidates for the survey, but 230 (2%) refused to participate. Absent students were not considered. The final sample consisted of 10682 correctly answered surveys. Of these, 4106 were from 6-7-year-olds and 6576 were from 13-14-year-olds. The demographic characteristics of the children are presented in Table 1, along with the prevalence of symptoms of cumulative and current rhinitis and diagnosis of allergic rhinitis, as well as symptoms of rhinoconjunctivitis. The total prevalence of diagnosis of allergic rhinitis was 4.5%. The prevalence of symptoms of cumulative and current rhinitis was considered high (40.2% to 55% and 29.5% to 47.7% respectively), but the prevalence of the diagnosis of allergic rhinitis was considered low (ranging from 3.4% to 5.6%). The prevalence of rhinitis with conjunctivitis had intermediate values (ranging from 20.3% to 30.2%). The prevalence of symptoms of cumulative and current allergic rhinitis was higher than the respective prevalence of symptoms of asthma and atopic eczema in the same group of children (Table 1). Events during the first year of life were registered only in the 6-7-year-old group, as the related

questions were completed by the parents. A large number of the children had used paracetamol (47.6%) and antibiotics (62.8%) during this period, and most had been breast-fed (83.8%).

Possible risk factors identified in the Fisher exact test ($P < .10$), that were included in the respective logistic regression analyses included sex, wheezing ever and in the last 12 months, asthma ever, itchy rash at any time and in the last 12 months, eczema ever, weekly exercise, daily television watching hours, paracetamol use in the first year of life and in the last 12 months, contact with farm animals during the first year of life, mother's education, smoking mother, smoke ever (in adolescents), current smoking (in adolescents), number of smokers at home, number of older siblings, and number of younger siblings. The results of the logistic regression analyses of variables with a possible influence on the different kinds of rhinitis are presented in Table 2.

In the case of the symptoms of cumulative and current rhinitis in the 6-7 year old children, as well as the symptoms of current rhinoconjunctivitis, the main factors related to higher risk ($OR > 1$, $P < .05$) were symptoms of asthma ever and current asthma (wheezing ever, and wheezing in the last 12 months), the use of paracetamol in the last 12 months, and

the use of antibiotics during the first year of life, and symptoms of atopic eczema (itching rash at any time for cumulative symptoms of rhinitis, and itching rash in the last 12 months for current symptoms of rhinitis and rhinoconjunctivitis). The presence of younger siblings decreased the risk of symptoms of both rhinitis and rhinoconjunctivitis ($OR < 1.0$, $P < .05$). Contact with farm animals during the first year of life diminished the OR ($OR < 1$, $P < .05$) for cumulative symptoms of rhinitis, but increased them for current symptoms of rhinitis and rhinoconjunctivitis ($OR > 1$, $P < .05$).

In the case of the symptoms of cumulative and current rhinitis in the 13-14 year old children, as well as the symptoms of current rhinoconjunctivitis, the main factors related to higher risk ($OR > 1$, $P < .05$) were symptoms of asthma ever, use of paracetamol in the last 12 months and symptoms of atopic eczema (at any time for cumulative and current symptoms of rhinitis, and in the last 12 months for current symptoms of rhinoconjunctivitis).

Discussion

The prevalence of allergic rhinitis has increased in recent decades and it is an important health issue for children and adults. In order to reduce the incidence and prevalence of allergic rhinitis it is necessary to identify the factors associated with it to plan preventive programs and specific actions in public health. Previous studies have identified factors associated with allergic rhinitis, such as asthma, wheezing, atopic eczema, allergen sensitization, and a family history of atopy [18-20], and to a lesser extent, paracetamol use at different ages [14,15]. The ISAAC program has allowed the prevalence of allergic diseases and some of the specific factors related to them to be evaluated at the regional level [21].

Studies of allergic rhinitis in Phase One of ISAAC [22] have revealed high prevalences in Japan and Scandinavia. However, a lower frequency of symptoms was reported in São Paulo (a large, polluted city). Specific environmental factors may be critical in explaining the different prevalence of allergic diseases but the exact nature of risk factors for allergic rhinitis has not been fully explored [23,24]. The difficulties involved with identifying the source of variations in asthma prevalence in the distinct Hispanic communities and the possible role of diversity of ethnic background and socioeconomic status have been point out in a recent review. Similarly, the need for standard survey strategies in Hispanics including well defined data on ethnicity, country of origin, place of birth, area of residence, and indicators of socioeconomic status has been highlighted [25]. In the present study, most of the population is a mixture of Amerindians and Spaniards, born and living in North Mexico City, of low-middle socioeconomic status.

In the present survey the main risk factors associated with the different kinds of symptoms of rhinitis were the presence of symptoms of cumulative and current asthma, the presence of symptoms of cumulative and current atopic eczema, and the use of paracetamol. A previous survey which investigated risk factors for rhinitis in children 3-5 years old demonstrated a clear association between allergic rhinitis and asthma, wheezing, atopic eczema, allergen sensitization, and family

history of atopy [18]. A study of 13-14-year-old children found that allergic rhinitis was related to current asthma, a history of asthma in parents, and ethnicity [19].

The association between atopic eczema, allergic rhinitis, and asthma could be attributed to the allergic march; that is, the progression of one allergic disease to another with the possibility of therapeutic interventions to delay or stop the progression to asthma [26]. Longitudinal studies have pointed to the development of allergic rhinitis and asthma from an initial atopic eczema [27-29]. The association between allergic rhinitis and asthma is even closer: for example, 80% of asthmatic patients also suffered from allergic rhinitis [30].

The relationship between rhinitis and asthma may be regarded as manifestations of a chronic allergic syndrome comprising both the upper and lower airways. In these patients there is evidence of allergic inflammation and mucosal sensitivity throughout the respiratory tract [31]. Allergic rhinitis has been described as a risk factor for asthma [32], yet it is possible that rhinitis is in fact an earlier step of a common disease of the respiratory tract, involving both the nose and the bronchi and a state of persistent minimal inflammation, even in the absence of symptoms. Once manifested, the two conditions usually parallel each other in disease severity.

The main factor associated with symptoms of cumulative and current allergic rhinitis were symptoms of asthma and to a lesser extent, symptoms of atopic eczema. The association between symptoms of allergic rhinitis and symptoms of asthma and atopic eczema has been observed in ISAAC centers with a lower prevalence [20] and it may be related to the concurrent evolution of these diseases [27-29].

The present results support the World Health Organization's Allergic Rhinitis and its Impact on Asthma initiative [33] which proposes that a common approach to the evaluation and treatment of allergic rhinitis and asthma should be sought.

On the other hand, symptoms of atopic eczema have also been related to symptoms of allergic rhinitis and to asthma, and have also been found to predict the development of symptoms of allergic rhinitis and asthma [26].

As for paracetamol, its use in adults has been associated with rhinitis in non-asthmatic individuals [15]. Newson et al found that per capita sales of paracetamol are related to the prevalence of rhinoconjunctivitis in adults as well as in children [14]. It has been postulated that the association of paracetamol with allergic disease is due to depletion of glutathione as a result of the pharmacokinetics of this drug, leaving the respiratory mucosa without adequate antioxidant protection [34]. This mechanism could explain the possible association between paracetamol consumption and the prevalence of symptoms of rhinitis in our patients. Yet it is possible that the use of paracetamol and antibiotics reflects attempts to treat symptoms of rhinitis and asthma in childhood.

A systematic review and meta-analysis of retrospective and prospective studies found a positive relation between the use of antibiotic in the infancy and the development of asthma [35]. Regarding the relation between early antibiotic use and prevalence of symptoms of rhinitis, a relatively small birth cohort study (n=498) by Celedon et al [36] did not find an association between antibiotic use in the first year of life and allergic rhinitis at age of five years. In our study

antibiotic use in the first year of life was related to cumulative and current symptoms of rhinitis and current symptoms of rhinoconjunctivitis in the group of 6-7 years.

In the present study, we did not find a relation between weight or body mass index, and breast feeding with allergic diseases.

The present study has some limitations. One that should be mentioned is the absence of questions on family history of allergy and atopy in the ISAAC questionnaire, given that family background has been recognized as an important risk factor. On the other hand, in cross-sectional studies, the answers to the background questions depend in part on the memories of the individuals or their parents, conferring a potential information bias, so the results must be considered as only estimates of prevalence. Only longitudinal epidemiological studies are able to prove suitable hypotheses regarding risk factors of diseases.

Despite its limitations, the present study shows that the main factors associated with symptoms of allergic rhinitis were symptoms of asthma and atopic eczema, and paracetamol use. Future interventions for prevention, early detection, and treatment must be based on the natural history of atopic march. The present study is among the few exploring factors associated with allergic rhinitis. We also report the relationship between rhinitis and paracetamol use in children. For new perspectives, longitudinal studies on the risk of allergic rhinitis with paracetamol use and on other allergic diseases will be necessary.

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