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Patterns of Adaptation to Children's Food Allergies

David A. Fedele, Ph.D.¹, Elizabeth L. McQuaid, Ph.D.², Anna Faino, M.S.³, Matthew Strand, Ph.D.³, Sophia Cohen, B.A.³, Jane Robinson, Ph.D.^{3,4}, Dan Atkins, M.D.^{3,4}, Jonathan O'B Hourihane, M.D.⁵, and Mary D. Klinnert, Ph.D.^{3,4,*}

¹University of Florida, Gainesville, FL ²Bradley/Hasbro Children's Research Center, Brown University, Providence, RI ³National Jewish Health, Denver, CO ⁴University of Colorado School of Medicine, Aurora CO ⁵University College: Cork, Ireland

Abstract

Background—Families with food allergy (FA) are at risk of reduced quality of life and elevated anxiety. A moderate level of anxiety may be beneficial to sustain vigilance for food avoidance; however, excessive anxiety may increase risk for burden and maladjustment. The current study presents a framework for understanding patterns of adaptation to FA across families and to identify typologies of families that would benefit from intervention.

Methods—Participants included 57 children, 6 to 12 years old with documented FA, and their mothers. Families were assessed using the Food Allergy Management and Adaptation Scale. Families also completed measures of quality of life, anxiety, FA management, and psychosocial impairment.

Results—A hierarchical cluster analysis revealed that 56 of the 57 families of food allergic children were categorized into four groups that differed on their adequacy of family FA management, levels of anxiety, and balanced psychosocial functioning: *Balanced Responders* ($n = 23$; 41%), *High Responders* ($n = 25$; 45%), and *Low Responders* ($n = 3$; 5%). The fourth group, *Anxious High Responders* ($n = 5$; 9%), was characterized by extremely high maternal FA anxiety scores and low scores for balanced integration of FA management and psychosocial functioning. Families in clusters differed across illness and psychosocial outcome variables.

Conclusion—Families with FA were characterized by patterns of FA management, anxiety, and ability to integrate FA demands into daily life. Identified adaptation patterns correspond with clinical impressions and provide a framework for identifying families in need of intervention.

*Corresponding Author: Mary D Klinnert, PhD, National Jewish Health, 1400 Jackson Street, Denver, Colorado 80206, klinnertm@njhealth.org, Ph. 303-398-1231, Fax 303-270-2141.

Author Contributions

MK, EM, and DA conceptualized and designed this study, and MK, DF, EM, AF, MS, SC, JR, DA, and JH conducted data acquisition, analysis, and interpretation. DF drafted and revised the article, with substantial contributions by MK, AF, and MS, and final revisions by all authors. All authors approved the final version of the article.

Conflict of Interest Statement

No authors have conflicts of interest to disclose.

Keywords

adaptation; anxiety; family; food allergy management; pediatric food allergy

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Introduction

The prevalence of self-reported food allergy (FA) in the United States increased 18% from 1997–2007⁽¹⁾ and in Europe the lifetime prevalence of self-reported FA is estimated to be 17.3%.⁽²⁾ Recent estimates indicate that as many as 8% of children may have FA.⁽³⁾ For affected youth and families, living with FA has been associated with decreased quality of life (QoL), increased disruptions in daily activities, and elevated psychological distress.^(4,5–8) Concurrently, many families have been found lacking in adequate FA management skills.⁽⁹⁾ Successful family adaptation requires both effective FA management and positive psychosocial adjustment.

Adaptation to FA varies widely across families, but patterns of adaptation are poorly understood.⁽¹⁰⁾ A mixed literature reports both elevated levels of anxiety in youth and families as well as *below* average levels of anxiety; study differences appear to depend on informant, family member targeted, specific measures, and reference groups.^(8,11–14) Studies report wide variability in psychological responses to FA, noting findings of subsets of children or parents with high anxiety and emotional distress.^(8,13,15,16) Variability in FA management has also been documented, with many families having major deficits in their FA knowledge, vigilance for allergenic foods, and comfort with FA treatment.^(17,18) Ideally, families possess effective FA management skills and have adequate levels of anxiety to sustain vigilance for food avoidance,⁽¹⁹⁾ without inhibiting normal family life. The extent to which families achieve this balance has clinical implications, since excessive anxiety or inadequate management skills increase risk for negative outcomes, increased burden and family maladjustment.⁽²⁰⁾

The current study presents a framework for understanding variability in family FA adjustment and examines patterns of adaptation by focusing on three behavioral dimensions: adequacy of FA management skills, regulation of FA anxiety for children and parents, and overall balanced integration of FA into family life. We hypothesized variation in families' functioning along the three dimensions would result in distinct patterns of families' overall FA adaptation.⁽²⁰⁾ Since no previous measures have simultaneously addressed the affected child and family's functioning in the three domains of FA adaptation, we developed and validated the Food Allergy Management and Adaptation Scale (FAMAS).⁽²¹⁾ The FAMAS is a semi-structured interview designed for families of 6 to 12 year-old children with FA, with rating scales that assess both child and family FA management skills and FA-related anxiety, and the family's overall balanced integration (Table 1).

Cluster analysis methodology using FAMAS scale scores was employed to identify distinct patterns of family FA adaptation. We hypothesized that three family adaptation patterns would emerge: a) *Balanced Responders* – characterized by high levels of FA management skills, moderate levels of FA-related anxiety, and high balanced integration; b) *High Responders* – characterized by adequate FA management skills, high levels of FA-related

anxiety, and low balanced integration; and c) *Low Responders* - characterized by inadequate FA management skills, low FA-related anxiety, and low balanced integration. We expected that the cluster groups of families representing distinct adaptation patterns would differ from each other in terms of demographic characteristics, atopic illness features, competence in epinephrine administration, FA impact on the family, parent quality of life, parent and child general anxiety, and parent FA outcome expectations.

Methods

Study Design and Population

The study was conducted at a tertiary care center and was approved by the Institutional Review Board. Families were recruited via physician referrals from the hospital pediatric outpatient clinic and local private allergy practices, and from mailings to members of a local FA support group. Inclusion criteria were: 1) having a 6 to 12 year-old child with physician-documented FA; and 2) child having a documented history of food reaction and positive testing for IgE-mediated FA within 18 months of the study visit, verified by medical record review. Children with unconfirmed FA, from non-English speaking families, or with severe developmental delays were excluded.

Study Visit Procedures

Families participated in an hour-long, video recorded FAMAS interview conducted by a clinical psychologist. Following the interview, parents and children were separated. Children completed general anxiety questionnaires, assisted as needed by a trained research assistant. Meanwhile, parents were video recorded using a familiar device to demonstrate administration of auto-injectable epinephrine (Epi-Demo), after which they completed questionnaires. Child demographic and medical information was obtained from parent report and chart review.

Food Allergy Management and Adaptation Scale (FAMAS)—The FAMAS is a validated semi-structured interview with both parents and children present that was designed to assess families' FA management and adaptation.⁽²¹⁾ Ratings for FAMAS subscales are based on parents and children's verbal responses and emotional reactions throughout the interview. Table 1 lists the FAMAS subscales; the FAMAS interview is available online.⁽²¹⁾ FAMAS interviews were video recorded to allow subsequent ratings to be made independently by study personnel using a standard scoring manual. Independent ratings of the interviews demonstrated excellent inter-rater reliability (ICCs 0.94–0.98 across scales).

The Family FA Management composite score represents averaged ratings for six subscales that measured family-level behavioral domains such as FA knowledge and readiness to respond to FA reactions; see Table 1 for subscale descriptions and selected scale-specific anchors. The Family FA Management composite scale had excellent internal consistency (Cronbach's $\alpha = 0.91$). Children's responses were rated separately for Food Avoidance and Response Readiness, using guidelines based on developmental capabilities, and averaged for a Child FA Management score. Parent and child's FA Anxiety are each rated separately using the rating guidelines (Table 1). The Balanced Integration subscale represents a global

judgment of how well the family has integrated FA management behaviors and skills with other aspects of child and family life, avoiding unwarranted restrictions on family members' behavior and maintaining normative age and role appropriate functioning for family members. Scales were constructed with 9 points, with high scores indicating more (e.g., Anxiety) or better (e.g., FA management); scores at 4 or below indicate inadequate FA management (e.g., unprepared to handle an anaphylactic reaction).

Questionnaire measures of FA family impact and general anxiety—The Food Allergy Impact Scale (FAIS) was used to evaluate the parent's perception of the impact of FA on eight aspects of daily family activities, with higher scores indicating greater impact.⁽⁶⁾ The Food Allergy Quality of Life-Parent Burden Questionnaire (FAQL-PB) assessed the impact of FA on QoL of parents.⁽¹²⁾ The Food Allergy Independent Measure (FAIM) assessed parent FA outcome expectations, with higher scores indicating increased likelihood of an outcome event such as their child dying from FA.⁽²²⁾

The State-Trait Anxiety Inventory (STAI)⁽²³⁾ and State-Trait Anxiety Inventory for Children (STAI-C)⁽²⁴⁾ are 40-item self-report instruments that measure the respondent's current anxiety symptoms (i.e., state anxiety) and general propensity to be anxious (i.e., trait anxiety). The Multidimensional Anxiety Scale for Children (MASC)⁽²⁵⁾ is a 39-item child self-report questionnaire that assesses a broad range of anxiety symptoms for children. STAI, STAI-C, and MASC *t* scores were used in this study; higher scores indicate more anxiety.

Behavioral index of parent FA management – Epi-Demo—Trained personnel independently reviewed video recordings of parents' demonstration of epinephrine injection (Epi-Demo), and rated proper use of the device based on six required behaviors.⁽²⁶⁾ Higher scores corresponded with more elements of effective device use. Inter-rater reliability, computed for sum correct, was excellent (ICC = .92).

Statistical Analyses

Cluster analysis is a statistical method used to group subjects or variables that behave similarly.⁽²⁷⁾ We used hierarchical cluster analysis based on Euclidean distances to group subjects with similar patterns of family FA management and psychosocial adaptation to FA. Five FAMAS variables were used for the cluster analysis: Family FA Management Composite, Child FA Management Composite, Parent FA Anxiety, Child FA Anxiety, and Balanced Integration. Balanced Integration was weighted doubly to allow for equal influence of FA management, FA anxiety and Balanced Integration in the cluster analysis. Average linkage was used to determine the distance between sets of observations. The dendrogram was used to identify the optimal number of clusters. Cluster names were determined by examining the patterns of variables in each cluster. Following cluster identification, tests for overall differences between clusters were performed for demographic and illness characteristics, as well as measures of impairment, anxiety, and FA management using ANOVAs, Kruskal-Wallis' test, or Fisher's Exact test, depending on the distribution and scale of the measure. For variables with $p < .05$ for the test of overall group differences, pairwise comparisons were performed using the false discovery rate (FDR) procedure,⁽²⁸⁾

with an FDR of .05. Non-hierarchical cluster analysis was also performed using k-means clustering (results not presented), but results were less consistent than with hierarchical cluster analysis. We chose to proceed with the hierarchical approach due to its less restrictive nature.

Results

Participant Characteristics

Participants included 60 families with physician documented FA that were part of a larger FAMAS validation study.⁽²¹⁾ Three children were accompanied to the study only by their fathers. The more homogenous sample of mothers and their children ($n = 57$) was used for reported analyses. Participant demographic and illness characteristics are presented in Table 2.

Cluster Analysis

Four clusters emerged at an average Euclidean distance of approximately 0.95, including the three hypothesized clusters and an additional one: *Balanced Responders* ($n = 23$; 41%), *High Responders* ($n = 25$; 45%), *Low Responders* ($n = 3$; 5%), and *Anxious High Responders* ($n = 5$; 9%). One family with a unique pattern (low FA management and high FA anxiety scores) did not enter a cluster; this case was omitted from cluster comparisons. The profiles of FAMAS scale means for the four clusters are displayed in Figure 1; associated mean scores are presented in Table 3. *Balanced Responders* had high Family and Child FA Management scores, moderate Mother and Child FA Anxiety levels, and high scores for Balanced Integration. Families in the *High Responders* cluster received relatively high ratings for Family and Child FA Management, high Mother and Child FA Anxiety levels, and average scores for Balanced Integration. *Low Responders* had low scores for Family and Child FA Management, Mother FA Anxiety, and Balanced Integration; Child FA Anxiety was in the average range. The additional cluster group identified, *Anxious High Responders*, was marked by high Family and Child FA Management scores, but while the children's FA Anxiety was high, Mother FA Anxiety was *extremely* high; Balanced Integration was very low.

Variables Associated with Cluster Membership

Demographic characteristics, FA history, and atopic illness features—Groups did not differ by demographic or illness variables, but a significant difference emerged in parent reports of prior auto-injectable epinephrine device usage (Table 4). Compared to *Balanced Responders*, the percentage of *High Responders* and *Anxious High Responders* who reported previous auto-injectable epinephrine device usage was greater (pairwise $p = .04$ and $.003$, respectively; difference between *Balanced Responders* and *Anxious High Responders* remained after FDR correction).

FA QoL and FA impact on the family—Differences across clusters were found for FAQL-PB (Table 5), with the *Anxious High Responders* reporting the worst QoL and the *Low Responders* being impacted least; significant differences were found between *High Responders* and *Low Responders* and between *Balanced Responders* and *Anxious High*

Responders (pairwise $p = .05$ and $.02$, respectively; differences across groups did not remain after FDR correction). One subscale of the FAIS differed across clusters; the *Anxious High Responders* reported higher impairment in caregiver-supervised social activities for their children compared to *Balanced Responders* (pairwise $p = .004$; difference remained after FDR correction). Differences in the Family Social Activities subscale of the FAIS approached significance.

Mother and Child Anxiety—Mothers' general anxiety did not differ across groups. Children's trait level anxiety scores differed across clusters. *Anxious High Responders* and *High Responders* reported higher trait anxiety than *Balanced Responders* (pairwise $p = .002$ and $.02$, respectively; difference remained after FDR correction for *Anxious High Responder* comparison). Compared to *Balanced Responders*, *Anxious High Responder* mothers rated the likelihood of their child dying due to FA significantly more highly (pairwise $p = .001$; difference remained after FDR correction).

FA Management—Parents' Epi-Demo scores, our behavioral index of FA management, were different across groups, with *Balanced Responders* having the highest scores (*High Responders* versus *Balanced Responders*: pairwise $p = .005$; *Balanced Responders* versus *Low Responders*: $p = .01$; *Low Responders* versus *Anxious High Responders*: $p = .02$; differences across groups remained after FDR correction).

Discussion

Families of children with FA are challenged to balance appropriate vigilance and management of FA while tempering the effects of FA on activities of daily living and QoL. Parents and children with FA are at risk of poor adaptation to FA for several reasons, including suboptimal management strategies, low treatment competencies and elevated anxiety.^(10,17) A validated semi-structured family interview was used to identify patterns of family adaptation to FA based on adequacy of FA management, levels of anxiety, and balanced psychosocial functioning. The distinct adaptation patterns identified correspond with clinical impressions and provide a framework for identifying families in need of intervention.

As hypothesized, families were largely categorized into three groups through cluster analysis: *Balanced Responders*, *High Responders*, and *Low Responders*. *Balanced Responders* were able to adequately manage the FA while minimizing effects on parent or child psychosocial functioning. *High Responders* had high competency in FA management; however, families were characterized by high FA-related anxiety with potential for interference with normative child and family activities and functioning. *Low Responders* had moderate FA anxiety, but also had serious inadequacies in food avoidance and knowledge and preparation for effective response to reactions.

We labeled as *Anxious High Responders* the unexpected, small group that was identified by the cluster analysis, since FA Anxiety scores for these mothers were at the highest levels of the FAMAS scale. These mothers made statements about being "scared to death" about their child's FA, being immobilized by fear of a reaction, or ruminating about the possibility of

food exposure resulting in their child's death. Compared with mothers in the *Balanced Responder* group, questionnaire responses for those in the *Anxious High Responder* group indicated worse QoL impact and burden for parents, higher impairment in caregiver-supervised social activities, and higher ratings of the likelihood of their child dying from FA. Determinants of the very high FA anxiety for mothers in this cluster group are unknown. Children in this group were reported to have experienced anaphylaxis and most had been administered epinephrine, suggesting that the mothers could be experiencing a post-traumatic stress reaction associated with encountering a life-threatening event.⁽²⁹⁾ Alternatively, this group, fearful of a fatal outcome, may have over interpreted reaction severity and reported anaphylaxis where less anxious caregivers might not have done so. Identification of the *Anxious High Responder* group underscores the importance of identifying mothers with extremely high levels of FA-specific anxiety who are in need of psychosocial intervention.⁽³⁰⁾

Mothers from the *High Responder* cluster were not as emotionally distressed as those from the *Anxious High Responder* group, but reported concerns such as frequently worrying when apart from their child, excessive fear of FA reactions, or great apprehension about administering epinephrine. Importantly, despite high FAMAS FA Anxiety scores, these mothers did not report higher *general* anxiety than mothers with lower FA Anxiety. This is consistent with previous research indicating that, for mothers of food allergic children, standardized anxiety assessment scores are not elevated compared with normative data^(7,8,16) These findings suggest that maternal FA anxiety may impact day-to-day activities for a subset of families, be qualitatively different from general anxiety, and require assessment and intervention approaches that are sensitive to FA-specific anxiety.

Child FA Anxiety was similarly high for the *High Responder* and *Anxious High Responder* groups, but means from neither group were as high as FA Anxiety scores of mothers from the *Anxious High Responder* group. Nevertheless, the mean scores for the *High Responder* and *Anxious High Responder* groups indicated that half of the children in the study experience high levels of anxiety about FA. Children who received scores of 7 on the 9-point Child FA Anxiety scale acknowledged FA fears that impacted daily behavior, such as being unwilling to be in the vicinity of food to which they are allergic. For children who received scores of 8 or 9 on this scale, fear of FA constituted a significant disruption in their lives. Unlike their mothers, children from the *High Responder* groups also had higher trait anxiety than children in the *Balanced Responder* group, suggesting that children's high FA-specific anxiety may be associated with more generalized anxiety. Previous studies have shown that, on average, children with FA have similar levels of general anxiety as controls⁽¹⁴⁾ or lower general anxiety relative to norms.^(10,13,16) In this study, general anxiety scores for the entire sample were not different from normative data. General anxiety was higher *only* for those children in *High Responder* groups, where both children and mothers had elevated FA anxiety. Further research is needed to understand the determinants of mothers' heightened FA anxiety, and how mothers' FA anxiety might influence child FA anxiety *and* general anxiety.

Children from the *High Responder* and *Anxious High Responder* groups were more likely to have received auto-injectable epinephrine. Previous research indicates that history of

anaphylaxis can be associated with increased maternal anxiety;⁽¹⁴⁾ however, anaphylaxis experiences and allergy number and type were not different across clusters in the current study. Therefore, it is unclear whether these children had more severe FA reactions, or if this finding represents differences in FA management style. However, Family FA Management scores were quite similar for *High Responders*, *Anxious High Responders*, and *Balanced Responders*. Importantly, *Balanced Responders* achieved the highest scores on the Epi-Demo task, demonstrating high levels of knowledge and preparedness to administer epinephrine when needed. Parents from the *Low Responder* group, characterized by inadequate FA Management, scored lowest on the Epi-Demo task.

Almost half of families in our sample were categorized into the *Balanced Responder* cluster group, characterized by appropriate FA management skills, moderate anxiety, and success in integrating tasks of FA management into their daily lives. Children from this group had high levels of FA management skills, commensurate with their developmental levels. The other families in our study appear adversely impacted by FA and would benefit from intervention dependent upon their identified pattern of adaptation and clinical presentation. The pattern of characteristics in the *High Responder* and *Anxious High Responder* groups suggests that children and their parents would benefit from behavioral health interventions with goals of processing severe FA reactions, addressing posttraumatic stress disorder symptoms when present, addressing potential cognitive distortions of threat, and improving skills for coping with FA anxiety and day-to-day FA challenges.^(31–33) For children, assessing and promoting developmentally appropriate self-management capabilities including self-advocacy, symptom awareness, and response readiness may facilitate greater balanced management in the entire family. Families with a *Low Responders* presentation could benefit from education about FA to increase their general FA knowledge and understanding of FA management principles.⁽⁹⁾

Our study has a number of limitations. Because a fourth cluster group was identified and the numbers of families per group were disproportionately distributed (e.g., $n = 25$ vs. $n = 3$), our power to detect differences between groups for the descriptive outcome variables was limited. Nevertheless, the identification of each of the groups was clinically meaningful in providing a preliminary estimate of numbers of families with different patterns of adaptation, as well as those in need of clinical interventions. The sample was restricted to mother-child dyads that were primarily Caucasian. The socioeconomic uniformity of the study group dictates caution in generalizing the interpretation of the results to other less affluent groups, where there may be barriers to consistent care and effective education.⁽³⁴⁾ We required documentation of FA testing within 18 months prior to study participation to ensure that subjects had current, IgE-mediated FA. As a result, the sample consisted of higher SES families that receive consistent health care from allergy specialists, possibly accounting for the predominance of high FA management scores in this study. Other recruitment approaches could result in a larger proportion of families with inadequate management. Future studies should utilize larger samples that include fathers and participants with a range of demographic backgrounds.

Despite these limitations, our study indicates that adaptation patterns among families of food allergic children can be characterized along dimensions of FA management adequacy,

optimal anxiety levels, and overall balance in family life, allowing identification of subsets of families in need of intervention. Our conceptualization integrates heretofore disparate aspects of adaptation challenges faced by children and their families living with FA, and defines a balanced management approach that could be facilitated by an effective physician-family partnership. This approach focuses on children's developing FA self-management skills and psychological responses to FA as well as on parents' supervisory adequacy and emotional distress. Using this conceptual framework, allergists are encouraged to use clinical encounters to query and guide children and parents regarding strategies for FA management, anxiety regulation, and adjustments in daily life. Families reporting debilitating anxiety or excessive activity restriction merit referral to behavioral health clinicians, who may find the FAMAS a useful tool for identifying both parents and children's strengths and difficulties with adapting to FA. Allergists and behavioral health clinicians can help families realize that living with FA need not be an unbearable burden with negative family impacts, but rather an opportunity for proactive coping with challenges that arise in the course of child-rearing.

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Figure 1.
Mean ratings on FAMAS 9-point scales for four cluster groups.

Table 1

Food Allergy Management and Adaptation Scale (FAMAS) subscales, constructs measured and representative anchor points

FAMAS Scales	Description / Specifications	Low, middle, and high anchor points
I. Family FA Management		
FA Knowledge	Knows basic mechanisms of FA, relevant organ systems, modes of exposure, risks for reaction or death, relationship with asthma, natural history.	1. Poor understanding 5. Understands basic elements 9. Excellent grasp of FA
Symptom Assessment	Knows FA symptoms, child's symptom pattern, gradation of symptoms from mild to anaphylaxis; specific indications of anaphylaxis.	1. Limited awareness 5. Knows primary symptoms 9. Comprehensive understanding
Family Response Readiness	Family members' preparation for managing reactions, judging appropriate response, using epi-pen; quality, availability of action plan.	1. Unprepared, minimize 5. Have reactive, inconsistent plan 9. Systematic, coherent plan
Family Food Avoidance	Strategies for food avoidance at and away from home; awareness of potential for accidental exposure; knowledge and use of food labels; awareness of cross-contamination.	1. Limited/given up on food avoidance 5. Adequate measures, but inconsistencies 9. Coherent strategy across settings
Medication Availability	Have current, filled prescriptions for injectable epinephrine & antihistamines; medications stored appropriately, available at all times, in all settings; asthma medications.	1. Not readily available 5. Generally on hand but have not practiced 9. Always at hand and have practiced
Alternate Caregivers	All alternate caregivers informed of child's FA, avoidance strategies, possible symptoms, action plan; medication available; prepared to assess symptoms, give epinephrine.	1. Do not inform or prepare other adults 5. Some, not all caregivers informed 9. All caregivers prepared, clear action plan
II. Child FA Management		
Child Response Readiness	Prepared for managing reactions, including recognizing symptoms, notifying adult, cooperating with treatment; developmentally appropriate level; knows action plan.	1. Denies or hides symptoms 5. Acknowledges symptoms/adequate plan 9. Coherent, age appropriate plan
Child Food Avoidance	Developmentally appropriate strategies for food avoidance; awareness of potential accidental exposure; knowledge and use of food labels; awareness of cross-contamination.	1. No strategies/resistant to avoidance 5. Good understandings of avoidance basics 9. Advocates for self in multiple settings
III. Maternal FA Anxiety		
IV. Child FA Anxiety		
V. Balanced Integration		
	Balanced attention to FA management, anxiety regulation, developmental, role, family issues (e.g., school attendance, participation in extracurricular and family activities).	1. Imbalanced, child at risk/high FA burden 5. Somewhat balanced, moderate burden 9. Balance between FA management/burden

Note. Each FAMAS subscale uses a 9-point scale, with higher scores indicating high (e.g., Anxiety) or better (e.g., FA management scales); scores below the mid-point of 5 indicate inadequate FA management.

Table 2

Demographic and Illness Characteristics

Demographic Variables	<i>Mean (SD)</i>	<i>Median (IQR)</i>	<i>N (%)</i>
Child Age	8.67 (1.78)		
Child Age at Food Allergy Diagnosis		1.75 (1.00)	
Child Sex			
Male			37 (64.9)
Female			20 (35.1)
Child Race			
Caucasian			49 (86)
African American			2 (3.5)
Asian			1 (1.8)
Multiracial			5 (8.8)
Mother Age	41.33 (4.92)		
Mother Education			
Vocational School or Some College			5 (9.0)
College Graduate			36 (63.2)
Professional or Graduate Degree			16 (28.1)
Illness Variables			
Number of Food Allergies			
One			11 (19.3)
Two or More			46 (80.7)
Anaphylaxis			
Never Experienced			22 (38.6)
Experienced			32 (56.1)
Unsure			3 (5.3)
Received Epinephrine*			
Never			40 (71.4)
One or more times			16 (28.6)
Asthma Diagnosis			
No			23 (40.4)
Yes			33 (57.9)
Unsure			1 (1.8)

Note.

*
n = 56 due to one participant with missing data.

Table 3

Mean FAMAS Subscale Scores for Four Cluster Groups

	Balanced Responders <i>n</i> = 23	High Responders <i>n</i> = 25	Low Responders <i>n</i> = 3	Anxious High Responders <i>n</i> = 5
FAMAS Variables				
Family FA Management	7.12 (0.80)	6.63 (1.22)	3.78 (0.25)	7.40 (0.45)
Child FA Management	7.52 (0.89)	6.20 (1.28)	4.67 (1.26)	7.30 (1.44)
Mother FA Anxiety	4.30 (1.36)	6.40 (1.12)	3.67 (1.15)	8.80 (0.45)
Child FA Anxiety	4.39 (1.08)	6.48 (1.45)	4.67 (1.53)	7.20 (1.30)
Balanced Integration	7.04 (1.30)	5.20 (0.82)	3.67 (0.58)	2.60 (0.55)

Note. Values in table represent subscale means and standard deviations.

Table 4

Cluster Comparisons across Demographic and Illness Characteristics

	Four Cluster Solution *				p
	Balanced Responders n = 23	High Responders n = 25	Low Responders n = 3	Anxious High Responders n = 5	
Demographic Variables					
Child's age	9.00 (1.78)	8.28 (1.77)	8.33 (1.15)	9.40 (2.19)	.416
Male children ⁺⁺	61%	64%	100%	60%	.811
Mother's age	40.30 (4.26)	42.38 (4.60)	43.67 (1.53)	43.00 (5.94)	.307
Married mothers ⁺⁺	100%	84%	100%	100%	.241
Non-minority mothers ⁺⁺	83%	78%	67%	80%	.941
Illness Variables					
Child's age at diagnosis ⁺	1.50 (2.00)	2.00 (2.00)	2.00 (2.00)	1.00 (1.00)	.405
Anaphylaxis ⁺⁺	50%	60%	50%	100%	.197
Received epinephrine ⁺⁺	9% ^{a,b}	38% ^b	0%	80% ^a	.004
Comorbid asthma ⁺⁺	52%	58%	100%	60%	.550
Peanut allergy ⁺⁺	83%	84%	67%	80%	.824
Tree nut allergy ⁺⁺	70%	84%	100%	100%	.369
Multiple allergies ⁺⁺	74%	80%	100%	100%	.714

Note.

* One participant was unable to be classified; descriptive data are not presented here. P values in last column are for the 4- cluster comparison. Cluster comparisons among demographic and illness variables with no superscripts were conducted with analysis of variance, with mean (SD) reported.

⁺ Cluster comparisons conducted with Kruskal-Wallis test. Medians (IQR) are listed when a Kruskal-Wallis test was conducted.

⁺⁺ Cluster comparisons conducted with Fisher's Exact test. Mothers answering "unsure" on the Anaphylaxis and Comorbid Asthma variables were removed before analyses. Other variables have less than 57 participants due to missing data.

^{a,b} Superscripts indicate significant pairwise differences (common letters for two groups within a row indicate they are significantly different); pairwise comparisons that remained significant after adjusting for the false discovery rate are bolded.

Comparisons of Four Cluster Groups for Food Allergy QoL, Impact on Family, Mother and Child General Anxiety, and Epi-Demo Scores

Table 5

Four Cluster Solution*					p
	Balanced Responders n = 23	High Responders n = 25	Low Responders n = 3	Anxious High Responders n = 5	
Impairment Variables					
Food Allergy QoL-Parent Burden (FAQL-PB)	15.91 (9.98) ^a	22.64 (13.42) ^b	6.00 (7.94) ^b	32.20 (24.08) ^a	.02
Food Allergy Impact Scale (FAIS)					
Family Social Activities	3.53 (1.37)	4.01 (1.44)	2.00 (0.20)	4.60 (2.22)	.08
CG-supervised Child Social Activity	2.52 (1.06) ^a	3.26 (1.46)	2.33 (0.58)	4.60 (2.30) ^a	.02
Stress and Free Time	1.75 (0.72)	2.25 (1.22)	1.83 (1.23)	2.25 (1.13)	.37
School or Structured Activities	3.14 (1.36)	3.62 (1.49)	2.67 (0.50)	4.09 (2.14)	.38
Autonomous Social Activities	4.21 (1.73)	4.89 (1.80)	2.72 (1.18)	5.42 (2.36)	.14
Meal Preparation ⁺	6.00 (3.50)	6.33 (2.00)	5.00 (3.83)	6.33 (2.00)	.54
Family Relations ⁺	1.33 (1.00)	2.00 (1.17)	1.67 (2.00)	1.00 (2.33)	.62
Employment and Finances ⁺	1.00 (0.67)	1.33 (1.67)	1.33 (0.33)	1.00 (3.67)	.59
Anxiety Variables					
Mother STAI-Trait	43.30 (8.29)	46.60 (7.14)	50.00 (13.75)	42.40 (4.04)	.28
Mother STAI-State ⁺	38.00 (7.00)	43.00 (12.00)	53.00 (39.00)	42.00 (9.00)	.28
Child STAI-C-Trait	38.86 (6.45) ^{a,b}	45.76 (11.92) ^b	37.67 (7.51)	49.60 (6.23) ^a	.03
Child STAI-C-State	42.26 (9.72)	49.70 (11.09)	41.33 (7.09)	49.80 (8.73)	.07
Child MASC-Total	49.30 (7.62)	53.60 (8.90)	53.00 (9.90)	59.60 (5.98)	.07
Food Allergy Independent Measure (FAIM)					
1. Ingesting food to which allergic	1.41 (0.80)	2.08 (1.04)	1.67 (1.15)	2.40 (1.52)	.08
2. Having a severe reaction if ingestion	3.50 (1.79)	3.76 (1.83)	3.00 (2.65)	4.80 (1.64)	.48
3. Dying from FA if ingestion in future	1.23 (0.92) ^a	1.92 (1.61)	1.00 (1.73)	3.00 (1.22) ^a	.04
4. Being effectively treated if ingestion	4.36 (1.43)	3.64 (1.58)	5.67 (0.58)	3.20 (1.92)	.07
FA Management					
Epi-Demo Score ⁺	6.00 (1.00) ^{a,b}	4.00 (2.00) ^a	3.00 (1.00) ^{b,c}	5.00 (0.00) ^c	.006

Note.

* One participant was unable to be classified; descriptive data are not presented here. P-values in last column are for the 4-cluster comparison. Cluster comparisons among outcome variables with no superscripts were conducted with analysis of variance, with mean (*SD*) reported.

+ Cluster comparisons conducted with Kruskal-Wallis test. Medians (*IQR*) are listed when a Kruskal-Wallis test was conducted. STAI = State-Trait Anxiety Inventory; T scores are presented. STAI-C = State-Trait Anxiety Inventory for Children; T scores are presented. MASC = Multidimensional Anxiety Scale for Children; T scores are presented.

a,b,c Superscripts indicate significant pairwise differences (common letters for two groups within a row indicate they are significantly different); pairwise comparisons that remained significant after adjusting for the false discovery rate are underlined.