

LETTER TO THE EDITOR

Food-induced anaphylaxis to a known food allergen in children often occurs despite adult supervision

To the Editor,

Food-related allergic reactions are the leading cause of anaphylaxis and emergency department visits, and hospital admissions for food-induced anaphylaxis in children are increasing.^{1,2} Strict avoidance of food allergens is the main strategy in the prevention of food-induced anaphylaxis, and there are continuous efforts to educate patients and caregivers and to ensure proper food labeling.³

Nevertheless, inadvertent exposures in children are frequent and there are no studies assessing the role of food labeling and adult supervision in cases of food-induced anaphylaxis to a known food allergen in children.²

We aimed to estimate the percentage of cases attributed to food-labeling issues, to assess the presence of adult supervision, and to identify risk factors associated with unsupervised reactions in a pediatric anaphylaxis cohort.

C-CARE (Cross-Canada Anaphylaxis REgistry) is an ongoing, prospective study documenting triggers and management of anaphylaxis. As part of this registry, we assessed a subgroup of children who were exposed to a previously known food allergen and presented with food-induced anaphylaxis (definition below) to the same food allergen. Participants were recruited through the emergency departments of the Montreal Children's Hospital (Montreal, QC), Hôpital Sainte-Justine (Montreal, QC), London Health Sciences Center Children's Hospital (London, ON), and Hôpital du Sacré-Coeur (Montreal, QC) from December 2012 until April 2015, the first three being pediatric tertiary centers with emergency departments reporting between 36 000 and 82 000 children visits per year.

After obtaining informed consent, the physician who attended the reaction in the emergency department completed a standardized questionnaire regarding reaction characteristics, triggers, patients' comorbidities, and management.

Anaphylaxis was defined as involvement of 2 organ systems and/or hypotension in response to a potential allergen,¹ and anaphylaxis severity was classified according to a modified grading system published by Brown.⁴

Within 18 months of recruitment, consenting parents or caregivers of children who presented with food-induced anaphylaxis to a known food allergen were asked through a telephone survey if the reaction at study entry was linked to a known food allergen, where the reaction occurred, whether there was adult supervision at the time of ingestion, and what the source of the food allergen was (ie, labeled versus a bulk product). The survey was performed by trained members of our research team.

Statistical analysis was conducted using R version 2.12.0 (R Core Team [2013]); R: A language and environment for statistical computing; R Foundation for Statistical Computing, Vienna, Austria). Descriptive statistics were used to describe demographics, triggers, atopic comorbidities, severity of reaction, treatment, location of accidental ingestion, presence of supervision, and source of the food.

For categorical variables, percentages were presented with a 95% Confidence Interval.

Uni- and multivariate regression models were performed to identify risk factors, such as demographics, anaphylaxis triggers, and comorbidities, associated with unsupervised inadvertent cases in children.

This study was approved by the University Health Centre Ethics Review Board of all participating sites. Participating families all provided a written informed consent.

Among 137 children with a reaction to a known food allergen, 92 (67%) parents or caregivers of those children responded to the questionnaire. The majority (83%) were recruited at the Montreal Children's Hospital. The median time between the reaction date and response to the questionnaire was 11.1 months (IQR: 1.9, 15.6). Sociodemographics and reaction characteristics of respondents and non-respondents were similar between both groups (Table 1). The median age was 6.1 years (IQR 3.6, 11.2) in responders versus 9.9 years (IQR 4.0, 14.4) in non-responders. Almost half of anaphylaxis cases to a known food allergen [46.0% (95% CI 35.4%, 57.0%)] occurred at home followed by restaurant [19.5% (95% CI 12.1%, 29.7%)], day-care or school [18.4% (95% CI 11.2%, 28.4%)], and other (eg, friend's house) [16.1% (95% CI 9.4%, 25.9%)], respectively.

Almost a third of all cases occurred under adult supervision [$N = 29/92$; 31.5% (95% CI 22.5%, 42.2%)]. Among them, most occurred when the supervising adult was not the parent [65.5% (45.7%, 81.4%)] versus 34.5% (95% CI 18.6%, 54.3%) supervised by the parent. In 16 of 92 cases [17.4% (95% CI 10.6%, 27%)], the culprit food was ingested without supervision. In 47 of 92 cases or 51.1% (95% CI 40.5%, 61.6%), participants did not know if there was any adult supervision at the time of accidental ingestion.

After adjusting for age, sex, type of food trigger, reaction severity, and presence of asthma, unsupervised reactions were more likely in boys [OR 5.5 (95% CI 1.22, 24.82)] and in children with peanut allergy [OR 3.5 (95% CI 1.02, 12.13)], but less likely in children with asthma [OR 0.15 (95% CI 0.03, 0.95)] (Table 2).

In 32 of 92 cases [33.7% (95% CI 24.4%, 44.4%)], participants thought that the inadvertent reaction could be linked to the consumption of a prepackaged product with a label and 20 of 92 cases [21.7%

TABLE 1 Demographics and reaction characteristics among children with a known food allergy presenting with food-induced anaphylaxis

	Responders (N = 92) % (95% CI*)	Non-responders (N = 45) % (95% CI*)
Age (median, IQR)	6.1 (3.6, 11.2)	9.9 (4.0, 14.4)
Sex (males)	60.9 (50.1, 92)	53.3 (38.0, 68.1)
Reactions triggered by peanut (PN)	26.1 (17.7, 36.5)	37.8 (24.2, 53.5)
Reactions triggered by tree-nut (TN)	14.1 (8.1, 23.3)	6.7 (1.7, 19.3)
Reactions triggered by nut (not clear if PN or TN)	8.7 (4.1, 16.9)	11.0 (4.1, 24.8)
Reactions triggered by milk	13.0 (7.2, 22.1)	15.6 (6.9, 30.1)
Reactions triggered by egg	8.7 (4.1, 16.9)	4.4 (0.8, 16.4)
Reactions triggered by fish	4.3 (1.4, 11.4)	2.2 (0.1, 13.2)
Reactions triggered by shellfish	2.2 (0.4, 8.4)	0
Known asthma	28.3 (19.6, 38.8)	22.2 (11.7, 37.5)
Not associated with exercise	88.3 (78.5, 94.2)	92.9 (79.4, 98.1)
Mild reaction	21.9 (14.1, 31.8)	17.8 (8.5, 32.5)
Moderate reaction	63.0 (52.3, 72.7)	73.3 (57.8, 84.9)
Severe reaction	15.2 (8.8, 24.6)	8.9 (2.9, 22.1)
Received epinephrine outside the hospital	52.2 (41.6, 62.6)	57.8 (42.2, 72.0)
Received antihistamines outside the hospital	50.0 (39.9, 60.0)	51.1 (35.9, 66.0)
Received steroids outside the hospital	3.3 (0.8, 9.9)	0

*Estimates for all variables are presented in percentage, unless otherwise indicated.

TABLE 2 Risk factors associated with unsupervised reactions

Variable	OR (95% CI) uni	OR (95% CI) multi
Age	1.07 (0.98, 1.18)	1.1 (0.99, 1.2)
Sex (male)	3.7 (0.97, 13.83)	5.5 (1.22, 24.8)
Peanut	3.3 (1.09, 9.86)	3.5 (1.02, 12.1)
Tree-nut	0.77 (0.16, 3.87)	
Milk	1.6 (0.38, 6.56)	
Severe reaction	1.2 (0.31, 5.06)	
Asthma	0.3 (0.06, 1.34)	0.15 (0.03, 0.95)
Epinephrine outside hospital	1.9 (0.63, 5.62)	

(95% CI 14.1%, 31.8%)] indicated that the reaction occurred due to the consumption of a bulk product with no label. In 34 of 92 cases [37% (95% CI 27.3%, 47.7%)], the reaction was attributed to other triggering factors, for example, reactions at restaurants and cross-contamination. In 6 of 92 cases [6.5% (95% CI 2.7%, 14.2%)], the participants were unable to identify a trigger.

Among the 32 cases in which parents or caregivers attributed the reaction to labeled foods, 10 [31.3% (95% CI 16.7%, 50.1%)] attributed the reaction to unclear labeling and 22 [68.7% (95% CI 49.9%, 87.3%)] ignored the food label.

Our study is the first to examine the impact of food labeling and parental/caregiver supervision in food-induced anaphylaxis in children with a known food allergy.

A considerable proportion [N = 29/92; 31.5% (95% CI 22.5%, 42.2%)] of reactions in children with food-induced anaphylaxis to a known allergen occur under adult supervision.

In the majority of supervised reactions, adults other than the parents were present. Hence, it is important to increase education and awareness among all caregivers. A fifth of all reactions occurred unsupervised and peanut-allergic boys were more likely to have unsupervised reactions. Previous studies have shown that food-induced anaphylaxis predominantly occurs in males and that peanut is a major trigger of food-induced anaphylaxis.^{5,6}

Surprisingly, unsupervised reactions were less likely to occur in children with asthma. Increased awareness in this specific subgroup, known to be at increased risk for severe anaphylactic reaction, might play a protective role.^{2,7}

Similar to other studies, a third of all reactions were attributed to food-labeling issues according to the participants [33.7% (95% CI 24.4%, 44.4%)].⁸ The majority, however, were due to ignoring the food labeling [68.7% (95% CI 49.9%, 87.3%)], which should be considered as an educational and/or awareness issue.

Our results describe a relatively small number of patients and are mostly limited at one tertiary center. As parents were contacted up to 18 months after entering the study, recall bias is inevitable. This might be reflected in the fact that in 50% of the cases, it was not known whether there was adult supervision. However, we do not anticipate that this has affected our regression as we do not expect that an association between the presence of supervision and the risk factors evaluated would be altered by the parent's ability to recall adult supervision.

In conclusion, we demonstrate that at least a third of inadvertent food exposures in children occur despite the presence of adult supervision. Further, most reactions to labeled food occur when the food label is ignored. These results indicate that better strategies are needed to avoid accidental ingestions inside and outside the home including educational programs to increase the awareness of allergic consumers and their caregivers to the risk of accidental reactions.

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