

SHORT COMMUNICATION

Consultation with registered dietitian to prevent accidental reactions to food: insight from an egg allergy influenza vaccination cohort

P Bégin^{1,2}, C Filion², F Graham², J Lacombe-Barrios¹, J Paradis¹, L Paradis^{1,2} and A Des Roches¹

Egg is an ubiquitous allergen found in many food products. Current food allergy guidelines recognize the importance of consultation with a registered dietitian to ensure nutritional adequacy. However, there is a lack of evidence on its impact on the implementation of allergen avoidance strategies. Taking advantage of a well-characterized cohort of influenza vaccination in egg-allergic children ($n = 397$), we tested the hypothesis that real-life professional dietary advice was associated with a decrease in accidental reactions to egg in allergic children with retrospective questionnaires. Lack of consultation with a dietitian was associated with a 1.89-fold increase in the risk of accidental reactions to egg (confidence interval: 1.47–2.42). The only other independent variable that predicted reactions was having had a history of acute reaction to egg prior diagnosis (relative risk = 2.02; confidence interval: 1.64–3.00). These findings support the usefulness of referral to a food allergy-specialized dietitian at time of diagnosis in order to prevent future accidental reactions to egg.

European Journal of Clinical Nutrition advance online publication, 21 December 2016; doi:10.1038/ejcn.2016.241

INTRODUCTION

The prevalence of IgE-mediated food allergies has tripled over the last decade, with up to 8% of children affected in North America.¹ It is estimated that ~14 000 food-induced anaphylactic events are seen in US emergency departments each year and that ~100 of these are ultimately fatal.² Egg allergy affects 1.2–2.0% of young children and accounts for up to 7% of food-induced anaphylactic reactions.^{3–5} It is an ubiquitous ingredient, which is found in many food products such as breaded foods, cream fillings, custards, candies, canned soups, frostings, ice creams, artisanal marshmallows, marzipan and pasta.

The current management of egg allergy consists of strict allergen avoidance and use of emergency self-injectable adrenalin in case of accidental contact. Counseling regarding avoidance includes discussions about cross-contact and hidden ingredients, food labels, advisory labeling, egg substitutes and non-food sources. Although some guidelines refer to the role of the dietitian to ensure nutritional adequacy, the very important role of the dietitian in the management of food allergy is still often overlooked.^{2,6,7} A prospective study of 52 food-allergic children found that a multidisciplinary approach (pediatric allergist, clinical nurse specialist and pediatric dietitian) significantly improved parental knowledge of allergen avoidance, management of allergic reactions and epinephrine auto-injector usage, and reduced the rate of allergic reactions; however, the individual impact of the consultation with a dietitian was not quantified.⁸

Here, taking advantage of a well-characterized cohort from influenza vaccination in egg-allergic children, we tested the hypothesis that real-life professional dietary advice is associated with a decrease in accidental reactions to egg in allergic children.

Briefly, all egg-allergic participants referred to our center for influenza vaccination during the 2009 and 2010 seasons were invited to participate in the study.^{9,10} Egg allergy was confirmed in all participants before recruitment. In subjects with a history of immediate clinical allergic reaction to egg, allergy was defined as either a skin prick test response to egg or an egg-specific IgE level of at least 0.35 kU/l (UniCAP; Pharmacia, Uppsala, Sweden). In subjects without a history of immediate reaction to egg, inclusion criteria were more stringent and required an egg-specific IgE level of at least 2 kU/l for children less than 2 years old, and at least 7 kU/l for children older than 2, which are associated with a 95% positive predictive value of reaction upon challenge.^{11,12}

Parents were invited to complete a questionnaire on their child's allergy, which included questions on egg allergy diagnosis and history, the occurrence of accidental exposures to egg and whether or not they had met a registered dietitian at the time of diagnosis for advice on avoidance diet. Student's t -test was used to compare continuous variables and characteristics. χ^2 was used to compare categorical variables. Signed consent was obtained from parents of all participants. This project was approved by the CHU Sainte-Justine research ethics committee.

Of the 397 egg-allergic patients referred to our vaccination clinic during the study period, 303 (76%) completed the whole questionnaire. Of these, 152 (50%) had a history of accidental reactions to egg since its diagnosis (Table 1). Allergy testing (skin prick test and specific IgEs) did not differ at the time of evaluation between those who had had accidents and those who did not. There was no difference regarding sex or age at evaluation or at diagnosis. Both groups reported comparable rates of asthma, eczema and concurrent food allergies. However, accidental

¹Service of Allergy and Clinical Immunology, Centre Hospitalier Universitaire Sainte-Justine, Montreal, Quebec, Canada and ²Department of Medicine, Centre Hospitalier de l'Université de Montréal, Service of Allergy and Clinical Immunology, Montreal, Quebec, Canada. Correspondence: Dr A Des Roches, Service of Allergy and Clinical Immunology, Centre Hospitalier Universitaire Sainte-Justine, 3175, Côte Sainte-Catherine, Montreal, Quebec, Canada H3T 1C5.
E-mail: a.des.roches@umontreal.ca

Received 2 May 2016; revised 12 September 2016; accepted 15 September 2016

Table 1. Characteristics of egg-allergic subjects with and without accidental reactions

	Accidents with egg since diagnosis (n = 152)	No accidents with egg since diagnosis (n = 151)	Relative risk	P-value
<i>Single variable analysis</i>				
Male	81 (53%)	85 (56%)	0.94	0.73
Age at analysis (years)	7.56 ± 4.68	6.08 ± 3.60	n.a.	0.35
Age at diagnosis (years)	1.05 ± 0.51	0.99 ± 0.50	n.a.	0.19
Asthma	68 (48%)	74 (49%)	0.92	0.49
Eczema	60 (39%)	76 (50%)	0.80	0.07
Other food allergy	95 (63%)	110 (73%)	0.80	0.07
Immediate reaction before diagnosis	116 (76%)	64 (42%)	2.20	< 0.0005
SPT size (mm)	9.59 ± 5.38	9.34 ± 5.41	n.a.	0.70
Specific IgE (kU/l) ^a	6.09 (0.35–100)	4.99 (0.35–100)	n.a.	0.32
Consultation with dietitian	51 (34%)	98 (65%)	0.52	< 0.0005
<i>History of clinical reaction before diagnosis</i>				
	Lack of consultation (n = 105)	Consultation with dietitian (n = 75)	Relative risk	P-value
<i>Stratified analysis</i>				
Accidents with egg	83 (79%)	33 (44%)	2.08	< 0.0005
<i>Absence of clinical reaction before diagnosis (sensitized)</i>				
	Lack of consultation (n = 49)	Consultation with dietitian (n = 74)	Relative risk	P-value
Accidents with egg	17 (35%)	17 (23%)	1.39	0.22

Abbreviations: n.a., not available; SPT, skin prick test. ^aPresented as the median and range. Bold values indicate statistically significant.

reactions were significantly associated with a clinical history of immediate acute reaction to egg before diagnosis ($P < 0.0005$) and with the absence of consultation with a registered dietitian at the time of diagnosis ($P < 0.0005$).

The relative risk of having had accidents with egg was 2.20-fold greater in subjects with a history of acute reaction compared with those with sensitization ($P < 0.0005$). Lack of consultation with a dietitian was associated with a 1.89-fold increase in risk of reaction ($P < 0.0005$). Stratified analysis showed that both variables were independent, with the protective effect of dietitian consultation being most significant in subjects with a history of clinical reaction to egg (relative risk = 2.08; $P < 0.0005$). A similar trend was observed in those without a clinical history (sensitized), which did not meet statistical significance, possibly because of smaller numbers in that subgroup (relative risk = 1.39; $P = 0.22$). The number of reactions reported since diagnosis also depended on whether a dietitian had been consulted or not (1.7 versus 0.9; $P < 0.0001$). There was no difference between age at or time since diagnosis in either groups, which could have been an important confounder. At the time of questionnaire completion, 40% of children reported being tolerant to baked eggs in both groups.

Interestingly, all patients participating in this study had been referred to our center by an allergist and thus were already expected to have had received counseling on egg-avoidance diet. This shows that the role of a registered dietitian is complimentary and non-redundant with that of physicians and should thus be sought at time of diagnosis. Whereas the allergist will often focus on the level of food avoidance required to prevent accidental reactions, the food allergy-specialized dietitian consultation aims at increasing the parents' knowledge on food labels and egg content in unpacked foods and issues surrounding cross-contamination in manufactured products, which is frequently found to be deficient.^{13,14} Such training is essential, given that patients often attribute accidental allergic reactions to misunderstanding label terms (16%) or to nonspecific ingredient terms such as spice and flavor (22%).¹⁵ Recent laws requiring the presence of

egg to be labeled unequivocally have helped. However, in Canada at least, there is a lack of resources to enforce and monitor their application. In addition, trace amounts, shared factory equipment, imported food not following labeling laws and unpacked food prepared 'in-house' remain major issues that families need to be trained on.

The 152 reactors in the study collectively added up to 50 emergency department visits (at 150\$ CAD) and 11 hospitalizations (at 2600\$ CAD), which represents an average added cost of 237.50\$ CAD per patient. Considering a number needed to treat (NNT) of 8.33 in sensitized subjects, the dietitian consultation can be valued at 28.50\$ CAD compared with 90\$ CAD (NNT = 2.57) in those with a prior clinical history of reaction. In the latter, this return fully covers the cost of consultation. In egg-sensitized subjects, consultation is still relevant, as the above-mentioned value does not include the value of the child and family not having to go through the reaction or of other benefits of dietitian intervention (that is, nutrition adequacy). In addition, in those diagnosed in the course of moderate to severe eczema, dietary control of underlying food allergens can also have an important role in disease management.¹⁶

An important limit to consider is the retrospective nature of the study, which was initially designed to test safety of influenza vaccination. As a retrospective study, we lacked control over timing and nature of the nutritionist intervention and the participants were subjected to recall bias. Moreover, we did not control for subsequent follow-up with a registered dietitian. This said, the size and the 'real-life' aspect of the study are important strengths. A concern with prospective trials is that the level of intervention may be more intense than what is expected in regular practice, thus introducing bias. Here we show that intervention by 'real-life' dietitians is indeed effective at preventing accidents.

On the basis of our findings, we conclude that parents of egg-allergic children should be referred to a food allergy-specialized dietitian at the moment of the diagnosis by an allergist. Including

this as a suggestion in future guidelines could have a favorable impact on dietitian recruitment by administrators, not only in Allergy divisions in hospital centers but also in private outpatient clinics where resources may be limited by financial considerations.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

ACKNOWLEDGEMENTS

We thank the participants of the study and their families.

ETHICS, CONSENT AND PERMISSIONS

This project was approved by the CHU Sainte-Justine Research Ethics Committee. All patients signed informed consent before enrollment.

AUTHOR CONTRIBUTIONS

PB, LP and ADR participated in the conceptual design. PB, JL-B, LP, JP and ADR assessed the patients and dispensed the questionnaires. CF compiled the data from the questionnaire. PB, CF, ADR and FG analyzed the data and wrote the manuscript. All authors reviewed and approved the final version of the manuscript.

REFERENCES

- 1 Rona RJ, Keil T, Summers C, Gislason D, Zuidmeer L, Sodergren E *et al*. The prevalence of food allergy: a meta-analysis. *J Allergy Clin Immunol* 2007; **120**: 638–646.
- 2 Sampson HA, Aceves S, Bock SA, James J, Jones S, Lang D *et al*. Food allergy: a practice parameter update-2014. *J Allergy Clin Immunol* 2014; **134**: 1016–25 e43.
- 3 Eggesbo M, Botten G, Halvorsen R, Magnus P. The prevalence of allergy to egg: a population-based study in young children. *Allergy* 2001; **56**: 403–411.
- 4 Colver AF, Nevantaus H, Macdougall CF, Cant AJ. Severe food-allergic reactions in children across the UK and Ireland, 1998-2000. *Acta Paediatr* 2005; **94**: 689–695.
- 5 Xepapadaki P, Fiocchi A, Grabenhenrich L, Roberts G, Grimshaw KE, Fiandor A *et al*. Incidence and natural history of hen's egg allergy in the first 2 years of life-the EuroPrevall birth cohort study. *Allergy* 2016; **71**: 350–357.
- 6 Muraro A, Werfel T, Hoffmann-Sommergruber K, Roberts G, Beyer K, Bindslev-Jensen C *et al*. EAACI food allergy and anaphylaxis guidelines: diagnosis and management of food allergy. *Allergy* 2014; **69**: 1008–1025.
- 7 Barry P, Beattie P, Brown T, Clarke S, East M, Fox A *et al*. *Food Allergy in Children and Young People: Diagnosis and Assessment of Food Allergy in Children and Young People in Primary Care and Community Settings*. National Institute for Health and Clinical Excellence: Guidance. London, UK, 2011.
- 8 Kapoor S, Roberts G, Bynoe Y, Gaughan M, Habibi P, Lack G. Influence of a multidisciplinary paediatric allergy clinic on parental knowledge and rate of subsequent allergic reactions. *Allergy* 2004; **59**: 185–191.
- 9 Des Roches A, Paradis L, Gagnon R, Lemire C, Bégin P, Carr S *et al*. Egg-allergic patients can be safely vaccinated against influenza. *J Allergy Clin Immunol* 2012; **130**: 1213–6 e1.
- 10 Gagnon R, Primeau MN, Des Roches A, Lemire C, Kagan R, Carr S *et al*. Safe vaccination of patients with egg allergy with an adjuvanted pandemic H1N1 vaccine. *J Allergy Clin Immunol* 2010; **126**: 317–323.
- 11 Boyano-Martinez T, Garcia-Ara C, Diaz-Pena JM, Martin-Esteban M. Prediction of tolerance on the basis of quantification of egg white-specific IgE antibodies in children with egg allergy. *J Allergy Clin Immunol* 2002; **110**: 304–309.
- 12 Sampson HA. Utility of food-specific IgE concentrations in predicting symptomatic food allergy. *J Allergy Clin Immunol* 2001; **107**: 891–896.
- 13 Joshi P, Mofidi S, Sicherer SH. Interpretation of commercial food ingredient labels by parents of food-allergic children. *J Allergy Clin Immunol* 2002; **109**: 1019–1021.
- 14 Vlieg-Boerstra BJ, van der Heide S, Bijleveld CM, Kukler J, Duiverman EJ, Wolt-Plompen SA *et al*. Dietary assessment in children adhering to a food allergen avoidance diet for allergy prevention. *Eur J Clin Nutr* 2006; **60**: 1384–1390.
- 15 Simons E, Weiss CC, Furlong TJ, Sicherer SH. Impact of ingredient labeling practices on food allergic consumers. *Ann Allergy Asthma Immunol* 2005; **95**: 426–428.
- 16 Caubet JC, Eigenmann PA. Allergic triggers in atopic dermatitis. *Immunol Allergy Clin North Am* 2010; **30**: 289–307.