



# Food Allergen Labeling



# Are food allergic consumers ready for informative precautionary allergen labelling?

## Abstract

Precautionary allergen labelling (PAL) has resulted in consumer confusion. Previous research has shown that interpretive labels (using graphics, symbols, or colours) are better understood than the traditional forms of labels. In this study, we aimed to understand if consumers would use interpretive labels (symbol, mobile phone application and a toll-free number) with or without medical advice that was advocated by the food industry rather than the normal PAL. This is relevant information for industry and clinicians as it provides an insight into the food allergic perception regarding PAL.

**Keywords:** Precautionary allergen labelling, Voluntary Incidental Trace Allergen Labelling, Food allergy

## Findings

Precautionary allergen labelling (PAL) has been in place since its voluntary establishment in approximately 2003. Recently several studies have shown that the food industry continual use of PAL is resulting in consumer confusion, reduced quality of life and increased risk-taking since consumers often ignore PAL. Previous research has shown that interpretive labels (using graphics, symbols, or colours) are better understood than the traditional forms of labels these labels may help to reduce the current confusion surrounding PAL [1–3].

In 2007, the Voluntary Incidental Trace Allergen Labelling (VITAL®), was developed by the Australian manufacturing industry and is currently managed by the Allergen Bureau. The VITAL® procedure encourages manufacturers to undertake a more intensive investigation into the possible presence of allergens before a product release to consumers. A major limitation of the VITAL® process is that no information is provided to the consumer alerting them that the product in question has undergone a specialised risk assessment and is therefore

safe to consume [4]. We have previously highlighted this limitation to industry but labelling to indicate a product has been VITAL® assessed has not been activated.

Food education allows individuals to build knowledge and values, reframe their food practices, and develop strategies for a healthy and safe diet.

In this study, we aimed to understand if consumers would use a symbol which was advocated by the Allergen Bureau on food products that had undergone the VITAL® process and represented a very low level of cross contact. We also examined if consumers would use a mobile phone application or a toll-free number to access information when buying food products.

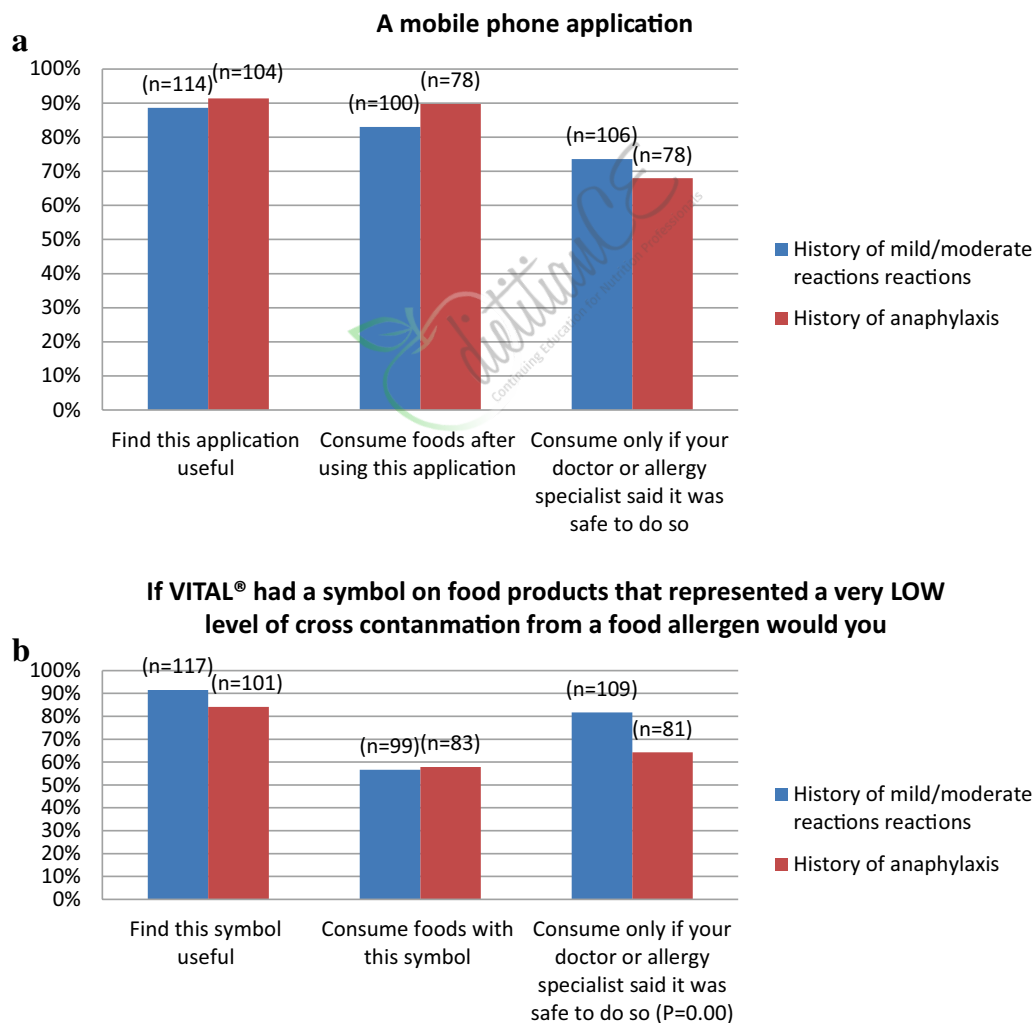
The methods of this study are described elsewhere [5] but in brief, 535 participants were recruited from the Department of Allergy and Immunology at the Royal Children's Hospital, Melbourne. 497 children (93%) agreed to participate. Food allergy had been medically diagnosed in 293 (59%) Of the 293 children with food allergy, 246 (84%) had sufficient information provided to allow past reactions to be classified as either a past history of anaphylaxis (113 children) or a past history of mild to moderate IgE mediated reactions (133 children).

We presented to the participants three different methods of labelling. The three questions were:

1. Participants were asked to consider if the “may be present” symbol was used to represent a LOW level of cross contamination, (an amount that is so low that will be unlikely to cause a severe allergic reaction) would they find this statement useful and consume foods with this statement, or consume foods with this statement only if your doctor or allergy specialist said it was safe to do so. (The participants were given no information regarding VITAL® or its processes).
2. If there was an independent toll free number listed on all food products would they call to gain more information regarding the products.
3. If there was a mobile phone application developed in which they could scan the barcode of a food product

and instantly receive more information regarding the ingredients.

Responders that reported on the usefulness of the proposed VITAL® symbol, 91% (n = 117) of participants that had mild to moderate reactions and 84% (n = 101) of participants that had a history of anaphylaxis reported that they would find this symbol useful. A lesser portion of responders reported that they would consume foods with these symbol 56% (n = 99) and 57% (n = 83) respectively. However this increased when asked if they would consume foods with this symbol if advised by their healthcare provider that it was safe to do so 81% (n = 109) and 64% (n = 81) respectively (Fig. 1a).



**Fig. 1** **a** Food allergic participants were asked to consider the above symbol been placed on food products and if this simple would be useful, would they consume foods with this symbol or would they consume foods with this symbol if advised by their healthcare provider? **b** Food allergic participants were asked to consider if there was a mobile phone application in which they could scan the barcode of a food product and instantly receive more information regarding the ingredients

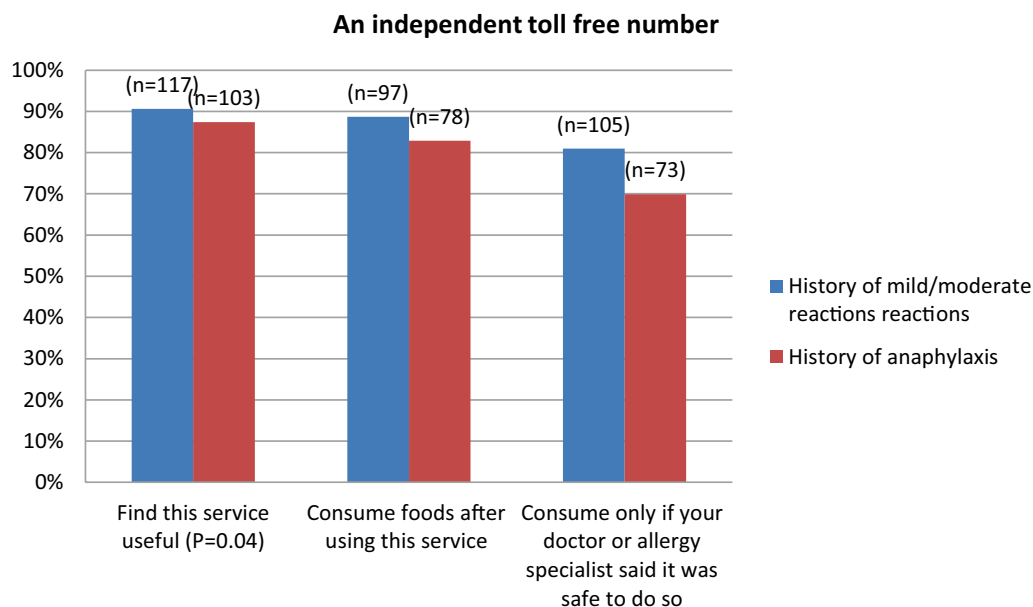
Responders that reported on the usefulness of a mobile phone application, 88% (n = 114) of participants with a history of mild to moderate reactions and 91% (n = 104) with a history of anaphylaxis reported that they would find this application useful. This proportion remained similar when asked if they would consume foods after using this application but slightly dropped when asked if they required their healthcare provider to inform them that it was safe to do so 73% (n = 106) and 67% (n = 78) respectively (Fig. 1b).

Responders that reported on the benefit of an independent toll-free number, 90% (n = 117) of participants with a history of mild to moderate reactions and 87% (n = 103) with a history of anaphylaxis reported that they would find this service useful. This proportion remain similar when asked if participants would consume foods after using this service and slightly dropped when asked if they would only consume foods from this service if their healthcare provider told them it was safe to do so 80% (n = 105) and 70% (n = 73) respectively (Fig. 2).

In this current study we presented to participants three different methods of information delivery for food labelling. The results show that the majority of responders would find all three very useful if they were placed on package goods. For the mobile phone application and the toll-free number, the majority of responders would consume food products without seeking endorsement from their healthcare provider. This may be due to the fact that participants felt receiving live information via

a mobile phone application or a toll-free number was sufficient enough information for them to support their decision to eat the product. However further studies will be required to examine the specific nature of the information given via mobile phone application or toll-free numbers in order to assess how much information is sufficient to bring about change in their behaviour before changes to policy can be recommended. In regards to the VITAL<sup>®</sup> symbol a greater portion of responders (81% mild-to-moderate reactions and 64% history of anaphylaxis p = 0.00), would only consume foods with this symbol if their healthcare provider instructed them that it was safe to do so. A possible explanation to this may be the uncertainty and legitimacy around the VITAL<sup>®</sup> statement.

The key strengths of our study are the response rate of 93%, and that participants received no education in relation to the VITAL<sup>®</sup> process, therefore it is unlikely that the participant bias in favour of VITAL<sup>®</sup> was present. A limitation to this study is that the results depend on what an individual states that they would or would not do and does not actually quantify whether this would correlate with action. Further studies would be required in order to examine this question. Another possible limitation is that we relied on parents' self-report that their child had medically diagnosed food allergy and a past history of anaphylaxis. However, we believe this is appropriate for this type of study as parents' perceptions and attitudes are likely to drive their choices when making decisions on behalf of their children.



**Fig. 2** Food allergic participants were asked to consider if there was an independent toll free number listed on all food products that they could call to gain more information regarding the product's ingredients

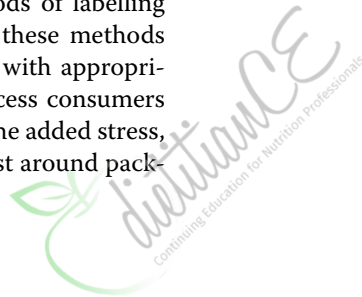


Souza et al. analyse 702 individuals to understand the effectiveness of an educational intervention regarding food labelling as a tool to promote public health. Participants were asked to complete a questionnaire regarding food labelling. Thirty days after the first initial questionnaire participants were asked to complete the same questionnaire but this time the participants were provided with a folder of educational material to promote the understanding of food labels. The results from the first questionnaire showed that, 55.8% of the respondents reported consulting information provided on packaged foods, however 30 days later 72.0% of respondents reported consulting this information ( $p < 0.001$ ) [6].

Currently there is no education or information on food products that have been through the VITAL<sup>®</sup> process that alerts the consumer regarding this process.

There is substantial evidence indicating that interpretive labels (using graphics, symbols, or colours) are better understood than the traditional numerical nutrition labels [3].

Our research shows that consumers would benefit from utilising any of the three different methods of labelling that were examined in this study and if these methods of labelling were delivered to consumers with appropriate education regarding the VITAL<sup>®</sup> process consumers would be able to consume foods without the added stress, anxiety and uncertainty that currently exist around packaged goods.



# Consumer preferences for food allergen labeling

## Abstract

**Background:** Food allergen labeling is an important tool to reduce risk of exposure and prevent anaphylaxis for individuals with food allergies. Health Canada released a Canadian food allergen labeling regulation (2008) and subsequent update (2012) suggesting that research is needed to guide further iterations of the regulation to improve food allergen labeling and reduce risk of exposure.

**Objective:** The primary objective of this study was to examine consumer preferences in food labeling for allergy avoidance and anaphylaxis prevention. A secondary objective was to identify whether different subgroups within the consumer population emerged.

**Methods:** A discrete choice experiment using a fractional factorial design divided into ten different versions with 18 choice-sets per version was developed to examine consumer preferences for different attributes of food labeling.

**Results:** Three distinct subgroups of Canadian consumers with different allergen considerations and food allergen labeling needs were identified. Overall, preferences for standardized precautionary and safety symbols at little or no increased cost emerged.

**Conclusion:** While three distinct groups with different preferences were identified, in general the results revealed that the current Canadian food allergen labeling regulation can be improved by enforcing the use of standardized precautionary and safety symbols and educating the public on the use of these symbols.

**Keywords:** Immune system diseases, Hypersensitivity, Hypersensitivity, immediate, Food hypersensitivity, Public health, Health planning, Health services research, Social control, Formal policy, Humans

## Background

Food allergy (FA) is a public health issue gaining world-wide attention [1–9]. While the overall prevalence of food allergy has been estimated to be approximately 7%, only 3–4% of adults and 5–6% of children have received a physician-confirmed food allergy diagnosis [10–12]. A meta-analysis published in 2007 suggested that the prevalence of food allergy ranges from 3 to 35%, and one Australian study suggested that more than 10% of 1 year olds had a challenge-proven egg allergy [1, 13]. This wide range is a reflection of the varying definition of food allergy (i.e.

self-report versus a requirement for symptoms compatible with an IgE-mediated reaction and confirmatory testing), non-reporting of incidents, and respondent bias [1, 14]. Studies suggest that food allergens are the primary cause of anaphylaxis [15–19]. There are about 7% of Canadians with food allergies—among all Canadian children, 1.7% specifically have peanut allergies [14], of which 90% have experienced a severe reaction [14]. A number of US studies have suggested that the incidence of anaphylaxis is increasing and is perhaps as high as 49.8 per 100,000 person-years [15, 20–24]. Additionally, within the last decade, US hospitalizations secondary to food-induced anaphylaxis increased by 350% [25]. Similarly, a study by Ben-Shoshan et al. has revealed that in at least one emergency department in Quebec, Canada,

the rate of emergency department visits for anaphylaxis doubled over a 4 year period [26].

There is no cure for food allergy and, thus, strict avoidance of allergenic foods is paramount in symptom prevention [7]. Food allergen labeling is an internationally recognized risk management tool and regulatory policies are being developed to lower food allergen exposure risk for individuals with food allergies [7]. In 2008, the Canadian Minister of Health announced new labeling requirements for food allergens and intolerances contained in pre-packaged foods. A regulatory update was released in August 2012 noting the requirement to list all food allergens, gluten sources, and sulphites in the ingredient lists or in a precautionary statement [27].

Despite the increasing public health concern surrounding food allergies and the recent update in Canadian food allergen labeling regulations, there is scarce information regarding the best way to present allergen information to consumers [28]. Knowledge about consumers' use of allergen labels may inform regulatory agencies about the appropriate packaging of foods and design of food labels to reduce risk of exposure to food allergens [29–33]. The objective of this study was to use a stated choice experiment to evaluate Canadians' preferences for different types of food allergen-related information on food labels, and to determine if there are differences in preferences across different types of respondents.

## Methods

### Recruitment and study sample

In order to recruit a representative sample of the Canadian population, respondents were recruited by IPSOS Reid Canada (Vancouver, British Columbia, Canada). Participants were selected from a balanced sample in terms of sociodemographic variables including gender, age, income, level of education, and region within Canada. Subjects were derived from the IPSOS I-Say panel of approximately 300,000 Canadian residents who have agreed to participate in surveys. Respondents were eligible to participate in the study if they were 19 years or older, currently residing in Canada, and were fluent in reading and writing in English.

Ethics approval was obtained from the University of British Columbia Behavioural Research Ethics Board (UBC BREB). Participants were required to provide informed consent prior to study enrolment and were remunerated using IPSOS Reid's points based system.

### Discrete choice experiment (DCE) questionnaire design

The DCE, one of the most frequently employed techniques to assess consumer preferences, is based on economic theory of choice behaviour and can take into account inter-linked human behaviours [34–37]. In a

DCE survey, participants are presented with an array of choice sets representing hypothetical but realistic choice scenarios. Each choice set is composed of different attributes defined by levels that are necessary for decision-making. Participants are asked to make trade-off choices among different combinations of attributes thereby revealing their preferences. By understanding participant preferences between different levels of an attribute, the relative importance of a product characteristic (in this study, the food label), can be determined [38–40].

A qualitative study using focus groups to identify specific attributes of allergen-related food labeling that are most important to consumers was conducted prior to the development of the DCE questionnaire with the approval from the UBC BREB [41]. Eight focus groups were conducted with 2 sample groups of consumers: (1) families with allergic member(s) ( $n = 26$ ); and (2) the general public ( $n = 24$ ). Recruitment for the first group was completed through Food Allergy Canada (formerly Anaphylaxis Canada), the largest anaphylaxis support group in Canada. IPSOS Reid conducted recruitment for the second group. The focus groups covered topics related to perceptions of current allergen labeling, information needs, and preferences for allergen labels. Interviews were digitally recorded, transcribed, and analyzed. Based on the results of the qualitative study, four attributes with their respective levels were included in the DCE questionnaire (Table 1).

Overall, there were 180 possible choice-set combinations, based on 13 levels across four attributes. To reduce the number of choice-sets that each respondent had to complete, a fractional factorial design divided into ten different versions with 18 choice-sets per version was developed. The DCE included 18 choice-sets per respondent in which each respondent was asked to choose between two hypothetical alternatives (Fig. 1a). Furthermore, a picture of the label was presented with each choice set that

**Table 1 Attributes and levels included in the DCE**

Attribute	Levels
Precautionary statement	Not suitable for consumers with allergies to peanuts or tree nuts May be present: peanuts and tree nuts May contain traces of peanuts and tree nuts Contains wheat, dairy, peanuts, and tree nuts
Safety statement	Does not contain soy, eggs, fish or shellfish Safety statement not included
Use of symbols	Precautionary symbol Safety symbol Both precautionary and safety symbol No symbols used
Placement of information	Package front Next to ingredients Package front and next to ingredients

- a** Please imagine The Shortbread Company makes packaged shortbread. The ingredients of the shortbread are listed on the package. The ingredients are: wheat flour, butter, sugar, salt. In addition to listing the ingredients, the shortbread company wants to provide allergen information on the package. Below is a description of two different options for allergen labeling. After considering the two options for allergen labeling, please click the button under the option you prefer:

Features	Option 1	Option 2
Precautionary Statement	May be present: peanuts and tree nuts	May be present: peanuts and tree nuts
Safety Statement	Does not contain soy, eggs, fish, or shellfish	Does not contain soy, eggs, fish, or shellfish
Use of Symbols	BOTH Precautionary and Safety	No Symbols
Placement of Information	Package Front AND Next to Ingredients	Package Front
I would choose:	<input type="checkbox"/>	<input type="checkbox"/>



**Fig. 1** **a** Example of discrete choice experiment choice-set for respondents' preferences and **b** graphical representation of the label representing attributes in the choice set

represented the exact attributes described in the choice set (see Fig. 1b for example). The internal consistency of individuals' responses was evaluated by including two fixed-repeated choice-sets (not included in the final analysis) in each 18 choice-set version. Prior to recruitment, the DCE was pilot tested in 100 respondents to evaluate the clarity of the questionnaire and that the attribute levels were consistent with the range of preferences. The final survey was designed to take respondents between 15 and 30 min to complete. The final version of the design was checked for orthogonality, level balance, and minimal overlap. In addition to the DCE, the following data

was also collected: demographic data (age, gender, province, marital status, household income, level of education, number of children); allergen related data (number of allergen affected individuals in the household, consideration of allergens when buying packaged foods, reasons for considering allergens when buying packaged foods, allergens that a household must avoid, food-related anaphylactic experience by an individual or anyone in their household, and willingness to pay (highest amount an individual was willing to pay above a \$500 monthly grocery bill for the inclusion of the allergen information on all food packages, reasons for not wanting to pay any



amount for the inclusion of the allergen information on food packages, and the amount an individual was willing to pay above an individual's annual income taxes in order to include allergen labeling on food packages).

### Statistical analysis

Participants' baseline characteristics were described using means with standard deviations for continuous variables and frequencies and percentages for categorical variables. Only those respondents who completed all 18 choice sets of the DCE were included in the final analyses. The demographics of consistent and inconsistent respondents (based on the two fixed-repeated choice-sets) were compared to determine if there were any statistically significant differences between these two groups. For the comparison of these two groups, two-sample *t* tests and  $\chi^2$  tests were used, with the significance level set at 5% (two-tailed). To account for preference heterogeneity between respondents, the respondents' relative preferences for each level of each attribute were estimated using a latent class model (LCM). Socio-demographic, allergen, and cost variables were investigated for inclusion in the final model based on their influence on class membership. Multiple models with 1–6 latent classes and with and without covariates, all with the same specification other than the number of classes, was evaluated. All attributes and covariates were effect-coded. To determine the most appropriate covariates to include in the final model, a forward selection method with a priori significance set at 5% was used. Selection of the best model (including the number of latent classes) was made based on the Bayesian information criteria (BIC), Akaike information criteria (AIC), and the log-likelihood function. To facilitate explaining the differences in preferences between classes, the relative importance of the attributes across latent classes was examined. The relative importance represents the maximum effects, re-scaled to sum to 1 across attributes within a latent class. All statistics were performed using SAS 9.2 (SAS Institute, Inc., Cary, NC, USA; <http://www.sas.com>) and Latent GOLD® version 4.5 (Statistical Innovations, Inc., Belmont, MA, USA).

### Results

Of the 1426 respondents who started the online questionnaire, 1100 (77%) completed all 18 choice-sets including the two fixed-repeated choice-sets. Of the 1100 respondents deemed eligible for the study, 108 (10%) did not answer the fixed questions consistently and were classified as inconsistent respondents. The average time to complete the survey was 20 min (SD = 22.6). Some respondents appeared to take a break from the survey, with 67 respondents taking over 24 h to complete the survey. The mean age of the respondents was 46 years

(SD = 16), 617 (56%) were female, 173 (16%) had at least a university degree, and 756 (69%) reported having an annual household income of \$40,000 or more (Table 2). In addition, 429 (39%) reported at least one allergic individual in their household, 437 (40%) consider allergens when buying food, and 132 (12%) respondents, or someone in their household, had experienced an anaphylactic reaction to a food (Table 3). Correspondingly, 820 (75%) respondents reported being willing to pay for the inclusion of food-allergen information on all food packages (Table 4). There were statistically significant differences between the inconsistent and consistent groups of respondents based on gender, number of allergens per household, number of reasons why respondents consider allergens when buying packaged foods, and all the willingness to pay questions with the exception of not willing to pay more on the respondents' annual income taxes in order to include allergen labeling on food packages. Therefore, all respondents were included in the final analysis, including a covariate for consistency of response to account for these differences. The only covariate found to be significant was group membership (consistent or inconsistent) thus, the inconsistent group of respondents was excluded from the final model.

A LCM including explanatory variables compared to a model including only the attribute responses improved the model fit. After considering the goodness of fit statistics, the interpretability and relative sizes of the classes, a 3-class model was selected as best representing respondents' preferences (Table 5). Most parameter values for the choice model were significant at the 5% level. Due to missing data on age, gender and marital status, only 985 respondents were included in the final latent class analysis.

The relative preferences and a weighted average over all classes were calculated for each attribute. Use of symbols was the most important attribute accounting for 43.5% of the variance explained, on average. The presence of a safety statement accounted for 26.4%. Placement of information and the precautionary statement accounted for 18.9 and 11.3%, respectively. The results indicate that class 1 respondents (with the probability of being in class 1 being the greatest, 44%) had the strongest negative preference for no symbols used (−0.925), and their strongest positive preference was for both a precautionary and safety symbol (0.796). Thus, the presence of symbols was the most important attribute for those in class 1 (Fig. 2). Class 2 respondents (with the probability of being in class 2, 38%) had even stronger preferences for having both precautionary and safety symbols on the label (1.069), but the presence of the safety statement, "Does not contain soy, eggs, fish, or shellfish" was equally preferred (1.073). Finally, the most

**Table 2 Baseline characteristics of participants**

Characteristic	All (N = 1100) N <sup>a</sup> (%) or mean (SD)	Consistent (N = 992) N <sup>a</sup> (%) or mean (SD)	Inconsistent (N = 108) N <sup>a</sup> (%) or Mean (SD)	p value
Age	46.4 (15.6)	46.7 (15.7)	43.8 (14.0)	0.06
Females	617 (56)	567 (57)	50 (46)	0.03
Province				0.97
British Columbia, Alberta, Saskatchewan, Manitoba	403 (37)	364 (37)	39 (36)	
Ontario	508 (46)	457 (46)	51 (47)	
Quebec, Atlantic Provinces, Yukon, Northwest Territories, Nunavut	189 (17)	171 (17)	18 (17)	
Education				0.21
Did not complete high school	81 (7)	74 (7)	7 (6)	
Completed high school and/or some college or trade	846 (77)	756 (76)	90 (83)	
Completed university or professional degree	173 (16)	162 (16)	11 (10)	
Income				0.30
<\$4000	339 (31)	305 (31)	34 (31)	
\$40,000–\$80,000	405 (37)	359 (36)	46 (43)	
>\$80,000	351 (32)	323 (33)	28 (26)	
Children (yes)	334 (31)	297 (30)	37 (34)	0.37
Marital status				0.33
Single, widowed, divorced, separated	359 (33)	328 (33)	31 (29)	
Married, domestic partnership	734 (67)	657 (67)	77 (71)	
Household size				0.40
One person	166 (15)	147 (15)	19 (18)	
Family of two	365 (33)	325 (33)	40 (37)	
Three or more family members	564 (52)	515 (52)	49 (45)	

SD standard deviation

<sup>a</sup> Not all respondents responded to all questions, therefore, the N varies

important attribute level for class 3 respondents (with the probability of being in class 3, 18%) was the placement of the allergen information next to ingredients on a food package (0.355), but overall, the preferences of class 3 respondents did not differ across the attributes (Fig. 2). Of note, those respondents who consider allergens when making food purchases preferred the ‘precautionary’ statements the least.

Table 5 also shows that the inclusion of the covariates in the model significantly improved the model fit of the three latent class segments compared to not including any covariates. A positive and significant coefficient of a covariate indicates a greater tendency for respondents in that class to have a particular characteristic. Seven covariates were found to be significant at 0.05 significance level: age, marital status, education, province, consideration of allergens, number of reasons to consider allergens, and amount willing to spend for the inclusion of allergen information. The respondents who identified the use of symbols as most important (class 1 respondents) were most likely to consider allergens for only one reason; no other covariates were significant. Class 2 respondents, who were most concerned about both the

presence of a safety statement and the use of symbols, were also most likely to consider allergens when shopping for food and were willing to pay an additional \$10–\$50 above the \$500 monthly grocery expense on food for the inclusion of the allergen information. They were also more likely to be older, single/widowed/divorced or separated, and have not completed high school. Class 3 respondents, who chose placement of information as most important, were the most likely not to consider allergens at all when purchasing food and were not willing to pay any amount above a \$500 monthly grocery expense on food for the inclusion of the allergen information. They also tended to be younger, completed at least a university undergraduate degree, and live in one of the Western provinces.

In terms of their willingness to pay, the majority of consistent respondents were willing to pay up to \$10 extra per month for groceries for the inclusion of allergen labels on food. Consistent respondents who were not willing to pay an additional cost either could not afford to pay more, thought that allergen labeling was of no value to their household, that other groups should be responsible for the cost, or were not willing to pay more for other

**Table 3 Participant experience with food allergens**

Variables	All (N = 1100) N (%)	Consistent (N = 992) N (%)	Inconsistent (N = 108) N (%)	p value
Have you or has anyone in your household experienced an anaphylactic reaction to a food (yes)	132 (12)	123 (12)	9 (8)	0.22
Do you consider allergens when buying food (yes)	437 (40)	402 (41)	35 (32)	0.10
Number of allergens per household				0.004
No allergens	671 (61)	596 (60)	75 (69)	
One allergen	230 (21)	204 (21)	26 (24)	
Two or more allergens	199 (18)	192 (19)	7 (6)	
Allergen(s) households if any must avoid				
N/A	671 (61)	596 (60)	75 (69)	
Peanuts	171 (16)	157 (16)	14 (13)	
Tree nuts	90 (8)	85 (9)	5 (5)	
Milk	99 (9)	95 (10)	4 (4)	
Egg	45 (4)	44 (4)	1 (1)	
Fish	35 (3)	34 (3)	1 (1)	
Shellfish	95 (9)	94 (9)	1 (1)	
Soy	16 (1)	15 (2)	1 (1)	
Wheat	67 (6)	61 (6)	6 (6)	
Sesame seeds	20 (2)	19 (2)	1 (1)	
Other	95 (9)	87 (9)	8 (7)	
Number of reasons why respondents consider allergens when buying packaged foods				0.02
Do not consider allergens	608 (55)	535 (54)	73 (68)	
One reason	347 (32)	321 (32)	26 (24)	
Two or more reasons	145 (13)	136 (14)	9 (8)	
Reasons why respondents consider allergens when buying packaged foods				
N/A	608 (55)	535 (54)	73 (68)	
I have a food allergy	156 (14)	143 (14)	13 (12)	
One or more of my children has a food allergy	82 (7)	75 (8)	7 (6)	
My spouse or partner has a food allergy	72 (7)	63 (6)	9 (8)	
Another member of my household has a food allergy	55 (5)	53 (5)	2 (2)	
A friend who visits my home has a food allergy	112 (10)	105 (11)	7 (6)	
My child's school has allergen restrictions	136 (12)	129 (13)	7 (6)	
My workplace has allergen restrictions	44 (4)	43 (4)	1 (1)	
Other	47 (4)	46 (5)	1 (1)	

unknown reasons. The respondents' characteristics associated with their cost preferences become apparent in the LCM analysis. Class 2 respondents were willing to pay \$10–\$50 more for their monthly groceries for the inclusion of allergen labels on food even though their income potential, as evidenced by their education level, may be lower. Conversely, class 3 respondents reported a higher income but were not willing to pay any additional cost for the inclusion of allergen food labels. This group did not have a need for allergen labels. It would seem that an individual's willingness to pay an additional cost for the inclusion of food allergen labels is not determined by

their income potential but rather their allergen labeling needs.

### Discussion

This is the first study in Canada to examine consumer preferences regarding food allergen labeling of pre-packaged foods using a DCE, one of the most effective methodological techniques, consistent with economic theory. The DCE and LCM account for the heterogeneity of food labeling preferences among Canadian respondents thereby reducing the potential for bias and loss of information related to food labeling regulatory practices.

**Table 4 Summary of the cost questions**

Cost questions	All (N = 1100) N (%)	Consistent (N = 992) N (%)	Inconsistent (N = 108) N (%)	p value
Above an average of \$500 per month spent on food, what is the most you would be willing to pay every month for the inclusion of the allergen information on all food packages?				0.0109
\$0	280 (25)	247 (25)	33 (31)	
Between \$0 and \$10	424 (39)	393 (40)	31 (28)	
Between \$10 and \$50	236 (21)	217 (22)	19 (17)	
More than \$50	160 (15)	135 (14)	25 (23)	
You specified that you are willing to pay \$0 for the inclusion of the allergen information on food packages—what is the reason?				0.017
The food allergen labeling is of no value to me or my family	88 (31)	71 (29)	17 (50)	
I cannot afford to pay more	63 (23)	54 (22)	9 (26)	
The government or another group in society should pay for it	57 (20)	54 (22)	3 (9)	
Other	72 (26)	68 (28)	4 (12)	
Are you willing to pay more on your annual income taxes in order to include allergen labeling on food packages?				
No	871 (79)	787 (79)	84 (78)	0.71
Yes	229 (21)	205 (21)	24 (22)	
\$0	11 (5)	8 (3)	3 (13)	0.03
Between \$0 and \$10	67 (29)	56 (27)	11 (46)	
Between \$10 and \$50	84 (37)	80 (39)	4 (17)	
More than \$50	67 (29)	61 (30)	6 (25)	

Overall, the majority of respondents prefer some type of allergen labeling. The use of symbols was the most important food allergen-labeling attribute for those in class 1 (44%) and the use of symbols and a safety statement were equally important to those in class 2 (38%) of respondents, with respondents in both classes preferring both precautionary and safety symbols. Those in class 3 (18%) were essentially indifferent to allergen labeling.

Overall, the second most important food allergen labeling attribute identified was the use of the safety statement “does not contain soy, eggs, fish or shellfish”. Placement of information and the use of precautionary statements were the third and fourth most important attributes. The use of precautionary statements, such as “may contain traces of peanuts” may be preferred the least due to the ambiguity of the statement and the necessity of consumers to use their discretion in choosing or avoiding these products. Different precautionary expressions may be confusing and the level of allergic risk associated with each expression may be deemed uncertain [30, 31]. Additionally, these statements may be viewed as causing unnecessary diet restrictions as opposed to providing informed food choices [28, 29, 31, 42].

We are not aware of any other quantitative studies that have specifically evaluated consumers preferences for

food allergen labeling. Although this is the first study that looked at consumer food allergen labeling preferences using the DCE, our results are consistent with qualitative studies investigating similar allergen labeling questions [28, 29]. In some qualitative studies, participants were interviewed and observed during the course of grocery shopping. For instance, in an Ontario study, Chow et al. found that parents of children with food allergies trusted products with allergen symbols and found them easily understandable [28]. Similarly, Cornelisse-Vermaat et al. reported that parents preferred labels with both allergen symbols and textual allergen information [29]. Perhaps, similar to nutrition labeling studies, symbol use in allergen labeling is favoured because it requires less information processing [29, 40, 43, 44].

The results of the DCE suggest that consumers' preferences for allergen labels on foods varied widely. A 3-class model appeared to best fit our data and the class memberships were associated with seven measurable sociodemographic factors. Class 1 individuals, accounting for 44% of respondents, predominantly reported considering allergens when buying food due to one unspecified reason which presumably was associated with someone in their household having a food allergy. This group preferred the use of both precautionary and safety symbols on food allergen labels. Respondents who preferred

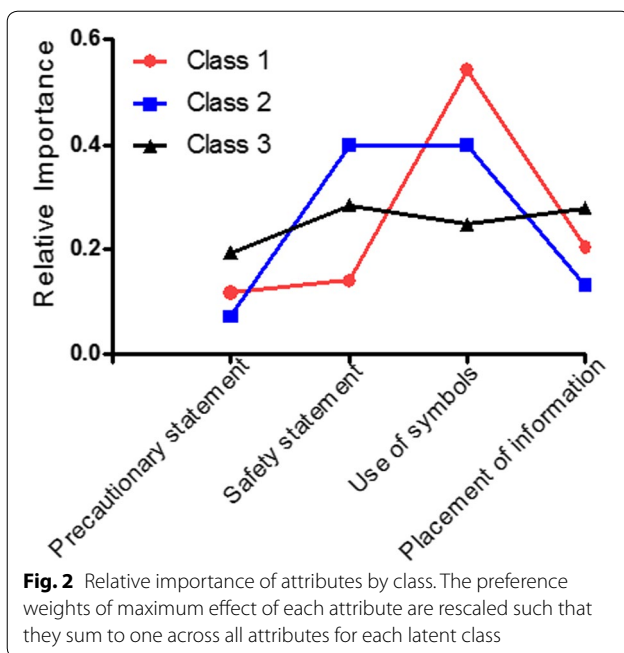


**Table 5 Preferences for each level of each attribute based on the latent class analysis**

Attribute	Class 1 Mean (SE)	Class 2 Mean (SE)	Class 3 Mean (SE)
Class probabilities	0.44 (0.0246)	0.38 (0.0241)	0.18 (0.0152)
Precautionary statement			
Not suitable for consumers with allergies to peanuts or tree nuts	0.162 <sup>†</sup> (0.0453)	0.252 <sup>†</sup> (0.0964)	−0.0078 (0.0612)
May be present: peanuts and tree nuts	−0.116 <sup>†</sup> (0.0396)	−0.109* (0.0736)	0.294 <sup>†</sup> (0.0614)
May contain traces of peanuts and tree nuts	0.040 (0.0398)	−0.0042 (0.0753)	−0.032 (0.0572)
Manufactured in a facility that also processes peanuts and tree nuts	0.119 <sup>†</sup> (0.0447)	−0.0057 (0.0799)	−0.136 <sup>†</sup> (0.0659)
Contains wheat, dairy, peanuts and tree nuts	−0.205 <sup>†</sup> (0.0419)	−0.133* (0.0843)	−0.119 <sup>†</sup> (0.0572)
Safety statement			
Does not contain soy, eggs, fish, or shellfish	0.220 <sup>†</sup> (0.0394)	1.073 <sup>†</sup> (0.0653)	−0.318 <sup>†</sup> (0.0497)
Not included	−0.220 <sup>†</sup> (0.0394)	−1.073 <sup>†</sup> (0.0653)	0.318 <sup>†</sup> (0.0497)
Use of symbols			
Precautionary symbol	0.433 <sup>†</sup> (0.0502)	0.094 (0.0959)	0.268 <sup>†</sup> (0.0625)
Safety symbol	−0.305 <sup>†</sup> (0.0544)	−0.084 (0.1032)	−0.071 (0.0749)
Both precautionary and safety symbol	0.796 <sup>†</sup> (0.0608)	1.069 <sup>†</sup> (0.1316)	−0.285 <sup>†</sup> (0.0823)
No symbols used	−0.925 <sup>†</sup> (0.0594)	−1.078 <sup>†</sup> (0.0861)	0.088* (0.0691)
Placement of information			
Package front	−0.054 <sup>†</sup> (0.0299)	−0.227 <sup>†</sup> (0.0486)	−0.269 <sup>†</sup> (0.0413)
Next to ingredients	−0.296 <sup>†</sup> (0.0352)	−0.234 <sup>†</sup> (0.0602)	0.355 <sup>†</sup> (0.0421)
Package front and next to ingredients	0.350 <sup>†</sup> (0.0318)	0.461 <sup>†</sup> (0.0621)	−0.086 <sup>†</sup> (0.0406)
Covariate parameter estimates			
Intercept	0.502 <sup>†</sup> (0.1968)	−0.780 <sup>†</sup> (0.2105)	0.278* (0.2254)
Age	−0.0025 (0.0037)	0.0225 <sup>†</sup> (0.0038)	−0.020 <sup>†</sup> (0.0045)
Marital status			
Single, widowed, divorced, separated	−0.058 (0.0579)	0.130 <sup>†</sup> (0.0599)	−0.072* (0.0679)
Married, domestic partnership	0.058 (0.0579)	−0.130 <sup>†</sup> (0.0599)	0.072* (0.0679)
Education			
Did not complete high school	−0.091 (0.1482)	0.309 <sup>†</sup> (0.1390)	−0.218* (0.1759)
Completed high school and/or some college or trade	0.058 (0.0901)	0.112* (0.0894)	−0.169* (0.1054)
Completed university or professional degree	0.033 (0.1120)	−0.420 <sup>†</sup> (0.1199)	0.388 <sup>†</sup> (0.1248)
Province			
BC, AB, SA, MA	−0.064 (0.0758)	−0.138 <sup>†</sup> (0.0793)	0.202 <sup>†</sup> (0.0869)
Ontario	0.083* (0.0734)	−0.017 (0.0759)	−0.066 (0.0879)
Quebec, Atlantic Provinces, Yukon, Northwest Territories, Nunavut	−0.019 (0.0937)	0.155* (0.0966)	−0.136* (0.1117)
Number of reasons to consider allergens			
No reasons	−0.158* (0.0993)	0.091 (0.1071)	0.067 (0.1191)
One reason	0.232 <sup>†</sup> (0.0959)	−0.216 <sup>†</sup> (0.1059)	−0.016 (0.1206)
Two or more reasons	−0.074 (0.1026)	0.125* (0.1019)	−0.051 (0.1295)
Do you consider allergens			
Yes	−0.066 (0.0745)	0.233 <sup>†</sup> (0.0790)	−0.167 <sup>†</sup> (0.0893)
No	0.066 (0.0745)	−0.233 <sup>†</sup> (0.0790)	0.167 <sup>†</sup> (0.0893)
Cost above \$500 for groceries			
\$0	−0.067 (0.0932)	−0.243 <sup>†</sup> (0.0984)	0.309 <sup>†</sup> (0.1033)
Less than \$10	0.027 (0.0824)	−0.064 (0.0848)	0.037 (0.0985)
Between \$10 and \$50	0.062 (0.1033)	0.223 <sup>†</sup> (0.1030)	−0.285 <sup>†</sup> (0.1315)
More than \$50	−0.023 (0.1201)	0.084 (0.1184)	−0.061 (0.1449)
Log-likelihood	−7538.16		
No. of individuals	985		
No. of observations	15,760		

SE standard error

<sup>†</sup> p value <0.05; \* p value <0.10; \* p value <0.15



the use of safety statements and both precautionary and safety symbols accounted for 38% of respondents and fell in the class 2 group. On average, these individuals were older, not in a partnership, had not completed high school or post-secondary education, and considered allergens for more than one unspecified reasons. It is possible that these individuals live or work in a care facility or work in a service industry where food allergen vigilance is typically high. Class 3, accounting for 18% of respondents, had the highest education levels of the three classes. This class did not consider allergens when buying foods, which could also explain why this group was not willing to pay anything for the inclusion of allergen information and that there was really no difference in the relative importance of each attribute versus classes 1 and 2 who likely had a specific need for food allergen information.

The inclusion of food allergen information could result in increased costs to the food industry which would then presumably be passed on to the consumer, thus it was important to not only evaluate Canadians' preferences for labeling but also their willingness to pay. Our results showed, as one might expect, that those without a specific need for food allergen labeling (i.e. class 3 respondents) were not willing to pay more for food to have specific allergen labeling on foods. However, the majority of consistent respondents were willing to pay \$0–\$10 for the inclusion of allergen labels on food and it appears that an individual's willingness to pay an additional cost for the inclusion of food allergen labels is not determined by their income but rather their allergen needs.

A 2011 Canadian study found that consumers do not trust Canadian food allergen labels rendering them largely ineffective [28]. The updated Canadian food allergen labeling regulation, released in August 2012, addressed the need to standardize the location of allergen information on food labels as well as the need for specificity of allergen sources [27]. Our research suggests that the regulation has a number of outstanding issues to address. First, consumers preferred the use of symbols on labels; however, the current Canadian regulation does not enforce the use of any symbols on allergen labels [27]. These symbols need to be standardized and the public educated about their significance. Second, consumers who consider allergens preferred the use of precautionary statements the least. While we did not specifically explore the reasons for choosing one format over another, previous studies suggest that these statements provide no definite allergen content information apart from cross-contamination thereby limiting food choices of consumers [28, 29, 31, 42, 45]. This limitation causes consumers to take on more risk and rely on product or brand experience as opposed to allergen labels in decision making [28, 29, 45]. Additionally, the terminology within precautionary statements is currently not standardized across manufacturers leaving consumers confused [29, 30, 45].

As with any questionnaire-based research, there are several limitations. Firstly, while the questionnaire was only administered in English, we do not anticipate that this would have biased the results in any way. It is also important to consider that the responses are based on a stated choice experiment and not on actual choices. However, the results provide a valid evaluation of relative preferences for each labeling attribute, which may direct allergen-labeling regulations towards a standardized and accepted food allergen label. Additionally, respondents were recruited through an IPSOS panel and only included respondents who had computer access. While this could result in a selection bias of respondents, we feel that these preferences do reflect the preferences of the average Canadian household.

While it is never possible to know if respondents completely understood the task or questions, the results do provide an assessment based on their face validity, e.g. those with a need for allergen avoidance had stronger preferences. Furthermore, we incorporated two fixed repeated choice questions in the final version of the survey which showed that approximately 10% of respondents were considered inconsistent and were deemed to not have made meaningful choices. Data from these respondents were therefore excluded from analysis, contributing to the validity of the final results. Finally, our results are also in agreement with earlier qualitative

findings, which supported the theoretical validity of our DCE methodology.

Labeling is the most important risk management tool in reducing exposure to allergens. Studies have shown that the current labeling system is insufficient in preventing allergen exposure [28, 29, 41]. Labels that are ambiguous and confusing have led to decreased consumer confidence in allergen labeling and increased risk exposure. Our results suggest that labels need to be standardized and intuitive to make them easily understandable by the broader public. A more definite allergen content statement is preferred as well as the use of symbols to communicate allergen information. Further studies are required to determine reasons behind the consumers' stated preferences and to compare these stated preferences with actual decisions. The current iteration of the Canadian regulation addressed the need for allergen content specificity on the labels however the results of this study identify additional changes that will make Canadian allergen food labels more effective according to stated consumer preferences.

### **Key messages**

- Canadian consumers' food allergen vigilance, labeling preferences, and willingness to spend on improved labeling were investigated.
- Three distinct classes of consumers emerged with different need and preferences for food labeling.
- Canadian consumers identified preferences for (1) standardized precautionary and safety statements and symbols; (2) the use of symbols more than statements; (3) little or no increase in cost for improved food allergen labeling.
- While the majority of respondents had strong preferences for safety statements and use of symbols, a small proportion of respondents appeared to be indifferent to food allergen labelling and were no likely to consider allergens when buying foods.

### **Capsule summary**

Canadian food allergen labeling regulations can be improved to reduce food allergen exposure risk by standardizing the precautionary and safety labeling and relying more on symbols than statements.



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