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Original Article

Rising prevalence of food allergies in Taiwan: An epidemiological study

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Abstract *Background:* Food allergies are becoming more prevalent globally. The purpose of this study was to investigate the epidemiology of food allergies in Taiwan.
Methods: In 2017, a food allergy questionnaire was administered to 6—7-year-old children, 13—14-year-old adolescents, and their parents in Taipei. The results were compared to those from a previous survey conducted in 2004.
Results: A total of 16,200 questionnaires were completed, revealing a rise in the prevalence of food allergies from 7.7% to 10.4% in the pediatric group and from 6.4% to 12.5% in the adult group. Peanut allergies also increased to 1.1%. Shrimp and crabs were the most common allergens, with urticaria being the most common symptom. Shortness of breath or wheezing occurred in 10% of individuals, while 2.1% experienced syncope or shock, and 0.1% were admitted to an intensive care unit. Personal history of allergic rhinitis and atopic dermatitis, as well as family histories of food allergies, were risk factors for food allergy in 6—7-year-old children. In the 13—14-year-old group, personal history of asthma, allergic rhinitis, or atopic dermatitis, recent use of acetaminophen, and living with dogs were risk factors. Females, personal histories of asthma, allergic rhinitis, atopic dermatitis, and moist and damp at home were risk factors in adults. Breastfeeding was a protective factor in 6—7-year-old children.

Abbreviations: CI, confidence interval; GAN, Global Asthma Network; IgE, immunoglobulin E; IQR, interquartile range; ISAAC, International Study of Asthma and Allergies in Childhood; OR, odds ratio.

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Conclusion: The increasing prevalence of food allergies, including peanut allergies, in Taiwan warrants attention from physicians to provide appropriate care and education to patients with food allergies. The protective effect of breastfeeding against food allergies shall be emphasized.

Introduction

In the past 20 years, there has been a rising prevalence of food allergies, regarded as the "second wave" of allergic epidemics after asthma and allergic rhinitis.[1] Peanut is now the most common food allergen during childhood in Western countries, such as the United States, United Kingdom, and Australia.[2] The prevalence of food allergies is also increasing in Asian countries.[3] In China, a longitudinal study revealed that the prevalence of food allergies rose from 3.5% in 1999 to 7.7% in 2009.[4] Similarly, in South Korea, an increase in physician-diagnosed food allergy from 4.2% to 4.7% was observed among 6- to 12-year-old children between 1995 and 2000.[5] In Hong Kong, Singapore, and the Philippines, the prevalence of peanut allergy remains low in the 2010s[6,7]; however, Hong Kong reported an increase in peanut-related anaphylaxis from 2010 to 2019.[8] Multiple factors, such as urbanized lifestyle, Westernized diet, decreased microbiome diversity, increased antibiotic use, and vitamin D deficiency, contribute to the growth of food allergies in Asia.[3,9]

According to a study by Wu et al., in 2004,[10] the prevalence of food allergies in Taiwan was 7.7% in the pediatric group aged 4—18 years old and 6.4% in adults. Since then, no recent epidemiological data about food allergies has been reported in Taiwan. In order to determine the current prevalence of food allergies in Taiwan, we conducted a questionnaire survey in Taipei. This survey also investigated the clinical presentation and risk factors of food allergies in Taiwan. In addition, we aimed to gain insight into how patients manage their food allergies.

Methods

Study design and study population

To determine the current epidemiology of food allergies in Taipei, Taiwan, a questionnaire survey was conducted in conjunction with the Global Asthma Network (GAN) survey. The GAN survey is a global asthma surveillance that follows the International Study of Asthma and Allergies in Childhood (ISAAC) survey. The ISAAC survey focused on the prevalence and severity of asthma, allergic rhinitis, and atopic dermatitis. The GAN survey differs from the ISAAC survey in that it includes not only 6- to 7-year-old and 13- to 14-year-old students but also their parents.[11,12] To meet the requirement of at least 3000 participants in each group, 25 elementary schools and 24 junior high schools from 12 districts in Taipei were randomly selected. The power of 3000 participants in each group was estimated to be 99% for the detection of a 3% difference at a 1% level of significance.[13] All students from the first grade (6- to 7-year-old group) and eighth grade (13- to 14-year-old group) of each school and their parents were enrolled. The food allergy questionnaire was a modified version of the questionnaire used in the nationwide food allergy survey in Singapore (Supplementary Data).[7]

The questionnaires were distributed to each school in October 2017, and the questionnaires were collected in November 2017. The questionnaires were deidentified, and those without complete information were excluded. The questionnaires of students and parents were matched using serial numbers. The study was approved by the Human Research Ethics Committee of Chang Gung Memorial Hospital (Protocol No. 201700105B0).

Data analysis

The prevalence of food allergies and the percentage of each food trigger were summarized and compared across different age groups. In addition, the symptoms and management strategies for food allergies were analyzed. Anaphylaxis was defined when shortness of breath, wheezing, syncope, or shock was reported after consuming food. Pure gastrointestinal symptoms, on the other hand, were defined as the presence of only abdominal pain, vomiting, or diarrhea without any other symptoms mediated by immunoglobulin E (IgE).

To compare with the prevalence of 2004,[10] the two age groups, namely 6—7 years (children) and 13—14 years (adolescents), were merged into a single pediatric group. The data obtained in 2017 from this pediatric group were then compared with the data of the 4- to 18-year-old group in the 2004 survey. Similarly, the data collected from the adult group in 2017 were compared with the data of the group >19 years old in the 2004 survey.

The R package 'corrplot' was utilized to illustrate a heatmap indicating the relationship between different food allergens.[14] Phi coefficients from the Pearson chi-square test were used to measure the relationship. A phi coefficient with a value greater than or equal to +0.8 was classified as a very strong association. A value between +0.6 and + 0.79 indicated a strong association, while a value of +0.4 to +0.59 indicated a moderate association. Additionally, a value between +0.2 and +0.39 represented a weak association, and a value less than or equal to +0.2 indicated a negligible association.

To analyze the risk factors associated with food allergies, both univariate and multivariate logistic regression analyses were carried out. Any risk factors that had a p-value of less than 0.1, as identified by univariate logistic regression or were previously reported as confounding

factors for food allergies, were included in the multivariate logistic regression. All hypothesis tests were two-sided, and a priori levels of significance were established at a p-value of less than 0.05. Statistical analyses were conducted using IBM SPSS Statistics for Windows version 20 (IBM Corp., Armonk, NY, USA).

Results

Questionnaire survey process

In October 2017, a total of 23,154 questionnaires were distributed to the selected schools. In November 2017, a total of 17,214 questionnaires were collected. For the final analysis, 16,200 questionnaires were validated, which included 3036 questionnaires from the 6- to 7-year-old group, 3474 questionnaires from the 13- to 14-year-old group, and 9690 questionnaires from the parents or guardians of the students. The median age of the parents was 42 years, with an interquartile range (IQR) of 39—46 years.

Prevalence and triggers of food allergy

22.7% of children, 25.6% of adolescents, and 31.5% of adults reported experiencing a food allergy at some point in their lives, while the prevalence of physician-diagnosed food allergies was 9.5%, 11.1%, and 12.5%, respectively (Table 1). The prevalence of food allergies in 2017 was found to be significantly higher than that in 2004, as shown in Fig. 1A and B. In the pediatric group, the overall prevalence of physician-diagnosed food allergies increased from 7.7% to 10.4%, particularly for peanuts (from 0.9% to 1.5%) and eggs (from 0.5% to 1.3%). Similarly, in the adult group, the overall prevalence increased from 6.4% to 12.5%, particularly for peanuts (from 0.5% to 0.9%), shrimp (from 3.3% to 6.1%), crabs (from 2.3% to 4.6%), and cow's milk (from 0.5% to 0.8%).

Peanut allergy was traditionally believed to be uncommon in Asia.[8] Nevertheless, the current survey demonstrated that 1.3% of children, 1.6% of adolescents, and 0.9% of adults in Taiwan had a physician-diagnosed peanut allergy. Among those diagnosed with peanut allergies, 97.4% of children and 98.2% of adolescents were native to Taiwan and had never lived outside of the country.

The percentages of different food triggers are presented in Fig. 2. Shrimp was the most common trigger for food allergies across all three age groups, followed by crabs. The prevalence of shrimp or crab allergies in the adolescent and adult groups was significantly higher than that in the children group (both $p < 0.05$). The prevalence of egg allergies in the 13- to 14-year-old group (1.3%) and 6- to 7-year-old group (1.4%) was significantly higher than that in the adult group (0.4%, both $p < 0.05$).

We conducted a comparison between the types of allergens and the associated allergic diseases. Across all three groups, individuals with asthma, allergic rhinitis, and atopic dermatitis had higher percentages of allergic reactions to various types of foods. However, the food allergen patterns did not differ based on the presence of different allergic comorbidities. As anticipated, patients with atopic dermatitis exhibited the highest rates of reaction to various foods.

Table 1 The prevalence of food allergy in the 2017 Taipei food allergy survey.

Group	Ever food allergy	Physician-diagnosed food allergy	Repeated food allergy	Food allergy in recent 1 year
6—7 year-old	22.7%	9.5%	5.0%	2.7%
13—14 year-old	25.6%	11.1%	3.4%	4.2%
Adult	31.5%	12.5%	8.8%	3.2%
Overall	28.6%	11.6%	6.9%	3.3%

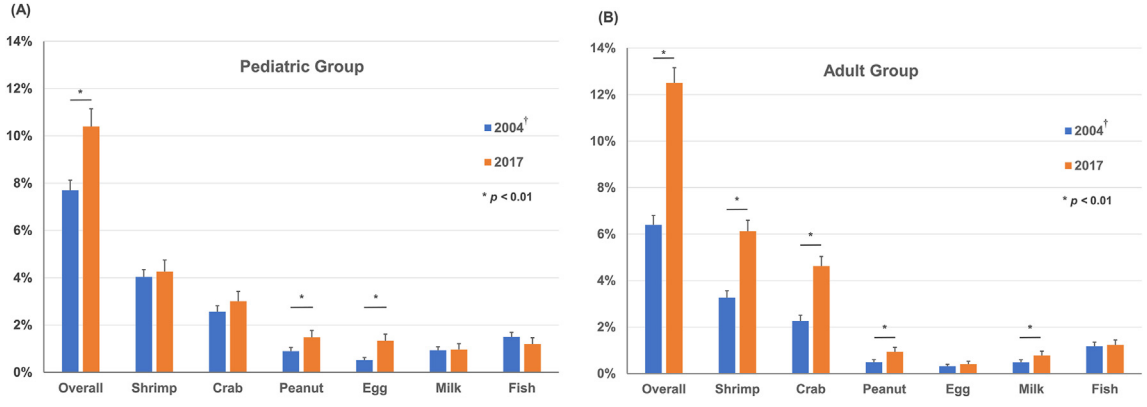

Figure 1. Prevalence changes of food allergy in Taiwan in the (A) pediatric group and (B) adult group, the food allergy data in 2017 was compared with those in 2004. The pediatric group data in 2017 included data from 6- to 7-year-old children and 13- to 14-year-old adolescents. Error bars represent 95% confidence intervals. (†The 2004 data are taken from Wu et al. [Intern Med J 2012; 42:1310-5].)

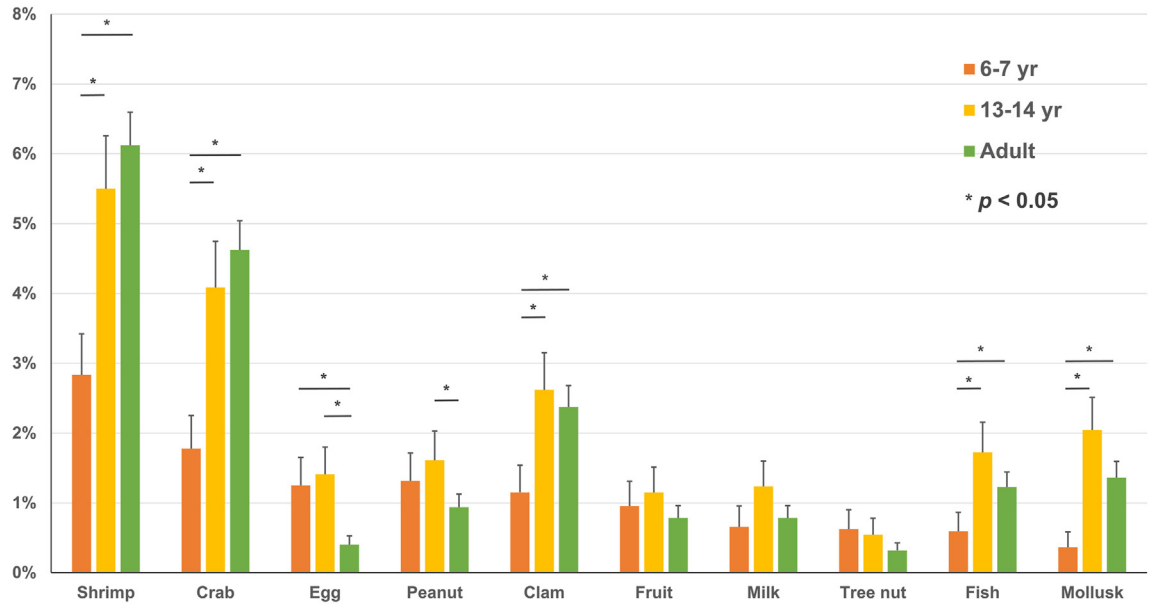

Figure 2. Percentage of each food trigger in different age groups, the percentage of each food trigger from different age groups was compared, and significant results are marked with an asterisk. Error bars represent 95% confidence intervals.

Cross reactivity between different food allergens

The majority of patients with food allergies reported being allergic to only a few types of food. Specifically, 53.8% of children, 40.5% of adolescents, and 46.4% of adults had a single food allergen, while 8.1% of children, 27% of adolescents, and 11% of adults were allergic to four or more different kinds of food.

When patients reacted to multiple types of food, certain patterns were observed (Fig. 3). Allergies to shrimp were strongly associated with allergies to crab (phi coefficient = +0.61, $p < 0.01$). Allergies to clams were moderately associated with allergies to shrimp, crab, and squid (phi coefficient = +0.43, +0.44, and +0.42, respectively; all $p < 0.01$). Cow's milk allergies were weakly associated with egg allergy (phi coefficient = +0.34, $p < 0.01$). In Taiwan, allergies to peanuts were only weakly associated with allergies to tree nuts (phi coefficient = +0.33, $p < 0.01$).

Onset age of food allergies

The median age of onset in children was 3 years (IQR 2—4). In the adolescent group, the median onset age was 7 years (IQR 5—10). Of the adults, 16.1% reported experiencing their first food allergic reaction between the ages of 0 and 10, while 29.9% experienced it between 11 and 20 years old. For 25.2% of adults, the onset of their food allergy occurred when they were older than 30 years of age.

Symptoms of food allergies

Urticaria was the most commonly reported symptom of food allergy (82.3%), followed by angioedema (34.0%). Additionally, 19.2% of the respondents believed that their atopic dermatitis was worsened by food allergies. Among the participants, 11.5% of children, 13.7% of adolescents, and 10.5% of adults reported experiencing anaphylaxis, characterized by shortness of breath, wheezing, syncope, or shock after consuming food (Table 2). Patients who experienced anaphylaxis were more likely to be admitted

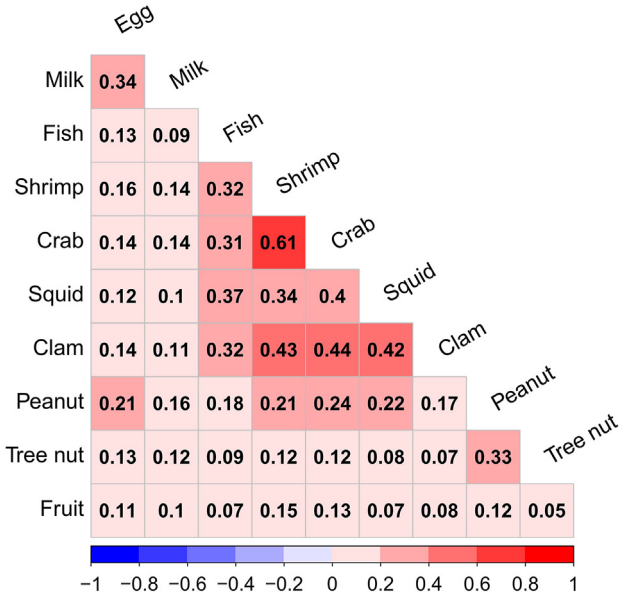

Figure 3. Heatmap of the association of each food allergy pattern, food allergy triggers from those reacting to more than one type of food were analyzed, and the association was demonstrated by a heatmap. The number in each cell denotes the phi coefficient from the Pearson chi-squared test (phi coefficient ≥ +0.8: very strong association; +0.79 ≥ phi coefficient ≥ +0.6: strong association; +0.59 ≥ phi coefficient ≥ +0.4: moderate association; +0.39 ≥ phi coefficient ≥ +0.2: weak association; phi coefficient < +0.2: negligible association).

Table 2 The percentages of different symptoms due to food allergy.

Group	Urticaria	Angioedema	Shortness of breath/wheeze	Syncope/shock	Atopic dermatitis exacerbation	Pure gastrointestinal symptoms
6–7 year-old	81.3%	37.8%	11.5%	1.0%	24.0%	3.5%
13–14 year-old	68.4%	26.7%	12.4%	2.6%	25.1%	3.9%
Adult	87.6%	35.4%	8.6%	2.2%	15.5%	2.3%
Average	82.3%	34.0%	10.0%	2.1%	19.2%	2.9%

to general wards and visit emergency departments but were less likely to use over-the-counter medications or seek medical care in outpatient clinics ($p < 0.05$).

Asthma and food-induced anaphylaxis

Food-allergic individuals with asthma were found to be at a higher risk of developing anaphylaxis compared to those without asthma. The odds ratios (OR) were 5.76 (95% confidence interval [CI] 2.69–12.32), 4.50 (95% CI 2.79–7.25), and 3.59 (95% CI 2.18–5.91) for children, adolescents, and adults, respectively. This highlights the importance of managing asthma to prevent anaphylaxis in cases of food allergies.

Management of food allergies

Table 3 summarizes the management of food allergies in the different age groups: 82.8% of respondents with food allergies reported that they ever went to seek medical care in the outpatient department, 24.6% ever went to the emergency department, 2.8% were ever admitted to general wards, and 0.1% were ever admitted to the intensive care unit. It is worth mentioning that 9.1% of patients ever purchased over-the-counter medications from a pharmacy to alleviate their allergic symptoms. The practice of self-medication was found to be more prevalent in adults (10.5%) and adolescents (10.6%) compared to children (2.7%; $p < 0.01$).

Risk and protective factors for food allergy

The study revealed that personal histories of allergic rhinitis (OR 2.19; 95% CI 1.60–3.01; $p < 0.01$) and atopic dermatitis (OR 2.93; 95% CI 2.15–3.99; $p < 0.01$) were risk factors for food allergy in 6- to 7-year-old children. Children with paternal (OR 1.75; 95% CI 1.12–2.74; $p = 0.01$) and maternal (OR 3.17; 95% CI 2.28–4.40; $p < 0.01$) food allergies were also found to be at risk of food allergies. In this survey, the delayed introduction of solid food was not a risk factor for food allergies (OR 1.05; 95% CI 0.83–1.35; $p = 0.68$). In addition, breastfeeding was a protective factor for food allergies in this age group (OR 0.46; 95% CI 0.27–0.79; $p < 0.01$).

The 13- to 14-year-old group had an increased risk of food allergy if they had a personal history of asthma (OR 2.24; 95% CI 1.63–3.07; $p < 0.01$), allergic rhinitis (OR 1.94; 95% CI 1.48–2.53; $p < 0.01$), or atopic dermatitis (OR 3.42; 95% CI 2.57–4.55; $p < 0.01$). Recent use of acetaminophen (OR 1.32; 95% CI 1.04–1.68; $p = 0.02$) and living with dogs (OR 1.41; 95% CI 1.02–1.95; $p = 0.04$) in the past year were also risk factors, whereas cats did not show a significant association. In terms of family history, a paternal history of food allergy was a risk factor (OR 1.75; 95% CI 1.15–2.66; $p < 0.01$). However, maternal atopic disease history did not show a significant association in the multivariate logistic regression analysis for this age group.

In adults, females had a higher risk of developing food allergies (OR 1.61; 95% CI 1.39–1.86; $p < 0.01$). Asthma (OR 1.56; 95% CI 1.01–1.33; $p < 0.01$), allergic rhinitis (OR 2.07; 95% CI 1.79–2.39; $p < 0.01$), and atopic dermatitis (OR 2.97; 95% CI 2.51–3.51; $p < 0.01$) were risk factors for food allergies. Moisture and damp spots at home (OR 1.16; 95% CI 1.01–1.33; $p = 0.04$) increased the risk of food allergies in this age group. Table 4 provides the risk and protective factors for food allergies in the three age groups.

Table 3 The percentages of different management of food allergy.

Group	OPD	ED	General ward	ICU	OTC
6–7 year-old	85.0%	24.4%	2.7%	0%	2.7%
13–14 year-old	71.4%	21.0%	4.9%	0%	10.6%
Adult	86.2%	26.0%	2.1%	0.2%	10.5%
Overall	82.8%	24.6%	2.8%	0.1%	9.1%

OPD: out-patient department; ED: emergency department; ICU: intensive care unit; OTC: over-the-counter medication.

Discussion

The growing prevalence of food allergies has been a global concern for the past 20 years.[1] In the United States, nationwide telephone surveys have shown that peanut and tree nut allergies in children have increased more than threefold from 0.6% in 1997 to 2.1% in 2008.[15] A similar trend was observed in the United Kingdom, where the prevalence rose from 0.6% to 1.8% in a decade.[16] However, recent data suggested that the increasing trend of food allergies in the United States has reached a plateau. According to Gupta et al.,[17] the updated prevalence of peanut allergies in children was 2.2% in 2018, which was similar to that in 2008.

Meanwhile, food allergies were on the rise in Asian countries. In China, the prevalence of food allergies increased from 3.5% in 1999 to 7.7% in 2009.[4] The prevalence of physician-diagnosed food allergies in South Korean children aged 6–12 years increased from 4.2% to 4.7% between 1995 and 2000. In addition, the prevalence of food allergies also increased from 3.8% to 5.1% among South

Table 4 The summary of risk and protective factors for food allergy at different age groups.

Variables	6-7 year-old students	
	OR (95% CI)	*P*-value
Male gender	0.81 (0.60—1.09)	0.17
Personal atopic diseases		
Asthma	1.28 (0.87—1.88)	0.21
Allergic rhinitis	2.19 (1.60—3.01)	**< 0.01**
Atopic dermatitis	2.93 (2.15—3.99)	**< 0.01**
Environment and feeding		
Antibiotics intake before 1 year old	1.22 (0.87—1.71)	0.25
Recent acetaminophen intake	1.33 (0.95—1.85)	0.10
Breastfeeding ever	0.46 (0.27—0.79)	**< 0.01**
Delayed supplementary foods	1.05 (0.83—1.35)	0.68
Father atopic history		
Asthma	1.28 (0.65—2.52)	0.49
Allergic rhinitis	0.94 (0.52—1.28)	0.57
Atopic dermatitis	0.93 (0.57—1.53)	0.79
Food allergy	1.75 (1.12—2.74)	**0.01**
Mather atopic history		
Asthma	0.94 (0.52—1.69)	0.83
Allergic rhinitis	1.01 (0.73—1.40)	0.94
Atopic dermatitis	1.33 (0.89—1.97)	0.16
Food allergy	3.17 (2.28—4.40)	**< 0.01**
Variables	13-14 year-old students	
	OR (95% CI)	*P*-value
Male gender	1.04 (0.96—1.13)	0.33
Personal atopic diseases		
Asthma	2.24 (1.63—3.07)	**< 0.01**
Allergic rhinitis	1.94 (1.48—2.53)	**< 0.01**
Atopic dermatitis	3.42 (2.57—4.55)	**< 0.01**
Environment and medication		
Recent acetaminophen intake	1.32 (1.04—1.68)	**0.02**
Dog as a pet at home	1.41 (1.02—1.95)	**0.04**
Cat as a pet at home	1.27 (0.79—2.05)	0.05
Father atopic history		
Asthma	1.37 (0.67—2.83)	0.39
Allergic rhinitis	0.98 (0.70—1.39)	0.93
Atopic dermatitis	0.93 (0.57—1.51)	0.78
Food allergy	1.75 (1.15—2.66)	**< 0.01**
Mather atopic history		
Asthma	1.37 (0.79—2.36)	0.26
Allergic rhinitis	1.03 (0.76—1.39)	0.86
Atopic dermatitis	1.01 (0.65—1.55)	0.98
Food allergy	1.27 (0.87—1.85)	0.21
Variables	Adults	
	OR (95% CI)	*P*-value
Male gender	0.62 (0.54—0.72)	**< 0.01**
Personal atopic diseases		
Asthma	1.56 (1.21—2.00)	**< 0.01**
Allergic rhinitis	2.07 (1.79—2.39)	**< 0.01**
Atopic dermatitis	2.97 (2.51—3.51)	**< 0.01**
Environment & cigarette smoking		
Moisture & damp spots at home now	1.16 (1.01—1.33)	**0.04**
Mold spots at home now	0.91 (0.74—1.11)	0.35
Ever smoking	1.17 (1.00—1.37)	0.05
Still smoking now	0.86 (0.72—1.02)	0.07

Korean adolescents.[5] The prevalence of peanut-related anaphylaxis in Hong Kong increased between 2010 and 2019.[8] In Taiwan, there has been a noticeable increase in the prevalence of food allergies, including peanut allergy, as shown in this survey. Contributing factors to this rise include an urbanized lifestyle, a Westernized diet, reduced microbiome diversity, increased antibiotic usage, and vitamin D deficiency in the Asian population.[3,9]

Traditionally, peanut allergy is believed to be uncommon in Asian countries.[3,7,8,18] The majority of peanut-allergic cases seen in Asia have been among Caucasian or Asian children who were born or had lived abroad.[7] However, the allergy pattern has been changing.[8] In Taiwan, for example, the prevalence of peanut allergy has increased from 0.9% to 1.5% in students and from 0.5% to 0.9% in adults, compared to the results of Wu et al.[10] Furthermore, as shown in this survey, 97.4% of children and 98.2% of adolescents with peanut allergy were students who were born in Taiwan and had never lived abroad. An increase in the prevalence of peanut allergy has also been reported in Singapore and Hong Kong.[8,18] Changes in diet habits towards a more Westernized diet might be one of the reasons for this increase.[3] For instance, the first peanut-containing food consumed by children in Singapore and Taiwan has shifted from boiled peanuts to peanut butter.[3] It is worth closely monitoring the rising trend of peanut allergies in Asia.

Consistent with previous epidemiological studies,[10] our study showed that shellfish, shrimps, and crabs were the most common food allergens in Taiwan. Shellfish allergy was more common in adults than in children.[19] Crustacean allergies are common in Southeast Asia and South Europe, and are responsible for a significant percentage of anaphylactic reactions.[3,20] The high prevalence of crustacean allergies in these regions has been linked to several factors, including a high percentage of house dust mite allergies and a high degree of homology between tropomyosin in crustaceans and house dust mites.[21] Additionally, the relatively high consumption of shellfish in these areas may also contribute to the prevalence of crustacean allergies.[22,23]

The prevalence of anaphylaxis in Taiwan was on the rise,[24] similar to what has been observed in Hong Kong.[8] Our study found that 11.4% of the respondents reported symptoms consistent with anaphylaxis, and 24.6% had to visit the emergency department due to food allergies. Alarmingly, 9.1% of the respondents attempted to relieve their symptoms with over-the-counter medication, which may delay the diagnosis and management of anaphylaxis. Therefore, it is crucial to educate patients and their families on proper food allergy management. The first-line medication for

anaphylaxis is an epinephrine auto-injector, and patients with food allergies and their families are encouraged to carry them at all times.[25] However, only a limited number of hospitals in Taiwan can prescribe epinephrine auto-injectors, and they are not covered by National Health Insurance, resulting in only a few patients with food allergies being prepared and using them. Therefore, we recommend that National Health Insurance cover epinephrine auto-injectors for patients with food allergies and at risk of anaphylaxis in Taiwan.

This study revealed some protective and risk factors for food allergies. Breastfeeding was a protective factor against food allergy for children, which is consistent with prior research indicating that breastfeeding protects against various allergic diseases, including food sensitization and allergy.[26,27] Breast milk reduced the generation of food-specific IgE, thus preventing early food sensitization.[26] Colostrum helped maintain appropriate oral tolerance, which reduces the risk of food allergies.[27] Therefore, it is important to remind parents about the beneficial effect of breastfeeding in preventing food allergies. Based on our results, physicians need to pay attention to food allergic symptoms in patients with other allergic diseases or family histories of food allergy. Unnecessary intake of acetaminophen should be avoided, and measures should be taken to reduce moisture levels at home to prevent food allergies.

Other studies, such as the Learning Early about Peanut Allergy trial, revealed the delayed introduction of peanuts was a risk factor for peanut allergy, especially in high-risk infants with eczema or egg allergy.[28] However, this study did not find a significant association between the delayed introduction of complementary food and physician-diagnosed food allergy in 6- to 7-year-old students. One possible explanation for this discrepancy is that the questionnaire survey was conducted on the general population rather than high-risk children. Additionally, the association might not have been identified due to recall bias or a lack of compliance data.

According to the survey, having personal allergic diseases increased the risk of developing food allergies. In three groups, both atopic dermatitis and allergic rhinitis were identified as risk factors for food allergies. Asthma was a risk factor for food allergies in the 13- to 14-year-old and adult groups. In the 6- to 7-year-old group, asthma was found to be a risk factor for food allergies in the univariate logistic regression analysis, not in the multivariate logistic regression. Pediatric asthma often resolves by the age of 6—7 years.[29] Therefore, in the multivariate logistic regression analysis, asthma could not be shown as a risk factor for food allergies in the 6- to 7-year-old group.

The HealthNut study, a large population-based cohort study in Australia, revealed that children with one immediate family member who had food allergies had a 1.4 times higher risk of developing food allergies, which increased to 1.8 times when two immediate family members had food allergies.[30] Our study also found that a parental history of food allergies increased the risk of food allergies in the pediatric group. Specifically, 6- to 7-year-old children with a paternal history of food allergies had a 1.75 times higher risk of developing food allergies, while those with a maternal history had a 3.17 times higher risk. Similarly, 13- to 14-year-old adolescents with a paternal history of food allergies had a 1.75 times higher risk of developing food allergies.

The major limitation of this study is that it is a questionnaire-based survey, which is known to overestimate the true prevalence of food allergies.[31] Another limitation is that the questionnaires for adolescents were self-reported at school, and at this age, students may not be fully aware of their food allergy history. A third limitation is that the food allergy data were collected only from students and parents in Taipei, and therefore, the findings cannot be generalized to the entire population of Taiwan, particularly those in rural areas. The major strength is that this study gathered a substantial number of questionnaires. Moreover, the concurrent acquisition of data from both students and their parents offers a comprehensive analysis of risk factors associated with food allergies, including family histories and personal allergic comorbidities.

In conclusion, there is a rising trend in food allergy prevalence in Taiwan, with rates of 10.4% in children and 12.5% in adults in Taipei, Taiwan. The prevalence of peanut allergy has also increased to an average of 1.1%, with most patients being domestic cases who have never lived abroad. A noteworthy finding is that 11.4% of patients with food allergies display symptoms of anaphylaxis, and 9.1% have solely relied on over-the-counter medication for symptom relief. It is crucial for healthcare providers in Taiwan to be aware of the increasing prevalence of food allergies, including previously uncommon peanut allergies. The insights gained from this study are expected to enhance medical care for food allergy patients in Taiwan in the future.

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Declaration of competing interest

All authors have no conflict of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jmii.2023.04.008.