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Available online February 9, 2012.
doi:10.1016/j.jaci.2011.10.049

Effect of precautionary statements on the purchasing practices of Canadians directly and indirectly affected by food allergies

To the Editor:

Precautionary labeling advises consumers that a priority allergen might be inadvertently present in a food, even though it is not listed as an ingredient. Although several publications¹⁻⁵ have examined how precautionary statements influence the purchasing behavior of informed allergic consumers recruited from allergists' offices or food advocacy associations, none have examined how these statements might influence the behavior of subjects with food allergy recruited from the general public. Furthermore, the attitudes of consumers who are indirectly affected by food allergy because they purchase or prepare food for an allergic subject outside of their households have never been explored. Here we describe the effect of precautionary statements on the purchasing habits of Canadian consumers either directly or indirectly affected by food allergy. Our study also included participants randomly sampled from the general population and examined sociodemographic factors potentially associated with purchasing behaviors.

Households directly affected by food allergy were recruited from 2 sources. The first source was a random sample of the Canadian population (recruited through the SCAAALAR Surveying Canadians to Assess the Prevalence of Common Food Allergies and Attitudes towards Food Labelling and Risk [SCAAALAR] study, as previously described).⁶ If any household member had a convincing history of an IgE-mediated reaction to peanut, tree nut, or sesame or a physician's diagnosis of these allergies, the household was included as part of the directly affected population.

The second source comprised the Canadian peanut allergy registry and food allergy advocacy associations. As previously

published,⁷ the peanut allergy registry consists of subjects with an allergist-confirmed peanut allergy. Subjects with peanut, tree nut, and sesame allergy were also recruited from food allergy advocacy associations (Anaphylaxis Canada, Allergy/Asthma Information Association, and Association Quebecoise des Allergies Alimentaires) if they self-reported a convincing history of an IgE-mediated food allergy or a physician's diagnosis of food allergy.²

Households indirectly affected by food allergy were recruited from a single source, the SCAAALAR study. In the SCAAALAR study, if the household respondent did not report any peanut, tree nut, or sesame allergy in the household but reported either purchasing or preparing food for an allergic subject outside the household, the household was included as part of the indirectly affected population.

SCAAALAR participants were interviewed between May 2008 and March 2009; questionnaires for the registry/association participants were administered between May 2007 and April 2008.

In the SCAAALAR study the household respondents reported on their age, sex, educational level, marital status, and province of residence. If there was a food allergy in the household, the household respondent was queried on the history of the most severe allergic reaction and the presence of a physician's diagnosis of allergy. Similar information was collected from the registry/association participants.

For both directly and indirectly affected households, the eligible adult household respondent was asked about his or her likelihood of purchasing a product in response to several precautionary statements.

The study was approved by the Institutional Review Boards of the McGill University Health Centre and McMaster University.

A multivariate regression analysis was conducted in 2 stages to assess both the effect of group membership (directly affected from the SCAAALAR study, directly affected from the registry/associations, or indirectly affected from the SCAAALAR study) and specific characteristics of food allergies on purchasing behavior. In the first stage the main independent factor was group membership, and other potential predictors were only included if they applied to all groups (sex and education level of household respondent and location of household).

In contrast to the first stage, the second stage distinguished the effects of characteristics of the food allergy from the remaining effect of group membership. Potential predictors included all variables considered in the first stage and factors that only applied to directly affected households (ie, presence of peanut allergy in the household, whether peanut/tree nut/sesame allergy affected only adults, whether the most severe reaction was moderate or severe, and the presence of a physician's diagnosis of peanut/tree nut/sesame allergy).

A total of 1318 directly affected subjects participated: 127 from the SCAAALAR study and 1191 from the registry/associations. A total of 1113 indirectly affected subjects participated (Table I).

Within each group, the precautionary statement "not suitable" was most effective in deterring purchasing of a product (Table II). When comparing between groups, regardless of the precautionary statement used, the directly affected subjects from the SCAAALAR study were the least vigilant, whereas those from the registry/associations were either slightly more vigilant than the indirectly affected subjects or expressed similar vigilance for 5 of the 6 statements (Table II).

TABLE I. Comparison of demographic and socioeconomic characteristics between directly and indirectly affected subjects

	Directly affected SCAAALAR subjects (n = 127)	Directly affected peanut registry/food allergy association subjects (n = 1191)	Indirectly affected SCAAALAR subject (n = 1113)
Age of respondent (y [95% CI])	46.1 (44.0-48.1)	39.9 (39.4-40.4)*	46.6 (45.7-47.4)
Male sex (% [95% CI])	26.5 (18.8-35.5)	7.6 (6.2-9.3)	28.3 (25.6-31.1)
College/university/professional degree or diploma (% [95% CI])	77.4 (68.7-84.7)	84.7 (82.5-86.7)	68.4 (65.5-71.2)
Married/cohabitation (% [95% CI])	89.0 (81.6-94.2)	90.1 (87.2-92.5)*	71.6 (68.7-74.3)
Rural† (% [95% CI])	36.3 (27.8-45.4)	20.8 (18.5-23.2)	37.7 (34.9-40.7)
Location (% [95% CI])			
Atlantic provinces (% [95% CI])	5.6 (2.3-11.3)	3.2 (2.3-4.4)	6.6 (5.2-8.2)
Quebec (% [95% CI])	34.7 (26.4-43.7)	49.8 (46.9-52.7)	34.1 (31.3-36.9)
Ontario (% [95% CI])	30.6 (22.7-39.6)	34.2 (31.5-37.0)	38.6 (35.8-41.6)
Prairies (% [95% CI])	12.1 (6.9-19.2)	8.6 (7.1-10.3)	11.6 (9.8-13.7)
British Columbia (% [95% CI])	16.9 (10.8-24.7)	4.1 (3.1-5.4)	9.1 (7.5-10.9)
Peanut allergy in household (% [95% CI])	51.2 (42.2-60.1)	94.4 (92.9-95.6)	—
Child with peanut/tree nut/sesame allergy in household (% [95% CI])	37.0 (28.6-46.0)	91.9 (90.2-93.4)	—
Moderate/severe reaction (% [95% CI])	83.5 (75.8-89.5)	77.7 (75.2-80.1)	—
Physician's diagnosis of allergy (% [95% CI])	84.3 (76.7-90.1)	92.9 (91.3-94.3)	—

*Only those from the registry provided these data (n = 570).

†Residing outside Canadian metropolitan area or in a Canadian metropolitan area with a population of less than 100,000.

TABLE II. Percentages of the directly affected subjects from the SCAAALAR study, directly affected subjects from the registry/associations, and indirectly affected subjects from the SCAAALAR study who will never purchase a product with the following precautionary statements

	Directly affected SCAAALAR subjects (n = 127), % (95% CI)	Directly affected registry/association subjects (n = 1191)	Indirectly affected SCAAALAR subjects (n = 1113), % (95% CI)	Difference, % (95% CI; (column 2 – column 1)	Difference, % (95% CI; column 3 – column 1)	Difference % (95% CI) (3 – 2)
May contain [allergen]	56.2 (46.9-65.2)	89.7 (87.9 to 91.4)	84.3 (82.0 to 86.5)	33.5 (24.5 to 42.5)	28.1 (19.0 to 37.2)	-5.4 (-8.1 to -2.6)
May contain traces of [allergen]	47.1 (38.0 to 56.4)	77.3 (74.8 to 79.6)	81.5 (79.1 to 83.8)	30.2 (21.0 to 39.4)	34.4 (25.2 to 43.6)	4.2 (0.9 to 7.5)
Manufactured in a facility (...)	40.5 (31.7 to 49.8)	74.4 (71.9 to 76.9)	73.6 (70.8 to 76.2)	33.9 (24.8 to 43.0)	33.1 (23.9 to 42.2)	-0.9 (-4.5 to 2.7)
Manufactured on the same equipment (...)	52.9 (43.6 to 62.0)	87.6 (85.6 to 89.5)	80.4 (77.9 to 82.7)	34.7 (25.7 to 43.8)	27.5 (18.3 to 36.7)	-7.3 (-10.3 to -4.2)
Packaged in a facility (...)	39.7 (30.9 to 49.0)	76.0 (73.5 to 78.4)	72.6 (69.8 to 75.2)	36.3 (27.3 to 45.4)	32.9 (23.8 to 42.0)	-3.4 (-7.0 to 0.2)
Not suitable (...)	80.2 (71.9 to 86.9)	96.8 (95.6 to 97.7)	87.7 (85.6 to 89.6)	16.6 (9.4 to 23.8)	7.5 (0.1 to 14.9)	-9.1 (-11.3 to -6.9)

In the first stage of the multivariate results (Table III), the directly affected subjects from the SCAAALAR study relative to the indirectly affected subjects were less likely to avoid the product in response to any of the precautionary statements. The directly affected subjects from the registry/associations were more likely than the indirectly affected subjects to avoid in response to “may contain,” “manufactured on the same equipment as products containing,” and “not suitable for,” but they had similar purchasing patterns for the other precautionary statements. Given that the directly affected subjects from the registry/associations were at least as vigilant as the indirectly affected subjects and the directly affected subjects from the SCAAALAR study were less vigilant than the indirectly affected subjects, it follows that the directly affected subjects from the registry/associations were more vigilant than the directly affected subjects from the SCAAALAR study.

In the second stage of the analysis, the presence of peanut/tree nut/sesame allergy in adults only within the household was

associated with less vigilance. Households reporting a moderate or severe allergic reaction were more likely to avoid (Table IV).

Although limited by the relatively small sample of directly affected subjects from the general population, we have demonstrated that (1) precautionary statements varied considerably in their effectiveness in deterring consumer purchasing; (2) the directly affected subjects from the SCAAALAR general population survey were the least vigilant and, surprisingly, those who were indirectly affected were more diligent than the general population of directly affected subjects; and (3) households having a child with peanut/tree nut/sesame allergy or an allergic subject with a previous moderate or severe allergic reaction were more vigilant.

The “not suitable” precautionary statement might be the most effective because it not only provides information for the consumer but also makes the decision for them regarding the appropriateness of the product for consumption. However, a possible disadvantage is that consumers might rely only on this

TABLE III. Predictors of never purchasing in response to different precautionary statements

	May contain [allergen]	May contain traces of [allergen]	Manufactured in a facility that also packages [allergen]	Manufactured on the same equipment as products containing [allergen]	Packaged in a facility that also packages products containing [allergen]	Not suitable for people with a [particular allergy]
Directly affected (SCAAALAR study)*	0.21 (0.14-0.32)	0.20 (0.14-0.30)	0.25 (0.17-0.38)	0.28 (0.19-0.42)	0.26 (0.17-0.38)	0.58 (0.35-0.95)
Directly affected (registry/associations)*	1.58 (1.22-2.04)	0.81 (0.66-1.00)	1.03 (0.85-1.24)	1.78 (1.41-2.25)	1.17 (0.97-1.42)	4.13 (2.85-5.99)
Postsecondary graduate†	1.33 (1.02-1.75)	—	—	—	—	—
Atlantic‡	2.23 (1.10-4.51)	—	—	—	—	—
Quebec‡	—	0.60 (0.49-0.74)	—	0.72 (0.57-0.91)	—	—
Prairies‡	—	—	—	—	—	0.55 (0.36-0.83)
British Columbia‡	—	0.56 (0.39-0.82)	0.69 (0.49-0.96)	0.53 (0.36-0.78)	0.65 (0.47-0.92)	—

Values are presented as odds ratios (95% CIs).

*Reference group is indirectly affected subjects.

†Completed college or university.

‡Reference group is all other provinces.

TABLE IV. Predictors of never purchasing in response to different precautionary statements after accounting for factors applicable only to directly affected groups

	May contain [allergen]	May contain traces of [allergen]	Manufactured in a facility that also packages [allergen]	Manufactured on the same equipment as products containing [allergen]	Packaged in a facility that also packages products containing [allergen]	Not suitable for people with a [particular allergy]
Directly affected (SCAAALAR study)*	0.33 (0.17-0.66)	0.27 (0.14-0.49)	0.39 (0.23-0.68)	0.39 (0.21-0.70)	0.33 (0.19-0.57)	0.46 (0.26-0.82)
Directly affected (registry/associations)*	1.32 (0.67-2.60)	0.69 (0.39-1.22)	1.13 (0.70-1.83)	1.53 (0.89-2.64)	1.00 (0.62-1.60)	2.60 (1.23-5.52)
Quebec†	0.76 (0.60-0.98)	0.61 (0.49-0.76)	0.82 (0.68-1.00)	0.70 (0.56-0.89)	—	—
Prairies†	—	—	—	—	—	0.55 (0.37-0.83)
British Columbia†	—	0.57 (0.39-0.84)	0.64 (0.45-0.91)	0.53 (0.36-0.78)	0.66 (0.48-0.93)	—
Peanut allergy in household‡§	1.03 (0.59-1.79)	1.00 (0.62-1.62)	0.99 (0.63-1.57)	1.27 (0.76-2.11)	1.26 (0.80-1.98)	1.65 (0.80-3.38)
No child with peanut/tree nut/sesame allergy in household‡	0.31 (0.19-0.50)	0.41 (0.27-0.62)	0.51 (0.34-0.76)	0.51 (0.32-0.80)	0.56 (0.37-0.83)	—
Moderate/severe reaction‡	1.64 (1.09-2.47)	1.42 (1.04-1.95)	—	—	—	—

Values are presented as odds ratios (95% CIs).

*Reference group is indirectly affected subjects.

†Reference group is all other provinces.

‡Applies to all directly affected households.

§Given that peanut allergy was a confounder and affected the magnitude of the odds ratio of the other predictors, it was retained, although its CI crosses 1.

precautionary statement and ignore other potential allergens listed in the ingredients. This variability that we observed in consumer behavior in response to precautionary statements is consistent with an American survey.⁴ It is to be expected that the wide range and frequent use of precautionary statements might lead to consumer uncertainty. Policies that promote the use of fewer variations of precautionary statements might be more effective in deterring purchasing.

The directly affected subjects from the general population are far less vigilant than those recruited from the registry/associations. These directly affected subjects differ from the directly affected subjects randomly recruited from the general population in that they consist mainly of parents who are highly informed and motivated regarding food allergy management. This effect was evident even after adjusting for potential confounders, including education; peanut allergy in the household; having a child with

peanut, tree nut, or sesame allergy; severity of the reaction; or physician's diagnosis.

It is possible that those indirectly affected subjects were more diligent than the directly affected subjects in the general population because they experience a greater sense of responsibility when buying food for children other than their own.⁸ Furthermore, the indirectly affected subjects were also not purchasing such foods as frequently as those directly affected, and therefore it might be easier for them to exercise greater caution when doing so.

Directly affected households caring for children with peanut/tree nut/sesame allergies were more diligent potentially because they were more concerned with their child's health than their own health or the health of another adult in the household.⁸

Our results suggest that when certain noncommittal precautionary statements are used, they are often ignored by consumers.

Policies promoting use of fewer variations of precautionary statements and use only when the risk of contamination is unavoidable should be promoted. Furthermore, all subjects with food allergies, particularly those who are not members of allergy advocacy groups, must be made aware of the importance of meticulous avoidance of the offending allergen.

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Supported by the Allergy, Genes, and Environment (AllerGen) Network of Centres of Excellence, Health Canada and Foundations of the McGill University Health Centre and Montreal Children's Hospital. M.B.-S. was partially supported by the Ross Fellowship from the Research Institute of the Montreal Children's Hospital, and D.H. is supported by a Social Sciences and Humanities Research Council (SSHRC) fellowship. L.J. and A.E.C. are National Scholars of the Fonds de la recherche en santé du Québec.

Disclosure of potential conflict of interest: M. Ben-Shoshan has received research support from AllerGen (the Allergy, Genes, and Environment Network) and Health Canada. S. Elliott has received research support from AllerGen. S. Waserman has received honoraria and provided consulting for Merck and has received honoraria from Nycomed, GlaxoSmithKline, King Pharma, Novartis, and Merck. The rest of the authors declare that they have no relevant conflicts of interest.

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Available online March 14, 2012.

doi:10.1016/j.jaci.2012.01.078

CD203c expression-based basophil activation test for diagnosis of wheat-dependent exercise-induced anaphylaxis

To the Editor:

Wheat-dependent exercise-induced anaphylaxis (WDEIA) is a special form of wheat allergy induced by the combination of wheat ingestion and physical exercise. We previously identified wheat ω -5 gliadin, a component of the water/salt-insoluble protein (gluten), as a major allergen in patients with WDEIA.¹ Recently, increased incidence of a new WDEIA subtype caused by hydrolyzed wheat protein (HWP) has been observed.^{2,3} We have encountered several patients with WDEIA who were sensitized to HWP primarily through percutaneous routes, rhinoconjunctival routes, or both by using HWP-containing facial soaps.³ Patients with this type of WDEIA showed HWP-positive results in a skin prick test (SPT) and had serum HWP-specific IgE. In addition, these patients had characteristic features of facial angioedema distinct from those seen in patients with conventional WDEIA (CO-WDEIA). Thus they were designated as having WDEIA sensitized by HWP (HWP-WDEIA). We examined the sera of several patients with HWP-WDEIA using the CAP-FEIA (Phadia, Uppsala, Sweden; detection range, 0.35-100 kU_A/L) and found that these patients have no or only low levels of ω -5 gliadin-specific IgE.

To establish a predictive *in vitro* test for differentiating these 2 subtypes of WDEIA (HWP-WDEIA and CO-WDEIA), we measured basophil CD203c expression induced by different types of wheat proteins and evaluated the diagnostic efficiency of the reactions in the patients. CD203c is an ectoenzyme belonging to a family of ectonucleotide pyrophosphatases and phosphodiesterases. It is expressed on the cell membrane of human peripheral basophils and mast cells, and cross-linking of the high-affinity IgE receptor upregulates CD203c expression on the cell membrane.

Ten patients with WDEIA were enrolled in this study: 5 with HWP-WDEIA and 5 with CO-WDEIA. The clinical features and the results of immunologic studies of these patients are summarized in Table I. All of the patients with HWP-WDEIA had been using the same brand of soap, which included HWP-A (Katayama Chemical, Osaka, Japan). None of the patients with CO-WDEIA had a prior history of using soap or other cosmetic products supplemented with HWP. Sensitization to wheat proteins was determined by means of SPT responses, specific IgE levels (CAP-FEIA), and challenge test results with wheat combined with exercise/aspirin.⁴ None of the patients had atopic diathesis.

Wheat fractionation and purification of ω -5 gliadin were performed according to a previously described method.⁵ SDS-PAGE and IgE immunoblotting were also performed as described previously.⁵ All IgE from patients with HWP-WDEIA reacted with HWP-A, and the molecular size ranged from 15 to 250 kDa. The IgE of all patients with HWP-WDEIA also reacted to both water-soluble and water-insoluble wheat proteins but not to ω -5 gliadin. The IgE of the patients with CO-WDEIA did not react to HWP-A but reacted to