

Prevalence and comorbidity of allergic diseases in preschool children

Hyeong Yun Kim, MD¹, Eun Byul Kwon, MD¹, Ji Hyeon Baek, MD², Youn Ho Shin, MD², Hye Yung Yum, MD³, Hye Mi Jee, MD², Jung Won Yoon, MD², Man Yong Han, MD²

¹Department of Pediatrics, Bundang Jesaeng General Hospital, Seongnam, ²Department of Pediatrics, CHA University College of Medicine, Seongnam, ³Department of Pediatrics, Seoul Medical Center, Seoul, Korea

Purpose: Allergic disease and its comorbidities significantly influence the quality of life. Although the comorbidities of allergic diseases are well described in adult populations, little is known about them in preschool children. In the present study, we aimed to assess the prevalence and comorbidity of allergic diseases in Korean preschool children.

Methods: We conducted a cross-sectional study comprising 615 Korean children (age, 3 to 6 years). Symptoms of allergic diseases were assessed using the Korean version of the International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire that was modified for preschool children. Comorbidities of allergic diseases were assessed by 'In the last 12 months, has your child had symptoms?'

Results: The prevalence of symptoms of asthma, allergic rhinitis, and atopic dermatitis as recorded using the ISAAC questionnaire, within the last 12 months was 13.8%, 40.7%, and 20.8%, respectively. The symptom rates of allergic conjunctivitis, food allergy, and drug allergy were 14.8%, 10.4%, and 0.8%, respectively. The prevalence of allergic rhinitis in children with asthma was 64.3% and that of asthma in children with allergic rhinitis was 21.6%. The prevalence of rhinitis in children with conjunctivitis was 64.8% and that of conjunctivitis in children with rhinitis was 23.6%.

Conclusion: The prevalence of current rhinitis in our preschool children is shown to be higher than that previously reported. Allergic conjunctivitis is closely associated with asthma and allergic rhinitis. However, further studies are warranted to determine the prevalence and effects of these comorbidities on health outcomes in preschool children.

Key words: Asthma, Allergic rhinitis, Preschool child, Prevalence, Comorbidity

Corresponding author: Man Yong Han, MD
Department of Pediatrics, CHA Bundang Medical Center, CHA University College of Medicine, 59 Yatap-ro, Bundang-gu, Seongnam 463-712, Korea
Tel: +82-31-780-6262
Fax: +82-31-780-5239
E-mail: drmesh@gmail.com

Received: 5 March, 2012

Revised: 22 February, 2013

Accepted: 8 May, 2013

Introduction

Asthma and allergic diseases are among the most common disorders in children, and their prevalence has increased in most parts of the world^{1,2}. The International Study of Asthma and Allergies in Childhood (ISAAC) found that the prevalence of allergic diseases in children aged 6 and 14 years varies significantly from 0.3% to 20.5%, but is gradually increasing^{3,4}. A National Survey on the prevalence of symptoms of allergic diseases on Korean children aged 6 and 14 years has demonstrated that the prevalence of asthma and allergic diseases is on the rise⁵. However, little data are available on the prevalence of allergic diseases in preschool children.

There are distinct epidemiological parallels between atopic dermatitis, asthma, and allergic rhinitis. Generally, childhood eczema precedes the development of asthma and allergic rhinitis in the so-called atopic march⁶. Furthermore, asthma and allergic rhinitis

Copyright © 2013 by The Korean Pediatric Society

This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/3.0/>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

frequently coexist⁷⁻¹⁰. In adult studies, allergic rhinitis is found in 30% to 90% of patients with asthma^{9,10}. Thus, the clinical signs of asthma and allergic diseases follow each other and can co-occur^{11,12}.

Although the comorbidities of allergic diseases have been well described in adult and children populations, less is known about such conditions in preschool children^{7,8,13}. A few previous studies have indicated that comorbidities in Western countries differ from those in Korean populations^{14,15}. Little data are available in preschool children to evaluate prevalence of asthma, allergic rhinitis, atopic dermatitis, allergic conjunctivitis, food allergy, drug allergy, and comorbidities. In addition, assessing the comorbidities of allergic diseases may help clinicians recognize symptoms of allergic diseases early and prompt treatment. Therefore, we hypothesized that asthma and other allergic diseases might coexist in preschool children and the prevalence of allergic diseases in our children differed from those of other regions. The aim of the present study was to determine the prevalence of allergic diseases and their comorbidities in preschool children using the standard ISAAC questionnaire, and to compare our results with previous studies.

Materials and methods

1. Subjects

The source population comprised 629 preschool children aged 3 to 6 years who were recruited from randomly selected 5 daycare centers in Seongnam from April to June of 2009. We used the Korean version of ISAAC questionnaire and the questionnaires were distributed and collected through each daycare center. Their parents filled out the ISAAC questionnaire at home and returned it within few days. A total of 615 subjects (97.7%) returned the questionnaires with valid answers. The study was approved by the ethics committee of the CHA University, and written informed consent was obtained from the parents of all participating children.

2. Methods

1) Questionnaires

The Korean version of the ISAAC questionnaire¹⁶ was used to determine the presence of symptoms of wheezing, allergic rhinitis, atopic dermatitis, allergic conjunctivitis, food allergy, and drug allergy. Questions regarding body mass index (BMI), a family history of allergic disease, secondhand smoking, and pet ownership were also asked.

2) Definition of allergic diseases

In this study, we estimated the prevalence of allergic diseases, such as, asthma, allergic rhinitis and atopic dermatitis, based on

positive answers to written questions per Hong et al.¹⁷: 1) 'Has your child ever had symptoms?' (symptom, ever); 2) 'In the last 12 months, has your child had symptoms?' (symptom, last 12 months); 3) 'Has your child been diagnosed by a physician as ever having the disorder?' (diagnosis, ever); and 4) 'In the last 12 months, Has your child been treated by a physician for the disorder?' (treatment, last 12 months). "Current" was defined as a positive response to 'symptom, last 12 months.'

To diagnose allergic conjunctivitis, food allergy, and drug allergy, which were not included in the ISAAC questionnaire, we considered a child to have allergic conjunctivitis if he responded yes to the question 'Has your child had itchy watery eyes without having acute hemorrhagic conjunctivitis?' A child had a food allergy if he responded yes to the question 'Has your child had allergic symptoms after ingesting certain foods?' A child had a drug allergy if he responded yes to the question 'Has your child had allergic symptoms provoked by certain drugs?'

3) Comorbidity

Comorbidities of wheezing, allergic rhinitis and allergic conjunctivitis were assessed, based on the presence of these disorders and positive answers to the written question of 'In the last 12 months, has your child had symptoms?' (symptom, last 12 months).

4) Statistics

Data were expressed as mean±standard deviation with 95% confidence intervals unless otherwise indicated. Data were analyzed using SPSS ver. 17.0 (SPSS Inc., Chicago, IL, USA). A *P*-value less than 0.05 was considered to be statistically significant.

Results

1. Clinical characteristics of subjects

Table 1 shows the basic characteristics of the 615 preschool children from whom questionnaire data were available. The mean age of the subjects was 60.2±10.5 months (male; n=326, 53%).

Table 1. Clinical characteristics of the children (n=615)

Characteristic	Value	95% CI
Age (mo)	60.2 (±10.5)	59.3–61.0
Male sex	326 (53.0)	
Body mass index (kg/m ²)	15.9 (±1.8)	15.7–16.1
Prematurity	22 (3.6)	
Parental asthma	84 (13.7)	
Secondary smoking	240 (39.0)	
Pet ownership in house	47 (7.6)	

Values are presented as mean (±standard deviation) or number (%). CI, confidence interval.

Table 2. Prevalence of allergic diseases in preschool children – comparison with previous studies

Allergic disease	Our result	Kim et al. ¹³⁾	Lee et al. ¹⁸⁾
Characteristics			
Year	2009	2009	2008
Age (yr)	3–6	2–7	0–6
Location	Seongnam	Seoul	Jeju
Number	615	917	5,249
Asthma			
Wheeze, ever	138 (22.4)	170 (18.4)	1,310 (25.3)
Wheeze, last 12 mo	85 (13.8)	123 (13.3)	791 (15.4)
Diagnosis, ever	53 (8.6)	54 (5.8)	594 (11.4)
Treatment, last 12 mo	22 (3.6)	26 (2.8)	250 (4.9)
Rhinitis			
Rhinitis, ever	272 (44.2)	294 (31.8)	1,491 (28.6)
Rhinitis, last 12 mo	250 (40.7)	243 (26.2)	1,228 (23.9)
Diagnosis, ever	213 (34.5)	150 (16.2)	552 (10.6)
Treatment, last 12 mo	172 (28.0)	119 (12.9)	423 (8.1)
Atopic dermatitis			
Itchy rash, ever	155 (25.2)	242 (26.1)	1,220 (23.4)
Itchy rash, last 12 mo	128 (20.8)	200 (21.6)	987 (19.0)
Diagnosis, ever	243 (39.5)	318 (34.3)	1,614 (31.0)
Treatment, last 12 mo	104 (16.9)	176 (19.0)	919 (17.9)

Values are presented as number (%).

2. Prevalence of allergic diseases identified by the ISAAC questionnaire

The prevalence of symptoms related to asthma, allergic rhinitis, and atopic dermatitis are presented in Table 2. The prevalence of current asthma, current allergic rhinitis, and current atopic eczema were 13.8%, 40.7%, and 20.8%, respectively. In addition, we compared these rates with those of previous studies from various regions of Korea. Specifically, the prevalence of current allergic rhinitis (40.7%) was higher in our study than in previous studies^{13,18)}.

3. Prevalence of the other allergic diseases

Table 3 presents the prevalence of symptoms related to allergic conjunctivitis, food allergy, and drug allergy, according to the positive answers to written questions per Hong et al.¹⁷⁾. We could not compare our results with previous studies due to a lack of data on allergic conjunctivitis, food allergy, and drug allergy in preschool children using the ISAAC questionnaire.

4. Comorbidity of allergic diseases

Comorbidity of wheezing, rhinitis, and conjunctivitis was assessed by ‘In the last 12 months, has your child had symptoms?’ (symptom, last 12 months). Of the 615 subjects, 292 (47.5%) had current symptoms of wheezing, rhinitis, and conjunctivitis.

Table 3. Prevalence of allergic conjunctivitis, food allergy, and drug allergy in preschool children

	Allergic conjunctivitis	Food allergy	Drug allergy
Symptom, ever	108 (17.6)	113 (18.4)	18 (2.9)
Symptom, last 12 mo.	91 (14.8)	64 (10.4)	5 (0.8)
Diagnosis, ever	138 (22.4)	33 (5.4)	9 (1.5)
Treatment, last 12 mo.	85 (13.8)	20 (3.3)	6 (1.0)

Values are presented as number* (%).

*Subjects who had symptoms related to allergic conjunctivitis, food allergy, and drug allergy among the 615 preschool children.

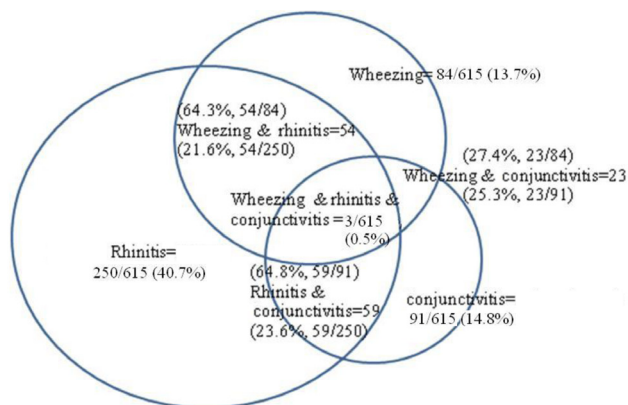


Fig. 1. Comorbidity of symptoms in children with wheezing, rhinitis, and conjunctivitis over the last 12 months (n=292).

The comorbidity of each allergic disease is shown in Fig. 1. In 138 subjects with ‘wheeze, current’ the prevalence of ‘rhinitis, current’ was 64.3% (54 subjects). In 91 subjects with ‘itchy-watery eyes, current’, ‘wheeze, current’ was combined in 23 (25.3%) and ‘rhinitis, current’ in 59 (64.8%). Conversely, in 250 subjects with ‘rhinitis, current’, ‘itchy-watery eyes, current’ was combined in 23.6% versus 21.6% with ‘wheeze, current’.

Discussion

We investigated the prevalence of allergic diseases and their comorbidities in Korean preschool children and found that asthma and other allergic diseases often coexist in preschool children, a finding consistent with previous studies^{14,19)}. We also found that preschool children in Seongnam have higher prevalence of allergic rhinitis compared with previous studies^{13,17,18,20)}.

Allergic rhinitis and asthma share common and possibly linked pathophysiology and thereby frequently coexist^{7-10,19)}. The prevalence of ‘wheeze, current’ was combined in 64.3% of ‘rhinitis, current’ subjects, which was similar to a previous study¹⁴⁾. Conversely, the prevalence of ‘rhinitis, current’ was combined in 21.6% of ‘wheeze, current’ subjects. Further, the prevalence of allergic conjunctivitis was 27.4% of ‘current

wheeze' and 23.6% of 'current rhinitis,' subjects—i.e., if a subject has airway symptoms, it is likely that he or she has concomitant allergic inflammatory responses in other parts of the body, namely conjunctival surfaces²¹). The ISAAC study also demonstrated that there is a close correlation between asthma and allergic rhinoconjunctivitis^{4,22}). Furthermore, the presence of comorbidities of allergic diseases may aggravate symptoms. Assessing the comorbidities of allergic diseases may help clinicians recognize allergic symptoms early and prompt treatment. These findings have important clinical implications because the prevalence of allergic disease in preschool children is on the rise. Thus, the prevalence of allergic conjunctivitis should be assessed in preschool children with allergic symptoms, because asthma and allergic rhinitis often coexist^{19,21}).

The prevalence and risk factors for allergic diseases can be compared between age groups and different regions through a standardized epidemiological study of the ISAAC^{3,4}). The prevalence of 'wheeze, last 12 months' was 13.8%, which is lower than that (12.8% to 22.2%) in children in Western countries in the ISAAC phase III^{3,13}) and is similar to that of preschool children in Korea^{13,18}). The prevalence of 'wheeze, last 12 months' in the present study (13.8%) was higher compared with that in a previous study of school children (4.7% to 4.9%)^{17,20}), possibly due to the fact that we could not completely exclude transient wheezers in the preschool period^{23,24}). This assumption was confirmed by the finding that 'wheeze, last 12 months' (13.8%) was higher than the rate of 'treatment, last 12 months' (3.6%).

The large variations in the worldwide prevalence of symptoms of allergic diseases were recorded, even in genetically similar groups³⁻⁵). Also, our results showed that the prevalence of 'rhinitis, last 12 months,' 40.7%, was higher in our study than for children in Taiwan (24.2%) and New Zealand (11.4%)³), as well as for preschool children (23.9% to 26.2%) and children aged 6 to 13 years from different regions of Korea (29% to 33%)^{13,17-18,20}). These differences, despite identical genetic predispositions, could be attributed to the finding that the prevalence of allergic diseases is influenced by environmental factors, such as air pollution, and factors related to social status, such as housing^{25,26}). Further research on air pollution and economic indices in subjects is needed to determine the effect of these factors on the prevalence of allergic diseases. Previous studies in Korea reported the risk factors for allergic diseases in children to be presence of a history of other allergic disease, parental history of allergic diseases, dwelling pattern, indoor humidity, number of family members, cesarean delivery, use of antibiotics, and a history of bronchiolitis^{13,18}). These factors and the response error of the questionnaire may have influenced the prevalence of rhinitis.

The prevalence of 'itchy rash, last 12 months' in our study

was 20.8%, similar to previous studies (21% to 22%)^{13,27}). The prevalence of 'itchy-watery eye, last 12 months' was 15%, lower than in the general population (20% to 40%)²⁸) and approximating that in preschool children (11% to 19%)^{29,30}). Our study demonstrated that the prevalence of allergic conjunctivitis in 292 children with current allergic diseases was 31.2%, close to the rate of ocular allergy (32%)²⁸). The prevalence of allergic rhinoconjunctivitis (20.2%, 59 subjects) in this current symptomatic group was similar to that in the ISAAC phase III study (2.2% to 24.2%) in children aged 6 to 7 years^{3,13}).

The limitations of our study are that 1) it does not represent the entire Korean preschool population; 2) we used the ISAAC questionnaire for preschool children, although it was originally designed for primary and middle school children; 3) there was a wide range of ages of the subjects; 4) allergic conjunctivitis, food allergy, and drug allergy were diagnosed using an unconfirmed ISAAC questionnaire, which we speculated could be used in population-based epidemiological studies; and 5) we investigated the prevalence of current allergic disease using the current allergic symptoms on questionnaire. Our method could not reflect the accurate prevalence of allergic disease than physician-diagnosed allergic disease. But, the prevalence of current allergic symptoms was commonly used to compare the trend of prevalence of allergic disease in worldwide ISAAC studies. Despite these limitations, our results merit attention, because there are little data on the prevalence of allergic diseases in this age group. Further research is warranted to determine the prevalence of allergic diseases in the entire Korean preschool population using valid questionnaires.

In conclusion, preschool children in Seongnam have a higher prevalence of allergic rhinitis and a similar prevalence of the other allergic diseases compared with previous studies. The prevalence of allergic conjunctivitis is relatively high in preschool children and even higher in preschool children with asthma and allergic rhinitis. Our data build on previous work, by suggesting that there is a substantial proportion of preschool children with concomitant allergic diseases.

Conflict of interest

No potential conflict of interest relevant to this article was reported.

Acknowledgments

The Korean version of ISAAC was provided by the Korean Pediatric Allergy and Respiratory Society.

References

1. Aberg N, Hesselmar B, Aberg B, Eriksson B. Increase of asthma, allergic rhinitis and eczema in Swedish schoolchildren between 1979 and 1991. *Clin Exp Allergy* 1995;25:815-9.
2. Lundback B. Epidemiology of rhinitis and asthma. *Clin Exp Allergy* 1998;28 Suppl 2:3-10.
3. Asher MI, Montefort S, Bjorksten B, Lai CK, Strachan DP, Weiland SK, et al. Worldwide time trends in the prevalence of symptoms of asthma, allergic rhinoconjunctivitis, and eczema in childhood: ISAAC Phases One and Three repeat multicountry cross-sectional surveys. *Lancet* 2006;368:733-43.
4. Worldwide variation in prevalence of symptoms of asthma, allergic rhinoconjunctivitis, and atopic eczema: ISAAC. The International Study of Asthma and Allergies in Childhood (ISAAC) Steering Committee. *Lancet* 1998;351:1225-32.
5. Ahn K, Kim J, Kwon HJ, Chae Y, Hahm MI, Lee KJ, et al. The prevalence of symptoms of asthma, allergic rhinoconjunctivitis, and eczema in Korean children: nationwide cross-sectional survey using complex sampling design. *J Korean Med Assoc* 2011;54:769-78.
6. Spergel JM, Paller AS. Atopic dermatitis and the atopic march. *J Allergy Clin Immunol* 2003;112(6 Suppl):S118-27.
7. Lack G. Pediatric allergic rhinitis and comorbid disorders. *J Allergy Clin Immunol* 2001;108(1 Suppl):S9-15.
8. Rondon C, Romero JJ, Lopez S, Antunez C, Martin-Casanez E, Torres MJ, et al. Local IgE production and positive nasal provocation test in patients with persistent nonallergic rhinitis. *J Allergy Clin Immunol* 2007;119:899-905.
9. Gaugris S, Sazonov-Kocevar V, Thomas M. Burden of concomitant allergic rhinitis in adults with asthma. *J Asthma* 2006;43:1-7.
10. Casale TB, Amin BV. Allergic rhinitis/asthma interrelationships. *Clin Rev Allergy Immunol* 2001;21:27-49.
11. Meltzer EO, Blaiss MS, Derebery MJ, Mahr TA, Gordon BR, Sheth KK, et al. Burden of allergic rhinitis: results from the Pediatric Allergies in America survey. *J Allergy Clin Immunol* 2009;124(3 Suppl):S43-70.
12. Yuksel H, Dinc G, Sakar A, Yilmaz O, Yorgancioglu A, Celik P, et al. Prevalence and comorbidity of allergic eczema, rhinitis, and asthma in a city in western Turkey. *J Investig Allergol Clin Immunol* 2008;18:31-5.
13. Kim YH, Urm SH, Kim WK. Prevalence of allergic diseases and risk factors in preschool children, 2009. *Pediatr Allergy Respir Dis* 2011;21:165-75.
14. Kocabas CN, Civelek E, Sackesen C, Orhan F, Tuncer A, Adalioglu G, et al. Burden of rhinitis in children with asthma. *Pediatr Pulmonol* 2005;40:235-40.
15. Bertelsen RJ, Carlsen KC, Carlsen KH. Rhinitis in children: comorbidities and phenotypes. *Pediatr Allergy Immunol* 2010;21(4 Pt 1):612-22.
16. Choi SW, Ju YS, Kim DS, Kim JY, Kwon HJ, Kang DH, et al. Reliability and validity of the Korean version of ISAAC questionnaire. *Korean J Prev Med* 1998;31:361-71.
17. Hong SJ, Ahn KM, Lee SY, Kim KE. The prevalences of asthma and allergic diseases in Korean children. *Pediatr Allergy Respir Dis* 2008;18:15-25.
18. Lee HS, Lee J, Hong SC, Kim JW, Kim SY, Lee KH. Prevalence and risk factors for allergic diseases of preschool children living in Seogwipo, Jeju, Korea. *Korean J Asthma Allergy Clin Immunol* 2012;32:107-14.
19. Bousquet J, Van Cauwenberge P, Khaltaev N; Aria Workshop Group; World Health Organization. Allergic rhinitis and its impact on asthma. *J Allergy Clin Immunol* 2001;108(5 Suppl):S147-334.
20. Jee HM, Kim KW, Kim CS, Sohn MH, Shin DC, Kim KE. Prevalence of asthma, rhinitis and eczema in Korean children using the International Study of Asthma and Allergies in Childhood (ISAAC) questionnaires. *Pediatr Allergy Respir Dis* 2009;19:165-72.
21. Rosario N, Bielory L. Epidemiology of allergic conjunctivitis. *Curr Opin Allergy Clin Immunol* 2011;11:471-6.
22. Strachan D, Sibbald B, Weiland S, Ait-Khaled N, Anabwani G, Anderson HR, et al. Worldwide variations in prevalence of symptoms of allergic rhinoconjunctivitis in children: the International Study of Asthma and Allergies in Childhood (ISAAC). *Pediatr Allergy Immunol* 1997;8:161-76.
23. Peroni DG, Piacentini GL, Bodini A, Rigotti E, Pigozzi R, Boner AL. Prevalence and risk factors for atopic dermatitis in preschool children. *Br J Dermatol* 2008;158:539-43.
24. Taussig LM, Wright AL, Holberg CJ, Halonen M, Morgan WJ, Martinez FD. Tucson Children's Respiratory Study: 1980 to present. *J Allergy Clin Immunol* 2003;111:661-75.
25. Zhao J, Bai J, Shen K, Xiang L, Huang S, Chen A, et al. Self-reported prevalence of childhood allergic diseases in three cities of China: a multicenter study. *BMC Public Health* 2010;10:551.
26. Li F, Zhou Y, Li S, Jiang F, Jin X, Yan C, et al. Prevalence and risk factors of childhood allergic diseases in eight metropolitan cities in China: a multicenter study. *BMC Public Health* 2011;11:437.
27. Oh JW, Kim KE, Pyun BY, Lee HR, Choung JT, Hong SJ, et al. Nationwide study for epidemiological change of atopic dermatitis in school aged children between 1995 and 2000 and kindergarten aged children in 2003 in Korea. *Pediatr Allergy Respir Dis* 2003;13:227-37.
28. Bielory L, Friedlaender MH. Allergic conjunctivitis. *Immunol Allergy Clin North Am* 2008;28:43-58.
29. Hesselmar B, Aberg B, Eriksson B, Aberg N. Allergic rhinoconjunctivitis, eczema, and sensitization in two areas with differing climates. *Pediatr Allergy Immunol* 2001;12:208-15.
30. Lee SI, Shin MH, Lee HB, Lee JS, Son BK, Koh YY, et al. Prevalences of symptoms of asthma and other allergic diseases in Korean children: a nationwide questionnaire survey. *J Korean Med Sci* 2001;16:155-64.