

Factors associated with the course of egg allergy in children



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ABSTRACT

Background: The risk factors that affect persistence of egg allergy are under investigation.

Objective: To investigate the factors associated with the course of egg allergy and anaphylaxis in children.

Methods: Children who had been diagnosed as having an IgE-mediated egg allergy and followed up until 6 years of age were enrolled. IgE-mediated egg allergy was diagnosed by a positive skin prick test result, specific IgE (sIgE) level of 0.35 kU/L or greater, and clear-cut history of egg-related symptoms or positive challenge test results.

Results: A total of 203 (56%) of 363 egg allergic children were followed up until 6 years of age. Egg allergy resolved in 92 children (45%) at 2 years of age, 134 children (66%) at 4 years of age, and 145 children (71%) at 6 years of age. The resolution of egg allergy was associated with baseline egg sIgE level of 6.2 kU/L or less and the absence of anaphylaxis (hazard ratio, 0.32; 95% CI, 0.21–0.49; $P < .001$; and hazard ratio, 0.38; 95% CI, 0.21–0.69; $P = .001$, respectively). Baseline factors, including cut-off level of egg sIgE level greater than 6.2 kU/L, egg sIgE level, gastrointestinal symptoms after egg exposure, anaphylaxis with egg, and concomitant cow's milk allergy, were significantly associated with later resolution of egg allergy. The multivariate logistic regression determined that the natural logarithm for egg-white sIgE (odds ratio, 1.44; 95% CI, 1.09–1.91; $P = .01$) and the baseline gastrointestinal symptoms with egg (odds ratio, 6.86; 95% CI, 2.93–16.06; $P < .001$) were significantly related to a higher risk of anaphylaxis with egg.

Conclusion: Baseline egg white sIgE levels, baseline gastrointestinal system involvement, concomitant cow's milk allergy, and anaphylaxis with egg may predict a more severe course of egg allergy with late resolution. Moreover, egg white sIgE levels and gastrointestinal symptoms after egg exposure seem to increase the risk of anaphylaxis with egg.

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Introduction

Egg allergy is one of the most common food allergies in children. In the past decade, its incidence has increase and appears to decrease with age.^{1,2} Although its estimated prevalence is 0.5% to 2.5% in early childhood,¹ these rates vary greatly from study to study. For example, a large Australian cohort study found that the prevalence of challenge-proven egg allergy in infants was as high as 8.9%.³ Because egg is an important source of protein, predicting the time to development of tolerance to egg is essential for avoiding unnecessary dietary restrictions in childhood.

Although it is known that most egg allergies are outgrown by school-age, 2 studies have recently found different patterns for the development of tolerance to egg. Savage et al⁴ determined that 26% of children outgrew their allergy by 8 years of age, and Sicherer et al⁵ found that 49% of children outgrew their allergies by 6 years

of age. The confounding genetic, nutritional, and geographic factors clearly have distinct effects on the prognosis of egg allergy in different populations. Although baseline egg specific IgE (sIgE) levels, other allergic diseases, and additional food allergies have been implicated in the persistence of egg allergy, the risk factors that affect persistence are still under investigation.⁴ Therefore, the aim of this study was to investigate the factors associated with the prognosis of egg allergy, including anaphylaxis, by using clinical and laboratory parameters at baseline and follow-up visits, as well as egg challenge tests.

Methods

Study Population

This study has both retrospective and prospective aspects. Children who had been diagnosed as having IgE-mediated egg allergy at the Division of Pediatric Allergy, Hacettepe University School of Medicine, Turkey, between September 2005 and December 2009 were analyzed retrospectively and those diagnosed

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as having IgE-mediated egg allergy from January 2010 until September 2012 were analyzed prospectively. Diagnosis of IgE-mediated egg allergy was made when patients met the following criteria: (1) titers of egg white sIgE of 0.35 kU/L or higher, or a skin prick test (SPT) result positive for egg white, defined by a wheal greater than 3 mm compared with the negative control, in combination with a consistent and clear-cut history of an early reaction that was unequivocally related to the ingestion of egg, and (2) positive oral food challenge (OFC) or a clear-cut history of anaphylaxis after egg ingestion diagnosed in full accordance with recently published guidelines.^{6,7} Patients were followed up for every 4 to 8 months until egg allergy was resolved. The food challenge (FC) tests with egg were performed again if the child did not experience any anaphylaxis with egg in the last year. Resolution of egg allergy was determined as negative results of FC test with egg and/or consumption of whole egg without any allergic reaction for at least 5 days.

Phenotypic features of children with egg allergy, such as sex, age, presence of concomitant allergic disease, initial symptoms, the age at initial symptoms, anaphylaxis history with egg, family history of allergy, eosinophil count, total IgE, baseline egg sIgE, and number of allergen sensitizations, were recorded. Atopic dermatitis was clinically defined by the presence of pruritus and a relapsing eczematous rash with typical age appropriate distribution.⁸ Diagnosis of anaphylaxis was made according to the previously published reports.^{6,7} Anaphylaxis was clinically defined as an acute, severe, systemic syndrome that involved cutaneous, respiratory, and/or cardiovascular symptoms and/or signs after ingestion of implicated food. Asthma was diagnosed in the presence of reversible airway obstruction as defined by at least a 12% improvement in forced expiratory volume in 1 second after bronchodilator administration in children capable of doing spirometry or improvement in asthma symptoms after inhaled steroid or leukotriene modifier agent therapy. In younger children who could not cooperate with spirometry, asthma was diagnosed by a history of recurrent wheezing and/or cough and a favorable therapeutic response to antiasthma treatment.⁹ Allergic rhinitis is clinically defined by the occurrence of symptoms such as rhinorrhea, nasal congestion, nasal itching, and sneezing in children with aeroallergen sensitivity.¹⁰ Pediatric allergy specialists made the diagnoses of the accompanying allergic diseases.

All study procedures were performed in accordance with a protocol previously approved by Ethics Committee of Hacettepe University. Study participants and their parents were informed about the test procedure in detail, and written informed consent was obtained.

Measurements

Total serum IgE and egg sIgE levels were measured with UniCAP (Phadia, Uppsala, Sweden) technology. The detection limit was 0.35 kU/L for egg sIgE. Eosinophil counts were measured with a flow Coulter counter (Beckman Coulter, Fullerton, California). Skin prick tests were performed with Alyostal ST-IR (Stallergenes SA, Antony, France).

Food Challenge Tests

Food challenge tests were performed as open OFC or double-blind placebo-controlled food challenge (DBPCFC) according to the European Academy of Allergy and Clinical Immunology guidelines.¹¹ All children were examined before food challenge tests. Tests were not performed in patients who had an active infection or who had used antihistamines within the last 7 days.

In open OFC and DBPCFC tests, boiled egg white (10 minutes of boiling) was given orally with stepwise, increasing doses (0.5, 1, 3, 6, 10, and 15 g of boiled egg white) every 15 minutes. For

preparation of DBPCFC, cooked rice, banana pudding, and caramel syrup were used as a food matrix in children with egg allergy without cow's milk allergy. The active and passive test foods were similar in appearance, and the taste was approved by at least 10 volunteers. Pasteurized egg white powder in juice was used for preparation of DBPCFC for children with concomitant cow's milk allergy. For this recipe, 6 g of egg white powder was added to 100 mL of juice and given orally with stepwise, increasing doses (0.02, 0.05, 0.1, 0.2, 0.5, 1, 2, and 2.5 g of egg white protein) every 15 minutes. The open OFC and DBPCFC tests were terminated if any objective allergic reactions developed, with the exception of transient perioral contact urticaria. Individuals with negative results were observed for at least 2 hours after the challenge test and examined for any allergic findings before they were sent home. Thereafter, those individuals continued to receive 1 whole egg (6 g of egg protein per day) for the next 5 days. For those individuals who underwent more than one challenge test, only the information obtained from the first challenge was analyzed.

Statistical Analyses

All data were analyzed using SPSS statistical software, version 18.0 (SPSS Inc, Chicago, Illinois). Pearson χ^2 or Fisher exact test, where appropriate, were used to compare proportions in different groups. When the distributions of all numeric variables were not normally distributed, Mann-Whitney or Kruskal-Wallis tests, where appropriate, were used for statistical comparisons. $P < .05$ was considered to indicate a statistically significant result.

Receiver operating characteristic curve analysis was used to determine baseline egg sIgE level that distinguished patients with persistent and resolved egg allergy with the highest sensitivity and specificity. Kaplan-Meier curves were used for persistence of egg allergy according to the baseline egg sIgE values (6.2 kU/L) in patients with the standard log-rank test. The factors related to the resolution of egg allergy were determined by Cox regression for a period of 72 months. The risk factors for anaphylaxis were determined by logistic regression analysis. For regression analysis, natural logarithm transformed egg sIgE was used.

Results

In our cohort of food allergic children, 363 were diagnosed as having IgE-mediated egg allergy. A total of 265 children reached 6 years of age, but follow-up information was available for only 203 children. The baseline characteristics of patients who were followed up until 6 years of age and those who were not followed were similar (eTable 1). Analyses were performed in children with complete follow-up until 6 years of age. In this group, the diagnosis of IgE-mediated egg allergy was made in 23 patients by anaphylaxis history with egg, 52 patients by positive oral challenge test result, and 128 patients by positive SPT or positive egg sIgE test result, with a consistent and clear-cut clinical history of egg-related symptoms. According to these records, egg allergy resolved in 92 children (45%) at 2 years of age, 134 children (66%) at 4 years of age, and 145 children (71%) at 6 years of age (Fig 1). Children who outgrew or had persistent egg allergy are compared in Table 1.

The baseline egg sIgE level that distinguished the cases with persistent egg allergy and the ones who outgrew allergy with the highest sensitivity and specificity was 6.2 kU/L by using receiver operating characteristic curve analysis (sensitivity, 59%; specificity, 77%; negative predictive value, 82%; and positive predictive value, 50%). The duration of egg allergy was significantly longer in children with a baseline sIgE level greater than 6.2 kU/L than children with a level of 6.2 kU/L or less according to the Kaplan-Meier analysis ($P < .001$, log-rank test, Mantel-Cox regression) (Fig 2A). At 24, 48, and 72 months of age, 84%, 56%, and 50% of children with a baseline egg sIgE level greater than 6.2 kU/L were still egg allergic

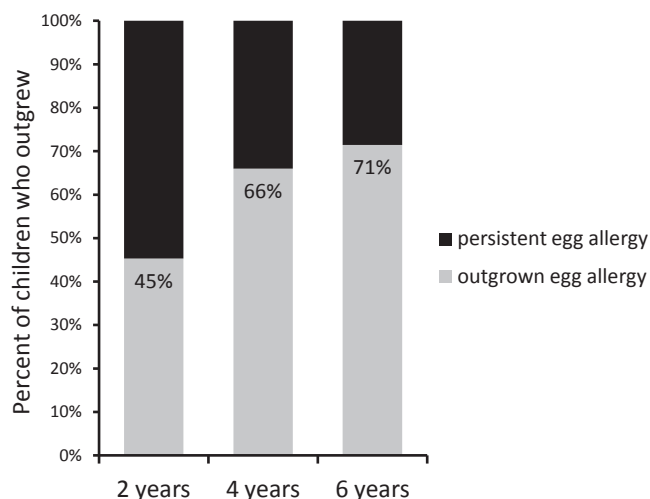


Figure 1. The percentage of children who outgrew egg allergy at 2, 4, and 6 years of age.

(and 16%, 44%, and 50% had resolved egg allergy, respectively), whereas 40%, 23%, and 18% were allergic when the baseline egg sIgE level was 6.2 kU/L or less (and 60%, 77%, and 82% had resolved egg allergy, respectively). The age when tolerance developed was significantly higher in children (mean, 37.2 months; age range, 27.6–48.0 months) with baseline sIgE levels greater than 6.2 kU/L

Table 1
Characteristics of children with persistent or outgrown egg allergy at 6 years of age^a

Characteristic	Outgrown egg allergy (n = 145)	Persistent egg allergy (n = 58)	P value
Male/female	106/39 (73/27)	38/20 (66/34)	.28
Initial symptoms			
Skin	138 (96.5)	55 (96.5)	.10
Gastrointestinal system	20 (14.2)	14 (25)	.07
Respiratory system	24 (17)	12 (21.4)	.47
Upper airway (only)	1 (0.7)	3 (5.4)	.14
Lower (with or without upper) airway	22 (15.6)	10 (17.9)	.70
Family history of allergic disease	51 (35.4)	26 (45.6)	.18
Multisensitization to foods	96 (66.2)	44 (75.9)	.55
Anaphylaxis with egg at OFC or from history	16 (11.2)	25 (43.1)	<.001
The onset age of egg allergy, median (IQR), y	0.2 (0.1–0.4)	0.3 (0.1–0.5)	.34
Eosinophil, median (IQR), %	5.8 (3.3–8.9)	5.9 (3.1–8.3)	.64
Total IgE, median (IQR), kU/L	59 (24–174)	116 (44–357)	.008
Baseline egg sIgE, median (IQR), kU/L	2 (0.7–5.9)	7.5 (2.2–18.3)	<.001
Highest egg sIgE, median (IQR), kU/L	2.6 (1.1–8.8)	11.1 (2.4–21.6)	<.001
Baseline atopic dermatitis	117 (83.6)	44 (80)	.55
Asthma	30 (20.7)	13 (22.4)	.79
Allergic rhinitis	3 (2.1)	3 (5.2)	.24
System involvement at OFC			
Skin	15 (14.2)	30 (88.2)	<.001
Gastrointestinal system	6 (5.7)	14 (41.2)	<.001
Respiratory system	2 (0.9)	10 (29.4)	<.001
Upper airway (only)	0 (0)	4 (11.8)	<.001
Lower (with or without upper) airway	2 (1.9)	6 (17.6)	.001
Duration of egg allergy, median (IQR), mo	19.2 (14–26.6)	30 (20.3–47)	<.001

Abbreviations: OFC, oral food challenge; IQR, interquartile range; sIgE, specific IgE.

^aData are presented as number (%) of study participants unless otherwise indicated.

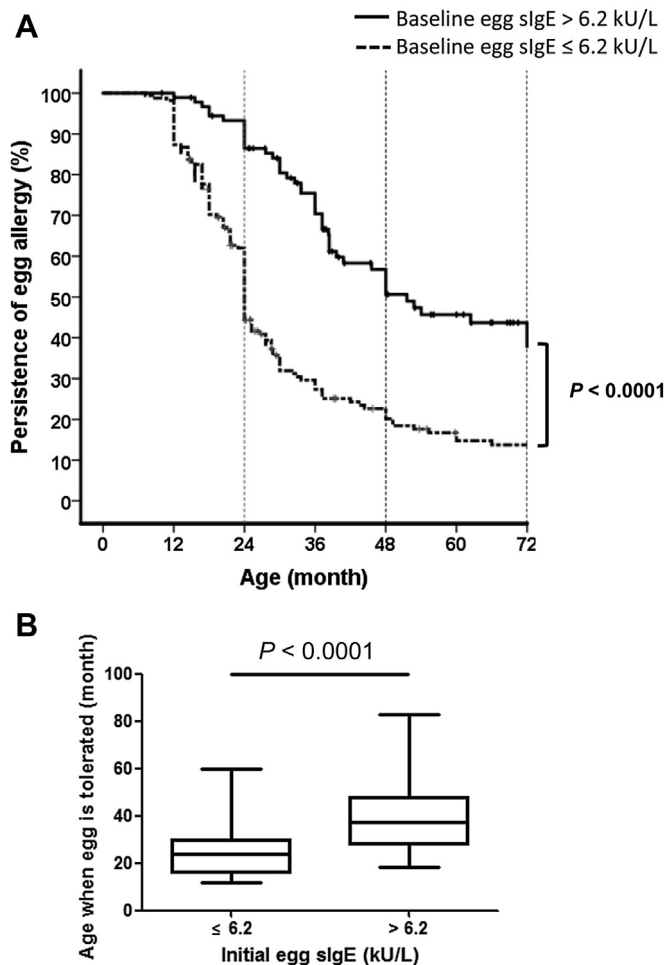


Figure 2. Tolerance and persistence to egg and association to the baseline egg specific IgE (sIgE) level. (A) Kaplan-Meier curve for persistence of egg allergy according to the baseline sIgE values (6.2 kU/L) in children with egg allergy ($P < .001$, log-rank test, Mantel-Cox regression). (B) Comparison of the age when egg allergy resolved in children with baseline egg sIgE levels of 6.2 kU/L or less and greater than 6.2 kU/L.

compared with children (mean age, 24.0 months; age range, 15.6–30.0 months) with baseline sIgE levels of 6.2 or less (Fig 2).

When all variables were analyzed in the Cox regression analysis for a duration of 72 months, baseline factors, including a cut-off egg sIgE level of greater than 6.2 kU/L, egg sIgE level, gastrointestinal symptoms (nausea, vomiting, abdominal cramp, diarrhea) after egg exposure, anaphylaxis on exposure to egg, and concomitant cow's milk allergy were all significantly associated with later resolution of egg allergy (Table 2). When the significant factors were analyzed with multivariate Cox regression analysis, it was determined that a baseline egg sIgE level greater than 6.2 kU/L and anaphylaxis significantly delayed the resolution of egg allergy (hazard ratio, 0.32; 95% CI, 0.21–0.49; $P < .001$; and hazard ratio, 0.38; 95% CI, 0.21–0.69; $P = .001$, respectively).

Forty-one children (20.2%) developed anaphylactic reactions until 6 years of age: 25 (61%) of whom had reactions observed at egg challenge tests and 23 (56%) of whom had anaphylaxis by unintentional exposures. Seven children had anaphylactic reaction both at FC test and by unintentional exposure. The study analyzing the risk factors for egg-induced anaphylaxis with the multivariate logistic regression determined that egg white sIgE (odds ratio, 1.44; 95% CI, 1.09–1.91; $P = .01$) and the baseline gastrointestinal

Table 2

Factors associated with the resolution of egg allergy (univariate cox regression analysis with one variable in the model at one time)

Factor	HR (95% CI)	P value
Sex (male vs female)	1.02 (0.70–1.50)	.90
Baseline factors		
Atopic dermatitis	1.02 (0.64–1.64)	.92
Skin symptoms ^a	1.03 (0.42–2.51)	.96
Respiratory symptoms ^b	0.72 (0.45–1.16)	.18
Upper airway (only)	0.23 (0.03–1.64)	.14
Lower (with or without upper) airway	0.83 (0.51–1.35)	.45
Gastrointestinal symptoms ^c	0.59 (0.35–0.98)	.04
Egg sIgE	0.95 (0.93–0.97)	<.001
Egg sIgE level >6.2 kU/L	0.25 (0.16–0.39)	<.001
Total IgE	0.99 (0.99–1.00)	.06
Eosinophil	1.02 (0.98–1.05)	.33
Factors determined at follow-up		
Asthma	0.75 (0.50–1.15)	.18
Allergic rhinitis	0.39 (0.13–1.26)	.12
Severe atopic dermatitis	0.39 (0.09–1.59)	.19
Anaphylaxis caused by egg	0.31 (0.18–0.52)	<.001
Other food allergy	0.76 (0.54–1.09)	.14
Cow's milk allergy	0.69 (0.49–0.97)	.03
Peanut and tree nuts	3.86 (0.50–29.57)	.19

Abbreviations: HR, hazard ratio; sIgE, specific IgE.

^aSkin symptoms, including urticaria, itching, angioedema, and atopic dermatitis.^bRespiratory symptoms, including rhinitis, stridor, cough, dyspnea, and wheezing.^cGastrointestinal symptoms, including nausea, vomiting, abdominal cramp, and diarrhea.

symptoms with egg (odds ratio, 6.86; 95% CI, 2.93–16.06; $P < .001$) were significantly related with higher risk of anaphylaxis (Table 3).

Discussion

Our study found that a baseline egg sIgE level greater than 6.2 kU/L, anaphylaxis with egg, gastrointestinal system symptoms

Table 3

Risk factors for egg-induced anaphylactic reaction by logistic regression analysis

Factor	Univariate		Multivariate	
	OR (95% CI)	P value	OR (95% CI)	P value
Age	1.26 (0.81–1.98)	.30		
Sex	0.75 (0.34–1.66)	.48		
Baseline egg sIgE	1.35 (1.05–1.75)	.02	1.44 (1.09–1.91)	.01
Baseline eosinophil	0.98 (0.92–1.05)	.62		
Baseline total IgE	1.00 (0.99–1.00)	.89		
Asthma	2.09 (0.97–4.53)	.06		
Atopic dermatitis	0.59 (0.25–1.40)	.59		
Allergic rhinitis	4.13 (0.80–21.28)	.09		
Family history of allergic disease	1.99 (0.99–3.98)	.053		
Aeroallergen sensitization	2.04 (0.70–5.96)	.19		
Pollen sensitization	0.96 (0.67–1.38)	.82		
Mite sensitization	1.62 (0.63–4.17)	.32		
Concomitant other food allergy	2.10 (0.91–4.86)	.08		
Concomitant cow's milk allergy	2.18 (1.04–4.59)	.04		
Baseline skin symptoms	1.54 (0.18–13.16)	.69		
Baseline respiratory symptoms	4.05 (1.83–8.94)	.001		
Upper airway (only)	8.21 (0.73–92.94)	.09		
Lower (with or without upper) airway	3.63 (1.60–8.25)	.002		
Baseline gastrointestinal symptoms	6.36 (2.84–14.19)	<.001	6.86 (2.93–16.06)	<.001

Abbreviations: OR, odds ratio; sIgE, specific IgE.

(including nausea, vomiting, abdominal cramp, and diarrhea induced by egg intake), and concomitant cow's milk allergy were significantly associated with persistent egg allergy. In addition, high egg sIgE levels and the history of baseline gastrointestinal symptoms after egg ingestion were found to be significant risk factors for anaphylaxis to egg.

A previous study found that egg allergy is resolved in 49% of children followed up to a median age of 74 months and that the presence of other allergic diseases or another food allergy was relevant in the persistence of egg allergy.⁴ Our cohort consisted of 203 children with egg allergy who were followed up until age of 72 months, and egg allergy resolved in 145 children (71%) at 6 years of age. A few studies have found that children with high egg sIgE levels are more likely to have persistent egg allergy than those with low levels.^{12,13} Shek et al¹³ found significantly higher baseline egg sIgE levels in persistent egg allergy than tolerant individuals, and they did not find any difference in the age of onset of initial symptoms, presence of other food allergies, or baseline atopic dermatitis (AD). Similarly, children with baseline egg sIgE levels greater than 10 kU/L have more persistent egg allergy than those who have levels less than 2 kU/L.⁵ The value of egg sIgE indicating persistence was reported to be higher than 50 kU/L in the study by Savage et al.⁴ Results of the present study are in line with these studies; egg sIgE levels were significantly higher in the persistent egg allergy group than the tolerant one. We found that the baseline egg sIgE level of 6.2 kU/L distinguished the persistence and resolution with highest sensitivity and specificity. When the resolution rate was analyzed in children who were followed up until 6 years of age, 60%, 77%, and 82% of the children with baseline egg white sIgE levels less than 6.2 kU/L had their conditions resolved at 24, 48, and 72 months, respectively. To dichotomize children according to the baseline egg white sIgE level is a relevant and easy way for practitioners to predict the course of egg allergy.

The anaphylactic reactions with egg exposure at challenge tests were observed more frequently in children with persistent egg allergy. Although precautions are put in place for severe allergic reactions, anaphylaxis can be life-threatening and is a still considerable issue for performing these tests. Therefore, determining risk factors of anaphylaxis during challenge tests is equally as important as determining cut-off values that predict clinical reactivity. The risk of anaphylaxis to foods is higher in patients with underlying diseases, such as uncontrolled asthma, cardiovascular disease, mastocytosis, or use of some medications, but to our knowledge it is unknown whether these specific risk factors play a role in anaphylaxis with egg.¹⁴ In our study population, we found an increased risk of anaphylaxis (odds ratio, 6.86) in cases with a history of gastrointestinal symptoms on egg ingestion. We also found that gastrointestinal system findings reported or observed on food challenge tests were significantly more frequent in persistent egg allergy than tolerant ones. A recent study found that egg and peanut are the most frequent causes of food-induced severe anaphylaxis and that the risk of vomiting in anaphylactic reactions to foods was doubled in the presence of clinical history of chronic or relapsing gastrointestinal symptoms.¹⁵ Moreover, the same study found that chronic or relapsing gastrointestinal symptoms are associated with an increased risk of severe anaphylaxis. Recently, Peters et al¹⁶ found that the presence of gastrointestinal and/or respiratory symptoms during raw egg challenge, the presence of other food allergy at 12 months of age, and high levels of egg sIgE were significantly associated with persistent raw egg allergy in a population-based cohort study. Gastrointestinal findings, such as nausea and abdominal pain, can be subjective and sometimes underestimated by the physician. Our study suggests that practitioners should carefully evaluate all symptoms, including gastrointestinal concerns described by patients, of IgE-mediated egg allergy because of a higher risk of anaphylaxis.

There were some limitations to the present study. Our analyses regarding the course of egg allergy at 6 years were performed retrospectively. These results are related to patients who were followed up by 6 years of age. Another weakness is that all children do not have SPT measurements reported in millimeters, which could add another variable in addition to the egg sIgE level. A recent article⁵ reported that severe AD is a significant risk factor for the delayed development of egg allergy resolution. In children with AD, egg allergy is reported as the most frequent food allergy. In our cohort of egg allergy, more than 70% of children had AD at baseline, with severe AD being rarely noted. In our study, an association with AD and persistent egg allergy was not observed. A population-based study by Peters et al¹⁶ similarly found that eczema was not associated with egg allergy persistence. However, the resolution rate of egg allergy was recently found to be 1.5 times faster in children with no or mild eczema than those with moderate or severe eczema.⁵ In our cohort, severity of AD was not recorded at baseline; therefore, the effect of baseline severe AD on the course of egg allergy could not be investigated. However, severe AD during follow-up was recorded, and when analyzed for resolution of egg allergy, it did not reveal a significant association with delayed outgrown egg allergy in our cohort. Because eating baked egg products may accelerate the rate of resolution according to some studies, a current approach for the resolution of egg allergy is to determine whether children can tolerate baked-egg products.¹⁷ Unfortunately, the children in this cohort do not undergo challenge testing with baked egg or have a history of tolerating baked eggs.

In conclusion, our findings indicate that a cut-off level of baseline egg sIgE level and history of anaphylaxis were associated with persistent egg allergy and that the involvement of the gastrointestinal system on exposure to egg and higher egg sIgE levels predicted high risk of anaphylaxis.

Supplementary Data

Supplementary data related to this article can be found at <http://dx.doi.org/10.1016/j.anai.2015.08.012>.

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eTable 1

Characteristics of children who were followed up until 6 years of age and not followed up^a

Characteristic	Followed up (n = 203)	Not followed up (n = 62)	P value
Male	144 (71)	49 (79)	.21
Initial symptoms			
Skin	193 (97)	56 (98)	.503
Gastrointestinal system	34 (17)	9 (15.8)	.79
Respiratory system	36 (18)	6 (11)	.18
Family history of allergic disease	77 (38)	23 (40)	.78
Multisensitization to foods	140 (69)	35 (58)	.12
History of anaphylaxis with egg	23 (11.4)	4 (9)	.62
The onset age of egg allergy, median (IQR), y	0.3 (0.2–0.5)	0.3 (0.2–0.5)	.95
Eosinophil, median (IQR), %	5.8 (3.3–8.7)	5.1 (3.5–8.9)	.10
Total IgE, median (IQR), kU/L	74.9 (29–196)	111 (34.5–250)	.21
Baseline egg sIgE, median (IQR), kU/L	2.9 (0.9–9.1)	3.8 (1.1–17)	.22
Highest egg sIgE, median (IQR), kU/L	3.5 (1.5–12)	4.4 (1.1–19)	.48
Baseline atopic dermatitis	161 (82.6)	47 (77.1)	.98
Baseline asthma	43 (21)	7 (11.5)	.09
Baseline allergic rhinitis	6 (3)	1 (1.6)	.58

Abbreviations: IQR, interquartile range; sIgE, specific IgE.

^aData are presented as number (percentage) of study participants unless otherwise indicated.