



A survey on prevalence and parents' perceptions of food allergy in 3- to 16-year-old children in Wuhan, China

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ABSTRACT

Background: The prevalence of food allergy (FA) has risen in recent decades, yet there is limited data on the cognition and beliefs of FA among the parents of FA children.

Objective: To investigate the prevalence of FA and assess the knowledge and perception of FA among parents of FA children in Wuhan, China.

Methods: Online questionnaires were conducted for the parents of 3- to 16-year-old children. They reported symptoms of suspected FA in the screening questionnaire were interviewed for further diagnostic evaluation. All the parents of the suspected FA children completed the subsequent assessments of the knowledge and perception on FA as well as their attitude towards the current online platforms.

Results: A total of 1963 children were recruited. The prevalence of self-reported FA was 10.2% (95% CI: 8.1–12.4%) and the physician-diagnosed FA was 6.2% (95% CI: 5.1–7.2%) in 3- to 16-year-olds in Wuhan. And the children with family history (57.9%) were predisposed to developing FA ($P < 0.001$). The total Brief Illness Perception Questionnaire (B-IPQ) score was 41.3 ± 10.0 among the parents. The B-IPQ scores correlated with symptom onset, but not with family history or other atopic comorbidities. The parents who never sought treatments obtained lower B-IPQ scores on most items compared to those who received treatments. The accuracy rate of the FA knowledge questionnaire was 56.7%. 11.6% of participants reported that children's FA had an impact on their lives. 67.2% of participants had searched information of FA online, among whom 80% expected to obtain professional suggestions on management and prevention strategies of FA from online platform.

Conclusion: In 3- to 16-year-old children in Wuhan, the prevalence of self-reported and physician-diagnosed FA was 10.2% and 6.2% respectively. Parents' knowledge of FA was insufficient and only a small proportion of parents perceived that their lives and careers have been affected considerably by FA of their children. Patient education and current online platforms should be improved among parents of FA children.

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INTRODUCTION

Food allergy (FA) is a pathological immune reaction triggered by food protein.¹ With the development of global economy and transformation of modern lifestyle, the prevalence of FA has substantially increased in recent decades.² Since finding radical cures for FA has been a challenge, FA has a significant impact on the quality of life.³ In Western countries, FA affected nearly 5% of adults and 8% of children.⁴ The self-reported prevalence of FA in Europe was approximately 6%.⁵ According to a study in 2018, 7.6% of children in the United States were found to have probable FA.⁶ A review demonstrated that the prevalence of FA ranges from 3.13% to 11.9% in north China, and 3.5%–21.13% in south China.⁷ However, there was a lack of data of FA prevalence in Wuhan, the biggest city in central China with more than 13 million inhabitants.

Several studies have demonstrated that history of FA may increase the risk of developing other allergic diseases such as allergic asthma.⁸ Early childhood, particularly infancy, is considered as a critical period for the acquisition of immune tolerance.⁹ FA and atopic dermatitis (AD) are regarded as the initial phase of atopic march.¹ Therefore, it is essential to conduct early screening for and avoidance of food allergens. However, the issue of overdiagnosis of food allergies persists. This overdiagnosis often leads to the inappropriate avoidance of foods suspected to cause allergies, largely due to an insufficient consideration of medical history. Such unnecessary avoidance can result in malnutrition and other health-related issues in children.¹⁰

Currently, oral food challenge (OFC) is the gold standard for diagnosis of FA, but in China, OFC is not widely used because of the consideration of the potential anaphylaxis;² clinical history, serum allergen-specific IgE (sIgE), and skin prick test (SPT) are common options to diagnose FA.¹¹ However, the variability of clinical history presents challenges for precise diagnosis, and misdiagnosis will lead to

wrong management and thus increase the burden of FA patients. EuroPrevall is a European multidisciplinary and multicentre research project which was used to investigate the prevalence, cost, and basis of FA, and to improve quality of life (QOL) for FA patients.¹² Currently, EuroPrevall has been translated into several languages and was widely used to assess the socio-economic impact of FA and QOL of FA patients and their family.¹² Feng et al investigated the epidemiological characteristics and risk factors of FA with modified EuroPrevall FA questionnaires;¹³ however, research on parents' perceptions and attitudes towards FA were important but scarce in China. Improving awareness of patients and guardians and encouraging them to seek early diagnosis and treatment will contribute to better management of FA. In this study, we aimed to investigate the prevalence of FA among children as well as their parents' perceptions and attitudes, in order to raise public attention to the management of FA.

METHODS

Study design

This was a cross-sectional study conducted with a suite of online questionnaires on a Chinese platform such as wechat, apps, websites, and wechat applets. Three schools (nursery school, elementary school, and junior middle school) were numbered and selected randomly by computer in Wuhan, China. Students were recruited by cluster sampling from June 2021 to July 2021. All parents of the enrolled students were requested to finish a screening questionnaire developed by EuroPrevall for adverse reactions to food.¹⁴ Prior to completing the questionnaire, they were provided with information on the purpose and procedure of the study. Participants reporting suspected FA symptoms in the screening questionnaire were invited to our department for further assessment. A detailed medical history was obtained including time interval between food ingestion and symptom onset, symptom duration, amount of food intake, prior reaction to

the same food, potential factors and treatment for symptomatic relief, and health seeking behavior including never (never sought for treatments), hospital (received treatment from doctors), and family (received treatment by self-medication). Participants who met all the following criteria were defined as physician-diagnosed FA:¹⁵ (1) systematic symptoms after ingestion of causative food such as egg, milk, wheat, soybean, fish, peanut, crustacean, and fruit; (2) symptoms were alleviated by food elimination or use of antihistamine and glucocorticoid; (3) recurrent symptoms after ingestion of specific food; and/or (4) positive test (skin prick test and/or serum specific-IgE) or previous diagnosis by a physician. Meanwhile, those who experienced subjective symptoms after food consumption were considered by the patient to have self-reported FA. Then the parents of physician-diagnosed FA children continued to finish the subsequent questionnaires divided into four sections as Brief Illness Perception Questionnaire (B-IPQ), Food Allergy Knowledge Questionnaire (FAKQ), Food Allergy Attitude Questionnaire (FAAQ) and Allergy Platform Questionnaire (APQ). The study was approved by the Independent Ethical Committee of Tongji Hospital (NO: TJ-IRB20210912).

Brief Illness Perception Questionnaire

Illness perception was assessed by the Brief Illness Perception Questionnaire (B-IPQ), a widely used questionnaire formulated by Broadbent et al.^{16,17} Eight items of B-IPQ were applied to assess the cognitive illness representation respectively as follows: Item 1 (consequences), Item 2 (timeline), Item 3 (personal control), Item 4 (treatment control), Item 5 (identity), Item 6 (concern), Item 7 (comprehensibility), and Item 8 (emotions).¹⁶ Item 9 (causal representation) was not adopted in this study due to the complicated pathogenesis of FA. Each item was scored on an 11-point Likert scale (range 0~10). The total score was calculated by adding up individual scores of each item (range 0-80).

Higher scores on the illness perception questionnaire indicate more negative perceptions of illness in terms of how much the illness impacts the patient's life (Consequences), the expected duration of the illness (Timeline), the extent of

symptoms experienced due to the illness (Identity), the level of concern about the illness (Concern), and the emotional impact of the illness (Emotional Response). Conversely, higher scores denote more positive perceptions of illness for the remaining aspects: the level of personal control patients feel they have over their illness (Personal Control), the degree to which patients believe their treatment will be beneficial (Treatment Control), and their understanding of their illness (Comprehensibility).¹⁶

FA knowledge questionnaire and FA attitude questionnaire

We modified and used the published Chicago FA Research Survey for Parents of Children with FA (CFARS-PRNT), a multidisciplinary expert panel (3 allergists and 1 specialty nurse) had reviewed and made some modifications to the former questionnaire to better suit the situation in China.¹⁸ The modified CFARS-PRNT was translated into Chinese and then back-translated into English to ensure the accuracy of each item. This questionnaire consists of 6 items on knowledge of FA (true/false) and 20 items on attitudes and beliefs towards FA (five-point Likert scale). Participants received 1 point for each correct answer to a knowledge item, and zero point for wrong answer. Each item corresponds to 1 of the 7 identified domains of FA content: (1) definition and diagnosis, (2) triggers and environmental risk, (3) perceptions of susceptibility and prevalence, (4) stigma and acceptability, (5) perceptions of quality of life, (6) treatment and utilization of healthcare, and (7) policy issues. The total knowledge score and the correct rate for each item were calculated.

Allergy Platform Questionnaire

The Allergy Platform Questionnaire consisting of 8 items was designed by the expert panel from our hospital, as to investigate the participants' attitudes, unmet demands and expectations for current online platforms of FA. Three items assess platform usage status and satisfaction, while another 3 focused on use of current platforms including preferred platform, usage habits, and update frequency. Two items assess unmet needs and expectations for improvement respectively.

The last 2 items were multiple-choice questions (with up to 5 answers) and the other 6 items were multiple-choice questions with just 1 answer.

Statistical analyses

Normally distributed continuous data were described with means and standard deviations. The two-sample *t*-test and one-way ANOVA were used to evaluate the continuous variables. The comparisons among groups were performed with LSD test or Tamhane's T2 test. Categorical data were calculated as frequencies and percentages. Pearson χ^2 test and Fisher's exact test were used to determine the correlations between the categorical variables. Multiple linear regression was used to determine relationships between demographic characteristics and B-IPQ scores. Binary logistic regression was used to explore the relationships between health seeking behavior and demographic variables and the B-IPQ scores. Variables analyzed through univariate binary logistic regressions with $P < 0.2$ were further analyzed by multivariate binary logistic. Odds ratios (OR) and 95% CIs for potential factors were calculated. P values < 0.05 was considered statistically significant.

RESULTS

A total of 2430 questionnaires were distributed to 3 schools, out of which 2148 were returned (valid response rate: 88.4%). One hundred eighty-five children were excluded owing to incomplete questionnaires. Finally, there were 1963 participants included in the study consisting of 930 females (47.4%) and 1033 males (52.6%). The average age was 10.6 ± 3.0 years. One hundred twenty-one children were diagnosed with FA based on their symptoms and allergists' assessment. Egg and milk were the common allergens among the children, 41% and 24.6% of those allergic to egg and milk respectively (Table 1). The prevalence of self-reported FA was 10.2% (95% CI: 8.1–12.4%) and the physician-diagnosed FA was 6.2% (95% CI: 5.1–7.2%) in children of 3- to 16-year-olds in Wuhan, and that in children aged 3–6 was higher than aged 11–16 (12.8% vs 5.3%, $P = 0.001$). The children with family history (57.9%) were inclined to suffer from FA ($P < 0.001$). Moreover, 6.6% of children with FA did not have

another atopic condition and that 14.9% did not receive treatment for their FA.

The total B-IPQ score was 41.3 ± 10.0 among the parents of children with FA. The score for personal control of FA (B-IPQ 3) was the lowest and followed by treatment control (B-IPQ 4). The highest score was item on the concerns about FA (B-IPQ 6). The detailed scores for each item were listed in Table 2. The symptom onset correlated with total B-IPQ scores ($P = 0.035$); nevertheless, family history and other atopic comorbidities with FA showed no correlation with total B-IPQ scores (Supplemental Table 1).

Regarding the influence factors of participants' treatment behavior (seeking specialized medical treatment at hospital compared to self-medication/no treatment), the univariate logistic regression analysis indicated that compared to participants without other atopic comorbidities and those got lower score, participants with a history of respiratory allergies (RA) (OR = 2.760, 95% CI: 1.240, 6.142, $P = 0.013$) and a higher TB-IPQ score (OR = 1.081, 95% CI: 1.035, 1.128, $P < 0.001$) tended to seek specialized medical treatment. However, no significant correlation was shown between the history of AD or family history and health-seeking behavior. The multivariate logistic regression analysis demonstrated that total B-IPQ score (OR = 1.073, 95%CI: 1.027, 1.122, $P = 0.002$) was statistically related with seeking for specialized allergic healthcare at hospital (Table 3). Then the comparison of B-IPQ scores among three different treatment groups by one-way ANOVA and LSD test showed that the parents who never sought treatments obtained lower B-IPQ scores on most items in contrast with those who had undergone treatments either through self-medication or seeking medical attention (Fig. 1).

All the 121 participants had finished the FA knowledge questionnaire. Total correct rate was 56.7%, ranging from 45.5% to 74.4%. Moreover, 47.1% of the participants realized that daily administration of antihistamine was ineffective in preventing FA, and 45.5% of the participants mistakenly identified food additives as common allergens (Table 4).

The attitudes and beliefs regarding FA were evaluated by a 5-point Likert scale ranging from strongly disagree to strongly agree.

| Variable | n | % |
|----------------------------------|-------|-----------|
| Age | | |
| 3-6 | 14 | 11.6 |
| 7-10 | 45 | 37.2 |
| 11-16 | 62 | 51.2 |
| Gender | | |
| Male/Female | 65/56 | 53.7/46.3 |
| Family history | 70 | 57.9 |
| Symptom onset | | |
| ≤12 months | 68 | 56.2 |
| >12 months | 53 | 43.8 |
| Atopic comorbidity | | |
| RA | 37 | 30.6 |
| AD | 32 | 26.4 |
| AD&RA | 44 | 36.4 |
| Treatment Status | | |
| Hospital-based treatment | 82 | 67.8 |
| Self-medication | 21 | 17.4 |
| Receiving allergen test | 61 | 50.4 |
| Identified food allergens | | |
| Egg | 25 | 41.0 |
| Milk | 15 | 24.6 |
| Wheat | 10 | 16.4 |
| Soybean | 5 | 8.2 |
| Fish | 7 | 11.5 |
| Peanut | 3 | 4.9 |
| Crustacean | 12 | 19.7 |
| Fruit | 3 | 4.9 |

Table 1. Characteristics of the children with FA (n = 121). RA, Respiratory Allergies; AD, Atopic Dermatitis

| Item | Scores |
|--|-------------|
| TB-IPQ | 41.3 ± 10.0 |
| B-IPQ 1 how much does your illness affect your life | 5.9 ± 2.5 |
| B-IPQ 2 how long do you think your illness will continue | 5.5 ± 2.6 |
| B-IPQ 3 how much control do you feel they have over your illness | 4.3 ± 2.2 |
| B-IPQ 4 how much do you think your treatment can help your illness | 4.5 ± 2.2 |
| B-IPQ 5 how much do you experience symptoms from your illness | 5.4 ± 2.0 |
| B-IPQ 6 how concerned are you about your illness | 6.1 ± 2.6 |
| B-IPQ 7 how well do you feel that you understand their illness | 4.6 ± 2.1 |
| B-IPQ 8 how much does your illness affect you emotionally (e.g., make you angry, scared, upset or depressed) | 5.1 ± 2.4 |

Table 2. Scores on the B-IPQ Dimensions of parents of children with FA. TB-IPQ, Total Brief Illness Perception Questionnaire; B-IPQ, Brief Illness Perception Questionnaire

| | Univariate regression | | Multivariate regression | |
|----------------|-----------------------|------------------|-------------------------|---------------|
| | OR (95% CI) | P | OR (95% CI) | P |
| Age | 1.003 (0.886, 1.136) | 0.957 | - | - |
| Gender | 2.134 (0.983, 4.637) | 0.055 | 1.998 (0.865, 4.618) | 0.105 |
| Family history | 0.674 (0.312, 1.453) | 0.314 | - | - |
| Comorbidity | | | | |
| RA | 2.760 (1.240, 6.142) | 0.013 | 0.490 (0.178, 1.347) | 0.167 |
| AD | 1.271 (0.581, 2.780) | 0.548 | - | - |
| AD&RA | 2.054 (0.885, 4.770) | 0.094 | 0.803 (0.275, 2.345) | 0.688 |
| TB-IPQ | 1.081 (1.035, 1.128) | <0.001 | 1.073 (1.027, 1.122) | 0.002* |
| B-IPQ1 | 1.418 (1.191, 1.688) | <0.001 | | |
| B-IPQ2 | 1.186 (1.017, 1.383) | 0.029 | | |
| B-IPQ3 | 1.071 (0.895, 1.282) | 0.454 | | |
| B-IPQ4 | 0.866 (0.728, 1.030) | 0.104 | | |
| B-IPQ5 | 1.663 (1.304, 2.120) | <0.001 | | |
| B-IPQ6 | 1.509 (1.251, 1.820) | <0.001 | | |
| B-IPQ7 | 0.835 (0.694, 1.005) | 0.056 | | |
| B-IPQ8 | 1.247 (1.054, 1.475) | 0.010 | | |

Table 3. Factors associated with the health seeking behavior in parents of children with FA. Demographic characteristics (age, gender, family history, comorbidity) and B-IPQ scores were analyzed by logistic regression to find the potential influence factors for professional health seeking behavior (at hospital) and non-seeking professional help behavior (self-medication or non-medication). AD, Atopic Dermatitis; RA, Respiratory Allergies; B-IPQ, Brief Illness Perception Questionnaire; CI, Confidence Interval; OR, Odd Ratio, *P < 0.05

Detailed responses to the items were presented in Table 5. As for quality of life, 11.6% of the participants perceived impact of child’s FA on their marriage/relationship, and less than 10%

thought FA made differences in their careers. Furthermore, 91.6% of the participants expressed their approval of allocating more funds for FA research (Table 5).

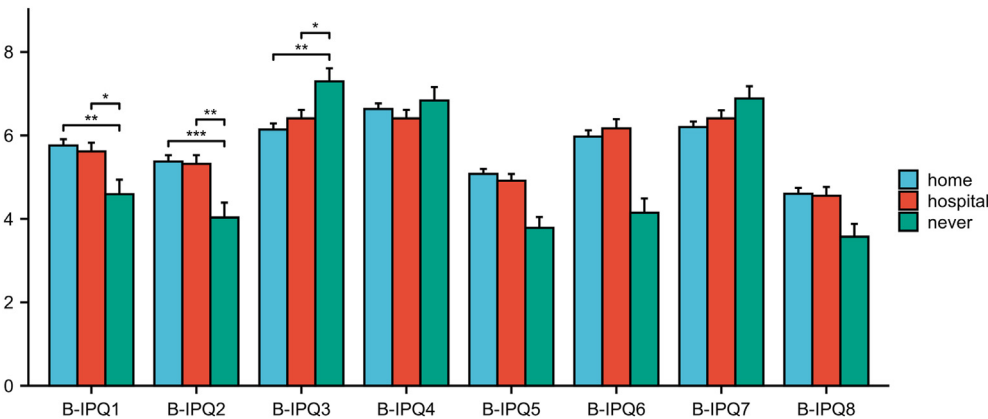


Fig. 1 Comparison of B-IPQ item scores in different health-seeking-behavior groups. The definition of eight items of B-IPQ were as follows: B-IPQ1 (consequences), B-IPQ2 (timeline), B-IPQ3 (personal control), B-IPQ4 (treatment control), B-IPQ5 (identity), B-IPQ6 (concern), B-IPQ7 (comprehensibility) and B-IPQ8 (emotions). Never: never sought for treatments; Hospital: received treatment from doctors; home: received treatment by self-medication. *P < 0.05, **P < 0.01, ***P < 0.001 (item 3,4,7 modified)

| Items | Correct percentage of knowledge score |
|---|---------------------------------------|
| Definition and diagnosis | |
| 1. FA involves immune system. (T) | 49.6% |
| 2. Medical test is the only way to know child has FA. (F) | 47.1% |
| Triggers and environmental risk | |
| 3. Food allergens can pass from mother to child by breast milk. (T) | 74.4% |
| 4. Food additives are common food allergens. (F) | 45.5% |
| Perceptions of susceptibility and prevalence | |
| 5. Age group most likely to have FA (0–5 year). | 71.9% |
| Treatment and utilization of healthcare | |
| 6. Daily antihistamine can prevent FA reaction. (F) | 47.1% |
| Total items | 56.7% |

Table 4. Itemized knowledge arranged by content domain and correct response rates (n = 121). FA, Food Allergy

In the study, 30.6% (37/121) of the parents had already known that their children were allergic to food(s) when they participated. We further compared the scores of FA knowledge and attitude, B-IPQ between the 2 parent subgroups as allergen known group and allergen unknown group. Interestingly, we found that the TB-IPQ scores and most of the B-IPQ item scores (B-IPQ1, B-IPQ2, B-IPQ5, B-IPQ6, B-IPQ8) were significantly higher in the allergen known group while the B-IPQ7 score was higher in the allergen unknown group. We did not find significant differences in FA knowledge scores ($P = 0.894$) and attitudes about FA between the 2 groups ($P = 0.743$) (Supplemental Table 2).

Approximately two-thirds of participants (66.9%) attempted to acquire FA information through the internet. Wechat allergy public accounts (57.9%) were proved to be the most popular platform, followed by Apps (22.3%), websites (14.0%), and Wechat applets (5.8%). Furthermore, 55.7% of the participants browsed the Wechat science articles on their own initiative, and 30.0% just skimmed through those articles when idle; 14.3% only passively accepted what was updated for them. In

the meantime, once a week was the optimal update frequency for most participants (77.2%), followed by 3 times a week (12.7%) and daily (10.1%) (Supplemental Figure).

Participants had inconsistent opinions on the unsatisfactory aspects of current platforms; 45.7% of the participants reported that the content is not comprehensive in initial medical guidance, diagnosis, treatment, prevention, life-style management and other aspects. 34.6% of those thought the staff is not professional, and there is no explanation from the top allergy medical experts in China. At the same time, 39.5% of the participants found the content is too academic for the general public to understand (Table 6).

So 85.2% of the participants desired platforms improvement more than daily management, and 76.5% of those considered that they need essential knowledge of allergy and precautionary measures to prevent allergies. However, only 7.4% of participants desired product recommendations on online platforms. Hardly any participant expressed interest in attending offline activities. (Fig. 2).

| Item | Strongly disagree, n (%) | Disagree, n (%) | Neutral, n (%) | Agree, n (%) | Strongly Agree, n (%) |
|---|--------------------------|-----------------|----------------|--------------|-----------------------|
| Treatment and utilization of healthcare | | | | | |
| 1. Frustrated because doctors say different things about child's FA | 5 (4.1) | 17 (14.0) | 64 (52.9) | 29 (24.0) | 6 (5.0) |
| Stigma and acceptability | | | | | |
| 2. Some relatives don't accommodate child's FA | 20 (16.5) | 27 (22.3) | 40 (33.1) | 29 (24.0) | 5 (4.1) |
| 3. Child's friends treat him/her differently because of FA | 22 (18.2) | 41 (33.9) | 40 (33.1) | 17 (14.0) | 1 (0.8) |
| 4. Experienced hostility from other parents in accommodating child's FA | 24 (19.8) | 50 (41.3) | 38 (31.4) | 9 (7.4) | 0 (0) |
| 5. How I deal with FA affects how child deals | 10 (8.3) | 20 (16.5) | 39 (32.2) | 45 (37.2) | 7 (5.8) |
| 6. Most people know symptoms of FA | 3 (2.5) | 11 (9.1) | 58 (47.9) | 41 (33.9) | 8 (6.6) |
| 7. Most people take FA seriously | 3 (2.5) | 16 (13.2) | 43 (35.5) | 51 (42.1) | 8 (6.6) |
| Perceptions of quality of life | | | | | |
| 8. Child's FA causes strain on marriage/relationship | 25 (20.7) | 56 (46.3) | 26 (21.5) | 12 (9.9) | 2 (1.7) |
| 9. Partner and I don't agree on how to care for child's FA | 22 (18.2) | 57 (47.1) | 20 (16.5) | 21 (17.4) | 1 (0.8) |
| 10. Pay more attention than partner to keep child from allergenic food(s) | 8 (6.6) | 22 (18.2) | 16 (13.2) | 59 (48.8) | 16 (13.2) |
| 11. Worry more than my partner about child's FA | 8 (6.6) | 28 (23.1) | 25 (20.7) | 45 (37.2) | 15 (12.4) |
| 12. Partner thinks I exaggerate seriousness of child's FA | 15 (12.4) | 48 (39.7) | 30 (24.8) | 26 (21.5) | 2 (1.7) |
| 13. Partner's career has suffered because of child's FA | 40 (33.1) | 56 (46.3) | 18 (14.9) | 6 (5.0) | 1 (0.8) |
| 14. Child with FA affects other children's daily lives | 34 (28.1) | 49 (40.5) | 25 (20.7) | 12 (9.9) | 1 (0.8) |
| 15. Career has suffered because of child's FA | 36 (29.8) | 59 (48.8) | 15 (12.4) | 10 (8.3) | 1 (0.8) |
| Policy issues | | | | | |
| 16. Comfortable that school/daycare staff can manage FA emergencies | 1 (0.8) | 14 (11.6) | 62 (51.2) | 41 (33.9) | 3 (2.5) |
| 17. Schools should ban all products with nuts | 18 (14.9) | 49 (40.5) | 38 (31.4) | 14 (11.6) | 2 (1.7) |
| 18. Trained adult should be at school lunch, parties, and field trips | 0 (0) | 3 (2.5) | 21 (17.4) | 68 (56.2) | 29 (24.0) |
| 19. Food labeling laws decreased choice of foods my child can eat | 0 (0) | 1 (0.8) | 6 (5.0) | 61 (50.4) | 53 (43.8) |
| 20. More government money should go towards FA research | 0 (0) | 1 (0.8) | 9 (7.4) | 66 (54.5) | 45 (37.2) |

Table 5. Attitudes and beliefs among parents of food-allergic children (n = 121). FA, Food Allergy

| Dissatisfaction | n (%) |
|---|-----------|
| 1. The staff is not professional, and there is no explanation from the top allergy medical experts in China; | 28 (34.6) |
| 2. The content is not professional enough, and much of the content is too simple and similar to other platforms; | 29 (35.8) |
| 3. The content is too academic for the general public to understand; | 32 (39.5) |
| 4. The content is not comprehensive in initial medical guidance, diagnosis, treatment, prevention, life-style management and other aspects; | 37 (45.7) |
| 5. The update is not timely enough, and the interval between releasing new content is too long; | 25 (30.9) |
| 6. Push too frequently, too many updates are pushed daily, but the quality is not high, affecting the user experience; | 11 (13.6) |
| 7. Lack of timely interaction, online consultation function; | 14 (17.3) |
| 8. The information is too general, lacking local characteristics and detailed guidance in daily life; | 10 (12.3) |
| 9. The content is too commercial, with too many advertisements and product links | 26 (31.2) |

Table 6. Dissatisfaction and expected improvement of the online platform (n = 81)

DISCUSSION

There were scarce epidemiologic data of FA in Wuhan. Our final result turned out that the prevalence of FA among children in Wuhan was 6.2%. A family history of allergic disease was a contributing factor to FA, and FA was frequently concomitant with other allergic diseases. There were still many parents who misunderstand the definition, diagnosis, treatment, and prevention of FA. FA has a significant impact on the quality of life and mental health of the patients’ families. Although parents can obtain FA related knowledge through various

platforms and from doctors, the authority of platform knowledge and the lack of professional doctors are also the reasons for parents’ lack of awareness of FA.

Accurate diagnosis of FA was difficult because of complexity of clinical presentations.¹¹ Oral food challenges (OFCs) especially double-blind placebo-controlled food challenges (DBPCFC) was the gold standard for diagnosis of FA,¹⁹ but it is not widely used in China. Based on inadequate diagnosis and cognition, most patients often regard food intolerance, intoxication, and

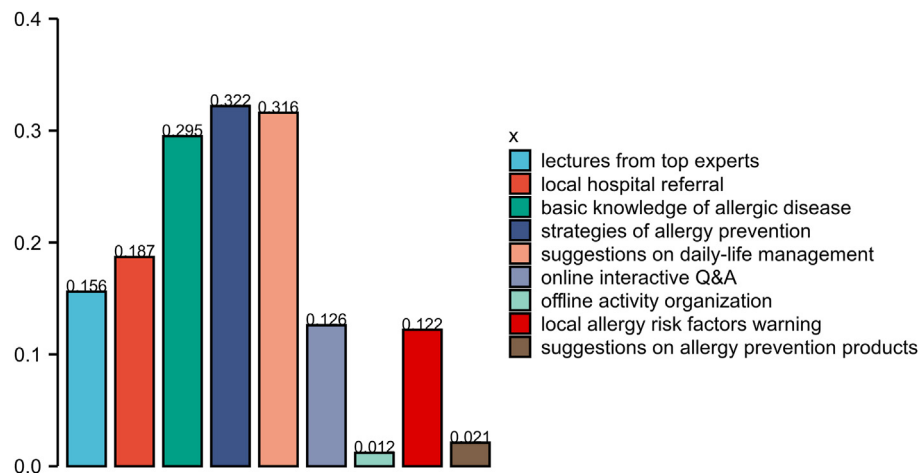


Fig. 2 Expected information and recommendations from online platform. (n = 81)

pharmacological adverse reactions as FA.²⁰ As a result, the self-reported prevalence consistently exceeded the actual prevalence. A meta-analysis in Europe showed that the prevalence of self-reported FA was 13.1%, while through food challenge showed positivity only 0.8%.²¹ One research conducted in Beijing urban area showed the prevalence of probable FA in 0-14-year-old children was 6.4%, almost twice that of doctors' diagnosis (3.2%),²² and a research in Jiangxi (a province in China) concluded that the prevalence of self-reported physician-diagnosed FA was 4.0% and 1.4% respectively.²³ Our study revealed that the self-reported prevalence of FA among children in Wuhan was 10.2%, which was also higher than the physician-diagnosed prevalence (6.2%). There is great heterogeneity in prevalence among different countries and regions, which suggested that in the context of DBPCFC being unavailable, the prevalence of FA we provided in Wuhan were still important for the epidemiology of allergic diseases in this region.

A series of surveys had demonstrated that family history might be a risk factor for FA and other allergic diseases.²⁴⁻²⁶ We also found that about 60% of the participants had reported family history of allergic disease, indicating that the children with family history were prone to developing FA. A research in Japan has demonstrated that the histories of parental FA and AD tended to show higher ORs for their child's FA than other parental allergic disease,²⁴ which suggested that family history especially AD and FA should be emphasized in the diagnosis of FA. FA and AD are considered as the initial manifestations of the allergic march.²⁷ Given that AD usually comes before the development of FA, and there's a strong association between early onset AD and FA, it stands to reason that preventing AD could be a strategy to slow down the development of FA.²⁸ Our study showed that 93.4% of the children combined with other allergic disease, indicating that majority were experiencing or had experienced an allergic march.

In our study, the total correct rate of FAKQ in parents of children with FA was 56.7%, and the scores varied across different content domains, revealing a significant knowledge gap in FA. Most

participants fared well in susceptibility and prevalence of FA and 71.9% identified the predilection age of FA (0-5 year) correctly. However, there were misconceptions about the definition and diagnosis of FA among nearly half of participants. Further, 50.4% of participants did not know that FA was an immune disease and 54.5% of them mistakenly regarded food additives as common allergen of FA. A previous review suggested that allergic reaction induced by food additives was uncommon, although the extensive use of additives has caused concern among consumers about the potential adverse reactions.²⁹ Therefore, the education of patients with FA and the awareness of food additives are very important in the management of patients with FA.

Moreover, there existed misunderstandings regarding the treatment and prevention of FA. In our study, we found that up to 78% of parents considered antihistamines as prophylactic treatment for FA, which was similar to another investigation in the Netherlands.³⁰ And the misunderstanding of prevention and treatment could increase potential risks of medication misuse and therapy delay. A higher B-IPQ score indicates a greater perceived psychological burden of the illness, a stronger disease perception and cognitive belief. In our study the higher scores (≥ 5.5) focused on items about consequences, timeline and concern. Greater perceived consequences, identity, emotional response and concern were shown to be associated with worse psychological, social, and physical functioning, and worse illness outcomes.¹⁷ In contrast, participants obtained lower scores on personal and treatment control as well as the comprehension of illnesses, which indicated their stronger beliefs in the effective treatment of FA. Parents who had already known their children were allergic to food(s) got significantly higher TB-IPQ and most of B-IPQ items scores associated with life impact, illness duration, symptoms, concern and emotional impact but got lower scores in illness understanding (B-IPQ7) in contrast to the parents in allergen unknown group. The explanation might be that parents who had known their children's FA situation might pay more attention to the symptoms and duration of FA, which would augment the influence to parents' life and emotion in turn.

These parents also had better understanding of FA and they might seek for professional medical advice and obtain FA related knowledge on their own. Therefore, we consider that enhanced parental awareness would improve their cognitive and affective domains.

Our study showed that FA had an adverse effect on the social life of the children as well as their parents. Our study found that 14.8% of participants indicated their children were treated differently by friends due to FA, which is lower than the 26.3% found in another study.³¹ We think this difference might be due to the lower incidence of anaphylaxis resulting from FA and the lack of sufficient FA awareness among children and their friends in China. Research by Herbert and colleagues noted that some parents, in an effort to protect their children with FA, limited their kids' social activities to prevent accidental exposure to allergens outside the home. However, this avoidance of group activities might cause children to feel socially isolated from their peers.

Herbert et al found that some parents of children with FA had limited their children's social activities due to the risk of accidental exposure to allergens outside of the home, while non-participation in group activities may result in social isolation among children from their peers.³² What's more, this isolation also leads to bullying. Research conducted by Lieberman et al revealed that 24% of children with FA have been bullied or teased because of their condition, primarily by classmates at school.³³ This is higher than our results. The difference might be due to the younger age group of children with FA in our study. Children in nursery and elementary schools, aged 3-12 years, constituted 78.5% (95 out of 121) of our study group. These younger children in China usually eat at home rather than at school. This becomes a social problem worth paying attention to. FA not only affects children but also their parents. Our findings also indicated an impact on the parents' quality of life, which coincided with the study of Gupta et al, they showed that 40% of parents had encountered hostility from other parents and 24.7% of parents thought their career was adversely affected by their children's FA.³¹ The severity of FA, coexisting allergic conditions, and the number of

food allergens are all factors that contribute to parental burden.³⁴

In addition to the aforementioned, parents' stress also arises from incomprehension of the general public. In our study, 18.2% of the participants stated that they had disagreement with their partners over care of children with FA. Compared to their partners, up to 62% of participants believed that they had paid more attention to prevent children from consuming allergenic foods and half of the participants expressed greater concern about their children's FA. One research study conducted by King RM et al reported that mothers of peanut allergy children experienced more anxiety, stress, and a greater impact on their quality of life than any other family member.³⁵ In addition, nearly one-third of participants expressed frustration due to inconsistent medical advice from different physicians. This inconsistency may be explained by that the majority of patients receive initial diagnosis from basic hospitals that lack allergists or pediatricians specializing in allergy. There are ≤ 3 pediatric allergists per million of population in Asia (with the exception of Japan)³⁶ and no definite data available in China, which causes difficulties in receiving accurate instructions and treatment even in hospital.

Although 80.4% of the participants agreed that trained adults should be present at school lunches, parties and field trips, only 36.4% of the participants expressed confidence in the ability of school staff to handle FA emergencies. Previous study showed a comparable attitude that most of the general populace agreed on the school interventions to ensure the safety of children with FA.³⁷ Schools still need to take a series of measures, including recruiting or designating personnel and providing materials required for treatment of allergic symptoms, to promote public awareness on FA management. In our study, about 60% of the participants had searched FA related information and academic articles actively, and quite a few participants passively accepted update information of FA. This phenomenon partially accounted for the unsatisfactory knowledge scores. Compared to passive acceptance of information from physicians, active parental involvement may be

more effective for management of FA. With the widespread usage of internet, patients and their parent access to health-related information become more convenient. For example, as a platform preferred by most participants, WeChat (a Chinese chat application) offers a variety of official accounts related to allergy and immunity. However, more than one third of participants expressed dissatisfaction with current platforms mainly due to incomplete or incomprehensible content and a lack of authority. To rectify the situation, the medical community should engage in the improvement of current social media tools, providing accurate information that adheres to evidence-based practice parameters.

Some limitations existed in our study. Firstly, the estimation of FA prevalence was primarily based on a screening questionnaire with parent-reported symptoms and interview rather than OFC, which may result in overestimation of actual prevalence. Secondly, the three selected schools are all situated in the urban area of Wuhan, China, where the children may have access to better healthcare than those in rural areas. However, our study still provides a basis for the epidemiological investigation of FA in 3-to-16-year-old children and their parents' perception and cognition of FA, which is worthy of reference for clinicians.

CONCLUSION

In conclusion, the prevalence of FA in 3-to-16-year-old children in Wuhan was 6.2%. Parents of children with FA possess inadequate knowledge on FA. Considering that psychosocial repercussions are highly prevalent among children with FA and their parents while the assessment of anxiety and stress is often overlooked by most allergists. It is imperative to launch patients and their families' education and make full use of online platform to bridge the gap between patients and healthcare providers.

Abbreviations

FA, food allergy; AD, atopic dermatitis; OFC, oral food challenges; SPT, skin prick test; FAKQ, Food Allergy Knowledge Questionnaire; B-IPO, Brief Illness Perception Questionnaire; FAAQ, Food Allergy Attitude Questionnaire; APQ, Allergy Platform Questionnaire; CFARS-PRNT, Chicago FA Research Survey for Parents of

Children with FA; RA, respiratory allergies; DBPCFC, double-blind placebo-controlled food challenges.

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Ethics statement

The study protocol was approved by the Independent Ethical Committee of Tongji Hospital (2013BJYYEC-042C-01). Each participant received detailed information about the study and study methods and provided written informed consent for their participation.

Author contributions

CH and ZR conceived and designed the study. CH, WY and ZR supervised the study. LJ and GS did the statistical analysis. LJ, GS and WY provide the general information about the participants. LJ drafted the manuscript. CH and ZR revised the manuscript, HN, LW, MD, YY and YL mainly performed the clinical tests and collected the data. All authors contributed to acquisition, analysis, or interpretation of data, revised the report, and approved the final version before submission.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Authors' consent for publication

We guarantee our manuscript is original, has not been published before, is not currently being considered for publication elsewhere, and has not been posted to a preprint server. The publication is approved by all authors and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, without the written consent of the copyright-holder.

Declaration of competing interest

The authors declare that they have no competing interests.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.waojou.2024.100883>.

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