

Maternal dietary allergen restriction while breast-feeding: Pediatric resident knowledge and practices

Daniel V. DiGiacomo, M.D.,^{1,2} Linda Herbert, Ph.D.,^{1,2} Marni Jacobs, Ph.D.,¹ Ashley Ramos, Ph.D.,¹ and Karen A. Robbins, M.D.^{1,2}

ABSTRACT

Background: An adequate understanding of the relationship between breast-feeding practices and infant food allergy is essential for clinicians. Although there is evidence of an education gap in general breast-feeding concepts, little is known about the pediatric trainee knowledge and practice with regard to breast-feeding, maternal diet, and potential allergy outcomes.

Objective: To assess pediatric residents' knowledge, describe practices, and evaluate a module designed to provide evidence-based education about breast-feeding, food allergy, and food avoidance to inform future resources on the topic of breast-feeding and allergic outcomes.

Methods: Pediatric residents completed a survey to assess the knowledge and comfort with regard to maternal dietary restriction, breast-feeding, and infant food allergy. Residents then viewed an online educational module about evidence-based breast-feeding and infant food allergy guidelines, and, after 1 month, completed the online questionnaire again.

Results: Among respondents (N = 68), only 8% and 5%, felt knowledgeable and comfortable with current maternal diet during breast-feeding and infant food allergy recommendations, respectively. Eighty-seven percent had not received formal training on the topic, and a large percentage relied on mentor teaching (49%) or anecdotal evidence (19%) as opposed to available guidelines (32%) for guidance. Most respondents (61–93%) correctly answered questions with regard to guidelines on primary and secondary food allergy prevention in relation to maternal diet. The upper-level residents answered more questions correctly about allergic proctocolitis compared with the interns ($p < 0.05$); no differences were noted for other topics. The majority (63%) did not believe that a mother's nutritional status could be adversely affected by dietary allergen restriction. A review of the pre- and posttest scores showed the educational module had little impact on knowledge.

Conclusion: Pediatric residents reported low comfort and perceived that they had little knowledge about maternal diet and infant food allergy, yet their actual performance suggested the opposite. Those who completed the educational module did not demonstrate knowledge improvement, which highlighted the need for the development of robust educational resources.

(J Food Allergy 3:50–55, 2021; doi: 10.2500/jfa.2021.3.210008)

The relationship among maternal breast milk, infant immune development, and food allergy is complex. A growing body of evidence has demonstrated a strong role of breast milk in the development of the infant microbiome and immune system, but the

impact on infant allergy disease is unclear.^{1,2} In the past, there was concern that maternal consumption of allergenic foods would result in the passage of proteins into breast milk that results in sensitization.^{2,3} There is some evidence that maternal consumption of commonly known allergenic foods may result in a higher level of infant immune tolerance, although a causal role has not been demonstrated.^{4,5}

Maternal dietary restriction during lactation is not recommended for the primary prevention of allergic disease.^{6–8} The 2010 National Institute of Allergy and Infectious Disease Guidelines for Diagnosis and Management of Food Allergy⁶ recognize a knowledge gap in this realm, and recent consensus guidance from the three major North American allergy organizations does not recommend maternal dietary exclusion during lactation.⁸ In addition, the American Academy of Pediatrics Committee on Nutrition reaffirmed the benefits of breast-feeding on limiting atopic disease, without making definitive conclusions with regard to prevention or delay of food allergy.⁹ Maternal dietary restriction can be recommended in breast-fed infants with food-protein proctocolitis, yet evidence in individuals with other

From the ¹Division of Allergy and Immunology, Children's National Health System, Washington, D.C., and ²Division of Pediatrics, George Washington University School of Medicine, Washington, D.C.

No external funding sources reported

The authors have no conflicts of interest to declare pertaining to this article

Published ahead of print August 3, 2021

Virtual poster presentation at the American Academy of Allergy, Asthma & Immunology Annual Meeting, Philadelphia, PA, March 2020

Address correspondence to Daniel DiGiacomo, M.D., Children's National Health System, Pediatric Residency Program, 111 Michigan Ave, NW, Washington, DC 20010

E-mail address: ddigiaco88@gmail.com

This article is distributed under the terms of the Creative Commons Attribution License-NonCommercial-NoDerivatives 4.0 International (CC BY-NC-ND 4.0) license (<https://creativecommons.org/licenses/by-nc-nd/4.0/>), which permits reproduction and redistribution in any medium or format according to the license terms, provided the work is not used for commercial purposes and provided the original authors and source are properly credited and a link is provided to the Creative Commons license. For commercial permissions, visit <https://oceansidepubl.com/permission-to-use-content/>
Copyright © 2021, The Author(s). Published by OceanSide Publications, Inc., U.S.A.

symptoms or mild atopic dermatitis is less clear.^{5,7,8,10} Results of research have also downplayed the role of maternal allergen ingestion on infantile colic.^{11,12} Also, although the World Allergy Organization conditionally recommends probiotics in breast-fed infants to prevent eczema, this guidance is not universally accepted, and no clear prevention guidelines exist for other supplements (e.g., vitamin D, fish oil).^{13–15}

An adequate understanding of the extant data that relate to breast-feeding practices and infant food allergy is essential for pediatric clinicians, yet analysis of the data suggests that parents receive inconsistent recommendations. A recent study of mothers who were breast-feeding and whose infants had potential immunoglobulin E-mediated (IgE) food allergy found that, although most children were able to keep breast milk in the diet, specific recommendations with regard to dietary avoidances were highly variable (or not addressed at all) and were frequently driven by the mother's perception of risk.¹⁶ More than 30% of mothers reported having received conflicting advice.¹⁶ Not surprisingly, pediatric trainees often feel ill-prepared to discuss breast-feeding practices and desire more education.^{17,18} Knowledge gaps, guidance limitations, and the potential persistence of outdated curricula can create inconsistent provider recommendations and training environments that may rely on anecdotes instead of published evidence. To appropriately educate pediatric residents about maternal breast-feeding and food avoidance, it is necessary to assess a baseline understanding of the recommendations for food avoidance in mothers who are breast-feeding. This study used questionnaire data to assess pediatric residents' knowledge, describe their practices, and evaluate a module designed to provide evidence-based education about breast-feeding, food allergy, and food avoidance.

METHODS

Pediatric residents, postgraduate years (PGY) 1–3, at a large academic institution during the academic year 2018–2019 were recruited from April to July 2019. The participants completed an online survey and reviewed an online educational module, which was in the format of a set of slides that addressed the topics of (1) breast milk composition and the developing immune system, (2) maternal diet and allergen transfer to the breast milk, (3) maternal diet and infant food allergy and colic, (4) maternal supplements and infant food allergy, (5) guidelines and resources, and (6) case examples. The participants were then contacted to repeat the online survey 1 month later. This study was approved by the institutional review board at Children's National Hospital.

Survey

The 27-item survey collected demographic variables and assessed the knowledge and comfort with regard

to maternal dietary restriction, breast-feeding, and infant food allergy. Comfort was assessed by six Likert scale questions with regard to familiarity, understanding, and communication about current guidelines. Trainees' knowledge was assessed by using eight true or false statements, four 5-point Likert scale questions, two multiple-choice questions, and four clinical vignettes. All knowledge questions pertained to current recommendations with regard to primary prevention of food allergy, secondary prevention of mild symptoms (i.g., eczema), colic, and other presentations (i.g., allergic proctocolitis). Survey items were created and reviewed by a group of content experts (a pediatric allergist, a pediatric psychologist with allergy expertise, and a pediatric trainee). Survey creation, data collection, and storage were performed by using Research Electronic Data Capture (REDCap).¹⁹

Educational Module

The educational module consisted of a PowerPoint (Microsoft Corporation, Redmond, WA) style presentation that was prepared by using the most up-to-date maternal dietary recommendations as of May 1, 2019, and reviewed by all authors and an additional pediatric allergist. Evidence was gathered from up-to-date published guidelines, systematic reviews, and meta-analyses from major allergy journals by using PubMed search queries related to the following terms: maternal dietary restriction, breast-feeding, and infant food allergy.

Statistical Analyses

Baseline knowledge and comfort levels were compared based on trainee characteristics by using the χ^2 test for categorical variables and the Wilcoxon-Mann-Whitney tests for ordinal scales. Improvement from baseline was assessed by using the McNemar test to compare knowledge differences before and after participating in the educational module. Statistical analyses were completed with SAS 9.4 (SAS Institute, Cary, NC); a two-tailed p value of <0.05 was deemed significant.

RESULTS

A total of 116 pediatric residents (PGY-1–3) were recruited. Of these, 59% enrolled (68/116) and of these, 43% (29/68) completed the follow-up survey. At baseline, 25 respondents (36%) were PGY-1, 24 (35%) were PGY-2, and 20 (29%) were PGY-3. The majority (78%) were women. Most reported no previous experience with allergy/immunology education (92%) or research (97%), or in clinical training (89%). Sources for recommendations with regard to maternal dietary restriction included previous mentors' recommendations (49%), mentor anecdote (19%), and published guidelines (32%: 31% American Academy of Pediatrics,⁶ 1%

Table 1 Demographics and baseline characteristics

	Results, n (%)
Women	53 (77.9)
Practice site	
Academic clinic	27 (39.1)
Other community clinic	26 (37.7)
Private practice	16 (23.2)
Training level	
PGY-1	25 (36.2)
PGY-2	24 (34.8)
PGY-3	20 (29.0)
Previous experience (elective/research): none	54 (79.4)
Formal training in residency: no	53 (86.9)
Have counseled mothers to restrict their diets if infants have the following*	
High risk for food allergy	4 (5.4)
Allergic proctocolitis	16 (21.6)
Atopic dermatitis	5 (6.8)
Colic	6 (8.1)
Never	39 (52.7)
Use of these resources when making recommendations for maternal dietary restriction*	
Previous mentor	36 (48.6)
Anecdotal evidence	14 (18.9)
American Academy of Pediatrics recommendations	23 (31.1)
NIAID guidelines	1 (1.4)
Parent-reported symptoms	10 (13.5)
Other source	5 (6.8)
Believe mother's nutritional status adversely affected if allergenic foods eliminated from the diet: yes	22 (37.3)

PGY = Postgraduate year; NIAID = National Institute of Allergy and Infectious Diseases.

*Multiple-choice questions.

Response rates: 57% baseline, 26% follow-up.

National Institute of Allergy and Infectious Disease⁹). Only 37% believed that mothers' nutritional status could be adversely affected if allergenic foods were eliminated from their diets (Table 1).

Among baseline respondents, 5% felt comfortable with their understanding of the relationship between the maternal diet while breast-feeding and the infant food allergy. When stratified by training level, the PGY-3 residents were significantly more comfortable compared with the PGY-1 and PGY-2 residents ($p < 0.05$). Only 8% of all the baseline respondents felt knowledgeable **with** their understanding of the relationship between the mother's diet while breast-

feeding and infant food allergy. There was a tendency not to initiate a discussion with parents in the clinic on the topic, although PGY-3 residents were significantly more proactive than were the PGY-1 and PGY-2 residents ($p < 0.05$). Most respondents (61–93%) correctly answered questions with regard to guidelines on primary and secondary food allergy prevention with concern to the maternal diet. Upper-level (PGY-2 and PGY-3) residents answered more questions correctly about allergic proctocolitis compared with the interns ($p < 0.05$); no differences were noted for other topics (Tables 2 and 3).

The follow-up survey results showed that the module had little impact on test scores. Knowledge of dietary restriction for immunoglobulin E-mediated food allergy prevention or treatment was more likely to be answered incorrectly because nine participants who initially answered correctly were incorrect on follow-up ($p = 0.01$). Knowledge of dietary restrictions for the prevention or treatment of colic showed slight improvement, with three participants who answered incorrectly on the pretest subsequently answering correctly on the posttest ($p = 0.08$). Similar trends were noted for the primary prevention of atopic dermatitis (five answered correctly, $p = 0.10$) and recommendations for the infants who are symptomatic and with atopic dermatitis (three answered correctly, $p = 0.08$) (Table 4).

DISCUSSION

This study evaluated the knowledge and the comfort level of pediatric residents on the topic of maternal breast-feeding and its relationship with the development of allergic illness in their infants. Although there has been increased interest with regard to maternal dietary restriction and allergy prevention, changes in guidelines, and an evolving body of knowledge likely contribute to uncertainty and gaps in knowledge. In addressing inconsistencies in guidance and promoting evidence-based practice, it is important to understand how this topic is approached during training. Most respondents correctly answered questions with regard to guidelines for food allergy prevention and maternal diet, yet they did not feel comfortable with the topic and believed that they had little knowledge about it, which raised the interesting question of how or where this knowledge was obtained. Residents did not tend to initiate the topic for discussion in the clinic, which potentially reflected discomfort and/or lower priority during visits. A majority (53%) had not recommended maternal dietary avoidance; in those who did the most common reason, not surprisingly, was allergic proctocolitis (22%). Even though residents did not initiate the discussion or feel comfortable with the topic, a sizable number (47%) recommended maternal dietary

Table 2 Baseline perception and comfort assessments

	PGY, mean (median)		
	1	2	3
Feel knowledgeable about topic	4.00 (4)*	3.81 (4)	3.35 (3)
Comfortable with my understanding	4.10 (4)*	4.10 (4)*	3.29 (3)
Comfortable counseling mothers	3.5 (3)	3.76 (4)*	3.00 (3)
Discussion with parents in clinic	3.95 (4)	4.00 (4)	3.47 (3)
Initiate discussion with parents in clinic	4.36 (4)*	4.48 (5)*	3.82 (4)

PGY = Postgraduate year.

*Significant difference at $p < 0.05$ from PGY-3.

Those in bold are statistically significant.

Numbers 1–5 refer to Likert scoring of comfort/perception/knowledge level. 1, strongly agree/always; 2, agree/often; 3, neutral/sometimes; 4, disagree/rarely; 5, strongly disagree/never.

Results compared across gender, clinic site, and previous experience on the topic, and were not found to be statistically significant.

restriction for one of the selected reasons. In addition, only a small percentage of the participants believed that maternal nutritional status would be affected by allergenic food elimination from the diet, which highlights other knowledge gaps (Table 1).

In our study, the educational module did not result in improvements in correctly answered questions on the knowledge assessment. It is possible that the

module was presented ineffectively, used a less comprehensive learning platform, or contradicted messages that the residents received elsewhere. Furthermore, a one-time online module may not be an effective method of achieving comprehension and understanding during residency. Knowledge gaps may be present for both practicing primary care providers and residents, and could be exacerbated by a tendency for trainees to rely

Table 3 Baseline perception and knowledge assessments: PGY-1 versus PGY-2 and PGY-3

	PGY, % correct (n)	
	1 (n = 25)	2 and 3 (n = 44)
Existing guidelines	36.0 (9)	27.3 (12)
Primary prevention		
IgE mediated	80.9 (17)	89.2 (33)
Allergic proctocolitis	71.4 (15)	86.8 (33)
Atopic dermatitis	80.9 (17)	84.2 (32)
Colic	85.7 (18)	97.4 (37)
Secondary prevention		
IgE mediated	70.0 (14)	65.8 (25)
Allergic proctocolitis	65.0 (13)	73.7 (28)
Atopic dermatitis	70.0 (14)	55.5 (21)
Colic	66.7 (14)	76.3 (29)
Scenario		
Asymptomatic sibling allergy	90.5 (19)	97.3 (36)
Symptomatic atopic dermatitis	76.2 (16)	78.9 (30)
Symptomatic colic	80.9 (17)	92.1 (35)
Symptomatic allergic proctocolitis	14.3 (3)*	47.4 (18)*

PGY = Postgraduate year; IgE = immunoglobulin E.

*Significant difference at $p < 0.05$ from PGY-2 and PGY-3.

Those in bold are statistically significant.

Numbers 1–5 refer to Likert scoring of comfort/perception/knowledge level. 1, strongly agree/always; 2, agree/often; 3, neutral/sometimes; 4, disagree/rarely; 5, strongly disagree/never.

Results compared across gender, clinic site, and previous experience on the topic, and were not found to be statistically significant.

Table 4 Participant educational module responses at baseline and follow-up

Knowledge	Baseline	Follow-up		<i>p</i> ^a
		Incorrect	Correct	
Existing guidelines	Incorrect	20	3	0.71
	Correct	4	2	
Maternal avoidance of highly allergenic foods when breast-feeding recommended for primary prevention of infant: IgE-mediated food allergy	Incorrect	0	4	0.18
	Correct	1	19	
Allergic proctocolitis	Incorrect	1	4	0.71
	Correct	3	17	
Atopic dermatitis	Incorrect	0	5	0.10
	Correct	1	19	
Colic	Incorrect	0	1	—
	Correct	0	24	
Maternal dietary restriction when breast-feeding recommended for prevention or treatment of infant: IgE-mediated food allergy	Incorrect	7	1	0.01
	Correct	9	8	
Allergic proctocolitis	Incorrect	1	4	0.18
	Correct	1	19	
Atopic dermatitis	Incorrect	3	6	0.32
	Correct	3	13	
Colic	Incorrect	3	3	0.08
	Correct	0	19	
Supplements while breast-feeding recommended for: Prevention of infant food allergy	Incorrect	1	2	0.16
	Correct	6	20	
A mother presents to your clinic with the following concerns, what is the recommendation? Asymptomatic 2-month-old, sibling with allergy to eggs	Incorrect	0	1	—
	Correct	0	24	
Symptomatic 2-month-old with atopic dermatitis	Incorrect	1	3	0.08
	Correct	0	21	
Symptomatic 2-month-old with colic	Incorrect	0	4	0.41
	Correct	2	18	
Symptomatic 2-month-old with atopic dermatitis and watery stools with occasional specks of blood	Incorrect	11	5	0.53
	Correct	5	4	

IgE = Immunoglobulin E.

^a*p value is based on the McNemar test.*

Significant difference at p < 0.05.

on mentors and anecdotal sources for guidance. These practices could lead to a lag in the implementation of new or changing recommendations. These findings underscored the need for improved communication and understanding of major society guidelines and consensus statements. Importantly, a significant percentage (31%) also sought guidelines/consensus opinions from the American Academy of Pediatrics, but only a few (1%) from the National Institute of Allergy and Infectious Disease. Although the participants were not queried with regard to other major international allergy

societies, these findings suggested that the major allergy specialty organizations may want to consider more effective dissemination of information to pediatric trainees (Table 1).

Limitations of this study included data collection at a single residency program, a limited response rate, and a single variable indicator for the training level. The results of this study may not represent training at other institutions, which would limit generalizability. Furthermore, a smaller number of trainees completed the postmodule evaluation, and it is possible that this

lower response rate contributed to the inability to detect an improvement in knowledge after the module. Nevertheless, it is clear that there is likely a need to improve residents' knowledge of the guidelines related to maternal dietary restriction for food allergy prevention. Future iterations of this project will include revisions with further testing of the educational module, with recruitment from multiple sites and additional queries to understand the low comfort level and hesitancy in initiating discussions about these topics.

CONCLUSION

Pediatricians are uniquely positioned to influence maternal dietary decision-making while the mother is breast-feeding, and confident guidance and understanding of this topic are important in fostering appropriate maternal nutrition and potentially improving allergic outcomes in infants.¹⁰ Given an evolving understanding of this topic and variability in medical guidance, the development of robust educational resources with regard to this topic is needed.

REFERENCES

1. Bravi F, Wiens F, Decarli A, et al. Impact of maternal nutrition on breast-milk composition: a systematic review. *Am J Clin Nutr.* 2016; 104:646–662.
2. Rajani PS, Seppo AE, Järvinen KM. Immunologically active components in human milk and development of atopic disease, with emphasis on food allergy, in the pediatric population. *Front Pediatr.* 2018; 6:218.
3. Fujimura T, Lum SZC, Nagata Y, et al. Influences of maternal factors over offspring allergies and the application for food allergy. *Front Immunol.* 2019; 10:1933.
4. Du Toit G, Foong R-X, Lack G. The role of dietary interventions in the prevention of IgE-mediated food allergy in children. *Pediatr Allergy Immunol.* 2017; 28:222–229.
5. Järvinen KM, Westfall JE, Seppo MS, et al. Role of maternal elimination diets and human milk IgA in the development of cow's milk allergy in the infants. *Clin Exp Allergy.* 2014; 44:69–78.
6. NIAID-Sponsored Expert Panel; Boyce JA, Assa'ad A, et al. NIAID-Sponsored Expert Panel. Guidelines for the diagnosis and management of food allergy in the United States: report of the NIAID-sponsored expert panel. *J Allergy Clin Immunol.* 2010; 126(suppl):S1–S58.
7. Sampson HA, Aceves S, Bock SA, et al. Food allergy: a practice parameter update-2014. *J Allergy Clin Immunol.* 2014; 134:1016–1025.e43.
8. Fleischer DM, Chan ES, Venter C, et al. A consensus approach to the primary prevention of food allergy through nutrition: guidance from the American Academy of Allergy, Asthma, and Immunology; American College of Allergy, Asthma, and Immunology; and the Canadian Society for Allergy and Clinical Immunology. *J Allergy Clin Immunol Pract.* 2021; 9:22–43.e4.
9. Greer FR, Sicherer SH, Burks AW, et al. The effects of early nutritional interventions on the development of atopic disease in infants and children: the role of maternal dietary restriction, breastfeeding, hydrolyzed formulas, and timing of introduction of allergenic complementary foods. *Pediatrics.* 2019; 143:e20190281.
10. Pier J, Jarvinen-Seppo KM. Breastfeeding and food allergy. *J Food Allergy.* 2020; 2:99–103.
11. Gordon M, Biagioli E, Sorrenti M, et al. Dietary modifications for infantile colic. *Cochrane Database Syst Rev.* 2018; 10:CD011029.
12. Rajani PS, Martin H, Groetch M, et al. Presentation and management of food allergy in breastfed infants and risks of maternal elimination diets. *J Allergy Clin Immunol Pract.* 2020; 8:52–67.
13. Yepes-Nuñez JJ, Fiocchi A, Pawankar R, et al. World Allergy Organization-McMaster University Guidelines for Allergic Disease Prevention (GLAD-P): vitamin D. *World Allergy Organ J.* 2016; 9:17.
14. Fiocchi A, Pawankar R, Cuello-Garcia C, et al. World Allergy Organization-McMaster University Guidelines for Allergic Disease Prevention (GLAD-P): probiotics. *World Allergy Organ J.* 2015; 8:4.
15. Turner PJ, Campbell DE, Boyle RJ, et al. Primary prevention of food allergy: translating evidence from clinical trials to population-based recommendations. *J Allergy Clin Immunol Pract.* 2018; 6:367–375.
16. Wangberg H, Bagsic SRS, Kelso J, et al. Provider recommendations and maternal practices when providing breast milk to children with immunoglobulin E-mediated food allergy. *Ann Allergy Asthma Immunol.* 2021; 126:548–554.e1.
17. Esselmont E, Moreau K, Aglipay M, et al. Residents' breastfeeding knowledge, comfort, practices, and perceptions: results of the Breastfeeding Resident Education Study (BRES). *BMC Pediatr.* 2018; 18:170.
18. Eden AN, Mir MA, Srinivasan P. The pediatric forum: breastfeeding education of pediatric residents: a national survey. *Arch Pediatr Adolesc Med.* 2000; 154:1271–1272.
19. Harris PA, Taylor R, Thielke R, et al. Research electronic data capture (REDCap)—a metadata-driven-methodology and workflow process for providing translational research informatics support. *J Biomed Inform.* 2009; 42:377–381. □