

Prevalence of immediate-type food allergy in Korean schoolchildren: A population-based study

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ABSTRACT

Although the prevalence and causes of food allergy (FA) vary by geographic location, large well-designed epidemiological studies in Asia are lacking. The purpose of this study was to evaluate the prevalence of immediate-type FA in the general population of Korean schoolchildren. A population-based, cross-sectional study was conducted in 2010 using a stratified two-stage cluster-sampling design. In this survey, children aged 6–7 years and 12–13 years were randomly selected, and the presence of FA was determined by a questionnaire survey and assessment of specific IgE. After adjustment for missing data, 3907 children aged 6–7 years and 3975 students aged 12–13 years who completed the questionnaire were included in this study. In children aged 6–7 years, the prevalence of confirmed immediate-type FA was 0.3%, and the prevalence of possible immediate-type FA was 0.3%. By contrast, 0.6 and 1.0% of children aged 12–13 years had confirmed immediate-type FA and possible immediate-type FA, respectively. In 6- to 7-year-old children, egg was the most frequent causative food associated with a confirmed or possible immediate-type FA. In 12- to 13-year-old children, crustaceans were the most frequent cause of confirmed immediate-type FA, and fruit was most frequently involved in possible immediate-type FA. This is the first nationwide population-based study of FA in Korean schoolchildren. Unlike in western countries, the prevalence of immediate-type FA seems to be low. In 12- to 13 year-old children with confirmed immediate-type FA, peanuts/tree nuts are not common causes, whereas crustaceans are frequent triggers.

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Epidemiological studies on food allergy (FA) have been reported in the general population, but the prevalence varies because of many factors such as misclassification, biased participation, lack of simple diagnostic tests, rapid evolution of disease, and large numbers of potential triggers.¹ According to recent meta-analysis in the EuroPrevall Program, the overall prevalence rates of FA were 12% self-reported in children and 13% in adults (based on

23 studies) and 3% for all ages based on studies that included double-blind placebo-controlled food challenge (6 studies).² In German children aged 0–17 years, 4.2% were confirmed to have FA when assessed using a structured telephone interview and/or specific IgE test.³ In the United Kingdom, a study using the clinical history plus objective assessment found that 2.3% of 11-year-old children had food hypersensitivity and that most showed an immediate reaction.⁴ Population-based serological data on four foods (peanut, milk, egg, and shrimp) indicated an estimated 3.8% of U.S. children aged 6–19 years have FA.⁵ In an Australian study, >10% of 1-year-old infants had challenge-proven IgE-mediated FA to one of the common allergenic foods of infancy.⁶

The FA prevalence in Asia is also available. In Korean children aged 6–12 years, the prevalence of doctor-diagnosed FA increased from 4.2% in 1995 to 4.7% in 2000.⁷ In the late 1990s, the prevalence of FA in Singaporean children aged 5–12 years and in Japanese children <6 years were reported as 4–5 and 12.6%, respectively.^{8,9} However, these data might be overestimated because the studies were based on parental report to a questionnaire without any objective assessment. Recently, the prevalence of challenge-proven FA in 0- to 1-year-old infants in Chongqing, China, was

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reported to be 3.8%, although the study population size was small.¹⁰

Geographic variations should be considered with respect to causative foods. For example, bird's nest,¹¹ buckwheat,^{12,13} and sesame¹⁴ are common food allergens in particular areas, but not in general. Peanut allergy is likely to be infrequent in Singaporean and Israeli children,^{15,16} although it is common in western countries.^{17–19}

Although the prevalence and causes of FA vary by geographic location, large well-designed epidemiological studies in Asia are lacking. We aimed to investigate the prevalence of immediate-type FA in the general population of Korean school children.

METHODS

Study Population

This population-based, cross-sectional study was conducted in Korea between October and November 2010 as a part of the International Study of Asthma and Allergies in Childhood phase three. We randomly selected more than 3000 participants in the first grade of elementary school and middle school according to the recommendations of the International Study of Asthma and Allergies in Childhood centers.²⁰

The participants were selected using a stratified two-stage cluster-sampling design. For the first stage, schools were stratified by seven geographic regions and the type of school location, *i.e.*, metropolitan, urban, and rural areas. The metropolitan area had >1 million people. Among the areas with the population size of <1 million, urban and rural areas were divided by the population density of 300 persons/km.² From each stratum, sample schools were selected using the systematic probability proportional-to-size sampling procedure. For the second stage of sampling, three classes were selected randomly from each sample school. In this survey, 4003 children in the first grade of 45 elementary schools (6–7 years) and 4112 students in the first grade of 40 middle schools (12–13 years) were randomly chosen across the nation.

This study was approved by the Institutional Review Board at Dankook University and informed consent was obtained from all parents.

Screening for Adverse Reaction to Food or Immediate-Type FA

Instead of using a food challenge test, we identified immediate-type FA according to the algorithm presented in Fig. 1. Parents of the participants completed a questionnaire to determine the prevalence of current food allergies. "Perceived FA, ever" was considered when the parents answered "yes" to the question, "Has your child ever had allergic reactions to food?" If their children still restricted ingestion of the suspected food,

they were considered to have "perceived FA, current." Then, we asked if their child has manifested common FA symptoms and if their allergic reactions were related to common food allergens such as hen's egg, cow's milk, soybean, peanut, wheat, buckwheat, beef, chicken, pork, sesame, tree nuts, fruit, vegetables, fish, and crustaceans (shrimp and crab). Children manifesting only one vague symptom such as abdominal pain or those who showed adverse reactions to an uncommon or uncertain food were excluded.

For the next step, children whose allergic reactions occurred within 4 hours after ingestion were chosen. If serum-specific IgE against the suspected food was positive, they were considered to have a confirmed immediate-type FA. Among those who had negative or undetermined food-specific IgE, children were considered to have possible immediate-type FA when they manifested repeated episodes of allergic reactions to the offending food. Those students who had allergic symptoms by fruit were also regarded as having possible immediate-type FA if they had positive pollen-specific IgE on skin-prick test (SPT), because fruit and pollen are known to have cross-reactivities. The overall prevalence of immediate-type FA was estimated by the sum of confirmed immediate-type FA and possible immediate-type FA. Delayed-type FA was not evaluated in this study, because an oral food challenge test was not performed.

Test for Specific IgE to Suspected Food Allergen and Pollen

Blood samples were obtained and the sera were frozen at -80°C until use. A reaction to offending foods was first screened by questionnaires, and then specific IgE antibodies to those offending foods were measured using ImmunoCAP (Pharmacia, Uppsala, Sweden). Specific IgE against fruit or vegetable was not tested in this study, because specific IgE test with commercially available fruit or vegetable allergens are often negative due to structural instability.²¹ A positive specific IgE level was defined as >0.35 kU/L.

To support the diagnosis of fruit allergy, the SPT was performed on the volar aspects of the forearms with pollens such as alder, birch, oak, Japanese cedar, Bermuda grass, orchard grass, timothy, mugwort, ragweed, and Japanese hop (Allergopharma, Reinbek, Germany; Lofarma, Milan, Italy). Histamine was used as a positive control and normal saline as a negative control. Fifteen minutes after the SPT, the largest diameter of the wheals and its perpendicular diameter for each allergen were measured. A positive response was regarded when the average of two values was ≥ 3 mm larger than the negative control.

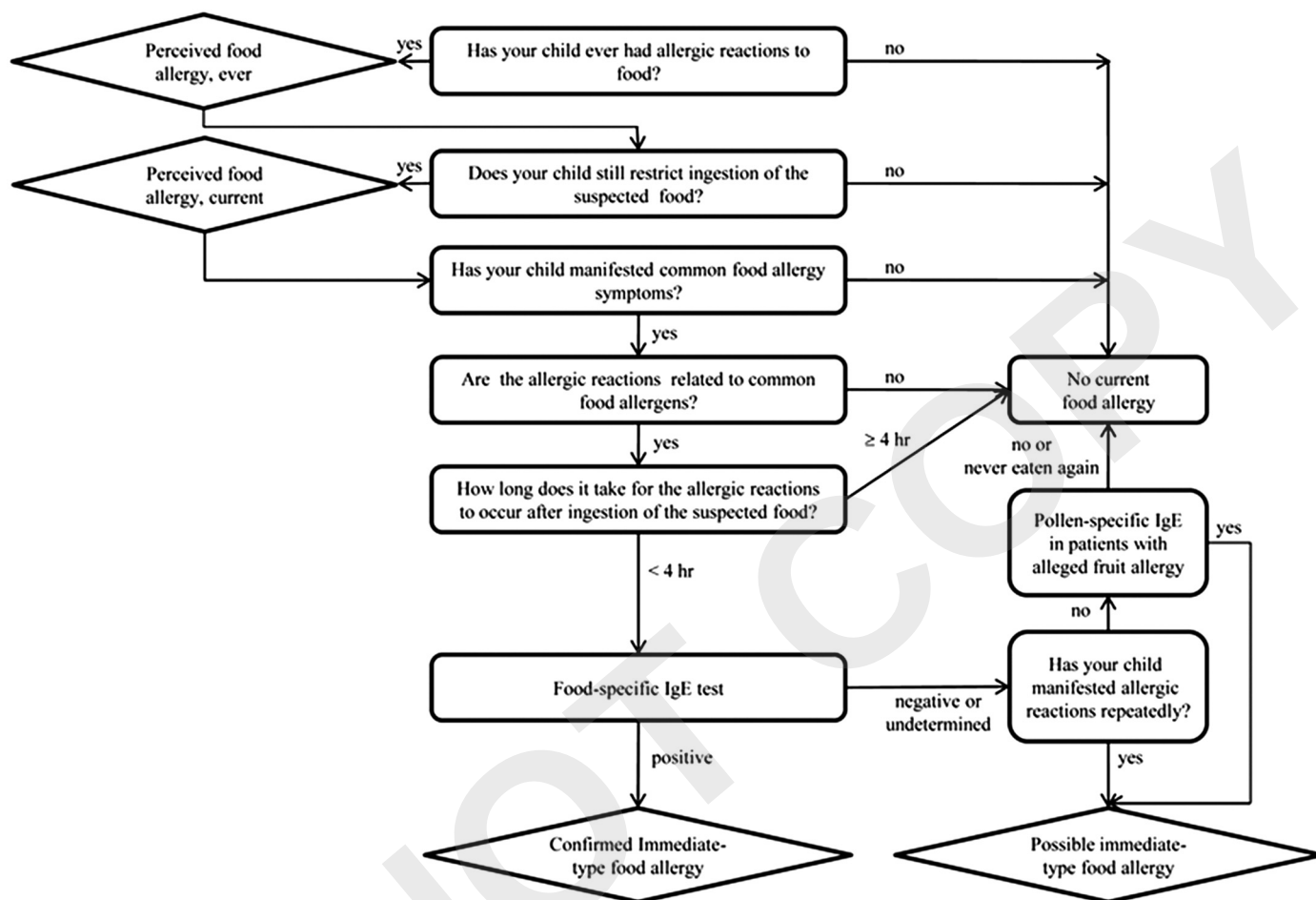


Figure 1. Algorithm for identifying IgE-mediated food allergy (FA).

Statistics

Because the participants for this survey were selected using a stratified two-stage cluster-sampling design, we calculated the sampling weights for this study to take into account different selection probabilities, non-responsive, and poststratification. SAS (Version 9.1; SAS Institute, Cary, NC) was used for statistical analyses. Weighted prevalence rates and 95% confidence intervals were calculated using the SURVEYFREQ procedure of SAS Version 9.1.

RESULTS

After adjustment for missing data, 3907 children aged 6–7 years and 3975 students aged 12–13 years who completed the questionnaire were finally included in this study. The response rates of the 6- to 7-year-old and 12- to 13-year-old children were 92.1 and 93.8%, respectively. Demographic data are reported in Table 1.

The FA prevalence is shown in Table 2. The prevalence of “perceived FA, ever” was 15.0 and 12.5% in 6- to 7-year-olds and 12- to 13-year-olds, respectively. The prevalence of “perceived FA, current” was 3.3 and 4.5%

in each age group. Of the 3907 children aged 6–7 years, the prevalence of confirmed immediate-type FA was 0.3%, and the prevalence of possible immediate-type FA was 0.3%. By contrast, of the 3975 children aged 12–13 years, 23 children (0.6%) had confirmed immediate-type FA, and 1% had possible immediate-type FA. The overall prevalence rates of immediate-type FA in 6- to 7-year-old and 12- to 13-year-old children were estimated to be 0.6 and 1.6%, respectively, by the sum of confirmed and possible immediate-type FA.

In 6- to 7-year-old children with confirmed and possible immediate-type FA, the most frequent causative food was egg. The other common food allergens in this age group were crustaceans, fruits, fish, and cow’s milk (Fig. 2). By contrast, crustaceans were the most frequent causative foods in 12- to 13-year-old children with confirmed immediate-type FA, and fruit was involved most frequently in possible immediate-type FA (Fig. 3). The overall prevalence rates of immediate-type FA to fruit and crustaceans were 0.7 and 0.5%, respectively, in 12- to 13-year-old children. The prevalence rates of confirmed immediate-type FA to any nut (pea-

Table 1 Demographic data of the participants in this study

	6- to 7- Year-Old Children	12- to 13- Year-Old Children
	No. (%)	No. (%)
Total no.	3907	3975
Sex		
Boys	1983 (50.8%)	1933 (48.6%)
Girls	1924 (49.2%)	2042 (51.4%)
School location		
Metropolitan area	1816 (46.5%)	1764 (44.4%)
Urban area	1428 (36.5%)	1607 (40.4%)
Rural area	663 (17.0%)	604 (15.2%)
Family history of allergic diseases*		
Yes	2095 (56.1%)	1459 (39.1%)
No	1638 (43.9%)	2271 (60.9%)

*Of 3907 in 6- to 7-year-old children and 3975 in 12- to 13-year-old children, information on family history of allergic diseases was obtained from 3733 and 3730 participants, respectively.

nut and/or tree nut allergy) were 0.03% in 6- to 7-year-olds and 0.1% in 12- to 13-year-old children.

The most common symptom of immediate-type FA in 6- to 7-year-old children was urticaria and/or angioedema, and oral allergy syndrome was also common in 12- to 13-year-old children (Table 3). Anaphylaxis was confirmed by clinical history and a positive specific IgE test. In this study, anaphylaxis was found in 0.13% of 6- to 7-year-old children and in 0.1% of 12- to 13-year-old children. In 6- to 7-year-old children, the causative foods for five cases of confirmed anaphylaxis were crustaceans ($n = 1$), buckwheat ($n = 1$), cow's milk ($n = 1$), hen's egg ($n = 1$), and soybean ($n = 1$), whereas in 12- to 13-year-old children crustaceans ($n = 1$), fish ($n = 1$), hen's egg ($n = 1$), and sesame ($n = 1$) were the causes of confirmed anaphylaxis. In 12- to 13-year-old children, fruit ($n = 7$) was the most predominant in anaphylaxis for possible immediate-type FA ($n = 9$). In this age group, crustaceans accounted for 11 cases of 23 children with urticarial and/or angioedema.

DISCUSSION

The strength of our study is that we attempted to ensure the reliability of the prevalence estimation in several aspects. We collected representative data from a large sample size of two age groups across the nation using a stratified, two-stage cluster-sampling design. The response rate was >90%, which avoided the issue

of biased participation. We also defined immediate-type FA according to a parent-reported convincing history plus a positive food-specific IgE test and did not depend only on the questionnaires. Ours is the first report on the prevalence of immediate-type FA in the general population of Korean schoolchildren and may be one of the largest epidemiological data sets on FA in Asia.

In this study, the prevalence of "perceived FA, ever" was 15.0% in 6- to 7-year-old children and 12.5% in 12- to 13-year-old children. These rates dropped to 3.3 and 4.5% of "perceived FA, current" in each age group, probably because of misdiagnosis or outgrowing over time. We found that the prevalence rates of confirmed immediate-type FA were 0.3 and 0.6% in 6- to 7-year-old and 12- to 13-year-old Korean children, respectively. The true prevalence rates of immediate-type FA might be estimated by including the prevalence of possible immediate-type FA, which was 0.3 and 1.0% in each age group. The group with possible immediate-type FA included those who did not agree to blood sampling and those with undetermined test results because of the lack of information about the specific food they were allergic to. For example, the questionnaire asked about allergy to tree nuts in general, but not to specific types of nuts.

Few studies have evaluated immediate-type FA in the age groups selected in this study. However, our data can be compared with the studies in western countries,^{3-5,17-19} as the pediatric age groups were stratified and immediate reactions were more likely to be included by using structured questionnaires and/or specific IgE test. The prevalence of immediate-type FA seems to be lower in Korean schoolchildren than in those in western countries. This might be related to ethnic difference^{6,22,23} or the high response rate in our study, because a low response rate may have led to a higher participation rate among those with food allergies.^{17,18} Nevertheless, the main reason might be because our study design was set to be very strict in definition, which perhaps led to underestimation of the FA prevalence. In fact, the prevalence of confirmed immediate-type FA in this study was found to be as much as the prevalence of peanut allergy alone in Singapore,¹⁵ Philippines,¹⁵ or Hong Kong.²⁴ We must consider possible exclusion of FA patients who have mild subjective symptoms or show false negative test results.

Peanut and tree nuts are common causes of FA and account for most of food-induced anaphylaxis.²⁵ The prevalence of self-reported peanut allergy in children was 1.77% in a Canadian study¹⁸ and 1.4% in an American study using a telephone survey.¹⁷ Of note, the prevalence of peanut and/or tree nut allergy is relatively low in Asian children. In Singapore, only 0.74% of 4- to 6-year-old children reported a convincing his-

Table 2 Prevalence of FA in Korean school children in 2010

	6- to 7-Year-Old Children	12- to 13-Year-Old Children
	% (95% CI)	% (95% CI)
Perceived FA, ever	15.0 (13.7–16.2)	12.5 (11.4–13.7)
Perceived FA, current	3.3 (2.7–3.9)	4.5 (3.8–5.2)
Confirmed immediate-type FA	0.3 (0.1–0.5)	0.6 (0.3–0.8)
Possible immediate-type FA	0.3 (0.1–0.5)	1.0 (0.7–1.4)

FA = food allergy; CI = confidence interval.

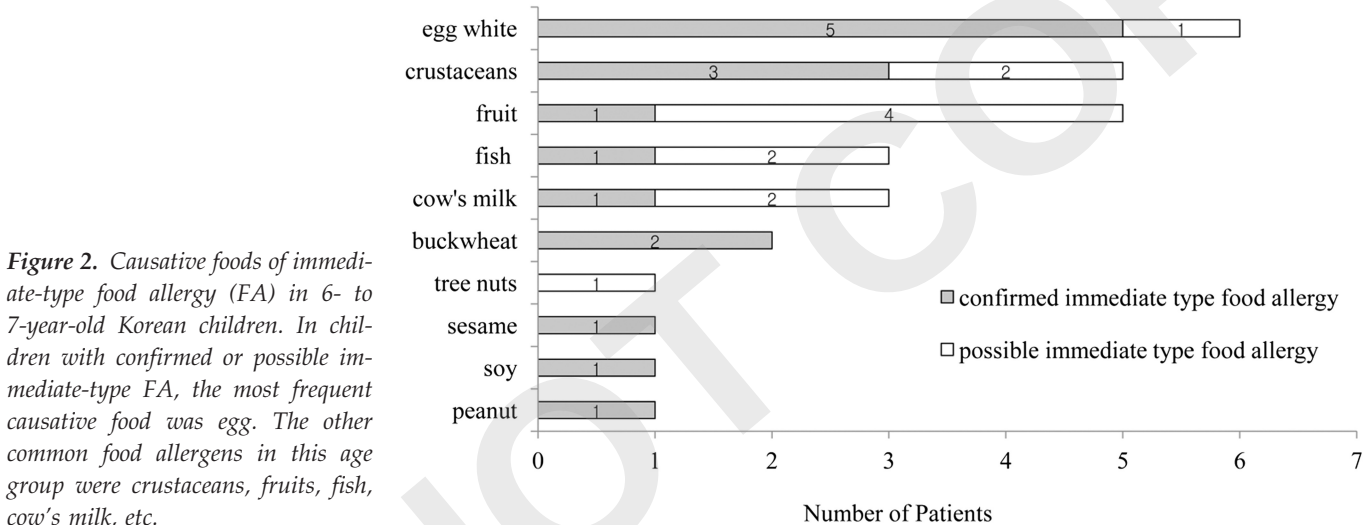


Figure 2. Causative foods of immediate-type food allergy (FA) in 6- to 7-year-old Korean children. In children with confirmed or possible immediate-type FA, the most frequent causative food was egg. The other common food allergens in this age group were crustaceans, fruits, fish, cow's milk, etc.

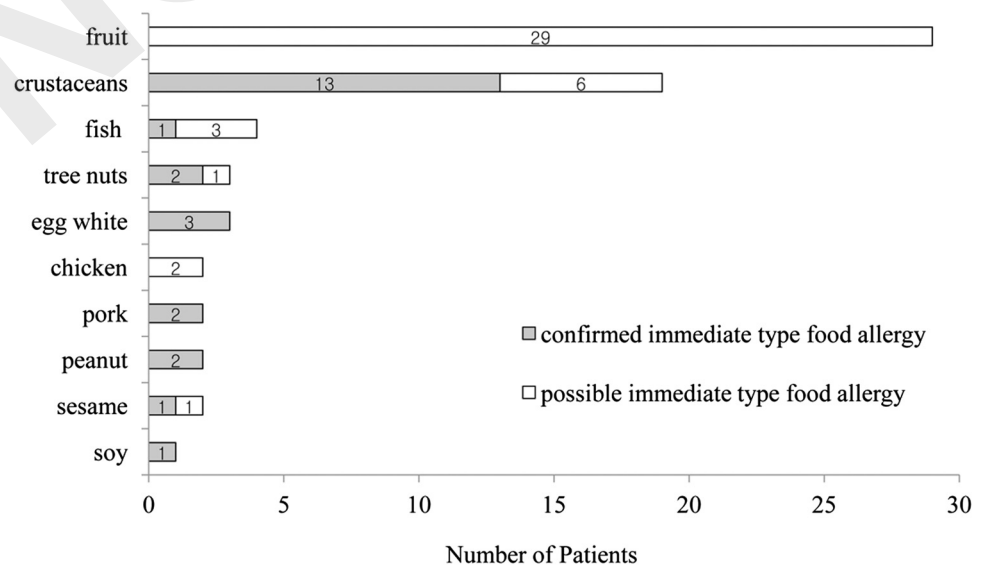


Figure 3. Causative foods of immediate-type food allergy (FA) in 12- to 13-year-old Korean children. Crustaceans were the most frequent causative foods in children with confirmed immediate-type FA, and fruit was involved most frequently in possible immediate-type FA.

tory of any nut allergy.¹⁵ In 14- to 16-year-old children, the prevalence was 0.54% in Singapore and 0.67% in the Philippines.¹⁵ In Hong Kong, the prevalence of parent-reported adverse reaction to peanuts in Chinese preschoolers was 0.65%.²⁴ The prevalence of peanut allergy in Israeli Jewish children was 0.17%, whereas

the prevalence in Jewish children in the United Kingdom was 1.85%.¹⁶ Our study showed a similar trend in that the prevalence of confirmed immediate-type FA to peanuts and/or tree nuts were 0.03 and 0.1% in 6- to 7-year-old children and 12- to 13-year-old children, respectively. The mechanism responsible for differ-

Table 3 Symptoms of immediate-type FA in 6- to 7-year-old and 12- to 13-year-old Korean children

	6- to 7-Year-Old Children		12- to 13-Year-Old Children	
	Confirmed Immediate-Type FA	Possible Immediate-Type FA	Confirmed Immediate-Type FA	Possible Immediate-Type FA
Anaphylaxis	5	0	4	9
Urticaria/angioedema	9	8	15	8
Pruritus/skin rash	1	0	6	2
OAS	1	4	0	23
Total	16	12	25	42

FA = food allergy; OAS = oral allergy syndrome.

ences between countries remains unclear, but different cooking method or dietary habits might affect the prevalence of peanut allergy.^{26,27} By contrast, the prevalence of confirmed immediate-type FA to crustaceans in our study was 0.1% in 6- to 7-year-old children and 0.3% in 12- to 13-year-old children. This indicates that crustaceans are more frequent allergens than are peanuts or tree nuts in Korean children; this is similar to the findings of a study from Singapore.¹⁵

Few epidemiological studies of the prevalence or causes of food-induced anaphylaxis have been reported in Asian children.¹¹ In our study, anaphylaxis was found in ~0.1% in both age groups. We noted that peanuts and tree nuts are not a major cause of food-induced anaphylaxis in Korean children. This finding differs from that in western countries showing peanuts, tree nuts, and shellfish are the most common triggers.^{25,28,29} This difference probably reflects the low number of anaphylactic reactions in our study. Interestingly, seven children aged 12–13 years reported severe allergic reactions after ingestion or contact with fruit. However, this must be confirmed by objective assessment.

Our study has some limitations. First, we did not perform an oral food challenge test, and the prevalence of immediate-type FA may have been underestimated or overestimated. For example, the prevalence of fruit allergy could be underestimated because its diagnosis was based on clinical history plus sensitization to pollen despite the possibility of false negative test results. Second, we can not exclude the possibility of recall bias in the parental reports. Third, we did not obtain prevalence rates for all ages, as in previous studies,^{5,17,18} but focused only on two age groups in schoolchildren. Fourth, categorizing allergic reactions to uncommon food allergens as no current allergy underestimates the overall prevalence of FA. Finally, the group of children classified as having confirmed immediate-type FA might have included those who have already outgrown their FA but not challenged again.

In conclusion, this is the first nationwide population-based study of FA in Korean schoolchildren. The estimated overall prevalence of immediate-type FA was 0.6% in 6- to 7-year-old children and 1.6% in 12- to 13-year-old children. Unlike in western countries, the prevalence seems to be low. In 12- to 13-year-old children with confirmed immediate-type FA, peanuts/tree nuts are not common causes, whereas crustaceans are frequent triggers. Our work will help expand our understanding of the geographic variations in FA.

REFERENCES

1. Sicherer SH. Epidemiology of food allergy. *J Allergy Clin Immunol* 127:594–602, 2011.
2. Rona RJ, Keil T, Summers C, et al. The prevalence of food allergy: A meta-analysis. *J Allergy Clin Immunol* 120:638–646, 2007.
3. Roehr CC, Edenharter G, Reimann S, et al. Food allergy and non-allergic food hypersensitivity in children and adolescents. *Clin Exp Allergy* 34:1534–1541, 2004.
4. Pereira B, Venter C, Grundy J, et al. Prevalence of sensitization to food allergens, reported adverse reaction to foods, food avoidance, and food hypersensitivity among teenagers. *J Allergy Clin Immunol* 116:884–892, 2005.
5. Liu AH, Jaramillo R, Sicherer SH, et al. National prevalence and risk factors for food allergy and relationship to asthma: Results from the National Health and Nutrition Examination Survey 2005–2006. *J Allergy Clin Immunol* 126:798–806, 2010.
6. Osborne NJ, Koplin JJ, Martin PE, et al. Prevalence of challenge-proven IgE-mediated food allergy using population-based sampling and predetermined challenge criteria in infants. *J Allergy Clin Immunol* 127:668–676, 2011.
7. Oh JW, Pyun BY, Choung JT, et al. Epidemiological change of atopic dermatitis and food allergy in school-aged children in Korea between 1995 and 2000. *J Korean Med Sci* 19:716–723, 2004.
8. Shek LP, and Lee BW. Food allergy in Asia. *Curr Opin Allergy Clin Immunol* 6:197–201, 2006.
9. Iikura Y, Imai Y, Imai T, et al. Frequency of immediate-type food allergy in children in Japan. *Int Arch Allergy Immunol* 118:251–252, 1999.
10. Chen J, Hu Y, Allen KJ, et al. The prevalence of food allergy in infants in Chongqing, China. *Pediatr Allergy Immunol* 22:356–360, 2011.

11. Goh DL, Lau YN, Chew FT, et al. Pattern of food-induced anaphylaxis in children of an Asian community. *Allergy* 54:84–86, 1999.
12. Wieslander G, Norback D, Wang Z, et al. Buckwheat allergy and reports on asthma and atopic disorders in Taiyuan City, Northern China. *Asian Pac J Allergy Immunol* 18:147–152, 2000.
13. Lee SY, Lee KS, Hong CH, and Lee KY. Three cases of childhood nocturnal asthma due to buckwheat allergy. *Allergy* 56:763–766, 2001.
14. Dalal I, Binson I, Reifen R, et al. Food allergy is a matter of geography after all: Sesame as a major cause of severe IgE-mediated food allergic reactions among infants and young children in Israel. *Allergy* 57:362–365, 2002.
15. Shek LP, Cabrera-Morales EA, Soh SE, et al. A population-based questionnaire survey on the prevalence of peanut, tree nut, and shellfish allergy in 2 Asian populations. *J Allergy Clin Immunol* 126:324–331, 2010.
16. Du Toit G, Katz Y, Sasieni P, et al. Early consumption of peanuts in infancy is associated with a low prevalence of peanut allergy. *J Allergy Clin Immunol* 122:984–991, 2008.
17. Sicherer SH, Muñoz-Furlong A, Godbold JH, and Sampson HA. US prevalence of self-reported peanut, tree nut, and sesame allergy: 11-Year follow-up. *J Allergy Clin Immunol* 125:1322–1326, 2010.
18. Ben-Shoshan M, Harrington DW, Soller L, et al. A population-based study on peanut, tree nut, fish, shellfish, and sesame allergy prevalence in Canada. *J Allergy Clin Immunol* 125:1327–1335, 2010.
19. Nicolaou N, Poorafshar M, Murray C, et al. Allergy or tolerance in children sensitized to peanut: Prevalence and differentiation using component-resolved diagnostics. *J Allergy Clin Immunol* 125:191–197, 2010.
20. Ellwood P, Asher MI, Beasley R, et al. The International Study of Asthma and Allergies in Childhood (ISAAC): Phase three rationale and methods. *Int J Tuberc Lung Dis* 9:10–16, 2005.
21. Ortolani C, Ispano M, Pastorello EA, et al. Comparison of results of skin prick tests (with fresh foods and commercial food extracts) and RAST in 100 patients with oral allergy syndrome. *J Allergy Clin Immunol* 83:683–690, 1989.
22. Kim J, Chang E, Han Y, et al. The incidence and risk factors of immediate type food allergy during the first year of life in Korean infants: A birth cohort study. *Pediatr Allergy Immunol* 22:715–719, 2011.
23. Luccioli S, Ross M, Labiner-Wolfe J, et al. Maternally reported food allergies and other food-related health problems in infants: Characteristics and associated factors. *Pediatrics* 122(suppl 2): S105–S112, 2008.
24. Leung TF, Yung E, Wong YS, et al. Parent-reported adverse food reactions in Hong Kong Chinese pre-schoolers: Epidemiology, clinical spectrum and risk factors. *Pediatr Allergy Immunol* 20:339–346, 2009.
25. Bock SA, Muñoz-Furlong A, and Sampson HA. Fatalities due to anaphylactic reactions to foods. *J Allergy Clin Immunol* 107: 191–193, 2001.
26. Kim J, Lee J, Seo WH, et al. Changes in major peanut allergens under different pH conditions. *Allergy Asthma Immunol Res* 4:157–160, 2012.
27. Beyer K, Morrow E, Li XM, et al. Effects of cooking methods on peanut allergenicity. *J Allergy Clin Immunol* 107:1077–1081, 2001.
28. Ross MP, Ferguson M, Street D, et al. Analysis of food-allergic and anaphylactic events in the National Electronic Injury Surveillance System. *J Allergy Clin Immunol* 121:166–171, 2008.
29. de Silva IL, Mehr SS, Tey D, and Tang ML. Pediatric anaphylaxis: A 5 year retrospective review. *Allergy* 63:1071–1076, 2008. □

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