

Examining Differences in Parent Knowledge About Pediatric Food Allergies

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Abstract

Objective Pediatric food allergy (FA) is a serious health condition that has become increasingly prevalent. Parents often play a primary role in assessing and managing risk for their child's FAs, making it critical that they remain informed of the most recent guidelines for FA management. This study aimed to examine if diagnostic source (i.e., pediatrician vs. allergist) and child- and parent-level variables predicted parental FA knowledge using a comprehensive measure.

Methods The Food Allergy Knowledge Test (FAKT) was administered to parents ($N=518$) of children aged 3–17 years with ($n=349$) and without ($n=169$; i.e., control group) FAs using internet-sampling procedures. The sample was further partitioned into parents of children diagnosed by an allergist or a pediatrician, and control group parents who did or did not endorse knowing someone with an FA. **Results** Significant group differences were found with respect to the overall FAKT score and diagnostic source. Among the FA group, parental relationship to child, income, identification with a minority status, parental anxiety, and child possession of an emergency action plan were significant predictors of FAKT scores. **Conclusions** Knowledge of FA was poor across all groups. Education for caregivers both with and without food-allergic children is important to ensure FA safety in multiple settings. Future directions and limitations are discussed.

Key words: internet sampling; knowledge; parenting; pediatric food allergies.

Introduction

Pediatric food allergy (FA) affects approximately 8% of children in the USA (Gupta et al., 2018). FAs are the most common cause of pediatric anaphylaxis (i.e., a severe reaction with life-threatening symptoms), and up to 40% of children report a history of reactions that could lead to hospitalization or death if not treated immediately (Chow, Pincus, & Comer, 2015). In addition to morbidity, FAs are associated with overall reduced quality of life and impairments in academic, social, and psychological domains (Abrams & Sicherer, 2016). No preventative treatments exist, and management involves allergen avoidance, checking ingredient labels, and preventing cross-contact. Recent changes in science's understanding of FA development have also resulted in a considerable shift in FA guidelines. For example, children are now advised to

regularly consume baked forms of allergens (if tolerated) based on research that up to 70% of children who are allergic to milk or eggs can well-tolerate the baked forms, which may increase tolerance to uncooked forms and dietary variety (Groetch & Nowak-Wegrzyn, 2013; Leonard et al., 2012). Such changes in our understanding of FA development and management means parents must remain informed and up to date on FA guidelines.

For younger children and often into adolescence, the burden of avoiding allergens, recognizing symptoms, and understanding the appropriate treatment response falls on the parent. Although fathers share some responsibility, mothers typically carry out the bulk of FA management (King, Knibb, & Hourihane, 2009) which is consistent with parenting literature showing that mothers traditionally play a greater role in childcare

(Cummings, Knibb, King, & Lucas, 2010). However, research has revealed alarming deficiencies in parental knowledge of FA facts and guideline adherence, such as IN symptom management. Although mild reactions can be treated with antihistamines, severe reactions require epinephrine auto-injectors (EAI). EAIs should always be carried as symptoms can occur immediately or up to several hours after allergen exposure and may be cutaneous, gastrointestinal, and/or cardiovascular (Abrams & Sicherer, 2016). However, parents often report carrying expired or no EAIs, incorrect medicine administration (Posner & Camargo, 2017), and misconceptions such as the belief that FAs are curable and allergy medicine can be taken as a preventative measure (Gupta et al., 2010). Such beliefs and medication mismanagement may worsen their child's FA symptoms or even increase the risk of a severe reaction, making it critical that parents are knowledgeable of FA medical facts. These risks are exacerbated for low socioeconomic status (SES) or minority families who are less likely to have access to and afford allergen-free foods, allergy medications, and preventative and specialized care (Bilaver, Kester, Smith, & Gupta, 2016).

Available evidence suggests that the source from which children receive their FA diagnosis appears to matter. For example, Gupta et al. (2010) developed a series of surveys to measure FA knowledge and found that parent report of an allergist- (vs. pediatrician-) diagnosed child predicted better scores, as did having more than one child with FAs and four or more yearly allergist visits. Over the past decade, however, there have been important updates in FA knowledge (e.g., diet, cross-contact, and label-reading) that were not reflected in the surveys and work of Gupta, Kim, Springston, Pongracic et al. (2009) and Gupta et al. (2010). Hahn, Dahlquist, Hoehn, and Elizabeth Bollinger (2017) developed the Food Allergy Knowledge Test (FAKT) with updated questions to assess domains identified as most clinically relevant in FA management. Among parents recruited from a pediatric allergy clinic ($n=77$), higher FAKT scores were predicted by parental age, education, SES, and exposure to FA education (i.e., involvement with Food Allergy Research & Education [FARE]), further evincing that higher-income and non-minority status families are more likely to seek out and receive specialized care. Given that the sample was limited to patients of two medical systems, the current study aimed to expand the literature by conducting a large examination of this issue in a non-clinical sample.

Inadequate FA knowledge has also been demonstrated in the general public (e.g., teachers, restaurant workers) and more alarmingly, medical professionals (Boyce et al., 2010). Gupta et al. (2010, 2014) found that primary care physicians had suboptimal knowledge concerning FA diagnosis, symptoms, and

environmental risk, and reported feeling inadequately trained to care for FA patients. Shortfalls of FA care do not go unnoticed by parents, as shown in a study by Blumenstock et al. (2016) that assessed perceived FA medical management of pediatric patients at a Chicago hospital. Parents ($n=859$) who saw non-specialty physicians were significantly less likely to report receiving FA education during visits compared with those who had. However, even among parents who visited an allergist, reported discussion for domains such as long-term prognosis and management (59%) and emergency action plans (EAP; 56%) were low. These studies imply that FA diagnoses from non-allergist sources may result in a poorer FA knowledge and was thus a central research question of the present study.

Predictors

In addition to differences by diagnoses source, a variety of research- and theory- (i.e., based on Bronfenbrenner's ecological model, 1994) driven predictors of FA knowledge may exist and were thus examined in the present study. Existing research has examined the role of both demographic parent variables (i.e., relationship to child, age, SES, education level, race) and FA-specific (i.e., number of children with an FA, FA severity, parent access to FA educational information) factors. Previous studies have also looked at the role of parental anxiety on certain FA management domains (e.g., EAI use) as parents of food-allergic children report significantly higher anxiety levels compared to the parents of children without (Cummings et al., 2010; King, Knibb, & Hourihane, 2009). This literature suggests that "adequate" but not excessive levels of anxiety may serve to initiate and sustain vigilance in FA management (Fedele et al., 2016; Polloni et al., 2015). Finally, two potential child-level predictors not previously examined within the context of FA knowledge were time since FA diagnosis and child EAP possession. Both were expected to be positively associated with FA knowledge, as parents may gain more FA experience with time and must meet with a doctor to formulate an EAP.

Pediatric FA is clearly an important problem, yet more up-to-date information is needed on if diagnosis source is associated with FA knowledge among a non-clinical sample. Using internet-sampling procedures, the proposed study sought to examine sources of pediatric FA diagnosis and provide an update to Gupta et al. (2010) in comparing parent FA knowledge by diagnosis source using the FAKT (Aim 1). We hypothesized that FAKT scores would be highest among parents in an allergist- (vs. pediatrician-) diagnosed group and lowest among parents of healthy controls. Given the high prevalence of FA, a portion of control group parents was expected to know someone with an

FA. This study therefore also investigated if FAKT scores differed between two control groups, those who either did or did not know someone with an FA. Among the control groups, parents who reported knowing someone with FAs were hypothesized to have higher scores than those who did not. An additional, exploratory aim (Aim 2) was to investigate what factors predicted FAKT scores among parents of children with an FA, regardless of diagnostic source.

Methods

Participants

Parents of children aged 3–17 ($N=725$) were recruited online using Amazon Mechanical Turk (mTurk). Eligibility for the current study required respondents to (1) be 18 years or older, (2) report English as their primary language, and (3) be the caretaker/guardian of a child between the ages of 3 and 17 who lived with them at least 50% of the time. Two parallel surveys were created for the FA and the Control groups (see *Procedures* section). FA group respondents were required to endorse that their child had an FA (inclusion criterion 4a), whereas Control group respondents had to deny having any children diagnosed with FAs, asthma, or any other potentially serious medical conditions (e.g., autoimmune disorder; inclusion criterion 4b). The surveys included six validity check questions (e.g., “The sun is hot”) and “seriousness checks” were conducted by checking the plausibility and accuracy of certain questions (e.g., the combination of child age and FA diagnosis length; Aust, Didenhofen, Ullrich, and Musch [2013]). Respondents who did not correctly respond to all validity questions and/or had implausible answers ($n=78$) or who completed more than one (i.e., both a control and FA) study survey ($n=91$) were excluded from further analyses. Remaining respondents ($n=556$) who reported employment as a healthcare professional ($n=38$) were excluded in order not to confound FA knowledge with medical training resulting in a sample of 518 participants.

Participant Diagnosis Source Characteristics

In total, 169 eligible respondents completed the Control survey, whereas 349 eligible respondents completed the FA survey. Among the FA group, the majority (59.9%) reported that their child received an FA diagnosis from a pediatrician ($n=209$), whereas 22.1% received one from an allergist ($n=77$). Of the remaining respondents, 12.6% received a diagnosis from a general (i.e., non-pediatrician; $n=44$) doctor and 4.6% ($n=16$) reported diagnosing their child themselves. Less than one percent (0.9%) of respondents received a diagnosis from a nurse practitioner ($n=3$). As a result, parents who reported receiving a diagnosis from a nurse

practitioner, parent, or general doctor were too small to include in subsequent analyses.

The resultant sample ($n=455$) of FA ($n=286$) and Control ($n=169$) groups was further partitioned into four diagnosis source subgroups. In addition to the Allergist group ($n=77$) and Pediatrician group ($n=209$), the Control sample was subdivided into parents who either denied (Controls; $n=63$) or endorsed knowing someone with an FA (Controls with FA Relationship; $n=106$). Finally, for Aim 2, the sample size was refined to include only the parents in the Pediatrician and Allergist groups ($n=286$). Of these, parents ($n=15$) with missing predictor data were excluded, resulting in 271 FA group respondents (see *Data Analytic Plan* section), 58.7% of whom ($n=159$) were mothers. Sample and group demographic information can be found in Table I.

Procedures

This study was part of broader research investigating differences in parenting practices between parents of children with and without FAs. The Kent State University Institutional Review Board approved this study. Data collection occurred over a 2-week period in January of 2018. Parents were recruited through mTurk, an online task platform where individuals select potential surveys of interest (Human Intelligence Tasks; HITs) and are paid for HIT completion. Two corresponding surveys were created for the FA and Control groups, which respondents were compensated \$0.75 to complete. Both groups completed the FAKT at the conclusion of the surveys, which had an estimated completion time of approximately 45 min for the FA group and 25 min for the Control group. Previous studies have used mTurk to examine parenting practices and perceptions (Flessner, Murphy, Brennan, & D'Auria, 2017) and participant data illustrated psychometric qualities equal to or higher than data from more traditional samples (Buhrmester, Kwang, & Gosling, 2011).

Measures

Demographics Questionnaire

All respondents completed questions assessing demographic variables. Analyses for Aim 2 utilized five demographic parent-level variables: age, race, relationship to child, education level (i.e., high school or GED, Associates, Bachelor's, post-graduate degree) and combined family income. At the end of the survey, the FA group answered additional embedded questions about their child's FA (e.g., FA type and severity, diagnosis source). Parent-level FA-specific variables included in Aim 2 were number of children with FAs and FA education access (modeled off a question used by Gupta et al. [2010]). Child-level FA-specific variables included were length of FA diagnosis, severity (measured number of FA-related emergency room or

Table I. Demographic Characteristics of Sample With and Without Food Allergies

	Total sample (N = 518)		By subgroup diagnosis source (n = 455)			
	With FA (n = 349)	Without FA (n = 169)	Pediatrician (n = 209)	Allergist (n = 77)	Control (n = 63)	Control + FA Relations (n = 106)
Parent characteristics						
Relationship to child, mother, n (%)	202 (58)	102 (60.4)	129 (61.7)	41 (53.9)	38 (60.3)	64 (60.4)
Age, M (SD)	34.83 (7.02)	35.16 (6.52)	34.94 (6.84)	33.68 (6.59)	35.67 (6.86)	34.86 (6.32)
Race, n (%) ^a						
White	258 (74.8)	115 (68.5)	157 (76.6)	58 (75.3)	41 (65.1)	74 (70.5)
Black or African American	30 (8.7)	18 (10.7)	19 (9.3)	5 (6.5)	10 (15.9)	8 (7.6)
Asian or Pacific Islander	43 (12.5)	30 (17.9)	18 (8.8)	12 (15.6)	10 (15.9)	20 (19)
American Indian or Eskimo	14 (4.1)	5 (3.0)	10 (4.9)	2 (2.6)	2 (3.2)	3 (2.9)
Ethnicity, Hispanic or Latino (n, %)	50 (14.6)	30 (17.8)	20 (9.7)	24 (8.4)	5 (8.2)	17 (6.5)
Marital status, partnered, n (%)	284 (81.4)	149 (88.2)	174 (83.3)	60 (77.9)	54 (85.7)	95 (89.6)
Education level, n (%)						
High school or GED	67 (19.2)	31 (18.3)	42 (20.1)	12 (15.6)	15 (23.8)	16 (15.1)
Associate	70 (20.1)	82 (48.5)	44 (21.1)	16 (20.8)	28 (44.4)	54 (50.9)
Completed ≥4-year college	212 (60.7)	56 (33.1)	123 (58.9)	49 (63.6)	20 (31.7)	36 (34)
Income, n (%)						
Less than \$25,000	43 (12.3)	14 (8.3)	24 (11.5)	9 (11.7)	8 (12.7)	6 (5.7)
\$25,000–\$49,999	96 (27.5)	47 (27.8)	57 (27.3)	26 (33.8)	16 (25.4)	31 (29.2)
\$50,000–\$99,999	158 (45.3)	74 (43.8)	98 (46.9)	31 (40.3)	24 (38.1)	50 (47.2)
\$100,000–\$199,999	52 (14.9)	34 (20.1)	30 (14.4)	11 (14.3)	15 (23.8)	19 (17.9)
Children with FAs ≥2, n (%)	53 (15.2)		31 (14.9)	14 (18.2)		
Child characteristics						
Biological sex, female, n (%)	136 (39)	64 (37.9)	79 (37.8)	32 (41.6)	26 (41.3)	38 (35.8)
Age, M (SD)	7.32 (3.93)	6.96 (3.73)	7.09 (3.81)	7.01 (3.58)	7.47 (3.67)	6.66 (3.76)
EAP possession, n (%)	132 (37.8)		102 (48.8)	45 (58.4)		
Years since diagnosis, M(SD)	3.99 (3.28)		4.1 (3.30)	3.7 (3.36)		
Type of FA ^a , n (%)						
Peanuts	101 (28.9)		52 (26.5)	29 (38.7)		
Dairy	134 (38.4)		79 (40.3)	29 (38.7)		
Eggs	52 (14.9)		23 (11.7)	16 (21.3)		
Tree nuts	29 (8.3)		16 (8.2)	10 (13.3)		
Fish	25 (7.2)		10 (5.1)	7 (9.3)		
Shellfish	54 (15.5)		32 (16.3)	13 (17.3)		
Wheat	21 (6.0)		12 (6.1)	7 (9.3)		
Soy	46 (13.2)		28 (14.3)	9 (12.0)		
Other	25 (7.2)		10 (5.1)	7 (9.3)		

Note. FA = food allergy; EAP = emergency action plan.

^aRespondents could select more than one answer.

urgent care within the past 12 months), and possession of an EAP.

The Food Allergy Knowledge Test

The FAKT is a measure intended to assess parental FA illness knowledge across the following domains: general knowledge, avoiding exposure, recognizing symptoms, EAI use, and anaphylaxis (Hahn et al., 2017). There are 59 possible points, and higher scores reflect greater FA knowledge. The FAKT has demonstrated excellent internal consistency (Hahn et al., 2017). For the current study, the internal consistency (Cronbach's alpha) of the overall scale was 0.88.

Depression, Anxiety, and Stress Scale, Short Version

The Depression, Anxiety, and Stress Scale, Short Version (DASS-21) is a self-report measure designed to assess adult levels of depression, anxiety, and

stress (Antony, Bieling, Cox, Enns, & Swinson, 1998). Each of these three subscales is composed of seven questions that ask to what extent symptoms are present within the past week. Higher scores indicate greater symptomatology. The DASS-21 has demonstrated high internal consistency and concurrent validity with other validated measures of depression and anxiety (Chow et al., 2015). The present study used the anxiety subscale, which had a Cronbach's alpha of 0.87.

Data Analytic Plan

Statistical analyses were conducted using the IBM Statistical Package for the Social Sciences (SPSS version 24.0). To address Aim 1, the FA and Control samples were partitioned into four diagnosis source subgroups. For Aim 2, the sample size was refined to

Table II. Pearson Correlation Coefficients for FAKT Predictor Variables ($N = 271$)

Variables	1	2	3	4	5	6	7	8	9	10	11	12
1.FAKT SUM	—											
2.Parent age	0.24**	—										
3.Relationship to child	0.24**	-0.01	—									
4.Income	0.22**	0.11	0.11	—								
5.Time since diagnosis	0.24**	0.47**	0.19**	0.1	—							
6.Parent race	-0.22**	-0.01	-0.13*	-0.07	-0.05	—						
7.Parent anxiety	-0.26**	-0.25**	-0.06	0.14*	-0.11	-0.20**	—					
8.FA EAP	0.25**	-0.10	-0.08	0.08	-0.01	-0.01	-0.03	—				
9.Parent education level	-0.05	-0.07	-0.29**	0.25**	-0.07	0.17**	0.09	-0.03	—			
10.FA-related ER trips	-0.20**	-0.07	-0.17**	-0.17**	-0.10	0.28**	0.39**	-0.04	0.17	—		
11.Number of children with FAs	0.11	0.02	0.12	0.10	0.02	0.04	0.02	-0.12*	0.07	-0.05	—	
12.FA education	0.12	-0.05	0.09	0.07	-0.02	-0.06	0.12*	-0.23**	0.07	0.09	0.011	—

Note. FA = food allergy; EAP = emergency action plan; ER = emergency room.

*Correlation is significant at the 0.05 level (two-tailed).

**Correlation is significant at the 0.01 level (two-tailed).

include only the Pediatrician and Allergist group parents (see *Participants* section).

Aim 1

Prior to conducting analyses, statistical assumptions of one-way analysis of variance (ANOVA) were examined. Skewness and kurtosis were within normal limits. Preliminary analyses revealed no significant differences between groups on selected demographic variables (i.e., age, sex, race, and income). Appropriate effect sizes were based on a previous study that examined FA knowledge cross-culturally (Goossens et al., 2013). A priori power analysis using G*Power (Faul, Erdfelder, Buchner, & Lang, 2009) indicated that a total sample size of 76 was required to detect a medium effect size ($d = .5$; $\alpha = .05$) and achieve a power of 0.80. The obtained sample of 455 was thus deemed sufficient for addressing this study's aims.

Aim 2

Bivariate Pearson correlations were used to examine associations between FAKT score and predictors of interest. Eleven initial predictors variables were considered (see Table II). Any variables with $\alpha \leq 0.1$ were included in the next step of the analysis. Three parent variables (education level, number of children with FAs, and FA education access) were excluded; all others were significantly correlated with FAKT score at levels of $p < .07$. Correlation coefficients indicated that no variables demonstrated inter-correlations with absolute values greater than 0.5. A multiple linear regression model was then used to examine the best predictor(s) of FAKT scores among parents with children with FAs. Predictors were included in the subsequent analysis using a forced-entry method.

Results

Aim 1: FAKT Differences by Diagnosis Source

A one-way ANOVA was used to examine group differences in overall FAKT scores. The results of the comparison among the four conditions yielded a statistically significant effect, $F(3, 451) = 4.89$, $p = .002$, $\eta^2 = .03$. Post hoc comparisons using Gabriel's pairwise test procedure indicated that the Pediatrician group ($M = 30.68$, $SD = 8.68$; $p = .001$, $d = .55$) and Controls with FA Relationship ($M = 30.3$, $SD = 8.99$; $p = .011$, $d = .5$) demonstrated significantly higher FAKT scores than the Control group ($M = 25.81$, $SD = 9.14$). FA knowledge among the Allergist group did not significantly differ from any other group, nor were there statistically significant differences between the Pediatrician and Controls with FA Relationship group scores. All group FAKT scores can be found in Table III.

Aim 2: Exploratory Analyses

A simultaneous multiple regression was conducted to analyze predictors of FAKT scores for FA group respondents included in Aim 1 ($N = 271$). The total FAKT score was entered as the dependent variable. Five parent variables (age, relationship to child, family income, race, and anxiety) and three child variables (diagnosis length, number of urgent care trips, and EAP possession) were included as predictors. Regression analyses indicated that the overall model was significant, $F(8, 267) = 12.51$, $p < .001$, and accounted for 25.6% of the variance in predicting parental FAKT score. The model showed a significant positive association between total FAKT score and three predictors: EAP possession ($\beta = .26$, $p < .001$), maternal relationship to child ($\beta = .18$, $p = .002$), and income ($\beta = .16$, $p = .004$). Report of parental anxiety report ($\beta = -.18$, $p = .005$) predicted lower FAKT scores, as did identification with a minority status ($\beta = -.13$, $p = .03$). Parental age ($\beta = .12$, $p = .066$), time

Table III. *FAKT Sum Scores by Diagnosis Source from One-Way Analysis of Variance*

FAKT Scores, M (SD)	Pediatrician	Allergist	Control	Control + FA Relations
Total sum	30.68 (8.68) ^a	29.16 (10.3)	25.81 (9.14) ^{a,b}	30.3 (8.99) ^b

Note. The superscript letters a, b denote statistically significant difference between groups. FAKT= Food Allergy Knowledge Test; FA = food allergy.

Table IV. *Regression Analyses for Variables Predicting FAKT Total Score*

Predictor	B	SE	Beta (β)
Parent age	0.15	0.08	0.12
Relationship to child	3.18	1.00	0.18**
Income	1.56	0.53	0.16**
Time since diagnosis	0.30	0.16	0.11
Parent race	-2.47	1.05	-0.13**
Parent anxiety	-0.18	0.07	-0.17**
FA EAP	4.57	0.95	-0.26***
FA ER trips	-0.13	0.21	-0.04

Note. $R^2 = .282$ ($p < .001$). FA = food allergy; EAP = emergency action plan; ER = emergency room.

*** $p < .001$; ** $p < .01$; * $p < .05$.

since diagnosis ($\beta = .11$, $p = .066$), and urgent care trips ($\beta = -.04$, $p = .56$), were not statistically significant FAKT predictors. Regression, coefficients (B, β), and standard error of the regression coefficient (B) can be found in Table IV.

Discussion

Pediatric FA is a growing health concern in which proper management is essential. The physical and psychosocial implications of FAs make accurate diagnosis and medical guidance critical to prevent misconception and mismanagement. The current study thus aimed to assess FA knowledge and its potential predictors among parents of children with and without differentially diagnosed FAs.

In the present study, most parents reported that their child had a pediatrician-diagnosed FA and approximately a quarter received a diagnosis from an allergist. The frequency of parent-diagnosed FA (4.6%) was consistent with the 3–6% found by Keet et al. (2014) yet much lower than the 30% found by Gupta, Dyer, Jain, & Greenhawt (2013). However, emerging evidence suggests that rates of parent- and nonprofessionally diagnosed FAs are higher in minority populations (Gupta, Dyer, Jain, & Greenhawt, 2013). Although not possible to examine within the current

study due to small sample size, this may help to explain, in part, the dramatic discrepancy in “parent-reported” rates of FAs across studies. As noted earlier, additional factors such as geography and health insurance access, while not examined in the present study, may also predict professional versus parent diagnoses source. This is an area that warrants further research as parents of affected children may not receive appropriate FA education and management from a medical professional and could thus be an especially vulnerable subpopulation within pediatric FAs.

The results of this study showed a main effect of diagnosis source on overall FAKT scores, but the directionality of this main effect was not entirely as expected. Strikingly, all groups scored below 60%, with the Pediatrician (57.33%) and Control with FA Relationship (56.32%) groups scoring significantly higher than the Control group (48%). Contrary to hypotheses, the scores of the Allergist group (54.09%) did not differ from those of any other group. The finding that control group parents with no FA relationships had the lowest scores, while expected, underscores the need for continuing FA education among the general public. As discussed by Gupta, Kim, Springston, Smith et al. (2009), improving FA knowledge among parents not directly impacted by FAs could improve safety for children with FAs in a public setting (e.g., school), which in turn could reduce the risk of FA reactions and improve the quality of life of affected children and their families. However, given that this is the first time the FAKT has been looked at within a non-clinical population, future research would benefit from looking at the benefits of establishing cutoffs scores to best gauge what level of FAKT is sufficient to best predict “positive” behavior. For example, AUC analyses (within the context of FAKT scores) might be useful for establishing optimal cutoffs for predicting the occurrence of severe versus mild allergic reactions or minimal versus marked FA complications. Our findings—which indicate a poor sense of FA knowledge for all respondents, regardless of group—are somewhat contradictory to those of Blumenstock et al. (2016) that found parents reported receiving less FA education from non-specialty physicians. However, this and other studies show parents report receiving suboptimal medical information from pediatricians and allergists alike (Xu et al., 2010) and have clinical implications for families who seek out allergist care over that of general physicians with the expectation that more specialized education results in better care. In addition, the current study did not collect data on the years of clinician experience; it is possible that the pediatricians seen by parents in the current sample had more professional medical experience or—alternatively—were more recently trained compared with the allergists. Future

research should explore if and how disparity in clinical experiences relates to delivery of FA education. These results may also highlight a possible discrepancy, and thus potential area of improvement, between the amount of information parents receive during pediatric visits versus what is retained.

The overall poor performance of both FA groups may relate to evidence that parents of children with chronic health conditions have poor recall of associated disease details and may immediately forget between 40% and 80% of information given by medical practitioners (Birtwell & Sandberg, 2014; Kessels, 2003). This reduced memory for medical facts may be due to several possible determinants, as discussed by Birtwell and Sandberg (2014). Parents often receive much more information than can be realistically retained during pediatric consultation visits. This information often covers multiple, broad domains (e.g., disease complications and treatments), which is linked to worse memory compared with narrower topic breadth. Retention may be further impeded by the proximity of a young child during a medical visit that might serve as an environmental distraction. Given that these qualities are often inherent to pediatric health visits, the authors noted the need for additional methods to communicate health facts, such as educational booklets, note-taking, and having the parent verbally repeat the information. Such auxiliary methods may be especially important for parents of young children, which made up most of the current sample. Another possible explanation relates to differing sources of diagnosis and care; within our sample, parents who received a pediatrician-diagnosis may have been subsequently referred to, and received care from, an allergist. This would align with the finding that most pediatricians report referring patients with FA symptoms to an allergist (Gupta et al., 2014). The present study did not measure potential referrals and differing care or temporal factors such as the timeline of yearly doctor visits. However, results from Aim 2 indicated that neither parent age nor time of diagnosis were significant predictors of FAKT suggesting that increased exposure to FA management (and/or experience with healthcare providers in general) does not necessarily result in a greater degree of FA fact retention. Further longitudinal research is needed to examine general and temporal relationships between FA education and parental subjective and objective retention of said information.

Several predictors of FA knowledge were significant in this study and have important clinical implications. Our finding that EAP possession predicted higher scores on the FAKT was not surprising, as parents must meet and discuss their child's FA with a doctor to obtain one. Mothers had significantly higher FAKT scores than fathers, which is in line with previous

evidence that mothers report higher levels of both general- and allergy-related childcare (HoeHN, Dahlquist, Hahn, & Bollinger, 2017). Although not measured in the current study, Hahn et al. (2017) found that parent report of FA care involvement was associated with increased knowledge. In addition, male gender is associated with decreased health vigilance and medical attendance (Soller et al., 2011). Taken together, fathers may be less informed on FA guidelines and thus less likely to adequately manage and treat pediatric FAs; as such, stay-at-home or single-parent fathers may particularly benefit from extra FA education. Additional health disparities were also evident in our finding that FAKT scores were positively associated with income and negatively associated with minority status. Minority groups are more likely to be low income, with worsened access to quality healthcare (Keet et al., 2014), and minority children are up to five times less likely to be prescribed and carry EAI's compared with Caucasian children (McQuaid, Farrow, Esteban, Jandasek, & Rudders, 2016). Our study adds to previous evidence that parents who are low income and/or of a minority status are at-risk for FA mismanagement and may need targeted FA education and/or EAPs. Finally, anxiety levels were inversely related to FAKT scores, indicating that parents' mental health may affect FA knowledge. Although Fedele et al. (2016) found high anxiety levels to be associated with adherence and low levels with decreased vigilance, Cummings et al. (2010) found that maternal anxiety levels were not associated with the likelihood their child carried medication or avoided allergens, despite reporting decreased anxiety when their child was prescribed an EAI. Thus, parent anxiety might have impairing rather than constructive effects on FA health literacy, particularly if the anxiety does not fluctuate over time and instead remains at a chronically high level that leads to feeling "paralyzed" by fear (Klinnert & Robinson, 2008; Mackenzie, Smith, Hasher, Leach, & Behl, 2007); however, more research is needed to better understand how this may impact memory for FA-related information.

Several limitations to the current study are worth noting. As mentioned, the parent-diagnosed group was too small to include in analyses. Given that parents who diagnose their children may never receive proper FA education, future research should continue to assess FA knowledge among these parents, as well as what potential factors may relate to diagnostic source more generally. The study used self-report measures, which are vulnerable to responder misinterpretation and bias. Data on diagnostic testing or biological samples were not collected; as such, FA diagnosis or related information could not be confirmed and it is possible that children had conditions commonly confused with, but different from, FAs

(e.g., food intolerances, sensitivities, Celiac's disease). Management of these conditions can differ from FA, which could impact their performance on the FAKT. Although the use of online sampling enabled broader samples, it also has several disadvantages, such as potential selection bias via the exclusion of those without the access or skill needed to use mTurk. Environmental factors may diminish respondent attention (Barger, Behrend, Sharek, & Sinar, 2011); validity check items were added as attention checks to minimize this risk. A final limitation was the cross-sectional design that limited the ability to draw causal and directional influences of the observed effects; future research is needed to explore how temporal factors may impact FA knowledge. Although these limitations should be considered in subsequent research, online sampling provided an easily obtained and cost-effective method by which to test the current hypotheses and inform future research. As a result, methodological strengths of this study include the large sample size and minimal missing data. In addition, although our sample was primarily Caucasian and of a higher education level, it had a large proportion of fathers and was more racially diverse than previous FA studies (e.g., Gupta et al., 2010; Hahn et al., 2017).

Overall, the findings of this study support prior research indicating suboptimal FA knowledge among parents. The overall low FAKT scores of our sample indicate a concerning lack of retention and/or recall of FA health facts among parents in general. Although awareness of and advocacy for pediatric FAs has grown, misperceptions of the disease still clearly exist among both affected parents and the general public. An improved understanding of predictors of parent knowledge could be used to help strengthen FA education and related health literacy, which in turn may lessen the chance for the negative impact of FAs on parent-child dyads. Research should, therefore, continue to explore risk factors for deficits in FA knowledge and how those deficits can be addressed. Although replication is necessary within a clinically ascertained sample, these results highlight potential areas for which targeted interventions may be useful. For example, there is a need for more effective methods to deliver and verify retention of FA medical facts, particularly for low income and minority families. Medical professionals should be aware of the unique socioeconomic and cultural barriers to FA management and work with families to help circumvent associated challenges (e.g., speaking with families about generic or low-cost medications) in order to improve health outcomes. In addition, measures such as the FAKT may be a time- and cost-effective method by which to check for FA comprehension during FA-related medical visits. Assessing literacy of FA topics,

followed by targeted education if necessary, may help increase FA knowledge and thereby improve both disease management and the overall quality of life for both food-allergic children and their parents.

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