



CME Review

Food Allergy Quality of Life

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At the conclusion of this activity, participants should be able to:

- Recognize that poor quality of life is a consequence of food allergy for many individuals and caretakers and identify specific attributes of food allergy that complicate the measurement of food allergy quality of life
- Evaluate the current measures of food allergy quality of life and review known associations between food allergy and quality of life

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Introduction

Food allergy is a growing public health concern, with an estimated worldwide prevalence of approximately 4% to 10%.^{1,2} Food allergy is attributable to approximately 150 fatalities, 300,000 ambulatory care visits, and 200,000 emergency department encounters per year in the United States and has an estimated socioeconomic burden of approximately \$25 billion per year.^{1–4} There is no known Food and Drug Administration–approved cure or treatment for food allergy, and some food allergies may be lifelong. Between 1997 and 2011 there was an estimated 50% increase in the diagnosis of food allergy based on nationally representative self-reported data, although these data are not based on a criterion standard of oral challenge to verify allergy.⁵ The exact increase in prevalence is hard to specify given poor disease estimates before the early 2000s. The effect of food allergy is felt in food allergic individuals (FAIs) and their caretakers. Food allergy is associated with increased anxiety and reduced quality of life (QoL). This review details the measurement of QoL, issues specific to food allergy in measuring QoL, and the effect food allergy has on generic and disease-specific QoL.

Defining QoL

The World Health Organization definition of QoL is “the individual’s perception of their position in life in the context of the culture and value systems in which they live and in their relation to their goals, expectations, standards, and concerns.”⁶ Health-related QoL measures patients’ perception of their health and how they feel.⁷ QoL can be measured with a generic measurement of health status (eg, 36-Item Short Form Health Survey and Child Health Questionnaire) or with a disease-specific measure. Generic measures can be used to compare general aspects of QoL across many disease states. Most diseases also have specific QoL measures developed and tailored to better measure the problems and concepts particular to that disease.^{8–10}

Measuring QoL Specific to Food Allergy

Food allergy as a chronic disease raises 2 issues in measuring QoL. The first issue is common to pediatric illness in that there are 2 different persons in whom QoL could be measured—the FAI and the caregiver. The FAI experiences an actual direct physical burden of disease in terms of symptom manifestations and potentially experiences psychological ramifications from living with food allergy (eg, bullying, anxiety, and exclusion). In contrast, caregivers only experience indirect burdens, such as the emotional burden or anxiety regarding the FAI’s safety, the burden of the FAI’s pain, and the frustration that unaffected individuals differentially perceive the seriousness of the FAI’s allergy.¹¹ It is unclear whether the FAI or the caregiver is more affected by the food allergy and which individual’s QoL is more important to measure as an outcome. Instruments have been specifically developed for caregivers and FAIs (including forms for FAIs of all ages).^{12–17} Younger children may not reliably be able to describe their QoL, so caregiver-proxy measures have been developed for the caregiver to assess their impression of the child’s QoL, although these may have validity issues regarding a caregiver’s ability to accurately evaluate their child’s QoL.^{18,19}

The second issue is that food allergy vs. other chronic illnesses is unique. The mortality rate is low and symptoms of illness are rarely experienced.^{1,20} Therefore, most FAIs rarely have large day-to-day changes in health status due to physical symptoms, and symptoms are a poor measure of food allergy QoL.¹⁰ However, the daily burden of vigilance affects most FAIs and caregivers frequently and is a better measuring stick for QoL.¹² The burden of daily vigilance within food allergy is broad and may include the following facets: fear of and persistent vigilance for unintentional

reactions, fear of hidden ingredients, fear of being able to treat a reaction, the burden lacking a disease cure or treatment, the burden of food avoidance or label reading, limitations (real or self-perceived) on activity or travel, and the social stigma of having a food allergy (social inclusion, interactions with others, bullying, and teasing).

Developing a QoL Measure

Although psychometric instrument development is beyond the scope of this review, the process can be briefly summarized.²¹ Most instruments are developed through qualitative research using detailed stakeholder interviewing of patients and caregivers affected by the disease to generate a list of thematic items regarding living with the condition.^{22,23} Items are converted into questions with a 4- to 7-point scale (Likert item).²⁴ The number of items is then reduced either mathematically (factor analysis) or based on clinical impact (clinical impact method) and tested in a disease-representative sample for reliability and validity.²⁵ Reliability assesses whether the instrument obtains consistent measurements (eg, the degree that respondent answers correlate with one another). Internal reliability is commonly assessed using the Cronbach α and external reliability (eg, test-retest within subjects) with the intraclass correlation coefficient (ICC). Validity assesses whether an instrument measures what it aims to do (eg, QoL or asthma control).²⁶ Additional testing can be performed to assess index dimensionality—do the items measure a single concept or multiple concepts (allowing for item subscales)?²⁷ Items are generally scored as a summation of the individual Likert items or subscales—sometimes as a mean of the items and domains, and sometimes as a total score.²⁸ Of note, an index must be specifically validated for use in a different language, population type, or culture from where it was originally validated.²⁹

In measuring QoL, statistical significance is not necessarily equivalent to clinical significance, and changes in scores must eclipse a threshold to affect clinical management, called the minimal clinically important difference (MCID). The MCID defines the smallest score change perceived as beneficial to the patient that would alter management.³⁰ In work related to chronic pulmonary and heart disease, Jaeschke et al³¹ described an MCID of 0.5 for use on 7-point Likert scale instruments, which is commonly used for other 7-point scales. However, 0.5 is not an absolute value with universal applicability; MCID is index specific. MCID can be measured in several ways: through the clinical impact method, the SEM, and calculation of the number needed to treat³² (Table 1).

Generic Measures for Food Allergy QoL

The initial studies for food allergy QoL used generic instruments and focused on defining what dysfunction existed and how that compared with other chronic disease states. These studies revealed that food allergy QoL is worse than several other prominent chronic illnesses. One of the earlier studies of QoL and food allergy found that families have greater familial-social dimension impairment and daily activity disruption in peanut allergy vs rheumatologic disorders.³³ Another early study found that food allergic families have worse health perception, emotional impact, and activity limitation than families with children with asthma, attention-deficit/hyperactivity disorder, juvenile rheumatoid arthritis, and epilepsy and that comorbid atopic disease in FAIs worsens QoL on the global health measurement domains.³⁴ It was also found that food allergic children have greater eating anxiety and fear of adverse events than diabetic children, that self-perceived food allergy is associated with poor QoL irrespective of a physician-verified diagnosis, that females have worse QoL than males, and that comorbid atopic disease worsens physical health-related QoL.^{35,36}

Table 1
Brief glossary of psychometric properties of quality-of-life instruments^a

Term	Definition	Measure	Notes
Reliability	Instrument's consistency measuring the same concept on repeated administration		
Single administration	Extent to which all respondent's answers are correlated with one another (eg, how correlated are the items to one another)	Cronbach α	Should be >0.7 but <0.9 . Caution against well-correlated responses that do not measure the underlying concept. Increasing number of items will increase α .
Multiple administration	Extent to which test items correlate with one another on multiple test administration (eg, test-retest)	ICC	Moderate ICC Good ICC >0.7 Excellent ICC >0.8
Validity			
Face	From quick inspection the index appears to measure what it intends to measure		Weakest form of validity
Criterion	Extent to which an instrument measures the unobservable concept, as demonstrated through correlation with an existing instrument that also measures the same concept	Pearson correlation	Desired to be >0.3 but <0.9
Convergent	Extent to which a new instrument correlates with an instrument that measures a related concept	Pearson correlation	Desired to be >0.3 but <0.9
Discriminant	Extent to which an instrument differs from an instrument designed to measure a different concept	Pearson correlation	Desired to be <0.3
Concurrent	Extent to which an instrument can differentiate among groupings it should be able to distinguish	Pearson correlation	Desired to be >0.3 but <0.9
Dimensionality	Number of underlying distinct themes measured within the index	Factor analysis, Eigen value	Dimensionality inferred by the number of factors (unique groupings of the variance explained by a matrix of the test items). Items can group under the factor they best explain (factor loading $\sim >0.3$), allowing for a subscale or domain to be formed.
MCID	Smallest difference in score on an instrument or domain of interest that a patient perceives as beneficial and would influence a change in the patient's management	SEM, number needed to treat, clinical impact rating	For 7-point Likert scales has been estimated to be approximately 0.5, but this is not an exact number. MCID is specific to the index and the population in which it is validated.

Abbreviations: ICC, intraclass correlation coefficient; MCID, minimal clinical important difference.

^aAdapted from Pesudovs et al.²¹

In generic index studies conducted exclusively with FAIs, children had domain-specific QoL deficits related to meal preparation and family activities, worse recall of severe events than their caregivers, and worse QoL compared with nonallergic siblings (in peanut allergic females only), as well as compared with diabetic children.^{37,38} Caregivers of FAIs have significant anxiety in transitioning responsibility to the child, higher anxiety with self-perceived food allergy diagnosis, but less anxiety if the child has an epinephrine device.³⁹ More specifically, mothers have worse anxiety, physical-domain scores, and self-perceived effect than fathers.⁴⁰ Mothers also harbor persistent feelings of living with risk, which worsens once the actual risks of food allergy were understood.⁴¹

Development of Food Allergy–Specific Indices

Although research using generic measures of QoL have identified that food allergy QoL is poor, these measures lack specificity to highlight the unique psychological burden of disease as opposed to the symptomatic burden of disease. In the past 10 years, several validated, food allergy–specific, QoL instruments have been developed for clinical and research use.

Instruments with Validity for US Populations

FAQL-PB

Cohen et al¹² developed and validated the Food Allergy Quality of Life Parental Burden Index (FAQL-PB) to assess food allergy QoL in US caregivers of FAIs younger than 12 years (a teenage form also exists).¹⁷ With the use of patient focus groups and author experience, 74 items were generated, tested in referral clinic patients, and reduced using the clinical impact method to 17 items on a 7-point scale. The index has a 1-week recall period, and lower scores indicate better QoL. The index was validated in combination with 2

expectation of outcome questions regarding the likelihood of what would happen with future reactions (content validity) and the Child Health Quotient-Parent Form 50 (CHQ-PF50) (convergent validity) for individual item correlation. The FAQL-PB had high internal ($\alpha = 0.95$) and external reliability (1-week ICC = 0.93) and a mean score of 2.8. Items correlated moderately with expectation of outcome questions ($r = 0.4$) and the food allergy relevant CHQ-PF50 domains ($r = -0.36/-0.4$). Significant differences in mean score were noted with more than 2 allergies ($r = 0.5$) and caregiver-reported anaphylaxis ($r = 0.3$, not deemed clinically significant). Limitations of the index include that it has only cross-sectional validity, a short recall time, no assessment of dimensionality or index-specific MCID, and validation in a potentially nonrepresentative population (tertiary referral center and advocacy group).¹²

The FAQL-PB was recently validated for use in British caregivers and Chinese caregivers residing in Hong Kong.^{42,43} These studies also included factor analysis to determine index dimensionality. Both groups noted high reliability ($\alpha = 0.94$ and 0.97 , respectively) and a 2-factor structure. Factor loadings for each were similar in that the first 3 items loaded to factor 2; however, items 4 through 17 in the Chinese population and items 7 through 17 in the British sample loaded to factor 1.^{42,43}

Findings Using the FAQL-PB

In US populations, using the FAQL-PB, Springston et al⁴⁴ found that increased food allergy knowledge (using a validated survey), epinephrine device familiarity, prior emergency department evaluation for food allergy, multiple food allergies, and milk or wheat allergy (vs other allergens) were independently associated with poor caregiver QoL. Howe et al⁴⁵ noted that milk and egg allergy (vs peanut and tree nut allergy), low family income, multiple food allergies, inaccurate reaction perception (eg, overperceive or underperceive severity), comorbid eczema in an FAI, and reported past

Table 2
HRQoL instruments for food allergy

Instrument	Whose HRQoL	Administered by	No. of items	Method of development	Internal and external reliability	Internal and external validation
FAQL-PB ¹⁷	Parents (0–17 years)	Parent	17	Item generation: patient/parent interview, literature review, expert opinion Item reduction: clinical impact method, factor analysis	$\alpha = 0.95$ ICC = 0.93	Internal: interitem correlations; factor analysis External: face, content, convergent/discriminant, construct, cross cultural validity: United Kingdom, responsiveness
PFA-QL ⁴²	Patients (6–16 years)	Parent/child	25	Item generation: patient/parent interview, literature review, expert opinion	$\alpha = 0.77–0.82$ ICC = 0.77	Internal: NP External: face, content, convergent/discriminant, discriminative abilities
FAIS ⁵²	Patients (0–18 years)	Parent	32	Item generation: patient/parent interview, literature review, expert opinion	$\alpha = 0.68–0.94$ ICC = NP	Internal: NP External: face, content
FAP-Q ⁵³	Parents (0–18 years)	Parent	18	Item generation: expert opinion	$\alpha = 0.32–0.80$ ICC = NP	Internal: factor analysis External: face, content
FAQLQ-PF ^{18,55,58}	Patients (0–12 years)	Parent	30	Item generation: patient/parent interview, literature review, expert opinion Item reduction: clinical impact method, factor analysis	$\alpha = 0.89–0.94$ ICC = 0.73–0.89	Internal: interitem correlations, factor analysis, floor and ceiling effects External: face, content, convergent/discriminant, construct (0.52–0.73), longitudinal (0.65–0.74), responsiveness, cross-cultural validation: United States, Netherlands
FAQLQ-PFT ⁶⁴	Patients (13–18 years)	Parent	27	Item generation: patient/parent interview, literature review, expert opinion Item reduction: clinical impact method, factor analysis	$\alpha = 0.94$ (Dutch version) ICC = NP	Internal: interitem correlations, factor analysis External: face, content, convergent/discriminant validity, discriminative abilities, construct ($\rho = 0.64$, Dutch version), cross cultural validation: Netherlands
FAQLQ-CF ²⁰	Patients (8–12 years)	Child	24	Item generation: patient interview, literature review, expert opinion Item reduction: clinical impact method, factor analysis	$\alpha = 0.94$ ICC = 0.91	Internal: interitem correlations; factor analysis, floor and ceiling effects External: face, content, convergent/discriminant, construct (0.60), longitudinal (0.51), responsiveness, cross cultural validation: in progress
FAQLQ-TF ^{19,55}	Patients (13–18 years)	Teenager	28	Item generation: patient interview, literature review, expert opinion Item reduction: clinical impact method, factor analysis	$\alpha = 0.92$ ICC = 0.98	Internal: interitem correlations; factor analysis, floor and ceiling effects External: face, content, convergent/discriminant, construct ($\rho = 0.57$) longitudinal ($\rho = 0.35$), responsiveness, discriminative abilities, cross-cultural validation: in progress
FAQLQ-AF ^{19,55}	Patients (≥ 18 years)	Adult	29	Item generation: patient interview, literature review, expert opinion Item reduction: clinical impact method, factor analysis	$\alpha = 0.97$ ICC = 0.95	Internal: interitem correlations; factor analysis, floor and ceiling effects; External: face, content, convergent/discriminant, construct ($\rho = 0.76$) longitudinal ($\rho = 0.71$), responsiveness, discriminative abilities, cross-cultural validation: United States
FAQL-TF ²²	Patients (13–19 years)	Teenager	17	Item generation: patient interview, literature review, expert opinion Item reduction: clinical impact method	$\alpha = 0.9$ ICC = NP	Internal: interitem correlation; no factor analysis External: face, content, convergent/discriminant validity, discriminative abilities, construct
You and your food allergy scale ⁶⁵	Patients (13–18 years)	Teenager	34	Item generation: patient interview, literature review, expert opinion Item reduction: factor analysis	$\alpha = 0.82$ ICC = 0.87	Internal: interitem correlation; factor analysis External: face, content, convergent/discriminant, discriminative abilities, construct
FLIP ⁶⁶	Family (0.5–7 years)	Parent	19	Item generation: patient/parent interview Item reduction: clinical impact method, factor analysis	$\alpha = 0.90$ ICC = 0.71	Internal: interitem correlation; factor analysis External: face, content, convergent/discriminant, discriminative abilities, construct

Abbreviations: FAIS, Food Allergy Impact Scale; FAP-Q, Food Allergy Parent Questionnaire; FAQL-PB, Food Allergy Quality of Life–Parental Burden Questionnaire; FAQLQ-CF, -TF, -AF, -PF, and -PFT, Food Allergy Quality of Life Questionnaire–Child Form, –Teenager Form, –Adult Form, –Parent Form (0–12 years), and –Parent Form Teenagers (13–17 years); FAQL-Teen, Food Allergy Quality of Life Questionnaire for Teenagers; FLIP, Food hypersensitivity family ImPact Questionnaire; HRQoL, health-related quality-of-life; ICC, intraclass correlation coefficient; NP, not performed; PFA-QL, Pediatric Food Allergy–Quality of Life questionnaire.

^aReprinted, with permission, from van der Velde et al.⁶⁷

anaphylaxis were all associated with worse caregiver QoL among a population cared for at a tertiary referral center. From the same center, Franxman et al⁴⁶ noted better caregiver QoL in children who had undergone oral food challenge (OFC) vs those who had not, and no difference in QoL between caregivers of FAIs passing vs failing OFC. Also from the same center, Baptist et al⁴⁷ noted improvement from baseline in QoL among caregivers of children with new and established food allergy randomized to use a novel self-regulation intervention for anaphylaxis management. In a British sample, Knibb and Salker⁴² noted worse QoL for divorced, single, or widowed caregivers, unemployed caregivers, FAIs with anaphylaxis, or those with multiple food allergies. Lastly, Leung et al⁴³ noted worse QoL in caregivers with children with multiple food allergy, specific allergens (peanut, egg, and cow's milk), and eczema among Chinese caregivers residing in Hong Kong.

Other US QoL Instruments

Bollinger et al⁴⁸ developed an 8-domain, 32-item Food Allergy Independence Scale that measured how family life and social interaction are affected by food allergy. Items were generated through the use of existing food allergy QoL measures and qualitative interviews. The Food Allergy Independence Scale had good internal validity ($\alpha = 0.68$ – 0.94) and indicated that a high percentage of respondents reported that food allergy affected daily meal preparation (60%), family social activities (49%), increased daily stress (41%), and school attendance (34%). The index did not differentiate children with prior anaphylaxis, asthma, or eczema. LeBovidge et al⁴⁹ developed the 4-domain, 18-item Food Allergy Parent Questionnaire to measure caregiver psychosocial adjustment to the child's food allergy. The domains assess anxiety, psychosocial effect of the allergy, coping or competence, and family support. Internal validity of the 4 domains ranged from $\alpha = 0.32$ to 0.8 . Higher domain scores were significantly correlated with a longer persistence of a food allergy, increased number of food allergies, a reported history of anaphylaxis, and younger child age.

QoL Instruments Validated for International Use

FAQLQ Family

The EuroPreval project used a multicentered, collaborative approach to develop a family of QoL instruments (Food Allergy Quality of Life Questionnaire [FAQLQ]) age specific for FAIs and a proxy measure for caregivers of FAIs 17 years or younger.^{14–16} Items were generated through focus groups and reduced using the clinical impact method. Investigators also created a 6-item food allergy-specific expectation of outcome measure to independently assess construct validity of the FAQLQ, called the Food Allergy Independence Measure (FAIM). The FAQLQ is similarly constructed and consists of 25 to 30 seven-point Likert items. Factor analysis revealed that the indices have multiple domains, each highly correlated to the FAIM ($\rho = 0.57$ – 0.74), demonstrating good content validity.⁵⁰ The instruments all have high internal validity ($\alpha > 0.9$), high external validity (ICC = 0.73 – 0.95) and were able to discriminate individuals with multiple food allergens (all indices), anaphylaxis (adult form), and sex differences (parent proxy and child forms).⁵¹ These instruments have cross-sectional and longitudinal validity, validation for Internet use (adult form), and validation in the United States and several European nations (multiple forms).^{52–54} In addition, evaluations that compared generic instruments to the FAQLQ family noted that the generic instruments had low agreement and ceiling effects, demonstrating the specific instruments as better measures for food allergy.⁵⁵

Key Findings Using the FAQLQ Family

In European populations, advancing FAI age, history of a severe reaction, having a food allergic mom or sibling, multiple food allergies, and female sex were associated with poor QoL using the FAQLQ–Child Form.^{15,56} Adult FAIs seeking medical care for food allergy had poor QoL and disease perception, and worse QoL was noted in US vs Dutch adult FAIs.^{52,57} Moreover, FAIs using the FAQLQ–Child Form reported a larger QoL effect than their parents using the proxy form,⁵⁸ and differences were found between parent and adolescents using the FAQLQ–Teenager Form and FAQLQ–Parent Form related to adolescent comprehension of illness.⁵⁹ The FAQLQ has also been used in interventional trials as a patient-reported outcome tool.^{60,61} In a European trial that explored the effect of OFC on QoL, investigators found QoL improvement from baseline to 6 months after challenge between challenged vs unchallenged patients and better QoL in FAIs passing vs failing OFC, but these changes were limited by the specific allergen and worse baseline QoL.⁶¹ In Australia, using the FAQLQ, being prescribed an epinephrine device, having more than 4 sensitizations, or having experienced prior anaphylaxis was associated with worse QoL in children.⁶² Lastly, in an oral immunotherapy study in a US office-based practice, the FAQLQ was used (without cross-cultural validation) to show that QoL improved with oral immunotherapy.⁶³

Other QoL Instruments with International Validity

Knibb et al³⁸ recently validated the Pediatric Food Allergy Quality of Life Questionnaire, a 25-item parent-proxy index developed in 2003 for UK children ages 6 to 16 years with nut allergies. Items were generated through patient and parent interviews, literature review, and expert opinion. The index was validated in clinic and self-report populations and correlated to the Pediatric Quality of Life Inventory (PedsQL) 4.0, the CHQ-PF50, and the FAQL-PB. The Pediatric Food Allergy Quality of Life Questionnaire had a $\alpha = 0.77$ /0.82 (clinic/self-report), a 2-week ICC = 0.77 (clinic only), moderate correlation with both the PedsQL total and domain-specific scores (clinic sample), strong correlation with the FAQL-PB (self-report), and slight correlation with the FAIM (self-report). The index discriminated sex differences in samples (QoL worse in females) and number of allergen (≤ 2 vs ≥ 3 foods) in the self-reported sample.⁶⁴ Mackenzie et al⁶⁵ developed the 34-item You and Your Food Allergy Scale specifically to measure QoL in UK teenage FAIs. Using standard qualitative methods, they generated 51 items from an advocacy group sample, which were reduced using factor analysis to a 34-question index with 5 domains and tested in comparison to the PedsQL teen report. The index has a $\alpha = 0.92$, an ICC = 0.87 , and strong correlation of its domains to the PedsQL for construct validity. The index differentiated QoL by allergen number and identified that food allergy had the highest effect on family relationships, independence, and social well-being. Lastly, Mikkelsen et al⁶⁶ developed an index for caregivers of Swedish children ages 6 months to 7 years. Using qualitative methods, they generated 68 items, which were reduced using the clinical impact method to form a 19-item, 3-domain index with a $\alpha = 0.9$ and ICC = 0.71 . The index revealed a moderate correlation with the Swedish stress index (construct validity) and was able to differentiate QoL based on the child's age, number of food allergies (multiple vs milk only), and number of children. Table 2 provides a full list of all the various QoL instruments and their psychometric properties.⁶⁷

Conclusion

QoL is an emerging, key patient outcome to measure. Although food allergy may be associated with potentially severe symptoms, these are rarely experienced; therefore, food allergy QoL focuses on

the burden of illness that our families and patients live with. Several measures are now available for clinical use in the United States and elsewhere. Research with these instruments has provided valuable data on what shapes the lives of our patients and families. The data indicate that FALs and caregivers have poor QoL, but limited intervention is available to fix this. At the same time, as physicians we must be aware of our potential iatrogenic role in the contributing to poor QoL—we have nothing to offer beyond an all-or-nothing avoidance approach that is backed by limited data and poor understanding of how food allergy differentially affects the population, which fosters a culture of fear and anxiety that may manifest as poor QoL. Although the scope of food allergy QoL research has barely scratched the surface, it has provided some insight that we can be taken advantage of to design interventions to help at-risk families.

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