ORIGINAL ARTICLE

Prevalence, Severity, and Time Trends of Allergic Conditions in 6-to-7-Year-Old Schoolchildren in Taipei

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Abstract

Background: Atopic diseases, including asthma, allergic rhinitis, and atopic eczema, are major illnesses among children. Recent studies conducted worldwide have shown diverse trends in the prevalence of asthma, with a steady increase detected in industrialized countries. Other studies, however, have revealed a leveling trend or even a declining prevalence.
Objective: The purpose of this study was to evaluate the current prevalence of allergic conditions in 6-to7-year-old schoolchildren in Taipei, Taiwan, and to analyze time trends.
Methods: We evaluated the prevalence and severity of asthma and other allergic conditions using a phase I International Study of Asthma and Allergies in Childhood core written questionnaire previously administered in Taipei in 1994 and 2002.
Results: A total of 24 999 first-grade students from 153 elementary schools completed the questionnaire. The proportion of children with wheeze ever and nocturnal cough in the past 12 months was significantly increased in 2007 compared to 1994 and 2002. No significant differences were detected in the prevalence of current wheeze or physician-diagnosed asthma. The prevalence of severe wheezing symptoms in the past 12 months (≥4 attacks of wheeze, ≥1 night of sleep disturbance due to wheeze per week, wheeze-limiting speech, and exercise-induced wheeze) decreased significantly. The prevalence and severity of rhinitis symptoms increased significantly during the 13-year period analyzed. The prevalence of eczema symptoms—defined as recurrent itchy rash and typical atopic eczema distribution in the past 12 months—also increased.
Conclusions: We observed an increase only in the prevalence and severity of current allergic symptoms in allergic rhinitis and atopic eczema.

Key words: Asthma. Rhinitis. Eczema. Childhood. Taipei.

Resumen

Antecedentes: Las enfermedades atópicas, como el asma, la rinitis alérgica y el eccema atópico, son enfermedades graves en los niños. Estudios recientes realizados en todo el mundo han mostrado varias tendencias en la prevalencia del asma, detectándose un aumento constante en los países industrializados. Otros estudios, no obstante, han revelado una tendencia a la estabilidad o incluso a la baja.
Objetivo: El objetivo de este estudio fue evaluar la prevalencia actual de las enfermedades alérgicas en niños de 6 y 7 años de edad en Taipei, Taiwán, y analizar las tendencias temporales.
Métodos: Se evaluó la prevalencia y la gravedad del asma y otras enfermedades alérgicas utilizando un cuestionario escrito básico de un Estudio Internacional de Asma y Alergias en la Infancia de fase I administrado previamente en Taipei en 1994 y 2002.
Resultados: Completaron el cuestionario 24.999 estudiantes de primer curso de 153 escuelas de educación primaria. La proporción de niños con sibilancias siempre y tos nocturna en los últimos 12 meses aumentó significativamente en 2007 en comparación con 1994 y 2002. No se detectaron diferencias significativas en la prevalencia de sibilancias actuales o asma diagnosticado por el médico. La prevalencia de síntomas de sibilancias graves en los últimos 12 meses (≥ 4 ataques de sibilancias, ≥ 1 noche con alteración del sueño debido a sibilancias a la semana, habla limitada por sibilancias y sibilancias inducidas por el ejercicio físico) disminuyó significativamente. La prevalencia y la gravedad de los síntomas de rinitis aumentaron significativamente durante el período de 13 años analizado. La prevalencia de síntomas de eccema, definidos como erupción cutánea pruriginosa recurrente y distribución típica del eccema atópico en los últimos 12 meses, también aumentó.
Conclusiones: Se observó un aumento solo en la prevalencia y la gravedad de los síntomas alérgicos actuales en la rinitis alérgica y el eccema atópico.

Palabras clave: Asma. Rinitis. Eccema. Infancia. Taipei.

Introduction

Atopic diseases, including asthma, allergic rhinitis, and atopic eczema, are major illness and the most common cause of school absence among children. In developed countries, they are now the most common chronic medical conditions in childhood. Over the past 3 decades there has been a general belief that the prevalence of asthma, allergic rhinitis, and atopic eczema is increasing [1-5], and atopic disease is now considered a significant public health burden worldwide. It has also been observed that asthma prevalence has increased in western counties such as the United Kingdom, Australia, and New Zealand, but not in Eastern Europe, India, China, or Africa [6]. Some studies, however, have revealed a leveling trend [7,8], while others have reported a declining prevalence [9,10]. Nevertheless, heightened awareness of atopic disease, changes in diagnostic labeling, and the presence of selection or information bias in certain studies may mean that increases in morbidity have been falsely interpreted [3].

To fulfil the goal of developing new epidemiological studies based on standardized questions and objective measurements capable of reflecting genuine trends in allergic disease, the standardized International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire was designed and implemented to investigate the prevalence of symptoms of childhood asthma, allergic rhinoconjunctivitis, and atopic eczema at the population level [11,12]. The ISAAC questionnaire, which has been validated and used throughout the world [12], was designed to allow comparisons of the prevalence and severity of allergic disorders in a standardized way in different populations and to form the basis of further studies to investigate the various influential factors. It was an international, multicenter project, with phases I and III involving identical surveys performed at least 5 years apart to examine the spread and time trends of childhood allergies worldwide [13]. It is hoped that the findings might provide further clues about the causes of these conditions by revealing information about geographical variations in the rate of change of symptom prevalence for the 3 disorders. According to the ISAAC Phase I and III multinational cross-sectional surveys conducted in 66 centers in 37 nations, the prevalence of asthma symptoms (wheezing in the past 12 months) in 6-to-7-year-old children increased in 25 centers, decreased in 14, and remained practically unchanged in 27 [14].

According to Hsieh and Shen [2], the prevalence of childhood asthma in Taipei, Taiwan, was 1.3% in 1974 and 5.0% in 1985. Using the ISAAC questionnaire in 1994 and 2002 in 6-to-7-year-old schoolchildren in the same place, an increasing trend was observed for asthma prevalence in 1994, but a leveling trend was detected for the period between 1994 and 2002 [14,15]. However, a phase III study conducted by Yan et al [16] in 2002 in 13-to-14-year-old schoolchildren in Taipei showed an increasing prevalence of symptoms of asthma, allergic rhinitis, and atopic eczema.

In the current study, we conducted a survey using the ISAAC protocol to evaluate the current prevalence and severity of asthma, allergic rhinitis, and atopic eczema in 6-to-7-year-old schoolchildren in Taipei and to analyze time trends in the prevalence and severity of these allergic conditions.

Methods

Study Population

Between October and November 2007, an ISAAC mass screening survey was conducted for asthma and allergic conditions in all first-grade schoolchildren in Taipei. In total, 26 418 students from 153 elementary schools in Taipei's 12 administrative districts were investigated. To ensure methodological consistency, the questionnaire used was identical to the standardized Chinese version of the ISAAC questionnaire used in the 2002 survey [16]. The questionnaire was taken home by students and answered by their parents. Classroom incentives but not individual incentives were used to encourage participation. A total of 24 999 students completed the questionnaires, yielding a response rate of 94.6%. Written parental informed consent was obtained individually from children through the school administrations. The study protocol was approved by the Institution Review Board of Taipei City Hospital and complied with the principles outlined in the Helsinki Declaration [17].

Questionnaire

The written questionnaire contained the ISAAC core questions on symptoms of asthma and allergies and was designed to evaluate the prevalence and severity of asthma, allergic rhinitis, and atopic eczema symptoms [12]. Following the ISAAC protocol instructions, all the questions were translated into Chinese and then back into English to ensure the adequacy of the translation.

Definitions

The definitions of asthma, rhinitis, and eczema symptoms (Table 1) were based on the answers to the ISAAC core questions, which investigated the presence of symptoms during the child's lifetime (ever symptoms) and in the past 12 months (current symptoms). Asthma, allergic rhinitis, and eczema symptoms were evaluated in children with affirmative answers to the questions "Have you ever had asthma?", "Have you ever have allergic rhinitis?", or "Have you ever have eczema?" As shown in Table 2, the severity of asthma symptoms was assessed among children with current wheeze from answers to questions about (1) the number of wheezing attacks in the past 12 months, (2) wheeze that limited speech, and (3) sleep disturbance due to wheeze in the past 12 months. Severity of allergic rhinitis symptoms was assessed among children with current rhinitis symptoms from answers to questions about the impact of rhinitis on daily activities (mild, moderate, or severe). Finally, severity of eczema symptoms was assessed among children with current eczema symptoms from answers to questions about the number of night wakings in the past 12 months (<1 night per week or ≥1 night per week).

Data Analysis

The prevalence of asthma and other allergic disorders was expressed as a percentage. The Pearson χ^2 test was used to assess the association between boys and girls with regard to a variety of risk factors. Crude and adjusted odds ratios were

Table 1. Self-reported Prevalence of Symptoms of Asthma, Rhinitis, and Eczema From Written ISAAC Questionnaires in 6-to-7-year-old children in Taipei in 2007

Responses	Total, %	Boys, %	Girls, %	*P* Value
Asthma				
Wheeze ever	20.3	23.0	17.1	<.001
Wheeze past 12 mo	8.8	10.1	7.1	<.001
Diagnosed asthma	13.0	14.3	10.6	<.001
Exercise-induced wheeze past 12 mo	3.8	4.4	3.1	<.001
Nocturnal cough past 12 mo	23.7	24.4	21.4	<.001
Allergic rhinitis				
Rhinitis ever	50.6	53.5	43.3	<.001
Rhinitis past 12 mo	45.1	47.7	37.8	<.001
Diagnosed allergic rhinitis	33.7	34.4	27.7	<.001
Rhinoconjunctivitis past 12 mo	28.1	31.3	24.8	<.001
Atopic eczema				
Recurrent itchy rash[a] ever	12.9	13.3	12.4	.0404
Recurrent itchy rash past 12 mo	10.7	11.1	10.2	.0165
Recurrent itchy flexural rash past 12 mo	9.2	9.5	8.9	.0767
Diagnosed eczema	29.8	30.2	29.3	.1432

Abbreviation: ISAAC, International Study of Asthma and Allergies in Childhood.
[a]Rash lasting at least 6 mo.

Table 2. Prevalence and Severity of Asthma, Rhinitis, and Eczema in the Past 12 Months From Written ISAAC Questionnaires in 6-to-7-year-old children in Taipei in 2007

Symptoms	Total, No. (%)	Boys, No. (%)	Girls, No. (%)	OR (95% CI)
Wheezing past 12 mo, No.	2165	1308	857	
Severe wheezing that limited speech past 12 mo	111 (5.1)	78 (6.0)	33 (3.9)	1.58 (1.04-2.40)
Wheezing attack past 12 mo				
1-3	1638 (75.7)	984 (75.0)	654 (76.3)	0.97 (0.72-1.30)
4-12	264 (12.2)	164 (12.5)	100 (11.7)	0.89 (0.61-1.29)
>12	60 (2.8)	41 (3.1)	19 (2.1)	0.76 (0.42-1.38)
Episodes of sleep disturbance due to wheezing past 12 mo				
<1 per wk	708 (32.7)	420 (32.1)	288 (33.6)	0.94 (0.78-1.13)
≥1 per wk	59 (2.7)	37 (2.8)	22 (2.6)	1.08 (0.63-1.85)
Rhinitis past 12 mo, No.	10 693	6170	4523	
Impact of rhinitis on activities ever				
Mild	4915 (46.0)	2779 (45.0)	2136 (46.8)	1.40 (1.31-1.49)
Moderate	3265 (30.5)	1895 (30.7)	1370 (30.0)	1.49 (1.38-1.61)
Severe	1029 (9.6)	615 (10.0)	414 (9.1)	1.61 (1.42-1.83)
Recurrent itchy rash past 12 mo, No.	2672	1440	1232	
Night awakening past 12 mo				
<1 night per wk	837 (31.3)	447 (31.0)	390 (31.7)	1.06 (0.93-1.22)
≥1 night per wk	444 (16.6)	253 (17.6)	191 (15.5)	1.24 (1.03-1.50)

Abbreviations: CI, confidence interval; ISAAC, International Study of Asthma and Allergies in Childhood.

used to interpret the magnitude of the association between risk factors and outcome variables. Ninety-five percent confidence intervals (CIs) were calculated when appropriate. The Cochran-Armitage test for trend was used to assess the significance and time trends of a variety of allergic conditions in 1994, 2002, and 2007. A *P* value of less than .05 was considered statistically significant. All statistical analyses were performed with SPSS (version 14; SPSS Inc., Chicago, Illinois, USA).

Results

Self-reported Prevalence

Table 1 shows the self-reported prevalence of symptoms of asthma, allergic rhinitis, and atopic eczema. The prevalence of wheeze ever and diagnosed asthma was 20.3% and 13.0%, respectively. For the current status (episodes occurring in the past 12 months), the prevalence of wheeze, exercise-induced wheeze, and nocturnal cough was 8.8%, 3.8%, and 23.7%, respectively. Boys tended to have a higher prevalence than girls and the differences were statistically significant (*P*<.001).

The self-reported prevalence of the symptoms of rhinitis ever, diagnosed rhinitis, current rhinitis, and current rhinoconjunctivitis was 50.6%, 33.7%, 45.1%, and 28.1%, respectively. Boys also tended to have a higher prevalence than girls in these cases and the differences were statistically significant (*P*<.001). The prevalence of itchy rash ever, current itchy rash, and itchy flexural rash was 12.9%, 10.7%, and 9.2%, respectively. Boys tended to have a higher prevalence than girls in all these conditions but the differences were statistically significant only for itchy rash ever and current itchy rash (*P*<.05).

Severity

The prevalence of current wheeze, rhinitis, and eczema symptoms according to severity are shown in Table 2. The denominator of prevalence is the number of patients who reported having a particular symptom. Approximately 5.1% of current wheezers (n=2165) had experienced severe speech-limiting wheeze in the past 12 months. Most of these (90.7%) had had at least 1 wheezing attack, and 35.4% had had wheezing episodes that disturbed their sleep in the same period. Of the students who reported current rhinitis (n=10 693), 86.1% thought that their condition had had an impact on their daily activities (mild 46.0%; moderate, 30.5%; and severe, 9.6%), and 16.6% of the students with itchy rash in the past 12 months had had at least 1 episode of nocturnal waking caused by the rash. The only significant difference detected between boys and girls in terms of the severity of the 3 allergic diseases analyzed was that more boys than girls tended to have experienced severe speech-limiting wheeze in the past 12 months (OR, 1.58; 95% CI, 1.04-2.40).

Prevalence Comparison: 1994, 2002, and 2007

We compared our findings with those from surveys conducted in 1994 and 2002 using the same questionnaire (Table 3). We found that of all the asthma-related symptoms, only the prevalence of wheeze ever and nocturnal cough had increased. There were no significant changes in the prevalence of current wheeze or physician-diagnosed asthma. Nonetheless,

Table 3. Time Trends of the Prevalence and Severity of Asthma, Rhinitis, and Eczema Symptoms From Written ISAAC Questionnaires in 6-to-7-year-old children in Taipei[a]

	1994	2002	2007	*P* Value[b]
Written Questionnaires, No.	4806	4832	24 999	
Wheeze ever	16.1	19.2	20.3	<.001
Wheeze past 12 mo	9.6	9.8	8.8	>.050
Wheeze 4 attacks past 12 mo	2.9	1.7	1.3	<.001
Sleep-disturbing wheeze past 12 mo, ≥1 per wk	0.8	0.4	0.2	<.001
Severe speech-limiting wheeze past 12 mo	1.2	0.7	0.5	<.001
Diagnosed asthma	12.7	14.4	13.0	>.050
Exercise-induced wheeze past 12 mo	6.0	4.8	3.8	<.001
Nocturnal cough past 12 mo	17.0	21.1	23.7	<.001
Rhinitis ever	36.5	46.4	50.6	<.001
Rhinitis past 12 mo	30.8	42.0	45.1	<.001
Diagnosed Rhinitis	34.9	39.4	33.7	>.050
Rhinoconjunctivitis past 12 mo	14.6	24.5	28.1	<.001
Activities severely limited by rhinitis past 12 mo	1.3	4.3	4.1	<.001
Recurrent itchy rash ever	5.2	10.2	12.9	<.001
Recurrent itchy rash past 12 mo	4.1	8.5	10.7	<.001
Recurrent itchy flexural rash past 12 mo	3.5	6.9	9.2	<.001
Diagnosed eczema	23.9	26.3	29.8	<.001
Severe eczema	0.7	1.4	4.2	<.001

Abbreviation: ISAAC, International Study of Asthma and Allergies in Childhood.
[a]Data expressed as percentage unless otherwise specified.
[b]Calculated using the Cochran-Armitage test for trends.

the prevalence of at least 4 wheezing attacks, severe speech-limiting wheeze, and exercise-induced wheeze in the past 12 months all decreased significantly ($P<.001$). It was also observed that, with the exception of diagnosed rhinitis, the prevalence of the symptoms of allergic rhinitis and atopic eczema (rhinitis ever, rhinoconjunctivitis, limited activity due to rhinitis in the past 12 months, itchy rash ever, itchy flexural rash, and severe eczema in the past 12 months) all increased significantly ($P<.001$).

Discussion

The prevalence of symptoms of childhood asthma varies greatly worldwide. Lai et al [18] reported that the prevalence of current wheeze (wheeze in the past 12 months) ranged from 0.8% in Tibet, China to 32.6% in Wellington, New Zealand in 13-to-14-year-olds, and from 2.4% in Jodhpur, India to 37.6% in Costa Rica in 6-to-7-year-olds. The prevalence of symptoms of severe asthma (≥4 attacks of wheeze or ≥1 night per week sleep disturbance due to wheeze, or speech-limiting wheeze in the past 12 months) in Pune, India and Costa Rica ranged, respectively, from 0.1% to 16% in 13-to-14-year-olds and from 0% to 20.3% in 6-to-7-year-olds. Time trends in the prevalence of asthma symptoms showed a mixed picture of increases in low-prevalence centers, and a leveling or even declining trend in high-prevalence centers.

Like the majority of ISAAC studies published, we used the ISAAC questions to compare the prevalence of current wheeze in different urban areas in the Asia-Pacific region, where a wide range of prevalence rates have been reported. The prevalence of current wheeze in 6-to-7-year-old children in Taipei (9.6% in 1994-1995 [15], 9.8% in 2002 [16], and 8.8% in 2007 [current study]) is quite similar to that detected in Hong Kong (9.1% in 1995 [15] and 9.4% in 2001 [19]), but lower than that reported for Fukuoka, Japan (17.3% in 1994-1995 [15], 18.2% in 2002 [14]), Singapore (15.7% in 1994 [15], 10.2% in 2001 [8]) and Seoul, Korea (15.3% in 1995 [20]), and higher than that observed in Beijing, China (6.0% in 1995-1996 [21]). The change in prevalence of current wheeze detected by the ISAAC phase III study is obvious in Singapore, but small in Hong Kong and Taipei.

One pediatric study in Sweden compared 2 large, population-based groups of 7-to-8-year-olds using identical methods in 1996 and 2006 [22-24], and found no increases in several asthma-related symptoms, including current wheeze [23]; their results are consistent with those from other European countries [25]. Within the same studies, it was also reported that children with asthma had fewer respiratory symptoms and better asthma control in 2006 than in 1996 [26]. On comparing our results with phase I ISAAC studies conducted in Taipei using the same core questionnaire, we found a significant increase in the prevalence of wheeze ever and nocturnal cough in the past year on comparing 2007 with 1994 and 2002 ($P<.001$). No significant differences were found for the prevalence of current wheeze or physician-diagnosed asthma, but we did detect a significant decrease in the prevalence of severe symptoms of wheeze in the past year (≥4 wheezing attacks a year, wheezing that disturbed sleep at least once a week, severe speech-limiting wheeze, and exercise-induced wheeze between 1994 and 2007 (Table 3). Thus, it seems that the trends detected (increase in the prevalence of wheeze ever and nocturnal cough and decrease in symptom severity of wheeze) could be primarily explained by changes in diagnostic practice and increased awareness of asthma among physicians and parents as this would lead to a greater proportion of children with mild or transient wheeze ever being noticed. Nocturnal cough might also indicate the presence of other respiratory symptoms (eg, postnasal drip due to allergic rhinitis). In other words, the increase in current rhinitis may explain the increase in nocturnal cough. In a survey conducted in Taiwan, the fact that 68% of physicians interviewed stated that they would follow asthma treatment guidelines and use controller medication including inhaled corticosteroids probably explains the major decrease in severe asthma symptoms detected in this country [27].

Several time-trend prevalence studies have reported a clear increase in rhinitis prevalence among adults and children in many countries [28-30]. The symptoms of allergic rhinitis were probably the most prevalent of all the symptoms of allergic diseases in Taipei. The prevalence of rhinitis ever and rhinitis in the past 12 months in 2007 was estimated to be 50.6% and 45.1%, respectively. Our results also show that the prevalence and severity of rhinitis symptoms in 6- to-7-year-old children increased significantly in the 13-year period analyzed. The prevalence of symptoms of rhinitis in the past 12 months increased 1.46-fold (from 30.8% to 45.1%) during the same period. The combination of rhinitis with itchy eyes in the past year is the best predictor of allergic rhinitis in children in Phase I ISAAC studies [31], and this showed a significant, 1.92-fold, increase (from 14.6% to 28.1%).The only factor that remained unchanged was physician-diagnosed allergic rhinitis. The persistence of a high prevalence of self-reported allergic rhinitis deserves attention because rhinitis is currently considered a significant independent risk factor for asthma and it may appear as the first manifestation of a common allergic airway disease, eventually leading to the onset of asthma [32].

The prevalence and severity of atopic eczema symptoms in 6-to-7-year-old children in Taipei also increased significantly during the 13-year period. Based on recurrent itchy rash in a typical atopic eczema distribution in the past 12 months as the indicator of atopic eczema, the prevalence of eczema symptoms also increased 2.63-fold (from 3.5% to 9.2%). The prevalence of severe eczema, defined as nocturnal waking at least once a week due to itchy eczema, also showed an increase (from 0.7% to 4.2%). Nevertheless, the prevalence of atopic eczema in our study was still much lower than that reported by other Asian countries: Singapore (20.8% among 7-, 12-, and 16-year-olds, 2002) [33], Hong-Kong (20.1% among 14-year-olds, 1994) [34], and Japan (19% among 7-to-9 year-olds, 1998) [35].The increase in the prevalence of atopic eczema may be due to a decline in breastfeeding, an inadequate use of antibiotics, or the widespread use of food additives.

The strengths of our study include the use of a standardized method duplicated in a repeat survey, a large sample size, a high response rate, the use of disease symptoms rather than labels, and the inclusion of children from all districts in the Taipei metropolitan area. The study, however, has several limitations, including the fact that we did not perform clinical examination or allergy skin tests to confirm reported symptoms.

In summary, we found that within the category of asthma-related conditions, only the prevalence of wheeze ever and nocturnal cough in the past 12 months increased in 6-to-7- year-old schoolchildren in Taipei. The prevalence of other symptoms of severe asthma decreased, and we observed a statistically significant increase in the prevalence of related conditions in allergic rhinitis and atopic eczema. The reasons why we only detected an increase in the prevalence and severity of allergic rhinitis and atopic eczema (and not in asthma, which showed a diverting trend with an increase in the prevalence of wheeze ever and a decrease in the severity of wheeze symptoms) are multifactorial and need to be explored further.

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