

## ORIGINAL ARTICLE

## Quality-of-life assessment in Chinese families with food-allergic children

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## Clinical &amp; Experimental Allergy

## Summary

**Background** Caucasian families with food-allergic children have a compromised quality of life (QoL) for fear of life-threatening food reactions. Such data are limited in Asian children. Based on our recent questionnaire-based survey, 8.1% of young children recruited from local nurseries and kindergartens had parent-reported adverse food reactions (AFRs).

**Objective** This study tested the robustness of the Chinese Food Allergy Quality of Life-Parental Burden questionnaire (FAQL-PB) and assessed QoL in families with childhood AFR. The correlations among FAQL-PB items were evaluated by factor analysis.

**Methods** Two hundred and ninety-eight of 3677 children aged 2–7 years had parent-reported AFR, and 197 (66.1%) of them completed the 17 items of our self-administered FAQL-PB. Six hundred and thirty-nine (18.9%) children without AFR returned this questionnaire. Factor analysis was used to delineate the inter-relationship among the FAQL-PB items.

**Results** Cronbach  $\alpha$  for our Chinese FAQL-PB was 0.976, and the median (interquartile range) FAQL-PB scores of children with and without parent-reported AFR were 0.10 (0.02–0.32) and 0 (0–0.18), respectively ( $P < 0.001$ ). Factor analysis confirmed excellent correlations between FAQL-PB items. The 17 items were clustered into two factors, which explained 79.7% of the total variance. Among children with AFR, FAQL-PB scores increased with increasing numbers of foods that caused AFRs ( $P < 0.001$  for trend). Thirty (15.2%) children had impaired QoL, defined as average item FAQL-PB score  $\geq 0.5$ . Impaired QoL was associated with AFR that was caused by  $> 3$  foods ( $P = 0.001$ ), current food avoidance ( $P = 0.005$ ) and AFR caused by peanut ( $P = 0.003$ ), egg ( $P = 0.011$ ) and cow's milk ( $P = 0.028$ ), and current flexural dermatitis ( $P = 0.011$ ).

**Conclusions** FAQL-PB is a robust measure of AFR-specific parental QoL, which is impaired in Chinese children with parent-reported AFR. Flexural dermatitis, current food avoidance and AFR caused by multiple foods are independent risk factors for lower parental QoL.

**Keywords** adverse food reaction, children, Chinese, factor analysis, quality of life

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## Introduction

Food allergy (FA) is a common, heterogeneous and potentially fatal allergic disorder in children. Adverse food reactions (AFRs) in these patients consist of one or more of the following: hives, angio-oedema, bronchospasm, hypotension and anaphylaxis [1]. FA affected 6% of American children younger than 3 years of age [2]. In the meta-analysis performed by Rona et al. [3], the self-reported prevalence of FA varied from 1.2% to 17% for milk, 0.2% to 7% for egg, 0% to 2% for peanuts and fish, 0% to 10% for shellfish and 3% to 35% for any food. Epidemiologic data suggest that its prevalence is increas-

ing in the Caucasian population [4]. Our recent questionnaire survey found that 8.1% of young Hong Kong children suffered from parent-reported AFR [5]. In contrast to published data, shellfish and beef were among the leading causes of AFR in Chinese. Because there is no cure for FA, meticulous food avoidance is the mainstay of patient management [6]. AFR sufferers experience considerable stress in managing their daily activities, such as reading the label on manufactured products, participating in common social activities associated with eating and avoiding cross-contamination of foods with their sensitized allergens [7, 8]. Accidental food ingestion may occur, which leads to potentially fatal outcomes and

additional psychological burden in FA families. These difficulties invariably change subjects' quality of life (QoL) in a profoundly negative way [9].

The deleterious effects of asthma and rhinitis on QoL have been studied extensively [10–12]. On the other hand, there are limited data on the impact of FA on children's QoL. Earlier studies attempted to measure QoL in food-allergic children using generic health-related QoL (HRQoL) questionnaires [13, 14]. Avery *et al.* [15] devised a disease-specific questionnaire for FA that was to be completed by the children themselves. They compared QoL data between children with peanut allergy and non-allergic controls with diabetes, and found impaired FA-specific QoL in the former group of children. In addition to its effect on QoL for children, FA exerts a significant influence on parental and family QoL. A Swedish study investigated the effects of food hypersensitivity on parental and family HRQoL. Parents of 220 schoolchildren were asked to report QoL in their families. They found that co-existing allergy predicted lower child and parental HRQoL and more disruption in family activities. The presence of FA in sibling(s) was also associated with lower parent-reported QoL and child's psychosocial QoL [16]. Cohen *et al.* [9] designed and validated the disease-specific 17-item Food Allergy Quality of Life-Parental Burden questionnaire (FAQL-PB), which could be used to evaluate parental burden for FA children. Areas of effect included family/social activities (restaurant meals, social activities, child care, vacation), school, time for meal preparation, health concerns and emotional issues, and each item was set in the form of seven-point Likert scale. They showed that FAQL-PB had a strong internal validity (Cronbach  $\alpha$  0.95) and a good correlation with the expectation of outcome questions and scores on a generic QoL questionnaire. Besides, FAQL-PB was able to discriminate between parents whose children had multiple FA than parents whose children had fewer allergies. However, these authors did not analyse the interdependence between different items, and whether they might be classified into distinct dimensions. Similar data on QoL assessment for childhood FA are not available in the Chinese.

This study investigated the robustness and structure of FAQL-PB in Chinese children. Using this Chinese FAQL-PB, this study also investigated disease-specific QoL of Chinese families with young children who suffered from AFR in order to identify the risk factors associated with impaired parental QoL.

## Methods

### *Participants*

Our research group conducted a population-based study of parent-reported AFRs in 3677 Chinese children aged

2–7 years from 21 randomly recruited nurseries and kindergartens in Hong Kong. The epidemiological findings of this study were reported recently [5]. Briefly, 298 (8.1%) children had parent-reported AFR as defined by the question 'Have your child ever suffered from any adverse food reaction?' The six leading causes of AFR were crustacean shellfish (15.8%), egg (9.1%), peanut (8.1%), beef (6.4%), cow's milk (5.7%) and tree nuts (5.0%). In addition to the reporting of AFR, parents of the participants were asked to complete the Chinese version of the 17-item FAQL-PB questionnaire. Informed written consent was obtained both from school principals and from participants' parents, and the Clinical Research Ethics Committee of our University approved this study.

### *Study questionnaire*

Participants' parents were given the self-administered questionnaire based mainly on the International Study of Asthma and Allergy in Childhood (ISAAC) questionnaire [17]. 'AFR ever' was defined as suffering from AFR in the subjects' life time. Children whose parents answered 'yes' to the question 'Have your child ever suffered from adverse reaction to food?' were defined as having parent-reported AFR, and details of their AFR were recorded. These parents were also asked 'Have your child ever suffered from any physician-diagnosed FA?' Respondents were asked to identify what food ingredients their children were allergic to. These items included any adverse reaction to milk intake (e.g. normal and hydrolysed cow's milk formulae, fresh cow's milk, soy-based formula, other milk formulae) and a list of 32 foods such as egg, peanut, nuts, soybean, beef and shellfish. The caregivers were allowed to indicate any additional food. Respondents were asked about the foods that their children currently avoided, and how seriously and frequently the previous AFRs occurred. Possible risk factors for AFR such as a family history of AFR and other atopic diseases, parental level of education and family size were also obtained. Parents were asked to complete this questionnaire at home and to return them to the class teachers within 1 week following distribution.

The last section of our study questionnaire contained 17 Chinese questions that were adapted and translated from FAQL-PB. Linguistic validation was conducted following the permission given by the original developers [9]. The questionnaire was translated into Chinese by a bilingual medical expert who was fluent in English and Chinese, and which was back-translated independently by another bilingual medical expert. A pretest was conducted, on five non-medical volunteers, followed by parents of 15 children with AFR who were followed in our Allergy Clinic, to ensure that the questionnaire is comprehensive to the Chinese respondents. The principal investigator (T. F. L.) proof read the final version before it was distributed to the study participants.

### Statistical analysis

Data were expressed in the number (percentage) or median [interquartile range (IQR)] as appropriate.  $\chi^2$  or Fisher's exact tests were used to compare categorical variables in subgroups with respect to parent-reported AFR or QoL impairment.  $P$ -value  $<0.05$  was considered to be statistically significant. Cronbach  $\alpha$  was used to evaluate the internal consistency of our Chinese FAQL-PB, based on the average inter-item correlation. A two-way mixed model was used to calculate the intra-class correlation coefficient as a measure of agreement of values within cases. Concerning the analysis of the FAQL-PB structure, Bartlett's test of sphericity was used to test for the possibility of performing a factor analysis. The Kaiser-Meyer-Olkin (KMO) measure  $\geq 0.5$  indicates that data are likely to factor well. Correlation coefficients were analysed by principal component analysis and subsequent rotation according to the standard varimax criterion [18–20]. Briefly, we decided *a priori* that the number of factors in the varimax rotation would be based on the number of eigenvalues  $\geq 1.0$  in the principal component analysis [21]. 'Factor loadings'  $\geq 0.45$  were considered to be high [18]. To assess the robustness of our findings, we repeated factor analysis after excluding outliers (i.e.  $>3$  standard deviations from the mean) from the data set as well as on children with AFR caused by more than two foods. All analyses were performed with SPSS for Windows (version 14.0; SPSS Inc., Chicago, IL, USA).

## Results

### Study participants

Parents of 197 (66.1%) children with parent-reported AFR and 639 (18.9%) of 3379 children without AFR completed our FAQL-PB questionnaire. One hundred and fifty-four (78.2%) children with parent-reported AFR were also diagnosed by physicians to have FA. Table 1 summarizes their demographic and clinical characteristics. As expected, parent-reported AFR was associated with a number of clinical factors including place of birth, a family history of AFR, parental education background and a personal history of co-existing atopic disorders.

### The Food Allergy Quality of Life-Parental Burden questionnaire in children with parent-reported adverse food reaction

The Cronbach  $\alpha$  for our FAQL-PB was 0.976, indicating a strong internal consistency, whereas the intra-class correlation coefficient was 0.701 (95% confidence interval 0.654–0.748,  $P < 0.001$ ). The median (IQR) FAQL-PB scores of children with and without parent-reported AFR were 0.10 (0.02–0.32) and 0 (0–0.18), respectively

**Table 1.** Clinical characteristics of study subjects with and without parent-reported AFR

| Variable                            | AFR<br>( <i>n</i> = 197) | No AFR<br>( <i>n</i> = 639) | <i>P</i> * |
|-------------------------------------|--------------------------|-----------------------------|------------|
| Age (years)                         | 4.2 (6.9)                | 4.4 (6.6)                   | 0.779      |
| Male                                | 106 (53.8)               | 311 (48.7)                  | 0.238      |
| Place of birth <sup>†</sup>         |                          |                             |            |
| Hong Kong                           | 187 (94.9)               | 572 (89.5)                  | 0.038      |
| Mainland China                      | 9 (4.6)                  | 61 (9.5)                    |            |
| Domestic tobacco smoke exposure     | 57 (28.9)                | 224 (35.1)                  | 0.133      |
| Father's highest education level    |                          |                             |            |
| Primary school and below            | 36 (18.3)                | 152 (23.8)                  | 0.029      |
| Secondary school                    | 116 (58.9)               | 389 (60.9)                  |            |
| College, university and above       | 45 (22.8)                | 98 (15.3)                   |            |
| Mother's highest education level    |                          |                             |            |
| Primary school and below            | 27 (13.7)                | 154 (24.1)                  | $<0.001$   |
| Secondary school                    | 128 (65.0)               | 403 (63.1)                  |            |
| College, university and above       | 42 (21.3)                | 82 (12.8)                   |            |
| Family history of self-reported AFR |                          |                             |            |
| Father                              | 17 (8.6)                 | 15 (2.3)                    | $<0.001$   |
| Mother                              | 37 (18.8)                | 24 (3.8)                    | $<0.001$   |
| Sibling                             | 14 (7.1)                 | 10 (0.2)                    | $<0.001$   |
| Details of parent-reported AFR      |                          |                             |            |
| Ever hospitalized due to AFR        | 17 (8.6)                 | NA                          | NA         |
| Current food avoidance              | 124 (62.9)               | 53 (8.3)                    | $<0.001$   |
| Co-existing atopic disorders        |                          |                             |            |
| Physician-diagnosed asthma          | 24 (12.2)                | 27 (4.2)                    | $<0.001$   |
| Current wheeze                      | 32 (16.2)                | 49 (7.7)                    | $<0.001$   |
| Rhinitis ever                       | 81 (41.1)                | 139 (21.8)                  | $<0.001$   |
| Eczema ever                         | 128 (65.0)               | 178 (27.9)                  | $<0.001$   |

Results expressed as number (percentage) or mean (standard deviation).

\*Analysed by Pearson's  $\chi^2$ .

<sup>†</sup>Excluded children not born in Hong Kong or mainland China (one in AFR group and six in non-AFR group). This explained the reason for the total not being 100%.

AFR, adverse food reaction; NA, not applicable.

( $P < 0.001$ ). Among children with AFR, we further found that FAQL-PB scores increased with increasing numbers of foods that caused AFRs (Fig. 1). Table 2 summarizes the average scores for the 17 individual items of the FAQL-PB questionnaire. In general, individual items showed a dose-response relationship with increasing numbers of foods that caused subjects' AFR. However, Q3, Q4, Q5, Q9 and Q17 could not adequately differentiate between subjects with AFR caused by one food, two to three foods and  $>3$  foods.

Previous data found that a score difference of 0.5 in a questionnaire with seven-point Likert scales is clinically significant [22]. Thus, we classify any subject with AFR and an average item score  $\geq 0.5$  to have impaired QoL. Parents of 30 (15.2%) children had impaired QoL. With regard to demographic and clinical factors (Table 3), impaired parental QoL was only associated with the presence of current flexural dermatitis ( $P = 0.011$ ). For factors related to AFR

(Table 4), impaired QoL was associated with AFR that was caused by > 3 foods ( $P=0.001$ ), current food avoidance

( $P=0.005$ ) and AFR caused by peanut ( $P=0.003$ ), egg ( $P=0.011$ ) and cow's milk ( $P=0.028$ ).

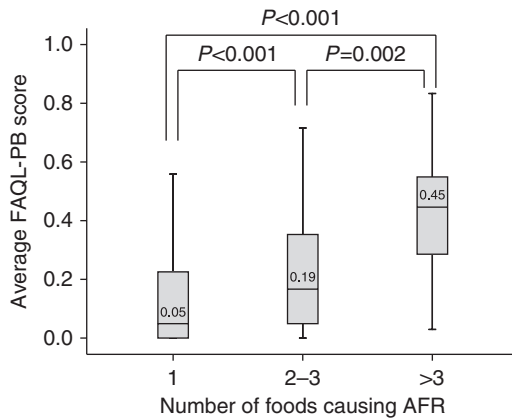


Fig. 1. Relationship between FAQL-PB scores and number of foods that caused reactions in 197 children with parent-reported AFR. Numbers inside the boxes represent respective median values ( $P<0.001$  for trend). FAQL-PB, Food Allergy Quality of Life-Parental Burden questionnaire; AFR, adverse food reaction.

### Factor analysis

Bartlett's test of sphericity indicated a satisfactory correlation between the presently used variables ( $\chi^2 = 3723.2$ , degree of freedom = 136,  $P<0.0001$ ). The KMO measure of sampling adequacy was 0.953. Factor analysis yielded two separate factors that could explain 79.7% of the total variance in the data set. The addition of one more factor only resulted in a slight increase of the total explained variance to 83.4%. Thus, factor analysis with two components was presented (Table 5). The robustness of the original factor structure was confirmed by the finding that all parameters were clustered into the same factors both after the removal of outliers and when factor analysis was repeated for 52 children with AFR caused by more than two foods (data not shown). Their respective KMO measures were 0.940 and 0.861.

Table 2. Comparison of responses to individual items of FAQL-PB for children with parent-reported AFR to one food, two to three foods and > 3 foods

| Items related to child's food allergy*                                                  | Group A<br>(1 food) | Group B<br>(2–3 foods) | Group C<br>(> 3 foods) | $P^\dagger$ |         |         |
|-----------------------------------------------------------------------------------------|---------------------|------------------------|------------------------|-------------|---------|---------|
|                                                                                         |                     |                        |                        | A vs. B     | B vs. C | A vs. C |
| Q1 – Choice of holiday/vacation for family                                              | 0 (0–0.33)          | 0.17 (0–0.50)          | 0.42 (0.17–0.67)       | 0.035       | 0.032   | <0.001  |
| Q2 – Choice of restaurant for family                                                    | 0.17 (0–0.33)       | 0.17 (0–0.50)          | 0.50 (0.17–0.67)       | 0.010       | 0.017   | <0.001  |
| Q3 – Participation in social activities that involve food (e.g. parties, holiday)       | 0.08 (0–0.33)       | 0.17 (0–0.50)          | 0.50 (0.04–0.50)       | 0.002       | 0.174   | <0.001  |
| Q4 – Need to spend extra time preparing meals                                           | 0 (0–0.17)          | 0 (0–0.33)             | 0.17 (0.17–0.50)       | 0.171       | 0.001   | <0.001  |
| Q5 – Need to take precautions before going out of home                                  | 0 (0–0.17)          | 0 (0–0.17)             | 0.33 (0.17–0.50)       | 0.087       | 0.001   | <0.001  |
| Q6 – Anxiety relating to child's food allergy                                           | 0 (0–0.17)          | 0.17 (0–0.33)          | 0.33 (0.17–0.67)       | 0.019       | 0.005   | <0.001  |
| Q7 – Trouble that child may not overcome food allergy                                   | 0 (0–0.17)          | 0.17 (0–0.50)          | 0.50 (0.17–0.67)       | 0.024       | 0.007   | <0.001  |
| Q8 – Possibility of or actually leaving child in the care of others                     | 0 (0–0.17)          | 0.17 (0–0.50)          | 0.42 (0.17–0.67)       | 0.002       | 0.015   | <0.001  |
| Q9 – Frustration over other's lack of appreciation for the seriousness of food allergy  | 0 (0–0.17)          | 0.17 (0–0.50)          | 0.25 (0–0.50)          | <0.001      | 0.456   | <0.001  |
| Q10 – Sadness regarding the burden of child carries                                     | 0 (0–0.17)          | 0.17 (0–0.50)          | 0.50 (0.17–0.67)       | 0.003       | 0.005   | <0.001  |
| Q11 – Child's attendance in school, camp, daycare or other group activity with children | 0 (0–0.17)          | 0.17 (0–0.50)          | 0.42 (0.21–0.83)       | 0.010       | 0.002   | <0.001  |
| Q12 – Concerns for child's health                                                       | 0 (0–0.17)          | 0.17 (0–0.50)          | 0.50 (0.17–0.79)       | 0.002       | 0.006   | <0.001  |
| Q13 – Worry of inability to help child if they have an allergic reaction to food        | 0 (0–0.33)          | 0.17 (0–0.50)          | 0.58 (0.17–0.83)       | 0.006       | 0.001   | <0.001  |
| Q14 – Worry that child may not have a normal upbringing                                 | 0 (0–0.17)          | 0.17 (0–0.50)          | 0.42 (0.17–0.79)       | 0.014       | 0.003   | <0.001  |
| Q15 – Concerns of child's nutrition                                                     | 0 (0–0.17)          | 0.17 (0–0.50)          | 0.58 (0.17–0.79)       | 0.006       | <0.001  | <0.001  |
| Q16 – Issues concerning child being near others while eating                            | 0 (0–0.13)          | 0 (0–0.33)             | 0.33 (0.04–0.50)       | 0.043       | 0.004   | <0.001  |
| Q17 – Frightened by the thought that child has a food allergic reaction                 | 0 (0–0.17)          | 0.17 (0–0.50)          | 0.17 (0.04–0.50)       | 0.003       | 0.157   | <0.001  |

\*All items refer to concern, worry or limitation in the preceding 1 week.

$^\dagger P<0.001$  by Kruskal–Wallis test for all 17 items; pairwise comparisons between groups analysed by Mann–Whitney test. FAQL-PB, Food Allergy Quality of Life-Parental Burden questionnaire; AFR, adverse food reaction.

**Table 3.** Relationship between demographic and atopic factors and QoL group in our children with parent-reported AFR

| Factor                                             | Impaired QoL* (%) | Normal QoL (%) | OR (95% CI)      | P <sup>†</sup>     |
|----------------------------------------------------|-------------------|----------------|------------------|--------------------|
| Male                                               | 55.6              | 53.6           | 1.08 (0.44–2.64) | 0.984              |
| Age < 3 years old                                  | 13.8              | 11.4           | 1.25 (0.33–4.34) | 0.952              |
| Born in Hong Kong                                  | 93.3              | 95.8           | 0.62 (0.11–4.54) | 0.630              |
| Domestic tobacco smoke exposure                    | 41.4              | 27.3           | 1.88 (0.77–4.56) | 0.188              |
| Family history                                     |                   |                |                  |                    |
| Paternal history of AFR                            | 13.3              | 7.8            | 1.82 (0.46–6.67) | 0.520              |
| Maternal history of AFR                            | 20.0              | 18.6           | 1.10 (0.37–3.14) | 0.946              |
| History of AFR in siblings                         | 6.7               | 7.2            | 0.92 (0–4.73)    | 1.000              |
| Father's highest education being college and above | 13.3              | 24.6           | 0.47 (0.13–1.54) | 0.266              |
| Mother's highest education being college and above | 13.3              | 22.8           | 0.52 (0.14–1.71) | 0.359              |
| Co-existing atopic disorders                       |                   |                |                  |                    |
| Doctor-diagnosed asthma                            | 13.3              | 12.6           | 1.07 (0.28–3.69) | 0.853              |
| Current wheeze                                     | 20.0              | 15.6           | 1.36 (1.62–9.57) | 0.736              |
| Rhinitis ever                                      | 39.3              | 44.3           | 0.81 (0.33–1.98) | 0.774              |
| Current rhinitis                                   | 50.0              | 52.7           | 0.90 (0.39–2.09) | 0.941              |
| Eczema ever                                        | 80.0              | 64.2           | 2.23 (0.81–6.49) | 0.140              |
| Current flexural eczema                            | 60.0              | 33.5           | 2.97 (1.25–7.12) | 0.011 <sup>§</sup> |

\*Defined as average FAQL-PB score  $\geq 0.5$ .

<sup>†</sup>Yates-corrected *P*-values analysed by  $\chi^2$  or Fisher's exact test.

<sup>§</sup>*P* < 0.05.

AFR, adverse food reaction; CI, confidence interval; NA, not available; OR, odds ratio; FAQL-PB, Food Allergy Quality of Life-Parental Burden questionnaire; QoL, quality of life.

## Discussion

This study is the first to investigate disease-specific parental QoL in Chinese families with AFR children. One hundred and ninety-seven children with parent-reported AFR and 639 children without AFR returned the Chinese version of FAQL-PB. The Cronbach  $\alpha$  (0.98) for our Chinese FAQL-PB was as good as the original version (0.95) [9]. This questionnaire was able to distinguish between young children with and without AFR, and also identify children with AFR caused by multiple foods. Using this Chinese FAQL-PB, we identified several risk factors for impaired QoL in local children. Understandably, the two factors of current food avoidance and multiple foods (>3) that caused parent-reported AFR would increase parents' burden in preparing snacks and meals for these young children and aggravate their worries of any potentially lethal food reactions. Similarly, peanut, egg and cow's milk affected QoL in children with parent-reported AFR. Lastly, impaired QoL was also associated with the presence of current flexural dermatitis. This observation is consistent with the traditional Chinese belief that patients with moderate-to-severe eczema should avoid eating certain foods such as seafood, fish, beef, egg and cow's milk that are 'toxic' to the skin [23].

**Table 4.** AFR details as potential factors for impaired QoL\* in our children

| Factor                                  | Impaired QoL (%) | Normal QoL (%) | OR (95% CI)       | P <sup>†</sup>     |
|-----------------------------------------|------------------|----------------|-------------------|--------------------|
| Details of AFR                          |                  |                |                   |                    |
| Current food avoidance                  | 89.7             | 60.9           | 5.57 (1.52–24.17) | 0.005 <sup>ψ</sup> |
| Ever hospitalised due to AFR            | 10.0             | 8.8            | 1.16 (0.25–4.74)  | 0.898              |
| Hospitalisation due to AFR in past year | 3.3              | 3.1            | NA                | 1.000              |
| AFR caused by > 3 foods                 | 33.3             | 9.6            | 4.72 (1.71–12.96) | 0.001 <sup>ψ</sup> |
| History of severe AFR                   | 10               | 4.8            | 2.21 (0.43–10.01) | 0.378              |
| Types of food causing AFR <sup>‡</sup>  |                  |                |                   |                    |
| Crustacean shellfish                    | 52.6             | 40.5           | 1.63 (0.56–4.77)  | 0.456              |
| Egg                                     | 45.5             | 18.5           | 3.67 (1.29–10.41) | 0.011 <sup>§</sup> |
| Peanut                                  | 52.4             | 19.3           | 4.59 (1.58–13.51) | 0.003 <sup>ψ</sup> |
| Beef                                    | 28.6             | 0.9            | 2.45 (0.56–10.16) | 0.309              |
| Cow's milk                              | 26.7             | 10.2           | 3.21 (1.11–9.11)  | 0.028 <sup>§</sup> |
| Nuts                                    | 36.4             | 14.3           | 3.43 (0.70–16.46) | 0.164              |
| Fish                                    | 16.7             | 5.4            | 3.51 (0.93–12.79) | 0.068              |

\*Defined as average FAQL-PB score  $\geq 0.5$ .

<sup>†</sup>Yates-corrected *P*-values analysed by  $\chi^2$  or Fisher exact test.

<sup>‡</sup>Included only the top seven foods causing parent-reported AFR in our young childhood population [5].

<sup>§</sup>*P* < 0.05.

<sup>ψ</sup>*P*  $\leq 0.005$ .

AFR, adverse food reaction; CI, confidence interval; NA, not available; OR, odds ratio; FAQL-PB, Food Allergy Quality of Life-Parental Burden questionnaire; QoL, quality of life.

Our findings support that FA-specific QoL would depend on the type of foods that caused AFR. In contrast to what the US Food and Drug Administration recommended [24], crustacean shellfish, egg, peanut, beef, cow's milk, tree nuts and fish were the most important foods for AFR in our young children [5]. Among these foods, we found that only peanut, egg and cow's milk would adversely influence children's QoL. Avery et al. [15] compared QoL in 20 children with peanut allergy with that of 20 diabetic children. They found that peanut-allergic children reported more fear of an adverse event and more anxiety about eating, especially when eating away from home. They felt more threatened by potential hazards within their environment, felt more restricted regarding physical activities and worried more about being away from home. Interestingly, another validation study on the FA-specific QoL questionnaire found that children with peanut allergy reported higher levels of anxiety than children with either allergy to other single foods or multiple foods, other than peanut. The likely reason is that peanut is very difficult to avoid compared with other foods, leading to higher levels of vigilance and thus anxiety [25]. Instead of identifying specific foods that affect parental QoL, Marklund et al. [16] found that a number of allergy-associated parameters

**Table 5.** Varimax rotated factor-loading matrix for 17 FAQL-PB items in children with parent-reported AFR\*

| Item                                                                                    | Factor 1     | Factor 2     |
|-----------------------------------------------------------------------------------------|--------------|--------------|
| Q1 – Choice of holiday/vacation for family                                              | 0.237        | <b>0.839</b> |
| Q2 – Choice of restaurant for family                                                    | 0.372        | <b>0.837</b> |
| Q3 – Participation in social activities that involve food (e.g. parties, holiday)       | 0.366        | <b>0.838</b> |
| Q4 – Need to spend extra time preparing meals                                           | <b>0.670</b> | 0.514        |
| Q5 – Need to take precautions before going out of home                                  | <b>0.675</b> | 0.521        |
| Q6 – Anxiety relating to child's food allergy                                           | <b>0.744</b> | 0.479        |
| Q7 – Trouble that child may not overcome food allergy                                   | <b>0.823</b> | 0.403        |
| Q8 – Possibility of or actually leaving child in the care of others                     | <b>0.803</b> | 0.355        |
| Q9 – Frustration over other's lack of appreciation for the seriousness of food allergy  | <b>0.794</b> | 0.311        |
| Q10 – Sadness regarding the burden of child carries                                     | <b>0.825</b> | 0.417        |
| Q11 – Child's attendance in school, camp, daycare or other group activity with children | <b>0.813</b> | 0.382        |
| Q12 – Concerns for child's health                                                       | <b>0.837</b> | 0.342        |
| Q13 – Worry of inability to help child if they have an allergic reaction to food        | <b>0.830</b> | 0.313        |
| Q14 – Worry that child may not have a normal upbringing                                 | <b>0.857</b> | 0.301        |
| Q15 – Concerns of child's nutrition                                                     | <b>0.882</b> | 0.271        |
| Q16 – Issues concerning child being near others while eating                            | <b>0.815</b> | 0.305        |
| Q17 – Frightened by the thought that child has a food allergic reaction                 | <b>0.864</b> | 0.320        |
| Eigenvalue                                                                              | 12.377       | 1.167        |
| Total variance explained (%)                                                            | 72.81        | 6.87         |

\*Bold values represent the highest factor loadings.

FAQL-PB, Food Allergy Quality of Life-Parental Burden questionnaire; AFR, adverse food reaction.

impaired QoL in Swedish FA children and their parents and families. Food-induced gastro-intestinal symptoms predicted lower parental HRQoL while food-induced breathing difficulties predicted higher psychosocial HRQoL for the child and enhanced HRQoL with regard to the family's ability to get along. However, this study suggested that the risk of food reactions and measures to avoid them were more important than the clinical reactivity induced by food intake in affecting HRQoL.

Under the aegis of EuroPrevall, DunnGalvin *et al.* developed another FA-specific QoL questionnaire called The Food Allergy QoL-Parent Form (FAQLQ-PF) [25]. A total of 374 children aged 12 years and younger were recruited from several Caucasian populations. Through a multi-stage validation process, these researchers showed that FAQLQ-PF was a psychologically robust and reliable tool for evaluating QoL in FA children. Factor analysis

further showed that these items represented three subscales of emotional impact, food anxiety and social and dietary limitations. In contrast, FAQL-PB did not attempt to classify the 17 items into different FA-related dimensions [9]. In our children, factor analysis revealed that FAQL-PB could be classified into only two dimensions – one that closely resembles the domain of social limitations in FAQLQ-PF and another that encompasses the domains of emotional impact, food anxiety and dietary limitations under FAQLQ-PF. This clustering of FAQL-PB items is different from that of FAQLQ-PF, but is understandable from the fact that FAQLQ-PF was designed to allow parents to report on their children's HRQoL *from the child's perspective*, whereas FAQL-PB enquired about *parental burden* in families with FA children. Although both questionnaires were disease-specific, they collected information on FA-related QoL from two inherently different target groups.

The correlations and clustering of 17 items in FAQL-PB have not been studied before. In this study, factor analysis clearly demonstrated excellent correlations among most FAQL-PB items. This testing is robust, and the same two factors were obtained when outliers were removed and on analysis of subjects with AFR caused by more than two foods. In contrast to the three subscales of 'emotional impact', 'food anxiety' and 'social and dietary limitations' obtained for FAQLQ-PF, factor analysis of our 17 items only yielded two clinically sensible dimensions for FAQL-PB. This study identified a factor that carried similar meaning as 'social and dietary limitations'. On the other hand, our parents might experience difficulty in assessing the subscales of 'emotional impact' and 'food anxiety' as identified in FAQLQ-PF *from their children's perspective* when they completed FAQL-PB *for parental burden*. Therefore, these two domains may merge into a single factor during our factor analysis of the FAQL-PB items.

One limitation of this study is the possibility of recall error from parents in citing their children's past experience of any AFR. Parents might not have reported all foods that caused AFR despite the fact that our questionnaire included a minimum of 32 common foods for them to choose. In close association with this, parents only reported the foods that they thought might cause AFR in their children. The diagnosis of FA caused by these suspected foods was not confirmed by the gold standard of double-blind, placebo-controlled food challenges [26]. Nonetheless, it would not be feasible or safe for us to perform these food challenges in this population-based study. In addition, some of the FAQL-PB items may not be very relevant for QoL assessment in parents of Chinese FA children. FAQL-PB was originally developed for assessing FA burden of Americans, and the initial conceptual frameworks of domains for food-related worries and activities were tested in the FA and Anaphylaxis Network [9]. It is possible that cultural differences with respect to AFR issues

being addressed in FAQL-PB that was validated for Caucasians may limit its applicability to our Chinese population.

In conclusion, this study confirms that FAQL-PB is a robust and useful tool for assessing QoL in Chinese families with young children who have parent-reported AFR. Factor analysis reveals good correlations between FAQL-PB items, and this questionnaire can be clustered into two independent factors. Impaired parental QoL is associated with children who practiced food avoidance, with AFR caused by multiple foods and specifically by peanut, egg and cow's milk, and in children with current flexural dermatitis. These findings suggest that AFR has a significant impact on QoL in parents with AFR children.

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