

Clinical Communications

Rates of anaphylaxis for the most common food allergies

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Clinical Implications

- Data on temporal trends in the rates of anaphylaxis for individual food groups are limited. The report demonstrates the changes in anaphylaxis rates for the 9 most common food allergens in a pediatric setting.

Food-induced anaphylaxis (FIA) is defined as a serious allergic reaction involving at least 2 organ systems or associated with hypotension.¹ Studies have reported that most anaphylactic cases presenting at emergency departments (EDs) in developed countries are food-induced.² We have reported previously that the percentage of anaphylaxis cases among all ED visits has more than doubled over a 4-year period.³ Similarly, according to the Food Allergy Research & Education, food allergy prevalence in children has increased by 50% in less than 20 years, whereas peanut and tree nut allergies have more than tripled.⁴

However, data on temporal trends in the rates of anaphylaxis for individual food groups are scarce. We aimed to estimate the change in anaphylaxis rates for the 9 most common food allergens (peanut, tree nut, milk, egg, soy, fish, shellfish, sesame, and wheat) in a tertiary pediatric center in Montreal.⁵ Although previous studies have evaluated temporal trends in food-induced reactions,³ the present study is the largest and longest study assessing temporal trends in anaphylaxis for specific foods.

Over a 6-year period, from May 2011 to April 2017, children (18 years old and younger) presenting to the ED at the Montreal Children's Hospital (MCH) with anaphylaxis were recruited as part of the Cross-Canada Anaphylaxis Registry. The ED is located in Montreal, Quebec, and treats close to 100,000 patients a year. A standardized form documenting symptoms and triggers of anaphylaxis was completed by a trained research team member at the time of presentation to the ED (ie, prospective recruitment). Any missed cases of anaphylaxis were identified retrospectively according to a previously validated algorithm based on *International Classification of Diseases, Revision 10* codes related to anaphylaxis.¹ Anaphylaxis severity was classified using a modified grading system previously described by Muraro et al.⁶ Briefly, mild reactions were defined as generalized pruritus, flushing, urticaria, angioedema, nausea or emesis, mild abdominal pain, nasal congestion and/or sneezing, rhinorrhea, throat tightness, mild wheezing, tachycardia, and anxiety. Moderate reactions were defined as crampy abdominal pain, diarrhea, recurrent vomiting, hoarseness, "barky" cough, difficulty swallowing, dyspnea, moderate wheezing, and "light headedness." Severe reactions were defined as those that manifested as a loss of bowel control, cyanosis, respiratory arrest, hypotension and/or

collapse, dysrhythmia, severe bradycardia and/or cardiac arrest, confusion, and loss of consciousness.⁶ The study received approval from the McGill University Ethics Board.

Descriptive statistics were used to present demographic characteristics (age, sex) and calculate the annual percentage of reactions to specific food groups among all FIA cases. Specifically, percentages (CI, binomial or multinomial for variables with more than 2 categories) were used to assess the rates of anaphylaxis over the years and the number of anaphylactic reactions per year, per food group. All statistical analyses were done using R version 3.2.2. (R Foundation for Statistical Computing, Vienna, Austria).

Between 2011 and 2017, 84.13% of all anaphylactic reactions presenting to the MCH ED were food-induced (see Table E1 in this article's Online Repository at www.jaci-inpractice.org).

From 2011 to 2017, there was an overall significant decrease in the percentage of FIA to peanut (−15.03%; 95% CI, −24.19% to −5.87%). Anaphylactic reactions to tree nut significantly increased in the same time frame (7.6%; 95% CI, 1.85% to 13.00%). Anaphylactic reactions to nut (defined when it was not clear whether the trigger was peanut or tree nut) significantly decreased from 2011 to 2017 (−11.0%; −18% to −3.0%) (Table I). It is noteworthy that these changes were not consistent every year (ie, from 2013-2014 to 2014-2015, peanut had an increase in anaphylactic reactions).

Over the 6-year period, only peanut, tree nut, nut, and unknown triggers changed significantly (Table I). There were no significant changes in rates of anaphylaxis over this time interval for other food allergens assessed (see Tables E2 and E3 in this article's Online Repository at www.jaci-inpractice.org).

When comparing the rates of the years 2011 through 2015 with their adjacent years, there were no significant increases in all FIA reactions among all ED visits at the MCH. However, from the years 2015-2016 to 2016-2017, there was a significant increase of 6.32% (95% CI, 0.26%-12.38%) (see Table E4 in this article's Online Repository at www.jaci-inpractice.org).

Our study reveals temporal changes in FIA reactions. Anaphylaxis to tree nut significantly increased over the time interval of this study, whereas the percentage of reactions to peanut decreased (Figure 1).

The increase in tree nut-induced reactions may be related to increased consumption of tree nuts in increasing plant-based diets widely promoted for health interests.⁷ This increase may also be due to cross-contamination, which is still very common within this food group, because tree nut allergy has not generated the same awareness, safety measures, and precautions as peanut allergy.⁴ According to the American Academy of Allergy, Asthma & Immunology, reactions toward tree nuts can be as life-threatening as toward other allergen triggers.⁸ It is therefore necessary that patients with tree nut allergy be educated regarding the risk of tree nut-induced anaphylaxis and the need to be vigilant and avoid foods potentially containing these allergens.

Anaphylaxis to peanut has significantly decreased over the 6-year period of our study. This change is likely attributable

TABLE I. Annual percentage of anaphylactic reactions to the indicated food group as well as the difference rate*

Yearly rates	Year	Peanut % among all food- induced reactions	Peanut rate (Δyear%, 95% CI)	Tree nut% among all food- induced reactions	Tree nut rate (Δyear %, 95% CI)	Nut % among all food- induced reactions	Nut rate (Δyear%, 95% CI)	Unknown food % among all food- induced reactions	Unknown food rate (Δyear%, 95% CI)
1	2011-2012	30%	Year 2 – 1 –5.2% (–15 to 4.7)	3.4%	Year 2 – 1 14% (7.1 to 20)	18%	Year 2 – 1 –11% (–19 to –3.2)	8.3%	Year 2 – 1 –2.6% (–8.7 to 3.4)
2	2012-2013	24%		17%		7%		5.6%	
3	2013-2014	20%	Year 3 – 2 –4.1% (–12 to 4.3)	22%	Year 3 – 2 4.3% (–3.1 to 13)	5%	Year 3 – 2 –2.1% (–7 to 2.9)	10%	Year 3 – 2 4.8% (–1.2 to 10)
4	2014-2015	23%	Year 4 – 3 2.3% (–5.2 to 9.7)	21%	Year 4 – 3 –1% (–8.5 to 6.4)	4.5%	Year 4 – 3 –0.45% (–4.5 to 3.6)	7.4%	Year 4 – 3 –3% (–8.1 to 2.4)
5	2015-2016	21%	Year 5 – 4 –2.1% (–9.3 to 5.1)	15%	Year 5 – 4 –6.2% (–9.3 to 23)	10%	Year 5 – 4 5.5% (0.78 to 10)	4%	Year 5 – 4 –3.4% (–7.3 to 1)
6	2016-2017	15%	Year 6 – 5 –6% (–13 to 1.1)	11%	Year 6 – 5 –3.8% (–10 to 2.4)	7.9%	Year 6 – 5 –2.2% (–7.6 to 3.2)	17%	Year 6 – 5 13% (7.7 to 19)
6 – 1	(2016-2017) – (2011- 2012)		Year 6 – 1 –15% (–24 to –5.9)		Year 6 – 1 7.6% (1.8 to 13)		Year 6 – 1 –11% (–18 to –3)		Year 6 – 1 9.1% (0.021 to 0.16)
Severity									
Mild		24% (19 to 29)		18% (13 to 24)					
Moderate		72% (67 to 76)		79% (73 to 84)					
Severe		4.3% (0 to 9)		3.2% (0 to 8.6)					

*The severity of all peanut and tree nut reactions for this time interval is also included.

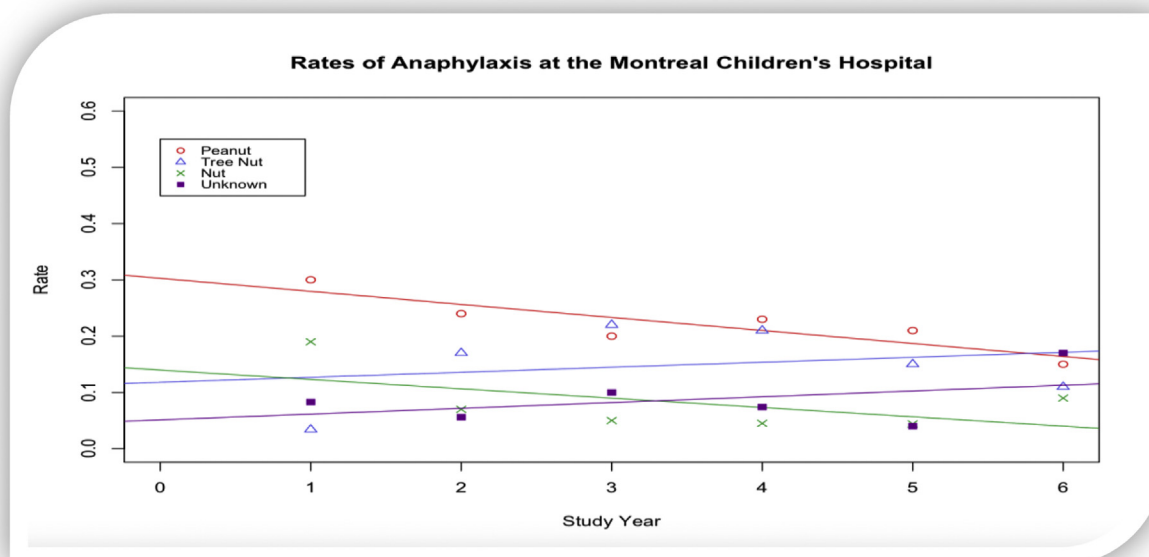


FIGURE 1. Significant changes over the years of peanut, tree nut, nut, and unknown.

to the increased awareness surrounding peanut allergy. Given that the rate of peanut-induced reactions did not significantly change over the years in children with a known peanut allergy, we believe that increased awareness accounts for these findings (see Table E5 in this article's Online Repository at www.jaci-inpractice.org). There was also a significant decrease in reactions to peanuts in individuals with no known history of peanut allergy over the course of the study. It is possible that the current guidelines recommending early introduction of peanut are responsible for this decrease⁹ (see Table E6 in this article's Online Repository at www.jaci-inpractice.org). Laws and regulations pertaining to safety measures for peanut allergy in daycares and schools have been instated in recent years to create safer environments for anaphylactic students, which may have contributed to this significant decrease.⁴

The increase in the "unknown" anaphylaxis trigger over the years may be due simply to cross-contamination and low awareness of the risk of anaphylactic reactions in these cases. The increase in FIA during the last year of the study and specifically for tree nut over the 6-year period is alarming. Despite increased awareness of food allergies, rates of FIA have not significantly decreased in recent years. These findings are in line with an observed increase in ED anaphylaxis visits.³

Our study has some potential limitations. The study was limited to 1 urban center and may not represent trends in other centers across Canada, or in more rural settings. However, previous studies by our group reveal similarities in clinical and sociodemographic characteristics in centers across Canada.¹⁰ In addition, our population was restricted to children and the temporal trends may not be generalizable to the adult population. Another important limitation to this study was that it was over a period of 6 years, and that with longer-term studies it may be possible to confirm or impact these findings.

In conclusion, educational programs and stricter guidelines are required to promote awareness and increase the safety of those who are allergic to tree nut. Furthermore, given the overall increase in FIA and unknown anaphylaxis, it is crucial to implement educational programs for children and parents to decrease the risk of inadvertent reactions. In more recent years, studies by our group and by others alarmingly demonstrated a steady increase in all FIA, which warrants newer and improved promotion and prevention programs for all common anaphylaxis triggers.

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ONLINE REPOSITORY

TABLE E1. Number of food-induced anaphylactic reactions among all cases of anaphylaxis

Year	No. of anaphylactic reactions caused by food among all cases of anaphylaxis
2011-2012	158 of 184 = 85.87% (79.80%-90.39%)
2012-2013	223 of 274 = 81.39% (76.15%-85.71%)
2013-2014	217 of 265 = 81.89% (76.77%-86.33%)
2014-2015	304 of 356 = 85.39% (81.19%-88.80%)
2015-2016	247 of 301 = 82.06% (77.15%-86.13%)
2016-2017	251 of 284 = 88.38% (83.93%-91.76%)
2011-2017 (all cases during the 6-y period)	1405 of 1670 = 84.13% (82.27%-85.83%)

TABLE E2. Annual percentage of anaphylactic reactions to the indicated food group (milk, egg, fish and shell fish) as well as the difference rate that had no significant changes

Yearly rates	Year	Milk % among all food-induced reactions	Milk rate difference (Δyear%, 95% CI)	Egg % among all food-induced reactions	Egg rate (Δyear)	Fish % among all food-induced reactions	Fish difference (Δyear%, 95% CI)	Shell fish food % among all food-induced reactions	Shell fish food rate (Δyear%, 95% CI)
1	2011-2012	7.6%	Year 2 – 1 8.6% (–5.4 to 7.2)	6.9%	Year 2 – 1 2.5% (–3.8 to 8.8)	5.5%	Year 2 – 1 –1.8% (–6.9 to 3.3)	3.5%	Year 2 – 1 1.2% (–3.5 to 6)
2	2012-2013	8.5%		9.4%		3.8%		4.7%	
3	2013-2014	9%	Year 3 – 2 0.6% (–5.2 to 6.4)	11%	Year 3 – 2 1.5% (–4.7 to 7.6)	2.7%	Year 3 – 2 –1% (–4.9 to 2.8)	2.3%	Year 3 – 2 –2.4% (–6.4 to 1.5)
4	2014-2015	10%	Year 4 – 3 1.3% (–4.2 to 6.8)	6.8%	Year 4 – 3 –4.1% (–9.4 to 1.3)	3.6%	Year 4 – 3 0.84% (–2.5 to 4.2)	3.6%	Year 4 – 3 1.3% (–2.2 to 4.2)
5	2015-2016	7.7%	Year 5 – 4 –2.7% (–7.8 to 2.4)	10%	Year 5 – 4 –3.7% (–1.4 to 8.8)	2.4%	Year 5 – 4 –1.1% (–4.3 to 2)	2%	Year 5 – 4 –1.5% (–4.2 to 1.8)
6	2016-2017	7.1%	Year 6 – 5 –0.56% (–5.5 to 4.4)	11%	Year 6 – 5 –0.19% (–5.4, 5.8)	2%	Year 6 – 5 –0.44% (–3.4 to 2.6)	4.3%	Year 6 – 5 2.3% (1.1 to 5.8)
6 – 1	(2016-2017) – (2011- 2012)		Year 6 – 1 –4.7% (–6.3 to 5.4)		Year 6 – 1 4.1% (–2.4 to 9.9)		Year 6 – 1 –3.5% (–8.2 to 1.1)		Year 6 – 1 0.9% (–3.5 to 5.3)

TABLE E3. Annual percentage of anaphylactic reactions to the indicated food group (soy, wheat and sesame) as well as the difference rate that had no significant changes

Yearly rates	Year	Soy % among all food- induced reactions	Soy rate difference (Δyear%, 95% CI)	Wheat % among all food- induced reactions	Wheat rate (Δyear)	Sesame % among all food- induced reactions	Sesame difference (Δyear%, 95% CI)
1	2011-2012	1.4%	Year 2 – 1 1.0% (–2.4 to 4.4)	1.4%	Year 2 – 1 –4.4% (–3.2 to 2.3)	2.8%	Year 2 – 1 0.53% (–3.6 to 4.7)
2	2012-2013	2.4%		0.94%		3.3%	
3	2013-2014	0.45%	Year 3 – 2 –1.95% (–4.6 to 0.78)	0%	Year 3 – 2 –0.94% (–2.7 to 0.82)	2.7%	Year 3 – 2 –0.57% (–4.6 to 2.5)
4	2014-2015	1.6%	Year 4-3 1.1% (–0.88 to 3.2)	0.65%	Year 4 – 3 0.64% (–0.64 to 1.9)	3.2%	Year 4 – 3 0.52% (–2.2 to 4.2)
5	2015-2016	0.81%	Year 5 – 4 –0.81% (–3.0 to 1.3)	0.81%	Year 5 – 4 0.16% (–1.4 to 1.7)	3.2%	Year 5 – 4 –0.01% (–3 to 3)
6	2016-2017	1.2%	Year 6 – 5 0.38% (–1.7 to 2.5)	1.6%	Year 6 – 5 0.77% (–1.5 to 3.1)	4.7%	Year 6 – 5 1.5% (–2.3 to 5.3)
6 – 1	(2016-2017) – (2011- 2012)		Year 6 – 1 –0.19% (–2.7 to 2.3)		Year 6 – 1 0.2% (–2.4 to 2.8)		Year 6 – 1 2% (–2.3 to 6.2)

TABLE E4. Rates of change of all food-induced anaphylactic reactions among all cases of anaphylaxis

Year	Rates
(2012-2013) – (2011-2012) (Year 2 – Year 1)	–4.48 % (–11.76% to 2.80%)
(Year 3 – Year 2)	0.5% (–6.41% to 7.41%)
(Year 4 – Year 3)	3.5% (–2.74% to 9.75%)
(Year 5 – Year 4)	–3.33% (–9.32% to 2.65%)
(Year 6 – Year 5)	6.32% (0.26% to 12.38%)
(2016-2017) – (2011-2012) (Year 6 – Year 1)	2.51% (–4.19% to 9.22%)

TABLE E6. Rates of change of an unknown peanut allergy anaphylactic reaction over all cases of anaphylaxis

Year	Rates
(2012-2013) – (2011-2012) (Year 2 – Year 1)	–3.41% (–11.55% to 4.74%)
(Year 3 – Year 2)	–5.00% (–11.26% to 1.26%)
(Year 4 – Year 3)	2.21% (–3.13% to 7.55%)
(Year 5 – Year 4)	–1.89% (–7.10% to 3.32%)
(Year 6 – Year 5)	–1.09% (–6.13% to 3.96%)
(2016-2017) – (2011-2012) (Year 6 – Year 1)	–9.17% (–16.50% to –1.84%)

TABLE E5. Rates of change of a known peanut allergy anaphylactic reaction over all cases of anaphylaxis

Year	Rates
(2012-2013) – (2011-2012) (Year 2 – Year 1)	–1.836% (–9.36% to 5.69%)
(Year 3 – Year 2)	0.95% (–5.57% to 7.47%)
(Year 4 – Year 3)	0.08% (–5.66% to 5.822%)
(Year 5 – Year 4)	–0.20% (–5.87% to 5.47%)
(Year 6 – Year 5)	–5.09% (–10.56% to 0.37%)
(2016-2017) – (2011-2012) (Year 6 – Year 1)	–6.1% (–12.90% to 0.71%)