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ORIGINAL ARTICLE

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Validation of the food allergy quality of life questionnaire series in Chinese families with food-allergic children

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Abstract

Background: Anxiety from accidental exposure and vigilant dietary monitoring impair the quality of life (QoL) of food-allergic patients. A comprehensive food allergy-specific questionnaire allows patients to accurately report their QoL. This study validated the Food Allergy Quality of Life Questionnaire (FAQLQ) series and assessed the QoL of Chinese food-allergic patients and their caregivers.

Methods: FAQLQ series developed by EuroPrevall consists of four separate questionnaires for parents, children, adolescents and adults. All questionnaires were translated into traditional Chinese by standard forward and backward methods. A cross-sectional study was conducted on food-allergic patients and children's parents using an age-appropriate questionnaire. The performance indices of FAQLQ and their correlation with independent measures of food allergy were analyzed, and factor analysis was performed to confirm the factor structure of FAQLQ questionnaires.

Results: Cross-sectional validation was performed on 214 participants, with 40 reassessed for test–retest reliability. Overall scores for the FAQLQ series had good internal consistency with Cronbach's $\alpha \geq .90$. Good construct validity was demonstrated by correlations between FAQLQ-Parent Form, FAQLQ-Child Form, FAQLQ-Teenager Form, FAQLQ-Adult Form and Food Allergy Independent Measure (FAIM) scores, except in 0- to 3-year-old children. Test–retest analyses revealed a significant correlation between total FAQLQ score, parent-reported FAIM and food anxiety domain in 4–6 years, and between total score and FAIM in 7–12 years. Exploratory factor analysis categorized items in the FAQLQ series into three to four domains.

Conclusion: FAQLQ series provide a valid and reliable measure for QoL in Chinese food-allergic patients and caregivers, except for parents of children aged 0–3 years. Items for all FAQLQ questionnaires are categorized into different functional domains in our population.

KEYWORDS
Chinese, disease-specific questionnaire, food allergy, health-related quality of life, validation

Agnes Sze Yin Leung, Nam Sze Cheng have equal contributions as co-first authors.

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Food allergy is the result of an adverse immune response that causes an immediate or acute reaction after ingesting certain foods,[1] and it affects people of different age groups.[2] A systematic review showed that the most common food allergies in Europe were cow's milk, hen's egg, peanut, wheat, soy, fish and shellfish,[3] which was comparable to the findings in Hong Kong.[4] Food allergy negatively affects patients' health-related quality of life (HRQoL), and food avoidance and post-exposure medication remain as the main effective management strategy for this problem.[5] However, food allergies can be fatal for some patients,[6] so patients and their parents or caregivers often need to vigilantly monitor patients' diets, which can affect their emotional, physical, and social status, thereby reducing their quality of life (QoL).[7] Generic questionnaires for HRQoL are useful, but less sensitive to corporate questions directly related to detect changes in the patient status.[8] Since HRQoL varies by patient's age, it is critical to developing specific questionnaires for different age groups. For example, children with cognitive limitations, different language abilities, and sensitivity to life-threatening threats require parents to provide information about their health and daily life.[9]

The Food Allergy Quality of Life Questionnaire (FAQLQ) series for parents, children, adolescents and adults was developed and validated with the support of the multi-center EuroPrevall project.[10] There are four separate questionnaires under this series. FAQLQ-Parent Form (FAQLQ-PF) was designed for parents of children from birth to 12 years of age.[11] This parental form requires parents to complete different sets of questions covering three HRQoL domains, namely, emotional influence (EI), food anxiety (FA) and social and dietary limitation (SDL). It consists of 14 items for parents of children aged 0–3 years, 26 items for parents of children aged 4–6 years and 30 items for parents of children aged 7–12 years. FAQLQ-Child Form (FAQLQ-CF) has 24 items for patients aged 8–12 years[12] while FAQLQ-Teenager Form (FAQLQ-TF) contains 23 items for patients aged 13–17 years.[13] These two questionnaires included three HRQoL domains, namely, allergen avoidance and dietary restriction (AADR), EI and risk of accidental exposure (RAE). The last one is FAQLQ-Adult Form (FAQLQ-AF) with 29 items for patients over 18 years old, which has four domains, namely, AADR, EI, RAE and food allergy-related health (FAH).[14] These four questionnaires could be found in the appendices of respective articles.[11–14]

This study aimed to translate and validate the Chinese version of these questionnaires to provide a comprehensive and sensitive measure for all food allergy patients and children's parents as well as to assess their limitations in daily life as well as negative emotion due to dietary restriction and life-threatening food reactions.

1 | METHODS

1.1 | Subjects

This study recruited subjects at or below 60 years old who experienced adverse food reactions within 2 years and parents of children aged 12 years old and below who suffered from adverse food reactions. All subjects must be able to read traditional Chinese. Following the completion of our questionnaires, these subjects were assessed by our pediatric allergists to ascertain their food allergy diagnosis by the details of their adverse food reactions together with skin prick testing with allergen extracts (ALK Abelló, Hørsholm, Denmark) and/or quantitation of serum allergen-specific IgE (ThermoFisher Scientific, Waltham, MA, USA). For uncertain cases, subjects underwent either open-label or double-blind, placebo-controlled food challenges. Exclusion criteria included subjects who were unable to give informed consent and those with mental problems that affected their QoL. All participants provided demographics and history of past health, family background and details of food allergy. They also completed our age-appropriate FAQLQ, and a randomly selected subgroup repeated the questionnaire 5 days later to evaluate test–retest reliability. The Joint Chinese University of Hong Kong-New Territories East Cluster Clinical Research Ethics Committee approved this study. Informed written consent was obtained from patients and/or their parents.

Key Message

The assessment of the quality of life (QoL) for food-allergic patients and their caregivers is essential for addressing their medical and psychosocial needs. The Food Allergy Quality of Life Questionnaire (FAQLQ) series developed by EuroPrevall is widely adopted in many European countries, while it is unclear how valid they reflect QoL for populations outside Europe. Our cross-cultural validation involving 214 subjects revealed this FAQLQ series to have generally good internal consistency, construct validity and test–retest reliability in Chinese food-allergic subjects. Nonetheless, our factor analysis categorized items of the FAQLQ series into different QoL domains.

1.2 | FAQLQ questionnaires

All FAQLQ questionnaires required a score for the impact of each item on a 7-point numerical scale from zero ("not at all") to six ("very much"), with higher scores indicating greater clinical impact on QoL. Parents who completed FAQLQ-PF were asked to score from the children's perspective, and the report on the Food Allergy Independent Measure (FAIM) consisted of both parent and child reports.[15] For children who completed the FAQLQ-CF, their parents could explain the question to them when needed if they could not understand it. Additionally, the answer was illustrated by pictures of smiley faces ranging from smiling faces ("not troubled") to sad faces ("extremely troubled").

The FAIM consists of four expectation of outcome questions and two independent measurement (IM) questions. The former four questions relate to the likelihood of accidental exposure, the

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likelihood of a serious reaction from accidental exposure, the likelihood of death from accidental exposure and the likelihood of ineffective measures against accidental exposure. Likert scale with ratings ranging from zero ("never") to six ("always") is used. Two IM questions relate to the number of food types a person needs to avoid and the impact of food allergies on social life. The answer is also a 7-point Likert scale ranging from zero ("almost none") to six ("almost all").[15] In the original FAQLQ series, FAIM was included as a separate section of the respective tools. Therefore, these questionnaires were able to obtain separate scores for both FAQLQ and FAIM for subsequent analysis of their correlations in different subject groups.

1.3 | Translation and adaptation of FAQLQ series

This process included the following three phases: (1) Translation of the original English FAQLQ series into Chinese by standard forward and backward translation methods[16]; (2) review by a focus group of six patients and three parents with food allergic children and (3) assessment of the psychometric properties of the Chinese version of FAQLQ (C-FAQLQ) series in a cross-sectional study involving 200 subjects from pediatric allergy clinic. Details of these phases can be found in Data S1.

1.4 | Statistical analyses

The internal consistency of the C-FAQLQ series and domains was measured by calculating Cronbach's alpha (α), with ≥.70 indicating good internal consistency.[17] The intra-class correlation coefficient (ICC) of test–retest reliability was assessed by repeating questionnaires on at least 10 participants for each questionnaire 5 days later, and ICC 0.4–0.7 was considered acceptable.[18] Pearson's correlation coefficient for parametric data and Spearman's rho correlation coefficient for nonparametric data were used to assess convergent validity. The construct validity of our Chinese questionnaires was assessed by the correlation between FAQLQ and FAIM, with a correlation coefficient of 0.40–0.70 being moderate.[19] Discriminant validity is the sensitivity of covariates (e.g., age, gender, food restriction and the number of food allergies) to total and subscale scores, which was evaluated by respective Pearson correlation coefficients.

Factor analysis was performed using AMOS of IBM Statistical Package for Social Sciences version 23 (IBM Corp, Armonk, NY)[20] to verify the factor structure of a set of observed variables in the original FAQLQ. Fitness of the model was checked by confirmatory factor analysis (CFA) based on global indices including χ^2 value, probability level, comparative fit index (CFI) and root mean square error of approximation (RMSEA).[21] χ^2 value close to zero and probability level >.05 implied small difference between the expected and observed covariance matrices. CFI >.90 indicates an acceptable model fit while RMSEA <.06 indicates a good fit of the data. Exploratory factor analysis (EFA) would be performed if CFA revealed an unacceptable model fit.[21] All statistical analyses were made two-sided using SPSS version 23, with *p*-value <.05 being statistically significant.

2 | RESULTS

A convenience sample of 230 patients with adverse food reactions was approached, and 214 (93.0%) of them consented to participate. Table 1 summarize participants' demographics while Table S1 provides details of their food allergy. Following allergists' consultation, food allergy diagnosis was confirmed in 193 (90.2%) subjects. The four Chinese-translated FAQLQs are accessible at our website <https://www.allergycuhk.org/assessmenttools>. Among 64 parents who completed FAQLQ-PF, 18 were in the 0- to 3-year-old group, 16 in the 4- to 6-year-old group and 30 in the 7- to 12-year-old group. Thirty-one children aged 8–12 years completed FAQLQ-CF, 32 adolescents aged 13–17 years completed FAQLQ-TF and 87 patients ≥18 years old completed FAQLQ-AF. The mean (standard deviation [*SD*]) age of participants who completed FAQLQ-AF was 29.7 (9.5) years. Two-thirds of participants had eczema while most participants reported allergy to 1–6 foods.

Table S2 summarizes the baseline FAQLQ scores in different age groups. Parents of children aged 7–12 years had higher scores on FA (mean 2.9, *SD* 1.2), while children aged 8–12 years had higher scores on EI (mean 3.1, *SD* 1.8). However, participants ≥18 years old reported the lowest score in RAE among the four domains (mean 1.8, *SD* 1.4). Both adolescents and adults had lower FAIM scores (adolescent: mean 1.7, *SD* 0.9; adult: mean 1.8, *SD* 1.0). Nonetheless, the overall score (mean 2.4, *SD* 0.9) for FAIM (0–3 years) reported in parent form was lower than those overall scores for 4- to 6-year-old (mean 2.7, *SD* 1.2) and 7- to 12-year-old (mean 2.8, *SD* 1.9).

2.1 | Internal consistency and test–retest reliability

The total scores on FAQLQ-PF ($n = 64$) had good internal consistency (Cronbach's α >.95) in all three age groups, with scores in different domains ranging from 0.85 to 0.95 (Table 2). Cronbach's α for items in different categories of FAQLQ-PF ranged between .94 and .97 if items were removed. Furthermore, Cronbach's α of total scores for FAQLQ-CF ($n = 31$), FAQLQ-TF ($n = 32$) and FAQLQ-AF ($n = 87$) was .95–.97, and the scores in different domains ranged between 0.76 and 0.94 (Table 3). The Cronbach's α of items in these questionnaires varied from .94 to .97 if items were removed.

Retest for the 0- to 3-year-old group was not analyzed because data were collected only from two subjects. Good correlation was found by test–retest for FAQLQ-PF for 4–6 ($n = 16$) and 7–12 ($n = 30$) years (respective ICC 0.95 and 0.83). The FAQLQ-CF ($n = 4$), FAQLQ-TF ($n = 5$) and FAQLQ-AF ($n = 22$) also showed good correlation (ICC 0.98, 0.94 and 0.99). High ICC >.7 for individual items were found between baseline and repeat FAQLQ-AF questionnaires ($p \leq .002$).

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TABLE 1 Demographic data of participants of FAQLQ series ($n = 214$)

Variable	Category or range	Result[a]
No. of Participants	FAQLQ-PF (0–3 years old)	18 (8.4)
	FAQLQ-PF (4–6 years old)	16 (7.5)
	FAQLQ-PF (7–12 years old)	30 (14.0)
	FAQLQ-CF (8–12 years old)	31 (14.5)
	FAQLQ-TF (13–17 years old)	32 (15.0)
	FAQLQ-AF (≥18 years old)	87 (40.7)
Ages of Participants	FAQLQ-PF (0–3 years old)	2.6 ± 0.8
	FAQLQ-PF (4–6 years old)	5.3 ± 0.9
	FAQLQ-PF (7–12 years old)	9.3 ± 1.8
	FAQLQ-CF (8–12 years old)	9.4 ± 1.6
	FAQLQ-TF (13–17 years old)	14.9 ± 1.4
	FAQLQ-AF (≥18 years old)	29.7 ± 9.5
BMI of Participants	FAQLQ-PF (0–3 years old)	17.2 ± 4.9
	FAQLQ-PF (4–6 years old)	18.3 ± 7.0
	FAQLQ-PF (7–12 years old)	18.9 ± 9.2
	FAQLQ-CF (8–12 years old)	18.5 ± 9.5
	FAQLQ-TF (13–17 years old)	20.6 ± 3.3
	FAQLQ-AF (≥18 years old)	22.4 ± 4.1
Gender	Male	106 (49.5)
Paternal education level	Primary education or below	25 (11.7)
	Secondary education	91 (42.5)
	University education or above	97 (45.3)
	Unknown	1 (0.5)
Maternal education level	Primary education or below	24 (11.2)
	Secondary education	107 (50.0)
	University education or above	83 (38.8)
Social history	Smoking	3 (1.4)
Family background	With siblings	172 (80.4)
	With breastfed	130 (60.7)
	Exposure to second hand smoking	30 (14.0)
	Family history of allergic diseases	84 (39.2)
Current allergic diseases	Asthma	43 (20.1)
	Allergic rhinitis	100 (46.7)
	Chronic urticaria	27 (12.6)
	Eczema	133 (62.1)
	Food allergy	193 (90.2)

Abbreviations: BMI, body mass index; FAQLQ-AF, Food Allergy Quality of Life Questionnaire-Adult form; FAQLQ-CF, Food Allergy Quality of Life Questionnaire-Child form; FAQLQ-PF, Food Allergy Quality of Life Questionnaire-Parental form; FAQLQ-TF, Food Allergy Quality of Life Questionnaire-Teenager form.

[a]Expressed in number (percentage) or mean ± standard deviation.

2.2 | Construct validity

Tables 2 and 3 show the correlation coefficients between the FAQLQ series and FAIM. There were significant correlations between FAIM and mean total as well as domain scores for FAQLQ-CF, FAQLQ-TF and FAQLQ-AF ($p < .001$), and for the correlations between mean FAIM and the total score and three domain scores, namely, EI, FA and SDL by child report in 4–6 years ($p = .005$, .044, .001 and .006, respectively). All the above factors were also significant in 7–12 years for FAQLQ-PF by both parent report and child report ($p < .001$). However, in 0–3 years, there was no significant correlation between FAIM and total and domain scores.

2.3 | Discriminant validity

Table 4 shows the discriminative validity of FAQLQ-PF with participant-related covariates. The total and FA domain scores of FAQLQ-PF of children aged 0–3 years were sensitive to within-group differences in age, gender and presence of cow's milk and fish allergy ($p < .001$, .010, .046 and .004, respectively). For 4–6 years, total and some domain scores were associated with age and presence of any food allergy and egg allergy ($p < .001$, .041 and ≤.05, respectively). The total score was not discriminatory for any covariate for 7–12 years, but FAIM and some domain scores were associated with age and allergies to egg, cow's milk and peanut ($p = .038$, .020, .029 and .032, respectively).

For other questionnaires in the FAQLQ series (Table 5), cow's milk allergy was associated with both total and EI scores of FAQLQ-CF and FAIM ($p = .049$, .039 and .023, respectively). Likewise, teenagers with any food, egg, peanut, and fish allergies were associated with higher total and some domain scores of FAQLQ-TF ($p = .024$, ≤.05, ≤.05 and .035, respectively). By FAQLQ-AF, there were significant correlations between total and some domain scores and any dietary restriction as well as allergies to peanut and fish ($p \leq .05$, ≤.01 and ≤.05, respectively).

2.4 | Factor analysis

Figure 1 summarizes the results from CFA of our Chinese FAQLQ series when compared with published studies,[11–14] namely the three-factor structure of FAQLQ-CF, FAQLQ-PF and FAQLQ-TF, and the four-factor structure of FAQLQ-AF. However, CFA results including χ^2, p-value, CFI and RMSEA did not fit the data well across all four questionnaires. Thus, principal component analysis (EFA) was done to determine the factor structure in our population. To interpret these components according to factor loading, Varimax rotations with Kaiser Normalization were performed on three and four factors with eigenvalues ≥1. All factors showed strong loads and were ≥.30 which was considered as an acceptable criterion.[22] Accordingly, items in the FAQLQ series were

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TABLE 2 Pearson correlation coefficients for internal consistency between FAQLQ-PF and FAIM

	FAIM										
	Parent report					Child report					
	Q1	Q2	Q3	Q4	Mean	Q5	Q6	Q7	Q8	Mean	Cronbach's α
Total FAQLQ-PF											
0–3 years	0.370	0.480	0.074	0.210	0.383	0.344	0.360	0.317	0.194	0.365	.95
4–6 years	0.630[a]	0.616[b]	0.220	0.010	0.561[b]	0.836[c]	0.760[c]	0.332	0.130	0.663[c]	.96
7–12 years	------	------	------	------	------	0.817[c]	0.889[c]	0.800[c]	0.839[c]	0.903[c]	.97
Emotional impact domain											
0–3 years	0.356	0.526[b]	0.050	0.395	0.451	0.400	0.440	0.249	0.236	0.411	.95
4–6 years	0.642[a]	0.436	0.050	0.040	0.455	0.778	0.573[b]	0.134	0.092	0.510[b]	.93
7-12 years	------	------	------	------	------	0.887	0.885[c]	0.809[c]	0.869[c]	0.926[c]	.95
Food-related anxiety domain											
0–3 years	0.154	0.105	−0.297	−0.068	−0.051	0.036	0.052	−0.128	−0.050	−0.021	.87
4–6 years	0.545[b]	0.683[c]	0.324	0.030	0.592[b]	0.853[c]	0.786[c]	0.403	0.265	0.745	.90
7–12 years	------	------	------	------	------	0.685[c]	0.869[c]	0.830[c]	0.757[c]	0.845	.93
Social and dietary limitation domain											
0–3 years	0.467	0.571[b]	0.324	0.102	0.499[b]	0.364	0.354	0.345	0.146	0.359	.92
4–6 years	0.564[b]	0.659[c]	0.299	−0.048	0.555[b]	0.001	0.726[c]	0.452	0.033	0.650[a]	.90
7–12 years	------	------	------	------	--------	0.661[c]	0.722[c]	0.596[c]	0.714[c]	0.726[c]	.85

Note: FAIM items consist of (i) parent report which evaluates the parental expectation of outcomes for children with food allergies and (ii) child report in which parent was asked to imagine items related to health-related quality of life from their child's perspective.

Abbreviations: FAIM, Food Allergy Independent Measure; FAQLQ-PF, Food Allergy Quality of life Questionnaire-Parent Form; Q, question.

[a]Correlation significant at the .01 level (two-tailed).

[b]Correlation significant at the .05 level (two-tailed).

[c]Correlation significant at the .005 level (two-tailed).

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TABLE 3 Pearson correlation coefficients for internal consistency between FAIM and FAQLQ-AF, FAQLQ-CF and FAQLQ-TF

	FAIM							
	EO1	EO2	EO3	EO4	IM1	IM2	Mean	Cronbach's α
Total FAQLQ-CF	0.362	0.603[a]	0.368[c]	0.691[a]	0.693[a]	0.375[c]	0.722[a]	.95
AADR	0.352	0.483[b]	0.266	0.594[a]	0.719[a]	0.247	0.618[a]	.91
EI	0.353	0.698[a]	0.504[a]	0.702[a]	0.571[a]	0.566[a]	0.794[a]	.90
RAE	0.258	0.518[a]	0.280	0.634[a]	0.528[a]	0.268	0.587[a]	.82
Total FAQLQ-TF	0.551[a]	0.384[c]	0.511[a]	0.491[b]	0.696[a]	0.547[a]	0.742[a]	.96
AADR	0.560[a]	0.325	0.452[c]	0.411[c]	0.701[a]	0.577[a]	0.706[a]	.93
EI	0.475[b]	0.409[c]	0.546[a]	0.511[a]	0.597[a]	0.457[c]	0.699[a]	.84
RAE	0.528[a]	0.385[c]	0.492[a]	0.532[a]	0.676[a]	0.495[a]	0.723[a]	.80
Total FAQLQ-AF	0.495[a]	0.708[a]	0.553[a]	0.567[a]	0.644[a]	0.780[a]	0.853[a]	.97
AADR	0.425[a]	0.647[a]	0.463[a]	0.472[a]	0.663[a]	0.728[a]	0.772[a]	.94
EI	0.504[a]	0.706[a]	0.557[a]	0.612[a]	0.638[a]	0.767[a]	0.864[a]	.94
RAE	0.414[a]	0.604[a]	0.549[a]	0.467[a]	0.531[a]	0.701[a]	0.740[a]	.93
FAH	0.505[a]	0.594[a]	0.418[a]	0.605[a]	0.370[a]	0.542[a]	0.700[a]	.76

Abbreviations: AADR, allergen avoidance and dietary restrictions; EI, emotional impact; EO1, chance of accidental exposure; EO2, chance of severe reaction when accidentally exposed; EO3, chance of dying when accidentally exposed; EO4, chance of not acting effectively when accidentally exposed; FAH, food allergy-related health; FAIM, Food Allergy Independent Measure; FAQLQ-AF, Food Allergy Quality of life Questionnaire-Adult Form; FAQLQ-CF, Food Allergy Quality of life Questionnaire-Child Form; FAQLQ-TF, Food Allergy Quality of life Questionnaire-Teenager Form; IM1, number of foods one needs to avoid; IM2, impact of food allergy on social life; RAE, risk of accidental exposure.

[a]Correlation significant at the .005 level (2-tailed).

[b]Correlation significant at the .01 level (2-tailed).

[c]Correlation significant at the .05 level (2-tailed).

rearranged into three to four domains, including AADR, EI, FAH, FA, RAE and SDL (Tables S3–S6).

3 | DISCUSSION

Valid and reliable tools for assessing the QoL of food allergic patients and their parents are essential for developing an appropriate individualized treatment plan and tracking their clinical progress. However, these tools must be relevant and culturally sensitive to patients of different native languages. Our analysis shows that the Chinese-translated FAQLQ series has good internal consistency, validity and reliability. On the other hand, our factor analyses suggested different clustering of items into the QoL domains for the four questionnaires in our population. The availability of this translated FAQLQ series facilitates QoL assessment in our food allergic subjects, and our findings revealed that it was sensitive to differentiate subjects with ($n = 193$) and without ($n = 21$) physician-diagnosed food allergies.

Due to the cognitive and expressive abilities of infants and toddlers, they are unable to display levels of stress and fear, making it difficult for parents to score in FAIM by guessing their child's burden.[23] In this regard, it is reasonable that we found the lack of correlation between the mean total score, all three-subscale scores of FAQLQ-PF and the FAIM score for the 0–3 year group.

Another interesting finding relates to the prevalence of allergic foods in each age group, we found that egg and milk allergies mainly occurred in 0- to 3-year-old, while shellfish was the main food allergy in our adults. Our validation work on Chinese FAQL-PB also found allergies to egg, cow's milk and peanut to be risk factors for impaired QoL among parents of preschool children in Hong Kong.[24] The natural history for egg and milk allergies suggested that most patients outgrew[25,26] and, as in the United States, patients have more shellfish exposure in adulthood.[27] Since Hong Kong is a westernized city, we believed the same situation is happening here.[4,28–30] This finding is comparable to recent research on pediatric anaphylaxis patterns, that food triggers such as milk and eggs are predominantly seen in the age group from birth to 4 years, while shellfish is the highest allergen trigger, usually at a later age factor.[6]

Furthermore, CFA helps to make sure that the components are measuring what they are supposed to but the goodness-of-fit statistics of CFA in this study showed a poor fit for the domains of all questionnaires. Therefore, exploratory factor analysis was done and the categories of items entered different domains. The inconsistent results may be due to cultural differences, as Chinese people may have a different understanding of the QoL issues than Caucasians[31] and affecting their score on the items.

This is an unexpected finding of this study, no differences in questionnaire scores were observed between children and teenagers with and without food restriction, as parents generally tend to avoid more foods than they should.[32] While Hong Kong is traditionally influenced by the concept of Chinese medicine, excessive food restriction is quite common.[33,34] In contrast, FAQLQ-AF and FAIM scores showed sensitivity between adult patients with and without food restriction.

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TABLE 4 Sensitivity by the significant within-group differences among different covariates of FAQLQ-PF

FAQLQ-PF Covariate	Total score	FAIM (parent report)	FAIM (child report)	EI	FA	SDL
Age						
0–3 years	−0.246	−0.489[a]	−0.505[a]	−0.177	−0.060	−0.356
4–6 years	0.171	−0.251	−0.106	0.015	−0.012	0.017
7–12 years	−0.211	------	−0.010	−0.125	−0.263	−0.293
Gender						
0–3 years	0.606[b]	0.128	0.071	0.568[a]	0.331	0.465
4-6 years	0.192	0.232	0.233	0.252	0.177	0.093
7–12 years	0.195	------	0.086	0.096	0.135	0.118
With food restriction						
0–3 years	0.031	0.178	0.373	0.032	0.087	−0.025
4–6 years	0.910	0.509	0.155	0.907	0.750	0.926
7–12 years	−0.192	------	0.025	0.053	0.003	−0.172
With food allergy						
0–3 years	All patients in this category reported to have food allergy					
4–6 years	0.516[a]	0.624[b]	0.478	0.435	0.493	0.536[a]
7-12 years	−0.042	------	0.113	0.160	0.174	−0.107
Egg allergy						
0–3 years	0.213	0.012	−0.391	0.148	0.113	0.362
4–6 years	0.679[c]	0.432	0.429	0.742[c]	0.533[a]	0.593[a]
7-12 years	0.351	------	0.172	0.221	0.423[a]	0.475[b]
Cow's milk allergy						
0–3 years	0.287	−0.098	0.244	0.276	0.070	0.200
4–6 years	0.425	0.098	0.204	0.437	0.347	0.394
7–12 years	0.234	------	0.051	0.155	0.202	0.405[a]
Peanut allergy						
0–3 years	0.304	0.099	0.101	0.350	−0.074	0.209
4–6 years	0.039	0.146	0.015	0.163	−0.093	−0.008
7–12 years	0.325	------	0.284	0.351	0.392[a]	0.249
Fish allergy						
0–3 years	0.448	−0.297	0.126	0.436	0.641[c]	0.267
4-6 years	0.366	0.129	0.317	0.313	0.493	0.248
7–12 years	−0.323	------	−0.355	−0.303	−0.190	−0.204
Shellfish allergy						
0–3 years	0.056	0.645	0.972	0.142	0.179	0.112
4–6 years	0.271	0.284	0.230	0.237	0.243	0.282
7–12 years	−0.050	------	−0.061	−0.127	0.103	0.081

Note: Analyzed by logistic regression for continuous independent variable (age) and Pearson correlation coefficients for binary independent variables. FAIM items consist of (i) parent report which evaluates the parental expectation of outcomes for children with food allergies and (ii) child report in which parent was asked to imagine items related to health-related quality of life from their child's perspective.

Abbreviations: EI, emotional impact; FA, food-related anxiety; FAIM, Food Allergy Independent Measure; FAQLQ-PF, Food Allergy Quality of life Questionnaire-Parent Form; SDL, social and dietary limitation.

[a]Correlation significant at the .05 level (2-tailed).

[b]Correlation significant at the .01 level (2-tailed).

[c]Correlation significant at the .005 level (2-tailed).

Our group tested the robustness with our translated Chinese version of the Food Allergy Quality of Life-Parental Burden questionnaire (FAQL-PB)[35] in assessing QoL in 197 families with preschool children who participated in a territory-wide epidemiological survey of adverse food reactions.[4] Parents of these young children completed this self-administered 17-item questionnaire.[24] The results

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TABLE 5 Sensitivity by significant within-group differences among different covariates of FAQLQ-CF, FAQLQ-TF and FAQLQ-AF

Covariate	Total score	FAIM	AADR	RAE	EI	FAH
FAQLQ-CF						
Age	−0.203	−0.363[a]	−0.132	−0.248	−0.202	NA
Gender	0.082	0.072	0.071	0.078	0.082	NA
With food restriction	0.234	0.149	0.236	0.263	0.133	NA
With food allergy	0.373[a]	0.262	0.404[a]	0.347	0.236	NA
Egg allergy	0.319	0.130	0.250	0.253	0.346	NA
Cow's milk allergy	0.335	0.296	0.275	0.263	0.340	NA
Peanut allergy	0.260	0.164	0.177	0.287	0.293	NA
Fish allergy	−0.231	−0.143	−0.237	−0.296	−0.145	NA
Shellfish allergy	−0.064	0.004	−0.122	−0.033	−0.005	NA
FAQLQ-TF						
Age	0.006	−0.183	0.027	−0.014	−0.022	NA
Gender	−0.177	0.011	−0.149	−0.108	−0.248	NA
With food restriction	0.080	0.154	0.044	0.133	0.081	NA
With food allergy	0.410[a]	0.339	0.387[a]	0.430[a]	0.361[a]	NA
Egg allergy	0.468[b]	0.495[c]	0.479[c]	0.430[a]	0.406[a]	NA
Cow's milk allergy	0.242	0.132	0.276	0.170	0.212	NA
Peanut allergy	0.395[a]	0.231	0.280	0.397[a]	0.479[b]	NA
Fish allergy	0.329	0.353	0.373[a]	0.315	0.178	NA
Shellfish allergy	−0.100	0.080	−0.063	−0.064	−0.174	NA
FAQLQ-AF						
Age	0.122	0.086	0.121	−0.004	0.129	0.71
Gender	0.170	0.254[a]	0.121	0.153	0.208	0.179
With food restriction	0.283[b]	0.189	0.332[c]	0.224[a]	0.261[b]	0.131
With food allergy	0.187	0.169	0.177	0.188	0.156	0.185
Egg allergy	0.059	0.130	0.077	0.094	−0.023	0.022
Cow's milk allergy	−0.108	0.164	−0.133	−0.074	−0.101	−0.101
Peanut allergy	0.292[b]	0.188	0.344[c]	0.260[c]	0.322[c]	0.286
Fish allergy	0.307[c]	0.224[a]	0.280[b]	0.237[c]	0.329[a]	0.198
Shellfish allergy	0.036	0.098	0.081	−0.047	−0.004	0.067

Note: Analyzed by logistic regression for continuous independent variable (age) and Pearson correlation coefficients for binary independent variables.
Abbreviations: AADR, allergen avoidance and dietary restrictions; EI, emotional impact; FAH, food allergy-related health; FAIM, Food Allergy Independent Measure; FAQLQ-AF, Food Allergy Quality of life Questionnaire-Adult Form; FAQLQ-CF, Food Allergy Quality of life Questionnaire-Child Form; FAQLQ-TF, Food Allergy Quality of life Questionnaire-Teenager Form; NA, not applicable; RAE, risk of accidental exposure.
[a]Correlation significant at the .05 level (2-tailed).
[b]Correlation significant at the .01 level (2-tailed).
[c]Correlation significant at the .005 level (2-tailed).

revealed impaired QoL among parents in these families, with the main risk factors being the presence of flexural dermatitis, current food avoidance and allergies caused by multiple foods especially peanut, egg and cow's milk in these preschool children. It would be interesting to know the concordance between FAQL-PB and the 14- to 30-item parental version of FAQLQ-PF,[11] and which of these tools would better evaluate QoL and food allergy outcomes in these parents.

This study has some limitations. Although FAQLQ-PF was described as "user friendly" in the original study,[11] different items were required to be completed by parents of different age groups. The non-significant results of FAQLQ-PF in 0–3 years suggest that it is insufficient to reflect infants' QoL. Therefore, further research on children aged 4–12 years incorporating parent-reported QoL questionnaires to see if the results are synchronized in order to consolidate the validity and reliability of this tool for parents of 4- to 12-year-old children. Another limitation is that in this report only cross-sectional validation is described. Although the sample size is calculated as 200 people according to the requirement of 50 people for each questionnaire, our recruited sample of 214 subjects from convenience sampling was not evenly distributed for the four questionnaires. We had only 31 subjects for FAQLQ-CF and 32 subjects for FAQLQ-TF. In addition, test–retest reliability was assessed only

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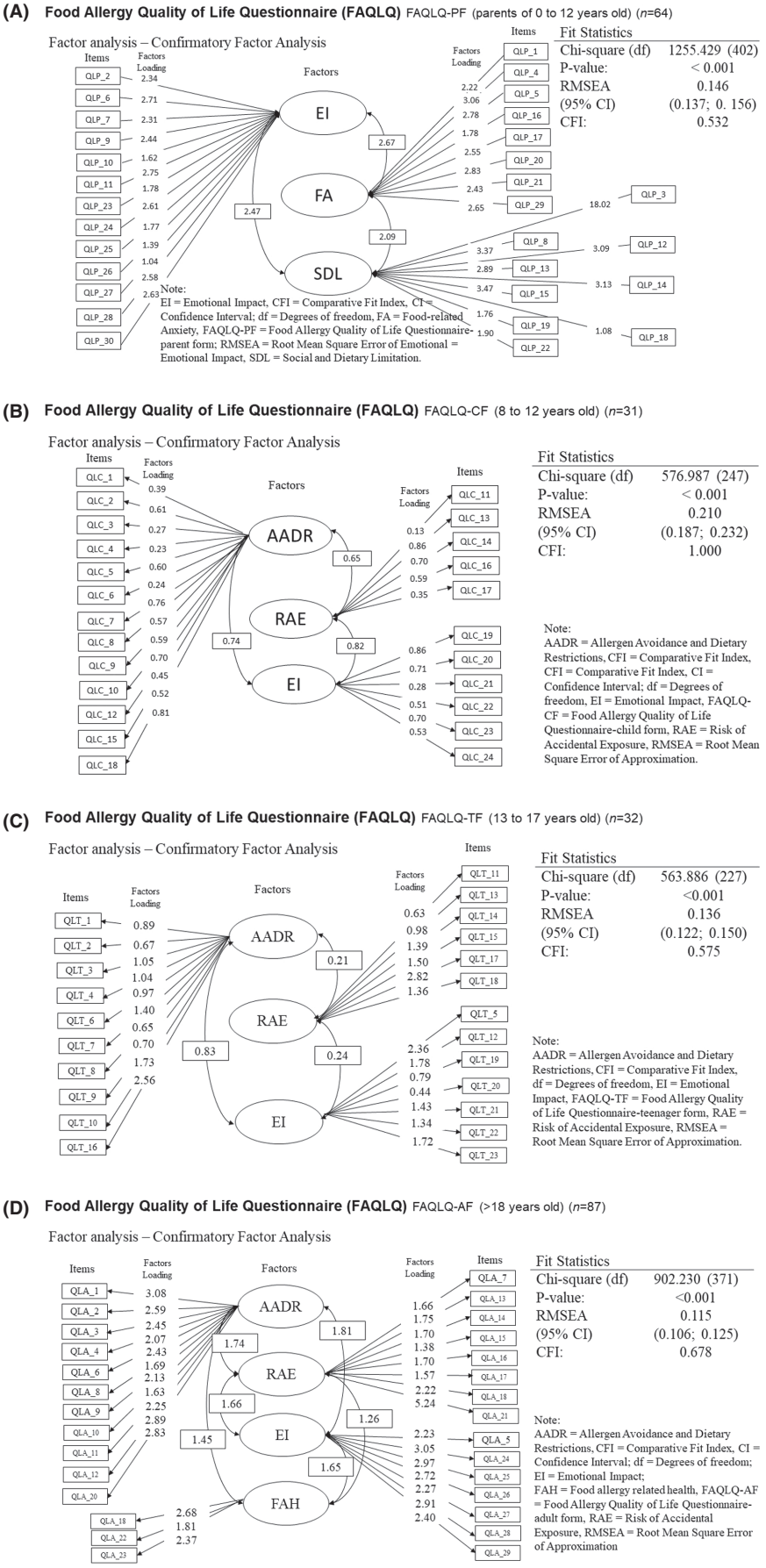
FIGURE 1 Results of confirmatory factor analysis of (A) FAQLQ-PF, (B) FAQLQ-CF, (C) FAQLQ-TF and (D) FAQLQ-AF in our Chinese participants.



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on four subjects for FAQLQ-CF and five subjects for FAQLQ-TF. Larger sample sizes may be valued to obtain more specific effects across groups, and larger numbers of participants with even allocation to the four questionnaires should be recruited.

In conclusion, the C-FAQLQ series is generally a valid and reliable measure for patients with food allergies and a useful tool for assessing their QoL, however, the results of this study do not support the construct validity of FAQLQ_PF for parents of children aged 0–3 years.

AUTHOR CONTRIBUTIONS

ASYL and TFL designed the study, recruited subjects and interpreted the results. NSC designed and administered questionnaires, assembled database, performed statistical analysis, interpreted results and wrote the first draft of this manuscript. RMYL designed and administered questionnaires and processed study data. PFL, CHWL, AWSA and CYYW administered questionnaires and collected study data. BF approved the cross-cultural validation of the FAQLQ series and critically reviewed the manuscript. All authors reviewed and approved the final manuscript.

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CONFLICT OF INTEREST

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SUPPORTING INFORMATION

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