

Parent-reported adverse food reactions in Hong Kong Chinese pre-schoolers: epidemiology, clinical spectrum and risk factors

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The epidemiology of adverse food reactions (AFRs), including the potentially life-threatening food allergy (FA), in Asia is unclear. AFR is believed to be less prevalent than in Caucasians. This study determines the prevalence, clinical features and risk factors for parent-reported AFR in Chinese pre-school children in Hong Kong. Children aged 2–7 yr living in Hong Kong were recruited through local nurseries and kindergartens to ascertain the occurrence and clinical spectrum of AFR and other atopic disorders. Subjects' parents answered a self-administered questionnaire that was modified and validated based on the International Study of Asthma and Allergy in Childhood. A total of 3827 children from 21 nurseries and kindergartens returned the study questionnaires, and information on AFR was analyzable for 3677 (96.1%) children. The prevalence rates of parent-reported AFR and parent-reported, doctor-diagnosed AFR were 8.1% and 4.6%, respectively, whereas 5.0% of pre-schoolers had doctor-diagnosed asthma. The six leading causes of AFR were shellfish (15.8%), egg (9.1%), peanut (8.1%), beef (6.4%), cow's milk (5.7%), and tree nuts (5.0%). When compared with children born and raised in Hong Kong, children born in mainland China ($n = 253$) had less parent-reported AFR (4.0% vs. 6.7%; $p = 0.016$). On logistic regression, parent-reported AFR was associated with younger age ($p = 0.010$), born in mainland China ($p = 0.038$), and AFR history in father ($p = 0.001$), mother ($p < 0.001$), siblings ($p = 0.020$), and paternal history of rhinitis ($p = 0.044$). This study shows that AFR is a common atopic disorder in Hong Kong pre-school children, and prevalence rates are comparable to the Caucasians.

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Food allergy (FA) is an atopic disorder that affects all age groups, and this condition is a potentially fatal form of adverse food reactions (AFRs) (1). As there is currently no cure for FA, sensitive individuals must manage their FA through avoidance of foods containing the allergen (2). AFR sufferers experience great stress and difficulty in managing their daily activities, and it

changes quality of life in a profoundly negative way (3). Clear food labeling regarding food allergens is essential to help allergic consumers manage their condition. The majority of FA is mediated by immunoglobulin E, but sensitization to a specific food as revealed by skin prick or serologic testing does not always imply clinical reactivity. Because of the lack of reliable diag-

nostic tests, estimates of the prevalences of FA and AFR are generally imprecise. In the 1990s, FA was estimated to affect 6% of American children <3 yr of age (4). A meta-analysis of studies has found that the incidence of self-reported AFR ranged between 3% and 35%. The incidence was lower (2–5%) in studies where subjects were also tested for food sensitization (5). The few studies that used diagnostic oral challenge procedures found that 1–4% of individuals suffer from FA. The reasons accounting for this marked heterogeneity include wide differences in response rates, problems in reliability, consistency of diagnosis across studies, poor clinical specificity of skin tests, and food-specific IgE measurement (5, 6).

The epidemiology and clinical spectrum of AFR is widely available among Caucasians, but such data is limited in Asian countries. The prevalence rates of parent- or self-reported AFR in Asian children ranged between 1.2% and 6.5% (7–10). Our children also appear to have a different spectrum of foods causing AFR. Bird's nest and crustacean seafood were much more common than peanut or tree nuts as food allergens in Singaporean children (11). In Israel, sesame was second only to cow's milk as a cause of anaphylaxis (8). These findings highlight the importance to obtain epidemiologic data on AFR and the spectrum of significant food allergens in our population. Another problem with the above epidemiologic studies for AFR is that most were performed in school age children. However, there is a definite advantage in studying pre-school children as opposed to school age children because the recall bias or error is less likely to occur in the former age-group. AFR also commonly affects young children, and this problem disappears in many children when they grow up.

In this paper, we describe the epidemiology and clinical features of parent-reported AFR and related atopic disorders in Chinese pre-schoolers in Hong Kong. We also investigate the possible risk factors for AFR, including demographic factors, family history, and early environmental exposures, in these pre-school children.

Patients and methods

Study population

Pre-school children aged 2–7 yr were targeted for study. A complete list of pre-school nursery and kindergarten were obtained from the Education Department of the Hong Kong Government. Nurseries and Kindergartens were

individually allocated a number. Twenty-one nurseries and kindergartens selected by computer randomization gave consent to participate. They were randomly distributed throughout the four representative geographic regions of Hong Kong (New Territories East, 6; New Territories West 3; Kowloon, 8; Hong Kong Island, 4). All children ($n = 4576$) from these nurseries and kindergartens were invited to participate, and 3827 returned the study questionnaire (i.e., overall participation rate 83.6%). Following ethical approval by the Clinical Research Ethics Committee of The Chinese University of Hong Kong, this study was carried out between November 2006 and March 2007. Informed written consents were obtained from both school principals and subjects' parents.

Study questionnaire

Each subject was given the self-administered questionnaire, which consisted of items adapted from FA questionnaire used by Allergy Clinic of the Royal Children's Hospital in Melbourne, Australia as well as questions on asthma and atopic disorders from the Chinese version of International Study of Asthma and Allergy in Childhood (ISAAC) questionnaire (12–14). Parents were asked to complete this questionnaire at home and returned to class teachers within 1 wk following distribution. In our questionnaire, information on demography, symptoms of AFR, asthma, and other atopic disorders, together with possible risk factors for AFR were recorded. These factors included family history of AFR and other atopic diseases, parental level of education, family size, environmental exposure factors currently and during the first year of life such as daycare attendance, breastfeeding and intake of partial hydrolyzed milk formulae. In addition, questions on the place of birth and age of migration to Hong Kong were included.

Adverse food reaction-related items in our questionnaire were translated into Chinese following the same protocol as we did for ISAAC. This involved an independent person who was bilingual to translate the original English questions into Chinese. Another bilingual person then back translated this into English. The translated questionnaire was pilot tested in a group of five non-medical volunteers in our hospital and then in parents of 15 children with AFR who were followed in our clinic. Necessary modifications were made before the population survey was carried out.

Definitions about AFR and other atopic disorders

Parents were asked about the occurrence and frequency of any AFR in their children. 'Current' symptoms referred to symptoms in the past 12 months, whereas 'AFR ever' was defined as suffering from AFR in the subjects' life time. Children with 'yes' answers on the question about any AFR were defined as having parent-reported AFR. On the basis of an additional question of whether they received a doctor's diagnosis for AFR, children who answered 'yes' to this question were defined as having parent-reporting and doctor-diagnosed AFR. Respondents were asked to identify what food or food ingredients to which their children were allergic. These items included any adverse reaction to milk intake (i.e., normal and hydrolyzed cow's milk formulae, fresh cow's milk, soy-based formula, other milk formulae) and a list of 32 foods, as well as any additional food that the caregivers might indicate. Respondents were asked the foods that their children currently avoided and how serious and frequent the previous AFRs were. The definitions of asthma and other atopic disorders were described previously (14).

Statistical analysis

Only returned questionnaires which provided answers to the item on parent-reported AFR were included in data analysis. The data, entered and verified by two people (double data entry) according to ISAAC protocol, was analyzed using SPSS 14.0 (SPSS Inc., Chicago, IL, USA). Chi-squared or Fisher's exact tests were used to compare the prevalence rates of parent-reported AFR between subgroups in relation to subjects' demographic data, family history of AFR and other atopic disorders, early dietary practices, and environmental exposure factors. Multivariable logistic regression was used to analyze the associations between parent-reported AFR and single factors that yielded p-values < 0.1 in the univariate analyses. The p-value < 0.05 was considered to be statistically significant.

Results

Of 3827 returned questionnaires, 3677 (96.1%) subjects provided answers to parent-reported AFR. Table 1 summarizes the demographic characteristics of children with parent-reported AFR. Four hundred and twenty-three (11.5%) children were avoiding any food at the time of this study, and the odds ratio (OR) and 95% confidence interval (CI) of current food avoid-

Table 1. The prevalence of parent-reported adverse food reaction (AFR) by demographic groups and family history of atopy

Variable	Total sample	Parent-reported AFR, n (%)	Parent-reported, doctor-diagnosed AFR, n (%)
All	3677	298 (8.1)	170 (4.6)
Sex*			
Male	1856	156 (8.4)	94 (5.1)
Female	1797	138 (7.7)	74 (4.1)
Age (years)†			
<3	262	34 (13.0)	21 (8.0)
≥3 to <4	1214	102 (8.4)	54 (4.4)
≥4 to <5	1137	87 (7.7)	54 (4.7)
≥5 to <6	971	70 (7.2)	38 (3.9)
≥6	80	5 (6.3)	3 (3.8)
Place of birth			
Hong Kong	3399	287 (8.4)	163 (4.8)
Mainland China	253	10 (4.0)	6 (2.4)
Other countries	25	1 (4.0)	1 (4.0)
Presence of siblings			
Older	1548	111 (7.2)	72 (4.7)
Younger	725	66 (9.1)	36 (5.0)
Father's highest education level			
Primary school and below	466	31 (6.7)	21 (4.5)
Secondary school	2621	200 (7.6)	114 (4.3)
College, university and above	590	67 (11.4)	35 (5.9)
Mother's highest education level			
Primary school and below	527	29 (5.5)	19 (3.6)
Secondary school	2675	210 (7.9)	120 (4.5)
College, university and above	475	59 (12.4)	31 (6.5)
Paternal allergy history			
Asthma	105	11 (10.5)	7 (6.7)
Rhinitis	853	95 (11.1)	48 (5.6)
Eczema	253	28 (11.1)	20 (7.9)
AFR	121	26 (21.5)	14 (11.6)
Maternal allergy history			
Asthma	106	8 (7.5)	4 (3.8)
Rhinitis	804	88 (10.9)	51 (6.3)
Eczema	272	38 (14.0)	21 (7.7)
AFR	218	48 (22.0)	28 (12.8)
Allergy history in siblings			
Asthma	125	15 (12.0)	8 (6.4)
Rhinitis	562	53 (9.4)	30 (5.3)
Eczema	290	40 (13.8)	20 (6.9)
AFD	92	18 (19.6)	11 (12.0)

*Four and two children did not report gender in the groups of parent-reported AFR and parent-reported, doctor-diagnosed AFR, respectively.

†Thirteen children did not provide their age.

ance for parent-reported AFR was 16.41 and 12.51–21.53 ($p < 0.001$). Table 2 summarizes the details of AFR and related atopic disorders in our cohort.

Two hundred and ninety-eight and 170 children had parent-reported AFR and parent-reported and doctor-diagnosed AFR, respectively. Table 3 lists the clinical manifestations and frequency of AFR in these patients. About 11% of them suffered from ≥3 AFRs in past 12 months. Table 4 describes the foods that commonly caused AFR. The most important

Table 2. Prevalence of symptoms of food allergy and co-existing asthma and atopic disorders in the total 3677 subjects

	Prevalence, n (%)
Food allergy	
Parent-reported adverse food reaction	298 (8.1)
Parent-reported, doctor-diagnosed adverse food reaction	170 (4.6)
Current food avoidance	423 (11.5)
Hospitalization due to adverse food reaction ever	26 (0.7)
Once	22 (0.6)
Twice	2 (0.1)
≥3 times	3 (0.1)
Hospitalization due to adverse food reaction in past year	27 (0.7)
Partial hydrolyzed formula ever	318 (8.6)
Co-morbid atopic disorders	
Wheeze ever	513 (14.0)
Doctor-diagnosed asthma	184 (5.0)
Current wheeze	295 (8.0)
Wheezing attack in past year	
1–3 episodes	202 (5.5)
4–12 episodes	73 (2.0)
>12 episodes	25 (0.7)
Awakening from sleep due to dyspnea in past year	
Never	3541 (96.3)
<once per week	126 (3.4)
≥once per week	10 (0.3)
Speech-limiting dyspnea in past year	48 (1.3)
Hospitalization due to wheeze ever	170 (4.6)
Received anti-asthma drugs in past year	620 (16.9)
Current rhinoconjunctivitis	477 (13.0)
Rhinitis ever	879 (23.9)
Current flexural eczema	268 (7.3)
Eczema ever	1165 (31.9)
Sleep disturbance due to eczema in past year	
Never	3510 (95.5)
<once per week	93 (2.5)
≥once per week	74 (2.0)

Table 3. Total number of reported food reactions* by adverse food reaction (AFR) category

Reaction	Parent-reported AFR n = 298, n (%)	Parent-reported, doctor-diagnosed AFR n = 170, n (%)
Skin reactions (hives, rash, itching)	189 (63.4)	122 (71.8)
Swelling of face	67 (22.5)	44 (25.9)
Nausea or vomiting	37 (12.4)	22 (12.9)
Abdominal pain	12 (4.0)	9 (5.3)
Diarrhea	12 (4.0)	4 (2.4)
Trouble breathing	14 (4.7)	13 (7.6)
Shock	9 (3.0)	9 (5.3)
Other reactions	47 (15.8)	31 (18.2)
AFR in past year		
Nil	212 (71.1)	101 (59.4)
Once	27 (9.1)	23 (13.5)
Two times	24 (8.1)	17 (10)
Three times	7 (2.3)	5 (2.9)
Four times or more	28 (9.4)	24 (14.1)

*Results expressed as number (percentage).

Table 4. Spectrum and population prevalence of reported allergic reaction to a food* by adverse food reaction (AFR) category

Food	Parent-reported AFR			Parent-reported, doctor-diagnosed AFR		
	n	% of those with allergic reaction (n = 298)	Prevalence (%) in total population (n = 3677)	n	% of those with allergic reaction (n = 170)	Prevalence (%) in total population (n = 3677)
Crustacean shell fish (mostly shrimp)	47	15.8	1.28	33	19.4	0.90
Egg	27	9.1	0.73	15	8.8	0.41
Peanut	24	8.1	0.65	19	11.2	0.52
Beef	19	6.4	0.52	12	7.1	0.33
Cow's milk	17	5.7	0.46	12	7.1	0.33
Tree nuts	15	5.0	0.41	11	6.5	0.30
Fish	12	4.0	0.32	9	5.3	0.25
Chocolate†	11	3.7	0.30	11	6.5	0.30
Cheese†	9	3.0	0.24	7	4.1	0.19
Tomato	9	3.0	0.24	7	4.1	0.19
Lamb	9	3.0	0.24	4	2.4	0.11
Orange, banana	5	1.7	0.14	5	2.9	0.14
Other foods‡	39	13.1	1.06	21	12.4	0.57
Reacted to ≥1 type of foods	60	20.1	1.63	42	24.7	1.14

*Children might be allergic to more than one food.

†Only counted subjects without concomitant allergic reaction to cow's milk.

‡Included foods that caused allergic reactions in <2% of subjects; percentage of persons with parent-reported AFR with allergic reactions to other foods: soybean 1.7%; prune, chicken, wheat, cauliflower, pumpkin, zucchini, broad bean, potato, pear, apple, grape, honey, mango, papaya, kiwi, cucumber, coconut, curry, monosodium glutamate <1.5% each.

foods in our pre-schoolers were crustacean shellfish, egg, peanut, beef, cow's milk, tree nuts, fish, and chocolate, each affected ≥5% of our doctor-diagnosed, food-allergic children.

In our subjects, a history of parent-reported AFR ever was associated with other atopic co-morbidities such as current wheeze (OR 2.22, 95% CI: 1.55–3.16; $p < 0.001$), current rhinoconjunctivitis (OR 2.44, 95% CI: 1.82–3.27; $p < 0.001$), and current flexural dermatitis (OR 8.62, 95% CI: 6.35–11.70; $p < 0.001$). The presence of parent-reported and doctor-diagnosed AFR ever was also strongly associated with current wheeze (OR 2.16, 95% CI: 1.37–3.41; $p < 0.001$), current rhinoconjunctivitis (OR 2.91, 95% CI: 2.03–4.18; $p < 0.001$), and current flexural dermatitis (OR 9.63, 95% CI: 6.70–13.82; $p < 0.001$).

Multivariable analysis was performed on single factors with statistical significance (i.e., $p < 0.1$) identified from univariate analyses (Table 5). Parent-reported AFR was associated with six independent factors, including age, place of birth, and family history of AFR in first-degree relatives and paternal history of rhinitis.

Table 5. Factors independently associated with parent-reported AFR by multi-variable logistic regression analysis*

Factor	OR	95% CI	p-value†
Age <3 yr old	1.67	1.13–2.48	0.010
Born in mainland China	0.50	0.26–0.96	0.038
Paternal history of AFR	2.24	1.38–3.62	0.001
Maternal history of AFR	2.66	1.84–3.86	<0.001
History of AFR in siblings	2.00	1.11–3.57	0.020
Paternal history of rhinitis	1.32	1.01–1.74	0.044

AFR, adverse food reaction; CI, confidence interval; OR, odds ratio.

*Only single factors with $p < 0.1$ by univariate analyses were entered into regression analyses. Apart from the above six variables, these analyzed factors included subjects' age, presence of older siblings, paternal and maternal highest education levels, history of rhinitis in mothers and siblings, history of eczema in fathers and mothers, and daycare attendance ever and during the first year of life.

†Listed only those factors with $p \leq 0.05$.

Table 6. Comparison of responses among children born in Hong Kong (n = 3399) and in mainland China (n = 253)

Symptoms	Hong Kong, n (%)	Mainland China, n (%)	OR (95% CI)	p-value
Food allergy				
Parent-reported AFR	287 (6.7)	10 (4.0)	2.24 (1.14–4.53)	0.016
Parent-reported and doctor-diagnosed AFR	163 (4.7)	6 (2.4)	2.07 (0.88–5.24)	0.106
Current food avoidance	401 (11.8)	21 (8.3)	1.48 (0.92–2.40)	0.115
Hospitalization due to AFR ever	23 (0.7)	3 (1.2)	0.57 (0.16–2.39)	0.421
Hospitalization due to AFR in past year	22 (0.6)	3 (1.2)	0.54 (0.15–2.29)	0.544
Co-morbid atopic disorders				
Doctor-diagnosed asthma	180 (5.3)	4 (1.6)	3.48 (1.24–11.09)	0.014
Wheeze ever	499 (14.7)	13 (5.1)	3.18 (1.76–5.85)	<0.001
Current wheeze	288 (8.5)	6 (2.4)	3.81 (1.62–9.57)	<0.001
Current speech- limiting wheeze	47 (1.4)	1 (0.4)	3.53 (0.52–69.24)	0.255
Exercise-induced wheeze	347 (10.2)	19 (7.5)	1.40 (0.85–2.34)	0.204
Hospitalization due to wheeze ever	162 (4.8)	8 (3.2)	1.53 (0.72–3.40)	0.311
Current rhinoconjunctivitis	1079 (31.7)	45 (17.8)	3.00 (2.04–4.41)	<0.001
Rhinoconjunctivitis ever	838 (24.7)	34 (13.4)	2.11 (1.44–3.11)	<0.001
Current flexural eczema	258 (7.6)	6 (2.4)	3.38 (1.44–8.50)	0.003
Eczema ever	1075 (31.6)	80 (31.6)	1.00 (0.75–1.33)	0.946

AFR, adverse food reaction; CI, confidence interval; OR, odds ratio.

Table 6 shows the comparison of responses to various questions between children born in Hong Kong and in mainland China. Many parameters of atopic symptoms were significantly more common in children born and raised in Hong Kong. In particular, the prevalence of parent-reported AFR was 6.7% for those born in Hong Kong compared with only 4.0% for children born in mainland China (OR 2.24, 95% CI: 1.14–4.53; $p = 0.016$).

Discussion

The prevalence of parent-reported AFR was 8.1% in this population-based study, and parents of 4.6% of Hong Kong Chinese pre-school children reported a physician diagnosis of AFR. The six leading causes of AFR were shellfish (15.8%), egg (9.1%), peanut (8.1%), beef (6.4%), cow's milk (5.7%), and nuts (5.0%). One-fifth of these young children had two or more AFRs in the past year. Most of them presented with cutaneous reactions, and only <10% had trouble breathing or shock during the episodes. Factors independently associated with parent-reported AFR include younger age, being born in Mainland China, family history of AFR in parents and siblings, and paternal history of rhinitis. Similar to other atopic disorders, we found that parent-reported AFR was less frequent among local born Chinese than those born in mainland China and subsequently moved to Hong Kong.

This population study reports for the first time the epidemiology of AFR in the Chinese population. The limited published data suggests that AFR affected 1.2–6.5% of children from several Asian countries (7–10), which appear to be lower than that of pre-schoolers (8.1%) in this study. In Caucasians, Woods et al. (15) studied adults aged 20–44 yr who participated in the European Community Respiratory Health Survey in 12 European countries, Australia, New Zealand, and the USA. Self-reported AFR ranged from 4.6% in Spain to 12% in the USA to 19.1% in Australia. In the 1990s, FA was estimated to affect 6% of the USA children <3 yr of age (4). The 1995 Manitoba Birth Cohort found 4.2% of Canadian children to have FA (16). Population-based surveys found that 4% of adults in the USA had FA (17, 18). A meta-analysis of studies has found that the incidence of self-reported AFR ranged between 3% and 35% (5). Regarding individual foods, Sicherer et al. (17) reported that the prevalence rates of self-reported AFR to peanut and tree nuts in the USA were 0.6% and 0.5%, respectively. These figures were comparable to our prevalence rates of 0.65% and 0.41%. Up to one-fifth of our children with parent-reported and doctor-diagnosed AFR were allergic to crustacean shellfish, and its prevalence in our population was estimated to be 0.90–1.28%. This figure was lower than the published data of 1.9–2.5% among Caucasians with self-reported AFR (1, 18, 19). Overall, and despite the common belief that AFR is uncommon in Chinese, this study shows that the prevalence of AFR in our children is similar to those reported in Caucasians.

The spectrum of foods causing AFR in our pre-schoolers is different from the prevalent ones among Caucasians. The US Food and Drug Administration recognizes peanut, soybean, cow's milk, egg, fish, crustacean shellfish, wheat, and tree nuts as the eight most common food allergens (20). The Food Allergen Labeling and Consumer Protection Act of 2004 requires plain-English declaration of the source of ingredients or that are derived from these eight foods or food groups within or adjacent to the ingredient statement of a food product. In Europe, the EuroPrevall recommended that the first priority of foods to be tested by serologic IgE assays or skin prick tests include egg, cow's milk, codfish, shrimp, peanut, hazelnut, apple, peach, and celery root (6). In the contrary, crustacean shellfish, egg, peanut, beef, cow's milk, tree nuts, fish, and chocolate were the most important foods in our young Chinese children. Beef, chocolate, and cheese seemed to be more common, and soybean, wheat and fruits less important, among our children with AFR. Avoidance of seafood, fish, beef, egg, and cow's milk was common in local children with moderate-to-severe eczema (21). Among Singaporeans, bird's nest and crustacean seafood were the most important foods for anaphylactic reactions (11) and another study also found shellfish sensitization to be present in two-fifth of the food allergic children (22). Sesame was second only to cow's milk as foods causing anaphylaxis among Israeli (8). Food labels are a critical source of product-specific information for individuals with AFR and caretakers of children with AFR. Precautionary labeling can lead to unnecessary dietary restrictions (23), resulting possibly in deleterious effects on growth and nutrition in children. Our findings highlight the importance of accurate food labeling to include items appropriate to the population of interest.

This study identified age, place of birth and presence of family history of AFR and rhinitis to be independently associated with parent-reported AFR in Chinese pre-school children. AFR is known to be more prevalent in young children, and many patients become tolerant to foods with time (i.e., 'allergy march'). This age factor is also supported by our published data in which sensitization to foods was more frequently found in asthmatics <6 yr old than in older patients (24). The protective effect of being born in mainland China is also consistent with our findings for other atopic disorders in local children (13, 14). Breastfeeding, early diet, gender, and subjects' education level are important determinants of FA development (19, 25, 26).

However, these factors do not seem to be important in our young children.

According to the hygiene hypothesis (27), environmental exposure factors in early life are believed to be important in determining subsequent development of atopic disorders. Consistent with our previous results in both school-age and pre-school children (13, 14), young children born in mainland China and subsequently migrated to Hong Kong have reduced risk of having parent-reported AFR as well as asthma and other atopic disorders than those born and raised in Hong Kong (Table 6). Our previous study has also shown that primary school children born in mainland China have lower rate of allergic sensitization documented by skin prick testing (13). Virtually all immigrant children in this study were born and lived in southern China (Guangdong province) before they moved to Hong Kong. As these two groups of subjects were genetically similar (Chinese), we believe that the observed protective effects of place of birth on atopic disorders is likely to be due to early environmental factors that children born in mainland China had been exposed to during the first few years of life. Future population studies should be carried out to identify any relevant modifiable protective and risk factors.

One limitation of this study is the possibility of recall error in accurately remembering the past. This population survey asked parents retrospective questions related to AFR in their children, including the frequency and clinical details of AFR. Parents might not have reported all food allergies despite the fact that our questionnaire included a list of 32 common foods for them to choose. Another limitation is that this study collected data on childhood FA by parental reporting of AFR. Questionnaire-based studies on FA as assessed by self-reporting of AFRs would overestimate the epidemiology of FA. Previous studies found that the prevalence rate for FA was much lower following the incorporation of objective measurements for the presence of food-specific IgE, such as by skin-prick or serologic testing, as well as oral food challenges (5, 6). Ninety-four (11.8%) 6-yr-old children from the Isle of Wight birth cohort reported an AFR. The prevalence of FA was 2.5% based on open food challenge and/or suggestive history and skin tests, which was lowered to 1.6% when diagnosed by double-blind, placebo-controlled food challenges (DBPCFC) (28). A Danish study of 1834 subjects revealed the prevalences of AFR and food challenge-confirmed FA to be 16.6% and 1–3.2% (29). Nonetheless, it would not be feasible or safe for us to do DBPCFC in this

population-based study despite the fact that this procedure is the gold standard for diagnosing FA (1, 30).

In conclusion, the current study confirms that AFR is common in Chinese pre-school children in Hong Kong and its prevalence is comparable to those of Caucasians. Whereas cow's milk, egg, crustacean shellfish, peanut, and tree nuts are equally important in these populations, our children appear to have more allergies to other foods such as beef, chocolate, and cheese. Our results have provided evidence that young age, family history of AFR, and place of birth are important determinants of AFR. The lower prevalence of parent-reported AFR in children born in mainland China further supports the importance of early environmental exposure in subsequent development of allergies.

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