ABSTRACT

Background: Early introduction of allergenic foods is recommended to reduce the risk of developing food allergies, but it is unclear whether recommendations are being followed. Objective: We examine patterns of allergenic food introduction in inner-city children enrolled in an academic pediatric practice in the greater Los Angeles area. Methods: This was a prospective study with patients ages 12 to 24 months recruited from the pediatrics continuity clinic at an inner-city tertiary medical center in the greater Los Angeles area. Caregivers were asked via anonymous surveys about their child’s history of atopic diseases and at what age they first introduced egg, soy, wheat, peanut, tree nuts, fish, shrimp, and shellfish into their child’s diet. Results: Two hundred caregivers responded to the survey. The average age of introduction of egg was 9.2 months, soy 10 months, wheat 9.3 months, peanut 10.5 months, tree nuts 10.9 months, fish 10.9 months, shrimp 11.3 months, and shellfish 11.5 months. Between ages 4–11 months, 65.3% of children were introduced egg, 19.1% soy, 55.8% wheat, 28.6% peanut, 17.1% tree nuts, 28.1% fish, 13.6% shrimp, and 7.0% shellfish. By age 24 months, 92% of children were introduced egg, 37.7% soy, 85.7% wheat, 67.3% peanut, 47.7% tree nuts, 67.8% fish, 48.2% shrimp, and 30.2% shellfish. Of the 14 children with eczema or egg allergy, 26.1% were introduced peanut by age 4–6 months and 50% by age 4–11 months. Conclusion: Despite recommendations, inner-city caregivers may not be introducing allergenic foods in a timely manner to their children. Keywords: Allergenic food introduction; Child; Early; Inner-city

INTRODUCTION

National guidelines regarding the timing of allergenic food introduction have shifted over the years. With the publication of The Learning Early about Peanut Allergy (LEAP) trial in 2015, a shift in the culture of allergenic food introduction occurred as early introduction of peanut at age 4–11 months was shown to decrease the risk of developing peanut allergy [1]. Following
LEAP, in 2017, the American Academy of Pediatrics (AAP) and the National Institute of Allergy and Infectious Diseases (NIAID)-sponsored expert panel published addendum guidelines supporting early introduction of peanut in the high-risk pediatric population, those infants with severe eczema, egg allergy, or both [2]. Current recommendations for the introduction of allergenic foods, especially peanut, are more aligned with that of early complementary food introduction at 4 to 6 months.

Although not delaying allergic food introduction and early introduction of peanut are recommended to reduce the risk of developing food allergies, it is unclear whether recommendations are being followed. In a recent clinical communication published in the Journal of Allergy and Clinical Immunology in Practice 2018, surveys sent to family physicians, pediatricians, and allergists showed a discrepancy in the implementation of NIAID guidelines [3]. The study showed that of those surveyed, family physicians were more likely to recommend the introduction of allergenic foods at age 1 or more, whereas pediatricians and allergists were more likely to recommend early introduction of allergenic foods. In this study, we examine patterns of allergenic food introduction among inner-city children enrolled in an academic pediatric practice to determine whether current recommendations are being followed by caregivers of this pediatric population.

MATERIALS AND METHODS

Study design
This was a prospective cross-sectional study examining when parents introduced various allergenic foods to their infants during the first 2 years of life. Patients and parents were recruited from the Pediatric Primary Care Continuity Clinic at Los Angeles County + University of Southern California (LAC+USC) Medical Center. An anonymous survey instrument in both English and Spanish was distributed by nurses and Pediatric residents to caregivers of children ages 12 to 24 months during well-child visits from June 1, 2018 to April 30, 2019 (Fig. 1). The survey assessed timing of introduction to the common allergenic foods: cow’s milk, egg, soy, wheat, peanut, tree nuts, fish, shrimp, and shellfish. Additional information about child and family history of atopic diseases, ethnicity, birth order, number of siblings, and length of breastfeeding was obtained. Caregivers were asked about the barriers they encountered during food introduction.

This study was approved by the Institutional Review Board (IRB) of the University of Southern California Keck School of Medicine (IRB number: HS-18-00457). The IRB also approved waiver of informed consent.

Statistical analysis
Descriptive statistics were used to describe the results. Analysis of variance was used to determine any significance between mean time to introduction of various allergenic foods.

RESULTS

Two hundred caregivers were surveyed. The children were predominantly Hispanic and breastfed. The majority did not have reported food allergies. Nine children had reported allergies to cow’s milk, egg, peanut, shrimp, and shellfish. Another 3 reported allergies to...
coffee, pineapple, and peas. A total of 7 children had reported atopic dermatitis, and 46 children had a family history of atopy, which included history of asthma, allergic rhinitis, atopic dermatitis, and food allergies (Table 1).

Of those caregivers surveyed, the average age of introduction of egg was 9.2 months, soy 9.3 months, peanut 10.5 months, tree nuts 10.9 months, fish 10.9 months, shrimp 11.3 months, and shellfish 11.5 months (Fig. 2). Cow’s milk and dairy was excluded from the study after we learned that many of our caregivers believed that formula which they fed their children early in life were not categorized as cow’s milk or dairy. There was no statistical difference between when the different foods were introduced. By age 4–11 months, 65.3% of children were introduced egg, 19.1% soy, 55.8% wheat, 28.6% peanut, 17.1% tree nuts, 28.1% fish, 13.6% shrimp, and 7.0% shellfish (Fig. 3). By age 24 months, 92% of children were introduced egg, 37.7% soy, 85.4% wheat, 67.3% peanut, 47.7% tree nuts, 67.8% fish, 48.2% shrimp, and 30.2% shellfish (Fig. 4). Of the allergenic foods, egg was the earliest food introduced to the children, whereas soy, peanut, tree nuts, shrimp, and shellfish were not as commonly introduced. Of the 14 children with eczema or egg allergy, 26.1% were introduced peanut by age 4–6 months and 50% by age 4–11 months, compared to 7.6% and 23.1% in patient without atopic dermatitis (Fig. 5). There was statistical significance due to the small sample size. Barriers of food introduction noted by caregivers include a fear of food introduction, lack of parental education by pediatricians regarding
food introduction, hesitation to introduce foods due to their child having eczema and other atopic diseases, cost of certain allergenic foods (namely fish and shellfish), and their own cultural practices.

Table 1. Patient characteristics (n = 200)

| Characteristic         | Value          |
|------------------------|----------------|
| Sex                    |                |
| Male                   | 88 (44.0)      |
| Female                 | 107 (53.5)     |
| Unreported             | 5 (2.5)        |
| Ethnicity              |                |
| Hispanic               | 171 (85.5)     |
| Black/African American | 7 (3.5)        |
| Asian                  | 5 (2.5)        |
| Hispanic Asian         | 3 (1.5)        |
| White                  | 3 (1.5)        |
| Armenian               | 3 (1.5)        |
| Hispanic Armenian      | 1 (0.5)        |
| Unreported             | 7 (3.5)        |
| Breast fed             |                |
| Yes                    | 159 (79.5)     |
| No                     | 41 (20.5)      |
| Food allergy           |                |
| None                   | 189 (94.5)     |
| Egg                    | 3 (1.5)        |
| Cow’s milk             | 3 (1.5)        |
| Peanut                 | 1 (0.5)        |
| Shrimp                 | 1 (0.5)        |
| Shellfish              | 1 (0.5)        |
| Other                  | 3 (1.5)        |
| Atopic dermatitis      |                |
| Yes                    | 14 (7.0)       |
| No                     | 186 (93.0)     |
| Family history of atopy|                |
| Yes                    | 46 (23.0)      |
| No                     | 154 (77.0)     |

Values are presented as number (%).

Fig. 2. Mean time of first introduction of allergenic food.
DISCUSSION

This study shows that caretakers residing in the inner-city in the greater Los Angeles area were not introducing allergenic foods to their children during early childhood as recommended by current guidelines [1-3]. The age of introduction to an allergenic food ranged from 4 months to more than 13 months. By 2 years of age, 8% of children had not...
been introduced to egg, 62.8% to soy, 14.6% to wheat, 32.7% to peanut, 52.3% to tree nuts, 32.2% to fish, 51.8% to shrimp, and 69.8% to shellfish.

Current guidelines support early allergenic food introduction in contradistinction to the previous 2000 AAP guidelines recommending delaying the introduction of certain highly allergenic foods in high-risk children in an effort to prevent the development of allergic diseases such as atopic dermatitis [4]. In 2008, due to the increasing incidence of allergic disease and food allergies, the AAP re-evaluated its previous recommendations and concluded that there was not enough evidence to promote this strategy for primary prevention of allergic disease in children [5]. Since the publication of the landmark trial LEAP, early introduction of peanuts has been shown to decrease the risk of developing peanut allergy [1]. The most recent guidelines from the AAP in 2019 states that there is no evidence that delaying the introduction of allergenic foods beyond 4 to 6 months prevents atopic disease [6].

The aforementioned previous and long held belief that early introduction of allergenic foods results in higher probability of developing food allergies may be a major reason why the children in our study were introduced to allergenic foods after an average of 9 months of age. The complete reversal of allergenic food introduction and food allergy paradigm within a short period of time may have resulted in confusion among parents in regards to the best strategies in feeding their infants allergenic foods. Moreover, this new food introduction paradigm may run counter to the cultural practices of some of our patients. We did not quantify reasons why parents in our patient cohort chose to delay introduction of allergenic foods however significant number of parents delayed allergenic food introduction because if their cultural practices and hesitation because they believed that it would result in development of atopic disease.

Similar to our results, other investigators have also reported delays in allergenic food introduction. Tran et al. [7] in Canada, found that 76% parents introduced egg between 7 and 12 months, and only 36% introduced peanut between 7 and 12 months, with most parents (63%) avoiding giving peanut during the first year of life. In contrast to our patient population in inner-city Los Angeles and that in the Canadian study, Schiess et al. [8] found that in 5 European countries, including Germany, Belgium, Italy, Spain, and Poland, some infants were introduced to allergenic foods much earlier than the recommended minimum age of 4 months. This dichotomy in timing of allergenic food introduction is consistent with a small survey of the providers in LAC+USC Medical Center Pediatrics Primary Care in regards to timing of food introduction for their own children. This group of parents introduced food introduction to their own children, allergenic foods such as egg, soy, peanut, and tree nuts were introduced at an average of 6 months of age, much earlier than the children in their medical care (data not shown).

One of the reasons cited by parents of our cohort for late introduction of allergenic foods was lack of pediatrician advice. Leo et al. [9] surveyed providers in British Columbia and found that pediatricians were less aware than dietitians of the recommendation of no benefit in delaying allergenic food introduction beyond 4 to 6 months. In our study, however, the pediatricians were aware of current recommendations of early allergenic food introduction as many of them followed guidelines for their own children. Therefore, there appears to be a disconnect between pediatrician knowledge and caregiver implementation of these recommendations. This finding could be due to provider time limitation during well-child visits to provide recommendations about nutrition when other anticipatory guidance needs to be communicated. In a national survey of 907 primary care pediatricians, Galuska et al. found that fewer than 11% of
pediatricians usually discussed all 6 anticipatory guidance topics included in the survey during well-child care visits [10, 11]. Diet/nutrition is but one topic amongst the many topics that need to be discussed, including seatbelt/car seat use, firearm safety, smoking in the home, healthy weight, and physical activity. Other barriers may include limited parental health literacy and challenges in coordinating all aspects of the anticipatory guidance.

When looking specifically at the high-risk population, which includes infants with severe eczema, egg allergy, or both, early introduction of peanut is recommended by the AAP and NIAID [2, 6]. In our study, 26.1% of high-risk infants were introduced peanut by age 4–6 months and 50% by age 4–11 months. Although there are low percentages, infants with severe eczema and/or egg allergy were more likely to be introduced to peanut than the general population, though our sample size was small. It is possible that our providers who are aware of guidelines were more likely to emphasize early introduction of peanuts among patients at higher likelihood of peanut allergy in contrast to those without significant risk.

Finally, a consequence of delayed allergenic food introduction on a large population basis is an increased risk of food allergy among these large cohorts [2]. Previous studies have suggested that food allergy prevalence among children is higher in the urban environment [12-14]. This may in part be due to late introduction of allergenic foods among inner-city children residing in these areas.

Limitations of our study include a fairly homogenous population with the majority being Hispanic and breastfed. The sample size of patients with atopic dermatitis and egg allergy was extremely small. Moreover, physician diagnosis of eczema/egg allergy was not correlated to the reported diagnoses since the survey was anonymous. We surveyed caregivers of children ranging from 12 months to 24 months of age, and recall bias for those children in the older age range may exist. Documentation of provider education was not reviewed. However, caregiver perception is a proxy for real life understanding and where focus should be to have true impact in patient care.

In conclusion, inner-city caregivers are not introducing allergenic foods in a timely manner to their children as recommended by current guidelines. This may lead to increased likelihood of developing food allergy among these children. Further efforts need to be focused on elucidating reasons for the disconnect between evidenced based guidelines and their implementation. These will be basis for strategies in reducing development of food allergies in this population.

REFERENCES

1. Du Toit G, Roberts G, Sayre PH, Bahnson HT, Rudolovic S, Santos AF, Brough HA, Phipppard D, Basting M, Feeney M, Turcanu V, Sever ML, Gomez Lorenzo M, Plaut M, Lack G; LEAP Study Team. Randomized trial of peanut consumption in infants at risk for peanut allergy. N Engl J Med 2015;372:803-13. [PUBMED] [CROSSREF]

2. Togias A, Cooper SF, Acebal ML, Assa’ad A, Baker JR Jr, Beck LA, Block J, Byrd-Bredbenner C, Chan ES, Eichenfield LF, Fleischer DM, Fuchs OJ 3rd, Furuta GT, Greenhawt MJ, Gupta KS, Habich M, Jones SM, Keaton K, Muraro A, Plaut M, Rosenwasser LJ, Rotrosen D, Sampson HA, Schneider LC, Sicherer SH, Sidbury R, Spergel J, Stukus DR, Venter C, Boyce JA. Addendum guidelines for the prevention of peanut allergy in the United States: report of the National Institute of Allergy and Infectious Diseases-sponsored expert panel. J Allergy Clin Immunol 2017;139:29-44. [PUBMED] [CROSSREF]
3. Abrams EM, Singer AG, Soller L, Chan ES. Knowledge gaps and barriers to early peanut introduction among allergists, pediatricians, and family physicians. J Allergy Clin Immunol Pract 2019;7:681-4.
PUBMED | CROSSREF

4. American Academy of Pediatrics. Committee on Nutrition. Hypoallergenic infant formulas. Pediatrics 2000;106:346-9.
PUBMED | CROSSREF

5. Greer FR, Sicherer SH, Burks AW; Committee on Nutrition, AAP Section on Allergy and Immunology; American Academy of Pediatrics Section on Allergy and Immunology. Effects of early nutritional interventions on the development of atopic disease in infants and children: the role of maternal dietary restriction, breastfeeding, timing of introduction of complementary foods, and hydrolyzed formulas. Pediatrics 2008;121:183-91.
PUBMED | CROSSREF

6. Greer FR, Sicherer SH, Burks AW; Committee on Nutrition, AAP Section on Allergy and Immunology. 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.
PUBMED | CROSSREF

7. Tran MM, Lefebvre DL, Dai D, Dharma C, Subbarao P, Lou W, Azad MB, Becker AB, Mandhane PJ, Turvey SE, Sears MR; CHILD Study Investigators. Timing of food introduction and development of food sensitization in a prospective birth cohort. Pediatr Allergy Immunol 2017;28:471-7.
PUBMED | CROSSREF

8. Schiess SA, Grote V, Scaglioni S, Luque V, Martin F, Stolarczyk A, Vecchi F, Koletzko B; European Childhood Obesity Project. Introduction of potentially allergenic foods in the infant’s diet during the first year of life in five European countries. Ann Nutr Metab 2011;58:109-17.
PUBMED | CROSSREF

9. Leo S, Dean J, Chan ES. What are the beliefs of pediatricians and dietitians regarding complementary food introduction to prevent allergy? Allergy Asthma Clin Immunol 2012;8:3.
PUBMED | CROSSREF

10. Galuska DA, Fulton JE, Powell KE, Burgess CR, Pratt M, Elster A, Griesemer BA. Pediatrician counseling about preventive health topics: results from the Physicians' Practices Survey, 1998-1999. Pediatrics 2002;109:E83-3.
PUBMED | CROSSREF

11. Nelson CS, Wissow LS, Cheng TL. Effectiveness of anticipatory guidance: recent developments. Curr Opin Pediatr 2003;15:630-5.
PUBMED | CROSSREF

12. Nwaru BI, Erkkola M, Ahonen S, Kaila M, Haapala AM, Kronberg-Kippilä C, Salmelin R, Veijola R, Ilonen J, Simell O, Knip M, Virtanen SM. Age at the introduction of solid foods during the first year and allergic sensitization at age 5 years. Pediatrics 2010;125:50-9.
PUBMED | CROSSREF

13. Gupta RS, Springston EE, Smith B, Warrier MR, Pongracic J, Holl JL. Geographic variability of childhood food allergy in the United States. Clin Pediatr (Phila) 2012;51:596-61.
PUBMED | CROSSREF

14. McGowan EC, Bloomberg GR, Gergen PJ, Vissness CM, Jaffee KE, Sandel M, O’Connor G, Kattan M, Gern J, Wood RA. Influence of early-life exposures on food sensitization and food allergy in an inner-city birth cohort. J Allergy Clin Immunol 2015;135:171-8.
PUBMED | CROSSREF