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Supporting Document 1 (at Approval)

Proposal P1044 – Plain English Allergen Labelling

Literature review on consumer knowledge, attitudes and behaviours relating to allergen labelling

Executive summary

Scope

This literature review provides a review of the available evidence regarding consumer awareness, attitudes, understanding and behaviours related to allergen labelling. In particular, consumers' preferences for elements of label design when communicating allergen information, such as location, terminology, and formatting are discussed. Additionally, this review explores whether certain alterations in these elements aid in the identification and comprehension of allergen information.

This review examines the evidence related to allergen declarations. This includes aspects of these declarations that are currently voluntary (e.g. the use of bolding of allergens in the statement of ingredients). However, voluntary precautionary allergen labelling, used to indicate the unintended presence of food allergens, is not in the scope of this literature review. For the purpose of this review, food allergic individuals (or FAIs) includes people with self- and medically-diagnosed food allergy or intolerance.

Method

A search of online literature databases was carried out. Two thousand documents were reviewed for relevance to the literature review. Thirty four of these were included. All studies were published either during or after 2002. Although the search targeted articles examining how different label elements assist FAIs (or those purchasing food for them) to identify and understand the presence of allergens, the bulk of the existing research relates to consumer preferences, and is correlational in nature. There is a paucity of experimental research in the field of allergen labelling, and this should be noted when reflecting on the findings of this review.

Findings – Consistency

To determine the safety of their food, FAIs (as well as those purchasing food for them) appeared to rely heavily on the statement of ingredients on commercial food products. Consumers in Australia, New Zealand, and internationally have reported several obstacles to accurate label reading and interpretation. Strong and consistent themes in consumer

preferences for the delivery of allergen information were identified. Consumers appeared to desire allergen information to be presented in a clear, consistent manner, so as to enable quick identification and comprehension of the information they require to make informed and safe food choices.

Location

To reduce the time required to identify allergens, consumers in four international studies also expressed a desire for a brief allergen summary statement. This provides a short summary of any allergens present in the product separately (but in close proximity to) the statement of ingredients, either just above or adjacent to it. Current non-mandated allergen summary statements are often located below the statement of ingredients, with consumers reporting frequently missing them when placed in this location (and unnecessarily reading the entire statement of ingredients). Research suggests repetition of consistent allergen information across different locations on a label aids in identification and comprehension. Fifteen studies found location of allergen information to play a significant role in ease of identification.

Terminology

Twenty four studies identified terminology issues as an impediment to allergen identification and comprehension of allergen information. In particular, complex (technical) terminology used for certain allergens, such as 'casein' for milk or 'ovalbumin' for egg, may not be generally recognised by consumers. This may be especially true for children, those shopping for FAIs, or FAIs recently diagnosed or from culturally and linguistically diverse (CALD) backgrounds. Further, the use of vague or ambiguous terms such as 'nut', without reference to the specific nut source may cause FAIs or those purchasing for them to unnecessarily restrict certain foods from their diet, thereby limiting dietary variety.

Throughout the literature, consumers in English-speaking countries expressed a preference for the adoption of plain English language to be consistently used when listing mandatory allergens. The use of the same, simple and specific terms across different products and across different locations on the package of the same product (e.g. both in the statement of ingredients and allergen summary statement) is desired, and has been shown to enhance allergen identification and result in appropriate precautionary action (i.e., not purchasing/consuming the unsafe food).

Formatting

Nineteen studies identified formatting issues such as small text in the statement of ingredients, extensive statement of ingredients, poor colour contrast between the background and font colour, shiny packaging, and inconsistent location of allergen information as potential barriers to allergen identification and comprehension of allergen information. Such labelling issues may cause frustration in consumers, as the result often means increased time spent examining product labels, and/or contacting the manufacturer (or engaging in some other form of research). Consumers are also unaware of the current voluntary nature of several allergen labelling elements (e.g. the emboldening of allergens in the statement of ingredients, the presence of an allergen summary statement), and may incorrectly assume that if these elements are not present, the food is free from allergens and safe to consume. This is of great concern given the implications of consumption can be fatal.

Consumers reported frustration at how ingredients of concern are often buried in extensive statements of ingredients, making their identification laborious and difficult. For this reason, consumers expressed a preference for the font of allergens to be altered to stand out from other ingredients in the list. This includes a preference for emboldening of text and the use of a different 'warning' colour e.g. red.

As with the allergens listed in the statement of ingredients, consumers expressed a desire for the allergen summary statement to be emboldened, and ideally placed within a box (or some other eye-catching shape). This is seen to grab attention more rapidly than if the information was presented solely as text, and is consistent with current studies examining effective warning labels and the use of borders. Some consumers also expressed a desire for the percentage amount of each allergen to be placed in brackets after the allergen is listed in the statement of ingredients to enable risk assessment e.g. 'almonds (10%)'.

Twelve of the studies included in this review found a consumer preference for the introduction of a universal allergen symbol labelling system. Ten studies found FAIs believed symbols would aid in allergen identification. Three studies found symbols actually increased the accuracy and speed with which FAIs and/or those shopping for them were able to identify allergens. However, consumers acknowledge the several obstacles surrounding the introduction of a symbol-based system, noting logistical difficulties such as the sheer number of allergens that exist, how to represent less well-known allergens (e.g. lupin), and whether the presence of a symbol indicates the presence or absence of an allergen. However, these concerns do not appear to relate to the use of a symbol to indicate whether a product is gluten free, with consumers expressing a strong desire for this to be mandated.

Cereals containing gluten

This review examined consumer preferences for terminology concerning cereals containing gluten separately, as this issue emerged as a separate topic in stakeholder submissions during the 2016 W1070 – Plain English Allergen Labelling project¹. There was limited literature on this topic, however the four studies identified as being suitable for inclusion in this review found gluten-sensitive² consumers, those purchasing for them, or those newly diagnosed appeared to rely on the inclusion of the word 'gluten' somewhere on the label. This is in addition to the source of the cereal still being identified in the statement of ingredients, as the consumer desire for specificity extends to gluten containing cereals. Specifying allergen source conveys to consumers that the allergen content of the food product has been assessed and considered by the manufacturer.

The inclusion of the word 'gluten' seems to be less necessary for individuals with Coeliac disease (CD) and/or with dermatitis herpetiformis, who are more experienced food label readers and appear more adept and comfortable with identifying whether gluten is present based solely on examination of the statement of ingredients. Nevertheless, these consumers still express frustration at increased time spent shopping due to label reading, and therefore the inclusion of the word 'gluten', ideally on the front of the pack, may still offer some benefit.

The search did not find any research examining consumers with specific cereal allergies e.g. wheat. Presumably, such individuals would be in a similar situation to FAIs allergic to specific nuts (for whom not specifying the type of nut would result in unnecessary restriction of certain foods).

Summary

Overall, the literature suggests consumers are dissatisfied with current allergen labelling practices and desire reforms be introduced to improve identification and comprehension of allergen information. This, in turn, will allow for more informed and safe food choices.

¹ <http://www.foodstandards.gov.au/code/proposals/Pages/P1044PlainEnglishAllergenLabelling.aspx>

² In this literature review 'gluten-sensitive' refers to both non-Coeliac gluten sensitivity and Coeliac disease.

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1 Introduction

This literature review was undertaken to provide a broad review of available evidence regarding consumer awareness, attitudes, preferences and understanding related to allergen labelling. The review examines evidence related to location, terminology, and formatting of allergen information, as well as whether or how these elements currently assist or limit consumers' ability to identify and choose foods and beverages based on their dietary requirements.

Allergen labelling is regulated in Australia and New Zealand by Standard 1.2.3 – Information requirements – warning statements, advisory statements and declarations of the Australia New Zealand Food Standards Code (the Code)³. This standard requires the mandatory declaration of the presence of certain substances in food which can cause severe allergic and other reactions. However, the standard does not mandate how these declarations should be made, or the terminology that should be used when making the allergen declarations.

This review was conducted as a part of a broader program of work surrounding allergen labelling. Proposal P1044 is a project initiated by Food Standards Australia New Zealand (FSANZ)⁴, with the aim to make allergen labelling clearer so that food allergic individuals (FAIs) have the information they require to make safe and informed food choices. In particular, FSANZ is considering variations to the Code to provide clarity in allergen declaration requirements, and to require the use of plain English allergen labelling (PEAL) as a means of improving communication of allergen information. PEAL is considered to be the use of clear and unambiguous terms in allergen declarations, primarily by reference to the specific source of the allergen (e.g. 'milk').

Some of the issues previously identified within current allergen labelling practices include:

- Inconsistencies in location and formatting of allergen information
- The use of technical language e.g. 'sodium caseinate', which some consumers may not know (or understand) is sourced from dairy
- The use of unclear (vague) terminology for certain allergens e.g. fish, crustacea, molluscs, tree nuts, and cereals containing gluten
- The use of general terms e.g. 'tree nuts', without reference to the source allergen/specific nut (e.g. 'almonds')
- Inconsistencies in the terminology used in mandatory label elements (e.g. in the statement of ingredients) versus declarations made in other label elements e.g. allergen summary statements
- Formatting issues (e.g. small font size) inhibiting the identification and interpretation of allergen information.

The lack of clarity relating to allergen declarations under current Code provisions means FAIs (or those who purchase foods for these consumers) may not always be able to use allergen declaration information to make informed and safe food choices. FAIs are defined in this review as people with either self- or medically-diagnosed food allergy or intolerance. The possible consequences of being unsure whether a product in question contains a target allergen may be unnecessary restriction (further limiting food choices in an already restricted diet), or engaging in risk-taking behaviour by purchasing and consuming the product. Clearly

³ <http://www.foodstandards.gov.au/code/userguide/pages/warningandadvisoryde1403.aspx>

⁴ See <http://www.foodstandards.gov.au/code/proposals/Pages/P1044PlainEnglishAllergenLabelling.aspx> for further information on this project.

the latter option creates risks for the health and safety of FAIs, which could ultimately lead to a loss of confidence in allergen declarations in general.

Food allergies are defined as abnormal immune responses in susceptible individuals to naturally-occurring proteins in foods or derivatives of these foods. Global prevalence of food allergies appears to be increasing, with more than 8% of children and 2% of adults in countries such as Australia and New Zealand being allergic to one or more foods (Allergen Bureau, 2019). The most common allergens for young children include milk and egg, although these allergies are often outgrown by the time children reach 5–7 years of age. Conversely, allergies such as those to peanut, seafood and tree nuts may develop later in life and become lifelong conditions with potentially fatal consequences (e.g. anaphylaxis). As there is currently no cure for food allergies, the only successful management method is avoidance of all foods containing the allergen (Allergen Bureau, 2019). Therefore, to avoid allergic reactions, FAIs or those purchasing food for them rely heavily on the information provided on labels of commercial products (Joshi, Mofiki, & Sicherer, 2002; Wortman, 2016).

This literature review considers the following aspects of food product labels:

- Location and consistency of allergen information (including placement of the statement of ingredients and allergen summary statement)
- Terminology used in making allergen declarations
- Formatting of allergen information
- Declaring cereals containing gluten

This review examined consumer preferences for terminology concerning cereals containing gluten separately, as this issue emerged as a separate topic in stakeholder submissions during the W1070 project¹. Voluntary precautionary allergen labelling, used to indicate the unintended presence of food allergens is not in the scope of the P1044 project, nor of this review. International studies are included in this review due to the limited relevant research conducted in Australia and New Zealand. Only relevant international studies produced in English were included. Nevertheless, care should be taken when interpreting and generalising international findings on this subject to the Australian and New Zealand context given differences in the food products available, label requirements, formats, nutrition education programs, food culture and typical dietary patterns.

The articles sourced for this review were obtained using searches of the six relevant online research databases that FSANZ subscribes to, as well as targeted searching of grey literature. Searching of the online research databases was restricted to articles published in English between January 2002 and August 2018. These articles were then assessed based on scope, relevance and quality. Additional relevant research from past reviews and forward searching were added if scope and timeframe criteria were met.

The search strategy targeted literature relevant to all four topic areas (location, terminology, format and cereals containing gluten). However, the bulk of the existing literature focused on consumers' preferences (using cross-sectional study designs), as opposed to consumers' ability to interpret allergen information (experimental designs). Further, the bulk of the research examined milk and nut allergies, with only few studies relating to cereals containing gluten. A total of 37 articles were included in the final review. More detail on the search and review process is provided in Appendix 1.

The report is structured based on the four areas listed above. Each section begins with a list of key findings identified within that section. In addition, each section is structured around themes. For example, key themes (boldening, use of symbols, etc.) were identified in consumers' preferences for formatting of allergen information. An overview of the key

limitations of the review and the research articles is in the final section of this report. There are three Appendices. Appendix 1 provides an overview of the literature review method, as well as an overview of the method used to assess study quality. Appendix 2 includes two tables. Table A2.1 provides an overview of the methodological and technical features of each study. Table A2.2 provides an assessment of study quality, including a rating of low, medium or high based on study validity, as well as applicability of results and generalisability to Australian and New Zealand contexts. Finally, Appendix 3 contains a list of acronyms used throughout this review.

2 Method

2.1 Inclusion criteria for research

This literature review was limited to primary research on allergen labelling. Studies examining precautionary allergen labelling were only included if relevant to the social science questions being asked. The search was limited to research published during or after 2002. This is based on mandatory labelling being fully implemented in Australia and New Zealand in December 2002. The review included studies that examined:

- Consumer understanding of allergen labelling on food packages
- Which food label elements consumers use to identify allergens
- Consumer beliefs towards current allergen labelling practices
- How and where on the food label consumers gain information about the presence of allergens
- Preferences of consumers towards the labelling of allergens (including location, terminology and formatting of information)
- Labelling of cereals containing gluten.

No criteria were set with respect to study design (e.g. experiment, survey, qualitative, or type of subject). Unless otherwise explicitly stated, searches were unconstrained with respect to country. All searches were limited to publications published in English.

2.2 Research review process

The review process is outlined in Figure A1.1 in Appendix 1. Searching was conducted on 3 August 2018. The first 2000 potentially relevant research documents were reviewed and assessed for relevance to the literature review questions. Thirty one relevant documents from other sources were also identified. Duplicates and out-of-scope papers (based on abstract and/or title) were excluded. Finally, documents identified as out of scope on the basis of full-text review were excluded. This resulted in 34 research documents included in the literature review, which are described in Table A2.1 in Appendix 2.

Each included research document has been assessed for quality (both internal and external validity), and was scored using three categories of low, medium, and high (Table A2.2, Appendix 2). The assessments related to methodological quality, details reported, and the applicability of the research to the literature review, as well as (to a lesser extent) Australian and New Zealand contexts. Due to limited local research, the final determination of study quality was made using internal validity, and this is what is reported throughout the review when referring to studies and their quality. For example, if a study is referred to as being a high-quality study, this refers to the fact it scored well for internal validity.

2.3 Literature review update drafting process

The literature review report structure is based on the primary areas of interest stated in the Introduction. The review was reviewed by the FSANZ Principal Social Scientist and by the Section Manager for Labelling and Information Standards Section. One external peer reviewer also provided comments on the literature review.

2.4 Method used to assess study quality

A checklist was developed to assess the quality of the included studies. This was developed using a number of resources⁵. Based on the guiding points set out below, as well as a judgement about relevancy and generalisability of results, a quality assessment rating was made. Options included low, medium and high. The quality assessment of each included article can be found in Table A2.2 in Appendix 2.

Study design

- Type of study (e.g. survey, interview, focus group etc.)
- Study delivery (e.g. face-to-face, postal etc.)
- Reporting of withdrawals and drop-outs
- Use of randomisation (including method used, if applicable)
- Evidence of biases
- Reflection on current state of knowledge and review of literature
- Theoretical grounding of study design and sampling strategy (particularly important for qualitative studies).

Selection bias

- Sample size
- Sampling method
- Response rate (reflection on possible response rate bias)
- Participation rate
- Sample representativeness.

Data collection methods

- Validity and reliability of data collection tools
- Measurement of dependent variables and independent variables (if applicable)
- Appropriateness of measures for research aim
- Data collection differences between groups (if applicable)
- Author rationale of method used (particularly important for qualitative studies).

Intervention related questions (if relevant)

- Intervention description
- Confounders (e.g. differences between groups prior to intervention and ways of controlling for this)

⁵ Hancock and Mueller (2010); Herzog et al. (2013); National Collaborating Centre for Methods and Tools (2008) and Petticrew and Roberts (2009)

- Blinding (e.g. assessor and participant awareness of the intervention, exposure status and research question)
- Intervention integrity (e.g. consistency of intervention, unintended interventions, time for differences to be identified).

Analyses

- Study size
- Calculations of statistical power/justification of sample size
- Appropriateness of statistical analyses
- Process from data to interpretation (qualitative only)
- Selection of themes (qualitative only)
- Number of researchers analysing the data (qualitative only)
- Negative and discrepant results (qualitative only)
- Participant response to data (qualitative only).

Note: due to limited methodological information provided (and in the interests of keeping the table concise), not all studies can be assessed against all of the above criteria. Only pertinent information is included in Table A2.2.

3 Location of allergen labelling

This section will address:

1. What location(s) of allergen labelling on food labels is the most effective at achieving identification and decision making; and
2. The efficacy of providing allergen declaration information consistently in the same location on all food labels

Key findings:

- Sixteen studies examined location of allergen information as an enabler or barrier to allergen identification. Of these, 7 studies were of *High*, 8 of *Medium*, and 1 of *Unknown* quality due to limited methodological information supplied (see Table A2.2 for further details). Only three of these studies [1 *High* and 2 *Medium* quality] were conducted in Australia or New Zealand. The remaining 13 studies came from Europe, North and South America, Asia or Africa.
- All studies found a consumer preference (both in FAIs and those who shop for them) for an allergen summary statement in addition to allergen information being displayed in the statement of ingredients. This reduced the time and effort spent identifying allergens due to often extensive statement of ingredients. There was a belief the more locations allergen information appeared on a food package, the faster and greater the likelihood of identification. Some consumers erroneously believe an allergen summary statement is mandatory.
- The preference for a separate allergen summary statement to be located adjacent to or above (but not below) the statement of ingredients was expressed by consumers in four international studies [2 *High* and 2 *Medium* quality]. Consumers expressed frustration at often missing allergen summary statements located at the end of a long statement of ingredients. They described noticing these allergen summary statements only after having unnecessarily read the entire statement of ingredients, making the presence of such statements redundant.

- Six international studies [3 *High*, 2 *Medium*, and 1 *Unknown* quality] found having some sort of alert (whether it be a cautionary statement or symbol) on the front of the package facilitated easier identification of allergen information and/or would lead them to inspect the statement of ingredients.
- Nine studies included in this review [6 *High*, and 3 *Medium* quality] found consumers (FAIs and members of the general population) desired allergen information placement to be consistent across labelling to enable easier and faster identification of target allergens. Of these studies, only two [1 *High*, and 1 *Medium* quality] were conducted in Australia and New Zealand. Both studies used a survey methodology.

3.1 Location of allergen information on food labels

3.1.1 Australian and New Zealand research

Of the fifteen studies (Barnett, Leftwich et al., 2011; Binsfeld et al., 2009; Brown et al., 2015; Chow, 2011; COI Communications & Creative Research, 2002; Henderson, 2003; Marra et al., 2017; NFO Donovan Research, 2004; Parikhal et al., 2018; Soogali & Soon, 2018; TNS Social Research, 2009; Verrill, Zhang, & Kane, 2013; Vierk, Koehler, Fein, & Street, 2007; Voordouw et al., 2009; Wortman, 2016) included in this review that examined location of allergen information one was from Australia and two were from Australia and New Zealand. The paucity of local research in this area warrants further investigation. Nevertheless, given a preference for location of information is not a label element that is country specific (as opposed to terminology), international findings may be extrapolated to an Australian and New Zealand context. Further experimental data is also needed on this topic, with the bulk of the existing literature focusing on consumer preferences collected using survey methodology.

In a quantitative study, Henderson (2003) assessed the impact of FSANZ's labelling changes on consumer, health professional and FAIs' knowledge of nutrition and allergens. Results of this medium-quality study revealed only 39% of consumer respondents knew to look for allergens in the statement of ingredients. Worryingly, 36% incorrectly believed if allergens were present in the product, a separate allergen declaration would be placed on the front label of the food package. This suggests some consumers incorrectly believed separate allergen declarations (in addition to listing them in the statement of ingredients) are a mandatory requirement.

Respondents had a strong preference for allergen information to be displayed both in the statement of ingredients and in a separate allergen summary statement, believing this would increase their likelihood of identifying the presence of allergens, and reduce the time taken to determine whether the product was safe for consumption. Of note, this study only examined FAIs ($n = 107$), and results may not reflect the views of non-allergic individuals who may purchase foods for FAIs, e.g. parents of food-allergic children or members of the general public who may infrequently purchase for FAIs (e.g. if hosting a dinner party).

In a high-quality study conducted on behalf of FSANZ (NFO Donovan Research, 2004), some respondents indicated a preference for the location of allergen declarations on the label. Survey respondents ($n = 510$) were asked (via an open-ended question) to provide any suggestions they had for how labels could be improved for people with food allergies. Eleven percent of New Zealand respondents and four percent of Australian respondents suggested that allergy warnings should be located near the statement of ingredients. Particular response options are often chosen more frequently when they are offered explicitly in a close-ended question rather than being spontaneously generated by respondents in response to an open-ended question (Schuman & Presser, 1981). So it is possible that the

percentage of respondents indicating a preference for allergen declarations to be located with the ingredients list would have been higher if this was presented in a close-ended question.

The 2008-09 follow up survey conducted on behalf of FSANZ (TNS Social Research, 2009) had similar findings. In response to the open-ended question, six percent of Australian and New Zealand respondents suggested that allergy warnings should be located next to the ingredients list.

3.1.2 International research

Thirteen international studies included in this review examined location of allergen information. In a high-quality Canadian study (Brown et al., 2015), eight focus groups were conducted with FAIs ($n = 27$) and members of the general public ($n = 24$) to identify consumer preferences and current obstacles associated with allergen labelling. The study was intended to inform future policy needs. Participants expressed a strong preference for a clear distinction between the allergen summary statement and a precautionary allergen labelling statement. The latter was viewed as vague, unnecessarily restricting dietary choices, and manufacturers' attempts to shy away from legal responsibility. While participants from the general public (including those purchasing for FAIs) preferred allergen information to be located on the front of the food package, FAIs expressed a preference for allergen information to be placed near the statement of ingredients, although where exactly was not specified. This finding supports existing literature, which suggests food allergic consumers are more familiar with label reading and accustomed to inspecting the statement of ingredients on a frequent basis, whereas members of the general public rely on summarised allergen information provided in a consumer-friendly format and easily identifiable location e.g. on the front label of the food package (Verrill et al., 2013).

The preference for having allergen information located both on the front and back of the food package is a recurring theme across the literature, even amongst FAIs who have been shown to be more diligent and experienced label readers (Verrill et al., 2013). In a study conducted in the United States, Vierk and colleagues (2007) found of the 4482 FAIs surveyed, over a quarter of respondents rated as a serious or very serious impediment to allergen identification the fact that allergens were often listed only in a very extensive statement of ingredients.

A recent high-quality Canadian study (Marra et al., 2017) used a combination of qualitative focus groups followed by an experimental design to test participants' preferences and ability to identify allergen information as a result of label element alterations (e.g. use of symbols, terminology, and placement of information). Results revealed participants ($n = 985$) preferred allergen information, such as an 'allergy alert' or 'contains' statements, to be located on the front of the food package, and next to the statement of ingredients (which also declared the allergens) at the back. This option was preferred to having the additional allergen information in just one location, or having no additional allergen information at all.

A Brazilian study by Binsfeld and colleagues (2009) highlights the challenge for consumers trying to find allergen information on food labels that is often on the back of the package and in small font. The study involved a label-identifying task followed by a series of structured interviews. During the interview component, parents of food allergic children reported difficulty locating the statement of ingredients, and thus relied on the general information provided on the front label of the food package. This has potential safety implications if parents assume the absence of an allergen statement on the front of the food package indicates the product is allergen-free. This is particularly the case in an Australian and New Zealand context, where such statements are voluntary at present. Due to the limited methodological information provided, the quality of this study could not be determined.

In his high-quality study, Chow (2011) used a triangulation of methods (validated survey, shopping observations, and follow-up interviews) to gain a deeper understanding of Canadian participants' preferences and behaviours when reading allergen labels. The use of several data collection methods increases confidence in the reliability of these findings (Cornelisse-Vermaat et al., 2008). Forty two percent of participants ($n = 5$) reported location of allergen information to be the second most prominent concern regarding allergen labelling, after terminology (discussed in section 3 of this review). Participants reported issues locating allergen related information, and expressed frustration at increased time spent searching for it, particularly on smaller packages. During the accompanied shop, most participants were observed to search for allergen warnings (e.g. allergen summary statement) in the first instance, and when/if they could not locate this, they would then refer to the statement of ingredients. Responses provided in follow-up interviews revealed allergen warnings were viewed by participants as an indication the company was aware of and had considered allergies in the formulation and manufacturing of their products (Chow, 2011).

The effect of an allergen summary statement was investigated in Parikh and colleagues' (2018) recent experimental study of non-FAIs pretending to shop for someone with a nut-allergy. The stimuli in this study included 49 products which contained a combination of ingredients, the presence or absence of a nut warning label, and a range of warning and package styles (including an allergen summary statement). Participants ($n = 32$) were asked to examine each product label, and determine whether they would be safe for someone with a nut allergy to consume. Products were divided into six categories depending on the amount and type of nut-related information present on the packaging. Participants reactions to the products were objectively measured using a GoPro camera. Participants were unaware they were being recorded. Speed, number of times the product was turned, and accuracy of responses served as the dependent variables. Unsafe products with a 'contains' label were categorised faster and more accurately than unsafe products without this statement. This finding suggest that allergen summary statements could help FAIs make safer, more accurate evaluations of which products contain allergens.

In a high-quality US study (Wortman, 2016), respondents were presented with a mock-up label for a 'Soy Yoghurt' product, based on current food labels available in the market place. FAIs or those who shop for them ($n = 223$) were asked to examine the labels, then report whether or not they would purchase the item if they were avoiding dairy/milk ingredients. Pretesting revealed that respondents believed that a 'Soy Yoghurt' product that contained milk/dairy ingredients was incongruent, i.e. that the presence of milk/dairy in such a product was unexpected.

The online experiment tested the effect of congruency and the presence of a 'contains' (or 'does not contain') statement on respondents' beliefs about the product. Respondents were randomly allocated to four groups, which saw different back labels for the Soy Yoghurt product. Respondents in the Congruent High Elaboration group were shown an ingredients list for the product that *did not* include any dairy/milk ingredients and did not see a 'contains' statement. Respondents in the Incongruent High Elaboration group saw an ingredients list that *did* include a dairy/milk ingredient ('live cultures (milk)') and did not see a 'contains' statement. Respondents in the Congruent Low Elaboration group saw an ingredients list that *did not* include any dairy/milk ingredients and saw a statement 'DOES NOT CONTAIN: MILK'. Respondents in the Incongruent Low Elaboration group saw an ingredients list that *did* include dairy/milk ("live cultures (milk)") and saw a statement "CONTAINS: MILK".

Results indicated that the presence of a 'contains' (or 'does not contain') statement did not affect respondents' belief that the product would (or would not) be safe for a person with a dairy/milk allergy. However, where the back labels were incongruent with the front label (i.e. where Soy Yoghurt *did* contain a milk/dairy ingredient), the presence of the 'contains' statement reduced the time respondents took to evaluate the labels. The findings of this

study suggest that where the source of an allergen (e.g. milk) is clearly declared in a statement of ingredients, the presence of a 'contains' statement may not further improve the accuracy of consumer judgements of whether the food is safe to eat. However, these statements may reduce the time needed to decide whether a food is safe to eat or not, particularly where other information on the label is unclear or seemingly contradictory.

As with many other studies in this review, respondents in this online experiment may have been more careful with their evaluations of the label than they would be in a real life setting (e.g. a supermarket). It is possible that the presence of an allergen summary statement may have had an impact on the accuracy of respondents' evaluations if they were under time pressure or experiencing distractions (as would often be the case in a real life shopping situation).

A study of medium-quality conducted in the United Kingdom (UK) examined how 32 adult participants with a clinical history of nut or peanut allergy used information on food labels to avoid target allergens (Barnett, Leftwich et al., 2011). The study methodology involved an accompanied shop followed by a semi-structured interview. Observers noted some participants referred to the statement of ingredients as their primary check for allergens, however most used the voluntary allergy advice box⁶ in the first instance, then referred to the statement of ingredients. When later questioned, participants revealed their preference for summarised allergy declarations, as they found these were easier and faster to read than an extensive statement of ingredients. Participants also reported frustration with allergens often listed at the end of a long statement of ingredients due to their small, albeit significant, presence in a product's formulation. There was a strong desire for labelling to be clear in its indication of nuts in the statement of ingredients, combined with a 'contains nuts' statement to prompt inspection of the statement of ingredients or a 'nut free' statement.

A high-quality UK study conducted by COI Communications on behalf of the UK Food Standards Agency (2002) examined consumers' responses to nut allergy labelling. The sample comprised FAIs and those who shopped for them ($n = 21$). Participants reported a desire for a mandated allergen symbol system to be introduced, with symbols being placed on the front of the packet, ideally next to an allergy alert e.g. "Take Care – Nuts", as a prominent first line alert. This was desired in addition to a separate allergen summary statement that would be located at the back of the package, to the left of or above the statement of ingredients, but not below it (where it could be easily missed).

The preference for a separate allergen summary statement to be placed above or adjacent to the statement of ingredients has been echoed in other international studies. Over 70% of shopper respondents (both FAIs and members of the general public) who were surveyed in a medium-quality study conducted in Mauritius (Soogali & Soon, 2018) reported a preference for having an allergen summary statement placed adjacent to the statement of ingredients.

A high-quality qualitative study conducted in Greece and the Netherlands (Voordouw et al., 2009) involved an observational accompanied shop followed by a series of interviews to explore FAI participants' preferences and behaviours surrounding allergen labelling. Participants reported they preferred having an allergen summary statement above (not below) the statement of ingredients, as it enabled quicker identification of allergens and reduced their likelihood of missing the statement and/or first unnecessarily reading the entire statement of ingredients. Although this data was self-reported, the observational findings

⁶ The allergy advice statement is a voluntary measure that can be used to explain how allergens are emphasised within the ingredients list e.g.

'Allergy advice: for allergens, see ingredients in **bold**', or

'Allergy advice: for allergens, including cereals containing gluten, see ingredients highlighted in **blue**'.

seemed to confirm that altering the location of allergen information would result in reduced time taken to identify allergens.

Overall, the desire for a separate allergen summary statement to act as a useful summary of allergens has been expressed by both FAIs and those who shop for them across a number of studies of varying quality. The preference for the allergen summary statement to be located adjacent to or above (but not below) the statement of ingredients was expressed by consumers in four studies included in this review (COI Communications & Creative Research, 2002; Marra et al., 2017; Soogali & Soon, 2018; Voordouw et al., 2009). The findings of six studies suggested that having some alert (whether it be an allergen summary statement or symbol) on the front of the food package would also facilitate easier and faster identification of allergen information, in addition to possibly prompting inspection of the statement of ingredients. No study investigated where on the front of the package this allergen information would best be placed. While non-allergic consumers appear to rely more heavily on front of pack information than FAIs (Verrill et al., 2013), the preference to have information in both locations has been expressed by both consumer groups. This suggests allergen identification could be enhanced by increasing the number of locations in which allergen information is presented on food packages.

3.2 Consistency in location of allergen information

Nine studies included in this review found consumers (FAIs and members of the general population) desired allergen information placement to be standardised across labelling to enable easier and faster identification.

3.2.1 Australian and New Zealand research

FSANZ has identified only two studies conducted in Australia and New Zealand that examined consumer views on the consistency of allergen information placement (NFO Donovan Research, 2004; TNS Social Research, 2009). In the high-quality quantitative study conducted on behalf of FSANZ (NFO Donovan Research, 2004), some respondents expressed a preference for standardised placement of allergen declarations. Respondents who had indicated in an earlier question that there were labelling issues that had caused them concern in attempting to identify foods that were safe for someone with an allergy were asked an open-ended question about the types of problems they had encountered. Six percent of New Zealanders and nine percent of Australian respondents indicated that the location of information not being standardised on the label was a problem. In another open-ended question where respondents were asked for suggestions for improvements to allergen labelling, six percent of New Zealand respondents and two percent of Australian respondents suggested that the location of label information should be standardised.

In the 2008-09 follow up survey conducted on behalf of FSANZ (TNS Social Research, 2009), some respondents had also had problems with the lack of standardisation of location of allergen information. Fifty eight percent of respondents indicated they had encountered 'other labelling issues' that had caused them concern. Of these respondents, 21% of New Zealanders and 13% of Australians identified the difficulty of finding the ingredients list or allergen warning (or the non-existence of these label elements) as a problem.

3.2.2 International research

Participants in the follow-up interview component of the aforementioned Canadian study by Marra and colleagues (2017) described being confused about where to look for allergen information in the first instance due to labelling inconsistencies and even changes across the same product (e.g. when a product changes formulation).

Joshi, Mofiki and Sicherer (2002) used a combined survey and experimental study design to examine how parents of food-allergic children ($n = 91$) interpret commercial food ingredient labels. Only 22% of parents in this medium-quality study correctly identified the presence of soy across the seven food labels that were presented to them. These labels were taken from widely available commercial products to reflect a natural setting as much as possible. When later questioned, they attributed this to the inconsistent placement of the allergen information, and the fact the word 'soy' was often buried in an extensive statement of ingredients. This finding is more concerning if we assume that participants are more likely to take their time investigating label elements under experimental conditions, where the time pressures and distractions present in a supermarket environment are absent. Further, 46% of participants in this study had prior consultation with an allergy clinic. Follow-up survey results revealed participants' frustration with how the statement of ingredients (and allergen information) were presented inconsistently amongst products, including differences amongst size variations of the same product (e.g. a block of chocolate when compared to a single-serve bar version). The number of incorrect classifications may be higher in the general population and amongst parents of food allergic children who have not received professional counselling on how to manage their child's allergies.

In the previously discussed study by Brown and colleagues (2015), focus group participants stressed the importance of standardising allergen information placement. Participants claimed that if they knew where to look from the outset, this would reduce the time and energy burden of having to inspect every label element. This sentiment was echoed by respondents in the survey component of Chow's above-mentioned study (2011). In this study, 8% of respondents rated inconsistency in how allergen information is displayed as being the most significant allergen labelling issue. When respondents were asked to report what improvements could be made to current labelling to facilitate identification and comprehension of allergen information, 33% reported having consistency in location of allergen information across food packages would assist.

The desire for an allergen summary statement to always appear adjacent to the statement of ingredients regardless of packaging size was expressed by the Greek and Dutch participants in Voordouw and colleagues' (2009) observational study. In the above-mentioned qualitative UK study examining nut labelling (COI Communications & Creative Research, 2002), participants expressed a strong preference for greater visibility and consistency in the placement of the three food label components considered essential to FAIs – an allergy symbol (if included), the statement of ingredients, and the allergen summary statement.

A nationally representative survey conducted on behalf of the Food Standards Agency in Ireland (TNS BMRB, 2016) found respondents ($n = 201$) valued label consistency to create habitual use. This included positioning of allergen information. Respondents reported this could encourage more regular use of labelling information by reducing their current frustration with the time and energy that goes into identifying allergens across different packages. For respondents, the ability to use allergen information rested on their ability to find information instantly, which could only be achieved when the location of the information was consistent across products, facilitating 'at a glance' decision making.

Overall, there is a clear consumer preference for allergen information to be placed in a consistent location to facilitate faster and easier identification of allergen information. However, further experimental and observational studies are required to confirm whether consistency contributes to faster identification and encourages greater label use by reducing consumers' current frustration.

Combining findings from the relevant studies included in this review, it would appear the ideal allergen label would have an allergy alert (a symbol or an allergen summary statement) on the front of the food package, in addition to a separate allergen summary statement above or

adjacent to the statement of ingredients at the back. The positioning of these three items would be consistent across food packages. The literature reveals this strong consumer preference for consistency in allergen labelling also extends to terminology and formatting.

4 Terminology in allergen labelling

This section will address the following two questions:

1. Does the consistent use of plain English terminology in allergen declarations on food labels assist allergen sensitive consumers (or those purchasing food for them) to identify the presence of an allergen and/or make better informed allergen-based food decisions? (section 4.1 and 4.2); and
2. Is it useful to declare the allergen source of the ingredients? If so, how do consumers interpret synonyms and common names for allergen sources? (section 4.3)

Key findings:

- Twenty four studies [9 *High*, 12 *Medium*, and 3 *Unknown* quality] examined the role of terminology in communicating allergen information on food labels. Terminology was the most researched of the four allergen labelling elements examined in this review.
- Eleven studies [5 *High*, 6 *Medium* quality] found a lack of consistency in terminology used across food labels, and/or differences amongst terms used on the same label (e.g. in the allergen summary statement and the statement of ingredients) caused confusion and frustration in consumers. This issue was examined in survey, interview and focus group studies. Inconsistent use of terminology led to consumers not understanding whether the product in question contained the target allergen. As a result, some consumers either contacted the manufacturer, or in the case of FAIs, unnecessarily restricted certain foods, and/or engaged in risk-taking behaviour.
- Fifteen studies [3 *High*, 9 *Medium*, 3 *Unknown* quality] found a strong consumer preference for the use of plain English allergen labelling. Consumers reported not understanding many of the technical, scientific terms used to describe common allergens. Four experimental studies [2 *Medium*, 2 *Unknown* quality] demonstrated the use of technical language was a significant barrier to consumers (FAIs and those who shop for them) correctly identifying whether a product was safe for consumption/was allergen free. The bulk of the experimental data revealed milk and egg allergens were the hardest for participants to identify and were associated with the highest number of incorrect responses.
- The use of vague, generic terms was also reported to be a major impediment to consumers correctly discerning whether a product was safe for consumption. In nine studies [4 *High*, 3 *Medium*, 2 *Unknown* quality], consumers expressed a strong preference for the source allergen to be identified whenever allergen information was presented (e.g. in the statement of ingredients and allergen summary statement). This was particularly the case (mentioned in five studies) for specifying the type of nut included in the product e.g. 'almond', as opposed to the current use of generic terms such as 'tree nuts'. Consumers reported the use of ambiguous allergen terminology caused them to potentially unnecessarily restrict certain foods from their diet (or the diet of the FAI they were purchasing for).

4.1 Consistent use of plain English terminology in allergen declarations

In this section, 'terminology' refers to any of the various terms that can be used to declare a particular allergen, for example 'casein', 'caseinate' and 'milk' which all describe the same allergen. Twenty four studies (Barnett, Muncer et al., 2011; Binsfeld et al., 2009; Brown et al., 2015; Chow, 2011; COI Communications & Creative Research, 2002; Creative Research, 2016; Hu, Grbich, & Kemp, 2007; Joshi et al., 2002; Marchisotto et al., 2017; Marra et al., 2017; Monks et al., 2010; NFO Donovan Research, 2004; Noimark, Gardner, & Warner, 2009; Parikhal et al., 2018; Sakellariou, Sinaniotis, Damianidou, Papadopoulos, & Vassilopoulou, 2010; Sheth et al., 2010; Simons, Weiss, Furlong, & Sicherer, 2005; Soogali & Soon, 2018; TNS BMRB, 2016; TNS Social Research, 2009; Vierk et al., 2007; Voordouw et al., 2009; Voordouw et al., 2012; Weber, Speridiao, Sdepanian, Neto, & Morais, 2007) examined the role of terminology in communicating allergen information on food labels. Terminology was the most researched of the four aspects of allergen labelling examined in this review (out of location, terminology, formatting, and gluten labelling), suggesting it is one of the most prominent impediments to consumers effectively identifying and understanding allergen information (Chow, 2011).

Terminology is a label element that may be country and/or language specific. This highlights a limitation in the existing literature, as only three studies (Hu et al., 2007; NFO Donovan Research, 2004; TNS Social Research, 2009) included in this review examining terminology were conducted in Australia and New Zealand. The remaining 22 studies were from Europe, Asia, North and South America, and Africa.

The majority of studies examining allergen terminology focused on consumer preferences as opposed to consumer understanding. Eight studies (Binsfeld et al., 2009; Joshi et al., 2002; Marra et al., 2017; NFO Donovan Research, 2004; Parikhal et al., 2018; Sakellariou et al., 2010; TNS Social Research, 2009; Weber et al., 2007) incorporated a task to test consumers' understanding of allergen terminology. Data was primarily obtained through natural observation, surveys, and/or interviews and focus groups. Some studies used a combination of methods (e.g. accompanied shop followed by an interview). More research that tests consumers' interpretation of terms against objective answers are needed.

4.1.1 Consistency in allergen terminology

Eleven studies (Barnett, Muncer et al., 2011; Brown et al., 2015; COI Communications & Creative Research, 2002; Joshi et al., 2002; Marchisotto et al., 2017; Marra et al., 2017; NFO Donovan Research, 2004; TNS BMRB, 2016; TNS Social Research, 2009; Vierk et al., 2007; Voordouw et al., 2009) point to consumers finding a lack of consistency in terminology used across food labels, and/or differences amongst terms used on the same label (e.g. in the allergen summary statement and the statement of ingredients). This was a source of frustration and confusion for consumers. Survey, interview and focus group data revealed consumers were often left questioning whether the product in question contained the target allergen, sometimes leading them to contact the manufacturer. In the case of FAls, this confusion led to unnecessary food restriction and/or risk-taking behaviour.

In the aforementioned US study by Joshi and colleagues (2002), participants raised the issue of consistency in allergen terminology in the survey component. Differences in terminology used to describe ingredients across products, different package sizes, and even across different label elements on the same food package reportedly caused confusion, frustration and errors in allergen identification amongst parents of food allergic children. Observational data from the accompanied shopping experience also revealed this was associated with increased time spent examining the product label. Interview data suggested this was the

result of consumers not understanding the terminology presented, and so searching for other sources of information (or clues as to whether the product was allergen-free) on the food package. This was reported even amongst those who had received professional counselling in allergen identification. These findings echo those of Vierk and colleagues' (2007) previously discussed US survey. Their results revealed over 40% of FAI respondents found inconsistency in the terms used for the same allergen across food products to be a serious or very serious impediment to effectively managing their food allergy.

Australian and New Zealand respondents have voiced similar concerns regarding consistency in terminology. In a high-quality study conducted on behalf of Food Standards Australia New Zealand (NFO Donovan Research, 2004), respondents were asked to indicate how often they had encountered a range of problems when selecting food products. Twenty five percent of survey respondents ($n = 510$) reported often encountering 'Different names on label for the ingredients I need to avoid'.

Respondents who had indicated in an earlier question that they experienced labelling issues when attempting to identify foods safe for someone with an allergy were asked an open-ended question "What problems do you encounter when trying to identify foods that are suitable for the person(s) with an allergy?". Many of the free text responses to this question related to terminology. Twelve percent of Australian respondents and nine percent of New Zealand respondents indicated the many names that were used on the label for the same thing was a problem for them.

The survey found some respondents dairy ingredients particularly difficult (NFO Donovan Research, 2004). Four percent of respondents, when suggesting improvements to labels, noted that the presence of dairy in food products was indicated with many different terms (e.g. casein, whey).

In a follow up survey conducted in 2008-2009 (TNS Social Research, 2009), 20% of survey respondents ($n = 1028$) reported often encountering the problem of different names on the label for the ingredients they needed to avoid. The sample comprised FAIs who were recruited using opportunistic methods from nationally-dispersed hospital-based allergy clinics, private allergy clinics, and support groups.

Inconsistency in terminology used amongst different label elements was also identified as an issue in the previously mentioned experiment by Parikhal and colleagues (2018). Results revealed that participants were generally able to accurately identify both safe (products that did not contain nuts) and unsafe (contained nuts) products. Across all products and participants, the average time spent to examine a product and reach a decision was 20.2 seconds. Products were turned an average of 2.15 times before a decision was reached.

Participants had to look at safe products for longer to reach a decision than for unsafe products. Where participants made incorrect decisions (i.e. categorising an unsafe product as safe, or categorising a safe product as unsafe) this was associated with looking at the product for longer. This suggests many of the incorrect decisions were not due to lack of effort by participants, but due to labels that were difficult to categorise. Older consumers required additional time to categorise each item compared to younger consumers, however accuracy was not affected by age. Participants seemed to adopt a "better safe than sorry" mentality; if they were unsure of a product's safety, after a period of time they gave up on searching and defaulted to avoiding the product entirely (would not purchase it). Non-FAI participants expressed empathy for the additional difficulties FAIs experience while grocery shopping.

Safe products with a nut-free label were examined significantly faster and more accurately than those without a nut-free label. Thirty one percent of participants mentioned that inconsistencies in the allergen labels on the products in the study made it difficult to categorise products as safe or unsafe.

While this high-quality study standardised experimental conditions as much as possible and used objective measures to collect data, no mention was made of the recruitment method employed. Therefore, external validity cannot be fully determined. Further, the study only included individuals without a peanut or tree nut allergy. It may be that FAls develop strategies or faster search methods while maintaining high accuracy of safe product identification.

The above results are supported by consumers' comments during interviews and focus groups. In the previously-mentioned high-quality qualitative study conducted in Greece and the Netherlands (Voordouw et al., 2009), participants reported inconsistent terminology used in the statement of ingredients was partially to blame for increased time spent examining a food package for allergen identification. In particular, participants reported the importance of ensuring allergen information was translated correctly from one language to another.

Unlike the countries examined in Voordouw et al. (2009), there is only one dominant language spoken in Australia and New Zealand (English). However, mistranslations could still be a potential issue in an increasingly globalised food market, where the number of imported products is likely to increase. Further market analysis is required to determine whether allergens being incorrectly translated poses a current concern in a local context.

Overall, studies indicate a strong consumer preference for consistency in the terms used to declare allergens. Some limited findings suggests terminology consistency may also facilitate greater consumer understanding.

4.2 Using plain English allergen labelling (PEAL)

In addition to consistency, studies also point to a strong consumer preference for the use of plain English allergen labelling (PEAL). Currently, Standard 1.2.3 of the Code does not mandate how allergen declarations should be made or the terminology to use when making allergen declarations. PEAL is the use of clear and unambiguous terms in allergen declarations, primarily by reference to the specific source of the allergen.

Fifteen studies (Binsfeld et al., 2009; Chow, 2011; COI Communications & Creative Research, 2002; Henderson, 2003; Joshi et al., 2002; Monks et al., 2010; NFO Donovan Research, 2004; Sakellariou et al., 2010; Sheth et al., 2010; Simons et al., 2005; Soogali & Soon, 2018; TNS Social Research, 2009; Vierk et al., 2007; Voordouw et al., 2012; Weber et al., 2007) found a strong consumer preference for the use of plain language allergen labelling. Consumers reported being left confused and frustrated with the use of technical, scientific terms currently used to describe common allergens.

Four experimental studies (Binsfeld et al., 2009; Joshi et al., 2002; Sakellariou et al., 2010; Weber et al., 2007) demonstrated the use of technical language was a significant barrier to consumers (FAls and those who shop for them) correctly identifying whether a product was safe for consumption.

In Australia and New Zealand, respondents to the aforementioned large-scale survey (NFO Donovan Research, 2004) reported having difficulty understanding what is meant by some terms on food labels. This was supported by the findings of a question in which respondents were asked to indicate which terms (from a list provided) would indicate a food product would need to be avoided by the person in the household with the most serious food allergy. Only

36% of respondents responsible for buying food for a person with a soy allergy believed textured vegetable protein needed to be avoided. Among respondents buying for a person with a milk allergy, 72% identified whey as an ingredient to avoid, 64% identified casein, and 68% identified lactose. Twenty nine percent of respondents buying for someone with a wheat allergy were aware that cornflour may be problematic, and 38% were aware semolina should be avoided.

Respondents who had indicated in an earlier question that they experienced labelling issues when attempting to identify foods safe for someone with an allergy were asked an open-ended question "What problems do you encounter when trying to identify foods that are suitable for the person(s) with an allergy?" (NFO Donovan Research, 2004). Eighteen percent of Australian respondents and 25% of New Zealand respondents indicated they did not understand what was meant by some things on the label.

In Australia and New Zealand, respondents to the aforementioned large-scale survey conducted on behalf of FSANZ (TNS Social Research, 2009) noted technical terminology and lack of plain English was a significant barrier to them understanding allergen information, with 7% reporting lack of understanding over some terms. Respondents were asked to indicate which terms (from a list provided) would indicate a food product would need to be avoided. Knowledge of problematic ingredients was often poor. For example, only 42% of respondents responsible for buying food for a person with a soy allergy believed they would need to avoid textured vegetable protein. Among respondents buying food for a person with a milk allergy, 71% identified whey as an ingredient to avoid, 73% identified casein and 81% identified lactose. Forty nine percent of respondents who were responsible for buying food for a person with a wheat allergy identified spelt as something to avoid, 33% identified cornflour, and 52% identified semolina. Ovalbumin and albumin were identified as problematic ingredients by 54% and 64% of respondents buying for someone with an egg allergy respectively. These results suggest that many FAIs (and those that buy food for them) are unaware of terms that indicate the presence of common allergens in food products.

These results reveal that the wide variety of terms that can indicate the presence of allergens are a problem for FAIs. The bulk of the experimental data revealed that milk and egg allergens were also the hardest for participants to identify and were associated with the highest number of incorrect responses.

In Vierk and colleagues' (2007) large-scale US survey of 4482 FAIs, over one-third of respondents noted the use of technical terms was a serious or very serious impediment to identifying allergens on food labels. A Canadian study of medium-quality (Sheth et al., 2010) found FAI respondents who were allergic to peanut, tree nut, fish or shellfish reported fewer accidental exposures due to an allergen not being identified in plain English language. This may be attributed to the fact there are few, if any, alternative terms to describe these foods. This is in contrast to allergens such as milk and egg, which are sometimes identified by complex terminology not readily recognised by consumers e.g. 'casein' (for milk) or 'ovalbumin' (for egg). As data was collected retrospectively in this study (respondents were asked to reflect over the past year), recall bias may have influenced results. However, to limit this, respondents were later contacted via telephone to verify their responses. Further, while respondents may have attributed their accidental exposure to a labelling error, there is no way of confirming whether this was actually the case given the limited data collection methods (i.e., there was no verification of customers' recount of events). Exposure may have been the result of preparation methods, ingestion of another food etc.

In Joshi and colleague's study (2002), milk was the ingredient most difficult for participants (parents of food-allergic children) to identify, with only 7% correctly identifying all 14 labels containing the allergen. The authors suggest replacing less familiar terms, such as 'casein',

with 'milk', to make allergen identification simpler. Such findings provide convincing support for the use of PEAL in allergen labelling.

A preference for the term 'milk' in place of more complex terms such as 'casein' and 'whey' was expressed by over 80% of respondents in a medium-quality face-to-face survey of 113 shoppers conducted in Mauritius (Soogali & Soon, 2018). While the study had low external validity due to the small sample size examined and location of data collection, it is interesting to note this consumer preference for plain English language appears throughout the literature.

These findings have been supported by other international studies. In Binsfeld and colleagues' (2009) aforementioned Brazilian study, participants were asked to inspect food product labels and determine whether each product was or was not suitable for someone with a cow's milk allergy. Four terms were tested (across 12 labels of common grocery products): lactose, casein, caseinate, and whey protein. Additionally, ingredient names were tested, including: powdered milk, skim milk, milk whey, milk protein, butter serum, and cheese. The study methodology involved a label-identifying task accompanied by follow-up structured interviews. The interview component was to allow participants ($n = 52$ parents/caregivers of food-allergic children) to reflect on why they believed allergen identification errors had occurred.

Forty eight participants reported having doubts when inspecting the label for allergens due to terminology-related issues. Lactose was the term most easily identified as problematic for someone with a milk allergy, with 55.8% of participants correctly noting its presence on all the labels on which it appeared. In order, 53.8% of participants correctly identified milk across all labels where it appeared, 38.5% milk whey, 36.5% cheese/cream cheese, 26.9% casein, 13.5% milk protein, 7.7% traces of milk, and a much smaller percentage identified caseinate and butter (only 5.8% for both terms). Only one participant was successful in identifying all terms correctly.

Notably, some participants who had correctly indicated (in an earlier question) that lactose, whey protein, casein and caseinate indicated the presence of milk, failed to identify these ingredients on all of the labels on which they appeared. For example, 92.3% of participants were aware that lactose indicated the presence of milk. However, only 55.8% were able to identify lactose on all the labels on which it appeared. The authors noted that many of the participants were unable to find the list of ingredients on some of the products and so based their decision on other parts of the label. Some of the participants who found the ingredients list had difficulty reading it due to the small font used and the large number of ingredients listed.

Considering all study participants had received prior medical and nutritional guidance, these results were much lower than expected. This suggests poor retention of information, and a need for clear labelling using simple terms, even amongst those trained in allergen management. As insufficient information was provided on this study's methodology, internal validity could not be determined and therefore results should be interpreted with caution. Further, as the stimuli presented to participants were real food labels, other aforementioned labelling limitations (e.g. issues with consistency and location) may have confounded results.

Another Brazilian study supports the notion that prior allergen education does not necessarily lead to accurate identification where complex terminology is used. In their experimental study of medium-quality, Weber and colleagues (2007) compared the difference in accuracy of allergen identification between parents of food-allergic children who had and those who had not received prior nutrition counselling. Twelve expressions relating to cow's milk served as the stimuli and was presented across labels of 10 products commonly given to infants and/or toddlers (e.g. cereal, whole milk drinks, cookies and yoghurts). Parents who had received

education (the experimental group – $n = 24$) were significantly more accurate in identifying the term ‘caseinate’ compared to participants who did not receive prior training (the control group – $n = 23$). The two groups did not differ significantly in identifying casein, lactalbumin, or lactoglobulin. Overall, as in Binsfeld and colleagues’ (2009) study, the number of labels read correctly by members of the experimental group was lower than expected. The authors conclude the use of simple terms on food labels and frequent reading of labels (to gain familiarity with terms) may be just as important as formal allergen management education.

In a Greek study, Sakellariou and colleagues (2010) tested 59 terms used to describe allergens found on common food grocery labels (the exact terms tested were not disclosed). The researchers compared the performance of two groups of parents in matching 59 ingredients with the correct allergen (e.g. matching lactose with milk). The first group of parents were randomly selected from the general population (some with one or more allergic children and some with no allergic children), the second group of parents had one or more food-allergic children which had attended the authors’ clinic. There was no statistical difference in the overall performance of the two groups of parents. However, there were slight differences in their ability to match particular ingredients with allergens. Parents of food-allergic children who had undergone nutrition counselling were able to correctly identify allergens labelled using scientific terms (e.g. ‘casein’ and ‘ovalbumin’) more frequently when compared to parents of children who had no allergies. This would appear to contradict previously discussed findings, where prior training did not appear to make a difference as to whether complex allergen terms could be readily identified. It may be the case that nutrition counselling has some effect, but that this wanes over time and without frequent label reading (i.e., one becomes less familiar with complex terminology if not frequently exposed to it).

If this is the case, then use of plain English language in allergen labelling may be particularly useful to those who underwent nutrition counselling for their/their dependents’ food allergy quite some time ago, and for those who never received formal counselling.

The use of PEAL would also be beneficial for members of the general public, who may only consider allergen labelling on an infrequent basis (e.g. cooking for a food-allergic house guest). In addition, not all FAIs receive education from healthcare practitioners on identifying allergens on food labels. In their aforementioned Australian study, Henderson (2003) found only 50% of FAI respondents had been shown how to recognise alternative ingredient names for their target allergen at the time of diagnosis. Plain English allergen labelling will be particularly beneficial for those who have not received this training.

Overall, milk was noted in several international studies as one of the most difficult allergens to identify due to the various synonyms used to declare its presence. However, results of the previously-discussed survey conducted on behalf of FSANZ (NFO Donovan Research, 2004) differ. In this high-quality study, respondents with milk, egg, or tree nut allergies were most accurate in their assessment of ingredients of concern to them, whilst those with peanut and wheat allergies were less accurate. However, the ability of respondents to identify food products that contained allergens did vary considerably depending on the terms used on the food label. When questioned on how the clarity of allergen labelling could be improved, the use of uniform wording in plain English was the most cited response.

In a survey conducted in the Netherlands and Greece (Voordouw et al., 2012), respondents were asked to comment on a range of food labels across three food categories (ready-made meals, snacks, and pre-packaged salads). For each category, two labels were presented: one that contained an allergen and one that did not. The “ideal format” for a food label communicating allergen information was developed based on consumer research.

Respondents were asked to comment on which elements of this “ideal format” they found useful in their determination of whether an allergen was present or not. Using lay terminology, and putting the chemical terms in between brackets afterwards was viewed positively by all FAI (doctor- and self-diagnosed) respondents ($n = 62$). Several measures were taken to enhance the internal validity of this study e.g. pilot-testing, randomisation of interaction effect, and collection of both quantitative and qualitative information (through free-text boxes in the questionnaire).

Overall, it would appear the consistent use of plain English language to communicate allergen information is viewed favourably by consumers across the globe. Consumers both prefer and are more able to understand terms communicated in plain English (e.g. milk) when compared to technical terms (e.g. caseinate). This may be relevant in a local context given Australia and New Zealand’s large culturally and linguistically diverse (CALD) population. As the rate of food allergy is particularly high in younger demographics, the use of plain English terminology may be beneficial for older children and teenagers who are able to shop for themselves (Monks et al., 2010). These populations may also benefit from enhanced formatting of allergen information on food labels (see section 5).

4.3 Declaring the source allergen

While the use of complex terminology has been noted as an allergen labelling issue, the use of vague, generic terms has also been identified as a major impediment to consumers correctly discerning whether a product is safe for consumption. In nine studies (Barnett, Muncer et al., 2011; Chow, 2011; Hu et al., 2007; NFO Donovan Research, 2004; Sakellariou et al., 2010; Simons et al., 2005; TNS Social Research, 2009; Vierk et al., 2007; Wortman, 2016), consumers expressed a strong preference for the source allergen to be identified whenever allergen information was presented (e.g. in the statement of ingredients and allergen summary statement). Five studies (Barnett, Leftwich et al., 2011; Chow, 2011; Hu et al., 2007; NFO Donovan Research, 2004; TNS Social Research, 2009) identified this was particularly the case for specifying the type of nut included in the product e.g. ‘almond’, as opposed to the use of generic terms such as ‘tree nuts’. Consumers reported the use of ambiguous allergen terminology caused them to potentially unnecessarily restrict certain foods from their diet, or from the diet of the FAI they were purchasing for. Focus group data reveals consumers may associate clear, common and informative wording with greater transparency and trust in the information.

In one UK study, 32 FAIs with a clinical allergy to peanuts and/or tree nuts participated in an accompanied shop followed by an individual interview (Barnett, Muncer et al., 2011). During the interview component, FAIs revealed labels that included more specific wording (e.g. reference to the type of nut as opposed to the use of generic ‘nut’ or ‘tree nut’), suggested there was greater knowledge by the manufacturer about the increased risk of the presence of a particular allergen because they specified them individually on the label. Participants were more likely to take precautionary action when the specific type of nut was declared on the food label (Barnett, Muncer et al., 2011). Results from a follow-up study demonstrated specificity in terminology was particularly valued when consumers were purchasing an item for the first time (Barnett, Leftwich et al., 2011).

In the aforementioned US survey (Vierk et al., 2007) of 4482 FAIs, 40% claimed that a statement of ingredients containing a general name for an ingredient without specifying its source (e.g. spices and flavourings not declaring the presence of milk solids) was a very serious barrier to them effectively managing their allergy. This did not differ between FAIs who were self or doctor-diagnosed.

The outcome of customer confusion is often unnecessary restriction of certain foods. In their US survey assessing the impact of ingredient labelling practices on FAIs, Simons and colleagues (2005) found 80% of respondents with a milk allergy also reported avoiding all products containing lactose, which, in certain instances, may not be warranted (e.g. processed grains, processed meats, and soups). Respondents felt that lactose was the source of their milk allergy, and therefore should be avoided. As the sample comprised adults who had attended a Food Allergy and Anaphylaxis Network conference, sampling bias may have affected these results (indicated by the high participation rate of 84%). It is interesting to note those who attend an allergy conference (and display a greater interest in the topic) would presumably have greater nutrition knowledge. Thus, it is likely this confusion about the difference between a milk allergy and lactose intolerance would be more pronounced in the general population and/or amongst less knowledgeable FAIs.

Nevertheless, while one may assume that FAIs are more cautious in their purchasing habits due to their allergy considerations, this may not always be the case. Findings from other studies suggest that members of the general public who may occasionally shop for FAIs if anything are more cautious in their purchasing habits, and pay more attention to claims made on food labels than FAI themselves.

It may be possible that FAIs are more likely to engage in risk-taking behaviour when it is their own (as opposed to another's) health at stake (Cochrane, Gowland, Sheffield, & Crevel, 2013).

In the aforementioned qualitative study commissioned on behalf of the UK Food Standards Agency (Creative Research, 2016), participants ($n = 32$ consumers, $n = 15$ health professionals and $n = 16$ businesses) with a lactose intolerance were uncertain whether products described as 'dairy free' or 'milk free' were safe for consumption. Similarly, there was considerable uncertainty (amongst all participant groups) as to whether products labelled 'lactose free' were suitable for those with a milk allergy or intolerance. There was also confusion among some participants over the term 'milk', as this was thought by some to include alternative milks e.g. soy and nut milks. Other participants reported associating the term 'milk' only with cow's milk. This suggests nutrition knowledge as opposed to labelling ambiguities may be behind these results. "Dairy free" was the term that had the broadest appeal and was most frequently used and understood across all three audiences. FSANZ cannot determine whether the method of collection affected responses, as a combination method of telephone and face-to-face interviews had been used to collect data from different participants e.g. social desirability bias may have been more of an issue in the face-to-face interviews.

The above findings are supported by results from a high-quality, qualitative Australian study examining parental food allergy information needs (Hu et al., 2007). Forty four parents of food-allergic children participated in a series of in-depth semi-structured interviews and focus group discussions. The use of several data collection methods (survey questionnaires were sent following the interviews/focus groups to obtain further information) has been shown to enhance internal validity. Overall, participants expressed confusion as a result of current allergen labelling. In particular, participants were unsure of what to exclude from their child's diet and environment e.g. whether all foods from a food group (e.g. tree nuts) should be avoided if they had been told their child was allergic to one particular ingredient (e.g. walnut).

The 2003 allergen labelling survey commissioned by FSANZ examined issues that FAIs had with food labelling and improvements they would like to see (NFO Donovan Research, 2004). Among those who indicated they had encountered problems when trying to identify foods, 12% mentioned determining what an ingredient was derived from was a problem. This was also apparent in other problems identified, including terms like 'flavours' and 'spices' not being explicit enough (7%) and the use of non-specific terms such as 'vegetable oil' (10%).

The suggestions for improvements to food labels provided by respondents mirrored these themes. Five percent of respondents suggested food labels should say what ingredients are derived from. Four percent said the terms 'flavours', 'spices', and 'colours' were not explicit enough. Three percent said the source of vegetable oil needed to be declared. Similar to above findings by Barnett et al. (2011) and Hu et al. (2007), four percent of respondents gave 'need to know what type of 'nuts'' as a suggested improvement to food labels (NFO Donovan Research, 2004).

In the follow-up survey conducted in in 2008-09 (TNS Social Research, 2009), seven percent of Australian and New Zealand respondents stated not knowing what certain ingredients in the statement of ingredients were derived from was a problem. Four percent were confused over the use of non-specific terms (especially where codes, E-numbers, spices and flavourings were mentioned). As in the 2003 survey, four percent of respondents suggested being more specific about which nuts are in products would improve food labels.

In the qualitative interview component of Chow et al.'s (2011) research, one of the 13 interview participants gave 'identifying tree nut type in labels' as an improvement that could be made.

In summary, based on local and international research, it would appear consumers (FAIs and those who purchase for them) need consistent, simple and specific terminology to appear on food labels when declaring allergens. Current practices (e.g. the use of vague and/or overly technical terms) appear to be leading to consumer confusion and uncertainty about which foods are safe for consumption. This poses a significant food safety risk, particularly in a local context where the prevalence of food allergy is increasing, and where there is a large CALD population who may already struggle with English comprehension. It also leads to consumers unnecessarily restricting foods from their diets that are safe for them to eat.

5 Formatting in allergen labelling

This section will address the following social science questions:

1. Does the format of allergen labelling assist allergen sensitive consumers (or those purchasing food for them) to identify the presence of an allergen and/or make better informed allergen-based food decisions? (section 5.1) and
2. What is the efficacy of allergen information being provided consistently in a particular format on all food labels? (section 5.2).

Eight strong themes emerged from the existing literature: a desire (and in some cases demonstrated efficacy) for: consistency, large font size, different coloured font for allergens, high contrast between allergen information and the background label colour, the use of symbols, listing the percentage amount of the allergen present, the boldening of allergens in the statement of ingredients and allergen summary statement, and placing the allergen summary statement in a box/attention-grabbing shape. This section will be organised around those themes.

Key findings:

- Nineteen studies [8 *High*, 10 *Medium*, and 1 *Unknown* quality] examined the role of formatting of food labels in communicating allergen information. Only three of these studies were conducted in Australia and/or New Zealand [1 *High*, 2 *Medium* quality]. However, there are common themes that emerged from the international and local findings, suggesting consumer preferences for most formatting aspects of allergen information may be universal.
- Consistency in formatting was seen to reduce the time taken to identify allergens, particularly if inspecting a new product. Nine studies [6 *High*, 3 *Medium* quality] mentioned consistency in font size, colour, boldening, and symbol use could aid in allergen identification.
- Nine studies [3 *High*, 5 *Medium*, 1 *Unknown* quality] found a strong consumer desire for larger font size. Small font size is particularly an issue on product labels where the allergen information only appears in the statement of ingredients.
- Eight studies [3 *High*, 5 *Medium* quality] found mandating the boldening of allergens was desired across both FAIs and those who shop for them, and could aid both groups in more rapid and effective identification of allergens on the label. Boldening was desired in all locations where allergens were declared (e.g. in the statement of ingredients and any additional statements). Consumers assumed boldening was mandatory for allergens.
- Eight studies [2 *High*, 6 *Medium* quality] found colour to be an important formatting element that influenced the ease of allergen identification on food labels. In particular, consumers expressed a desire for allergen information to stand out in the statement of ingredients. Poor contrast was noted in five studies [3 *High*, 2 *Medium* quality] as a significant barrier to allergen identification.
- Consumers expressed a desire for allergen summary and/or voluntary precautionary allergen statements to appear in a box (or some other eye-catching shape) in five studies [3 *High*, 2 *Medium* quality].
- Listing the percentage amount of each allergen present in a food product in brackets after it appears in the statement of ingredients was noted in five studies [3 *High*, 2 *Medium* quality]. This was seen by consumers to enable risk assessment.
- The desire for a universal harmonised allergen symbol labelling system was noted in 12 studies [6 *High*, 5 *Medium*, 1 *Unknown* quality]. Some consumers did acknowledge the difficulties in how this would be operationalised.

5.1 Format in aiding allergen-based food decisions

Nineteen studies examined the role of formatting in communicating allergen information on food labels (Barnett, Leftwich et al., 2011; Binsfeld et al., 2009; Brown et al., 2015; Choi & Choi, 2016; Chow, 2011; COI Communications & Creative Research, 2002; Define Research & Insight, 2009; Henderson, 2003; Ju et al. 2005; Marra et al., 2017; NFO Donovan Research, 2004; Noimark et al., 2009; Parikhal et al., 2018; Soogali & Soon, 2018; TNS BMRB, 2016; TNS Social Research, 2009; Voordouw et al., 2009; Voordouw et al., 2011; Voordouw et al., 2012). Only three of these studies were conducted in Australia and/or New Zealand (Henderson, 2003; NFO Donovan Research, 2004; TNS Social Research, 2009). However, as with location, formatting is not a label aspect that is likely to be country or language specific, and so the 18 international studies identified may still be relevant to a local context. Further, there is strong agreement amongst the international and local studies,

suggesting consumer response to the formatting of allergen information may be widespread. Nevertheless, it is important to recognise the different food products available and labelling requirements in overseas markets.

As with location and terminology, the majority of studies examining allergen declaration formatting focused on consumer preferences. Only three studies (Binsfeld et al., 2009; Marra et al., 2017; Parikhal et al., 2018) incorporated experimental designs. Data investigating the formatting of allergen information was primarily obtained through natural observation, surveys, and/or interviews and focus groups. Some studies used a combination of methods (e.g. accompanied shopping experience followed by an interview). Consequently, causation cannot be assumed based on these studies alone, i.e., it cannot be said that boldening allergens in the statement of ingredients will lead to reduced time taken to identify allergens based solely on consumer preference.

5.1.1. Font Size

Nine studies (Barnett, Leftwich et al., 2011; Binsfeld et al., 2009; Choi & Choi, 2016; Chow, 2011; COI Communications & Creative Research, 2002; NFO Donovan Research, 2004; Parikhal et al., 2018; Soogali & Soon, 2018; TNS Social Research, 2009) found a strong consumer desire for larger font size in the statement of ingredients. This sentiment was shared by both FAIs and those who shop for them.

In both the baseline (NFO Donovan Research, 2004) and follow-up (TNS Social Research, 2009) FSANZ allergen labelling surveys, font size was mentioned as an issue. In 2003, seven percent of the respondents who had encountered problems when trying to identify foods suitable for a person with an allergy indicated that illegible writing or writing that was too small was a problem for them. This was still a problem for seven percent of respondents in the follow-up survey in 2008-09 (TNS Social Research, 2009). Respondents in the 2003 survey suggested bold print or larger writing on labels would make labels easier for FAIs to use (NFO Donovan Research, 2004). This was the most common suggestion for improving allergen labelling and was suggested by 16% of respondents.

The aforementioned Brazilian study (Binsfeld et al., 2009) revealed parents of children with a diagnosed milk allergy were often unable to read the statement of ingredients due to the small font size. Consequently, their ability to discern milk allergens was limited. This clearly presents an issue on product labels where the allergen information only appears in the statement of ingredients (i.e., not mentioned elsewhere on the package such as in an allergen summary statement).

Frustration with small font size has also been expressed by FAIs when shopping for themselves. In Barnett and colleagues' (2011) aforementioned observational study examining the shopping habits of adults with a diagnosed peanut or tree nut allergy, observers noted participants seemed to use the statement of ingredients only if they were unable to discern the presence of allergens based on other label features e.g. a precautionary or allergen summary statement. During the follow-up interviews, participants reported frustration with the small font sizes used in the statement of ingredients, rendering some of them illegible.

Participants in Chow's (2011) high-quality Canadian study also reported searching for allergen warnings (e.g. allergen summary statements) in the first instance, and only inspecting the statement of ingredients when necessary. Twenty five percent of participants ($n = 1308$) reported small font size of the statement of ingredients as being a significant labelling issue, and barrier to allergen identification. This may explain the greater reliance on other labelling elements e.g. voluntary precautionary statements, which tend to be printed in slightly larger font.

In the previously-mentioned medium-quality qualitative study commissioned by Food Standards Agency UK (COI Communications & Creative Research, 2002), participants ($n = 21$ FAIs and partners/parents who shop for them) suggested font size should be large enough that those with mild near-sightedness do not require glasses to read the information. Participants claimed small font size was a major impairment to allergen identification, particularly creating a safety concern for the elderly or those with even minor visual impairments.

In Soogali and Soon's (2018) recent medium-quality international study, over 80% of respondents (FAIs and parents shopping for food-allergic children) reported the need for allergens listed in the statement of ingredients to be emphasised. Rather than increasing the font size of the entire statement of ingredients, respondents felt enlarging the font size of the allergens would lead to easier and faster identification by making them stand out. This sentiment was echoed by respondents in Choi and Choi's (2016) survey of 302 members of the general public, who stated increasing the font size of allergens would aid consumers in locating and distinguishing them from general nutrition information.

Overall, the literature reviewed is consistent in finding that consumers believe enlarged font size assists them in identifying allergens on a food label. While some would prefer the font size of the entire statement of ingredients to be increased, others feel that increasing the font size only of allergens would help distinguish this information from other ingredients and nutrition information. The desire for allergen information to be easily discernible from other labelling elements is also evidenced by consumers' desire for emboldening and the use of colour.

5.1.2 Emboldening

Eight studies (Barnett, Leftwich et al., 2011; Choi & Choi, 2016; Chow, 2011; Henderson, 2003; Ju et al. 2005; Soogali & Soon, 2018; TNS BMRB, 2016; Voordouw et al., 2009) found mandating the emboldening of allergens on food labels was desired across both FAIs and those who shop for them. Consumers believe emboldening allergens would facilitate rapid and effective identification, particularly in an extensive statement of ingredients. However, emboldening was desired in all locations where allergens were declared e.g. in the statement of ingredients and any additional statements. Across studies, the emboldening of allergens was cited as one of the simplest and most effective ways of improving allergen labelling. Indeed, in Soogali and Soon's (2018) previously-discussed survey, emboldening allergens in the statement of ingredients was the most preferred option for over 80% of respondents when asked how allergen labelling could be improved. Similarly, in Chow's (2011) high-quality Canadian study, when asked how allergen labelling could be improved, emboldening of font and increased font size was the most popular option amongst respondents (58% in support).

In both studies, emboldening of allergens was the most commonly used method (in the current marketplace) for distinguishing allergens from other ingredients in the statement of ingredients. It would appear consumers have come to associate the emboldening of information in the statement of ingredients with allergens. In his literature review of food allergy labelling requirements in the US, Demkin (2017) notes that due to the emboldening of allergens becoming so commonplace, there is the risk some consumers are unaware this formatting feature is voluntary. Thus, if no bold text is apparent, they may incorrectly assume the product is allergen-free, creating a major safety concern. This may also present an issue in a local context, where the emboldening of allergen information is voluntarily implemented by industry (Allergen Bureau, 2012).

In Voordouw and colleagues (2009) aforementioned observational study, participants were asked to purchase 15 potentially problematic food items (containing the allergen they were trying to avoid), and to comment on the labelling elements that were problematic. When noting areas for improvement, participants suggested consistency in the emboldening of allergens in the statement of ingredients, as this increased readability and assisted with faster identification.

Emboldening of allergen information appears to be the preference regardless of where allergens are declared on the food label. For example, in a medium-quality international study (Choi & Choi, 2016), survey respondents reported a desire for allergens to be emboldened when they appeared in voluntary precautionary statements, in addition to when they appeared in the statement of ingredients. In a large-scale survey commissioned by the Food Standards Agency of Ireland (TNS BMRB, 2016), respondents valued label consistency in allergen labelling to create habitual use, and noted allergens not always being emboldened as causing confusion and frustration. Data for this high-quality study was obtained through eight focus groups, eight accompanied shops, a survey ($n = 201$) using an online panel. The authors note every effort was made to recruit a representative sample, and where possible, validated measures were used.

Given the literature overwhelmingly supports a consumer preference for consistency in allergen labelling, it would make sense that emboldening of font would be desired wherever allergen information is presented.

5.1.3 Colour and contrast

The Code requires that written text is contrasted against the background of the label (Standard 1.2.1, section 1.2.1–2.4)⁷. Eight studies (Barnett, Leftwich et al., 2011; Choi & Choi, 2016; COI Communications & Creative Research, 2002; Ju et al. 2005; Parikhal et al., 2018; Soogali & Soon, 2018; TNS Social Research, 2009; Voordouw et al., 2009) found colour to be an important formatting element that influenced the ease of allergen identification on food labels. In particular, consumers expressed a desire for allergen information to stand out in the statement of ingredients, and viewed coloured font as a formatting option that could facilitate this. In the 2008-09 FSANZ allergen labelling survey, seven percent of respondents spontaneously suggested either putting common allergens in bold or in a different colour (TNS Social Research, 2009). In other studies, the desire for allergens to be in a standardised colour (e.g. red) was also expressed.

Across studies, consumer preference for allergens to be emboldened was often accompanied by the desire for allergens to be in colour. Both formatting alterations would cause the information to stand out from other nutrition information. Consumers expressed frustration at how, at present, allergen information is difficult to discern, and blends into the barrage of information displayed on food labels (Barnett, Leftwich et al., 2011). Again, the desire for consistency was evident with respect to colour. Consumers reported the use of the same colour to declare allergens wherever they appeared on the product e.g. in the statement of ingredients, allergen summary statement and any symbols, as well as across products, would result in more rapid and easier identification (COI Communications & Creative Research, 2002; Voordouw et al., 2009). Colour consistency indicated to consumers that all information presented in that colour referred to allergen information and warranted attention (COI Communications & Creative Research, 2002).

Poor contrast was noted in five studies as a significant barrier to allergen identification (Barnett, Leftwich et al., 2011; Chow, 2011; Parikhal et al., 2018; Voordouw et al., 2009). In particular, consumers noted issues with dark font being used on labels with a dark

⁷ See <https://www.legislation.gov.au/Details/F2014C01178>

background colour, and/or shiny packaging being used alongside white font. These colour schemes were seen to limit consumers' ability to read the statement of ingredients, and in turn identify allergens.

In the aforementioned observational study conducted in Greece and the Netherlands, Voordouw and colleagues (2009) investigated FAI consumers' (doctor or self-diagnosed) preference for allergen labelling in a real shopping environment. Participants reported colour contrast between label and font colour was low on several food packages, either partially or totally inhibiting their ability to identify allergens. Participants also noted food packaging was often shiny, glossy or clear, and, when combined with white font, presented a significant barrier to effective and easy label reading. Consumers expressed frustration at the increased time spent attempting to discern ingredients as a result of poor colour contrast. In Chow's (2011) aforementioned high-quality study, 25% of participants reported (in the survey component) that colour contrast was an area where improvement was needed to enhance identification and comprehension of allergen information.

In the previously mentioned medium-quality government-commissioned UK study (COI Communications & Creative Research, 2002), interview and focus group participants suggested placing allergen information in a different coloured panel if the background colour of the label made it difficult to read the text information. The literature suggests increasing colour contrast (e.g. by using a light font colour when a label's background colour is dark or vice versa) may help overcome some of these consumer-identified formatting issues.

5.1.4 Allergen summary statement in a box

Consumers noted the desire for allergen summary and/or voluntary precautionary statements to be placed in a box (or some other eye-catching shape) in five studies (COI Communications & Creative Research, 2002; Define Research & Insight, 2009; Ju et al 2005; Voordouw et al., 2009; Voordouw et al., 2011). This is in keeping with the theme of distinguishing allergen information for other nutrition information.

In the previously discussed cross-cultural study (Voordouw et al., 2011) examining preferred information strategies for allergen information, survey respondents ($n = 287$ FAIs and parents of food-allergic children) in all countries rated a standardised label to be their preferred information delivery tool. The inclusion of an eye-catching box with a standardised allergen declaration was viewed as an important label element in aiding allergen identification. This high-quality study employed a number of strategies to reduce respondent fatigue and included previously validated items. A pilot study was also conducted and the survey instrument was found to be reliable. While consumer preferences for allergen labelling did not differ profoundly between the three countries sampled (Germany, Greece and the Netherlands), the authors note the participants were not nationally represented in terms of age, gender and socio-economic status (SES).

The Food Standards Agency UK commissioned research to investigate consumer understanding of new labelling requirements for foods marketed to those with gluten sensitivity (Define Research & Insight, 2009). The high-quality qualitative study included 58 participants, including 15 parents of children diagnosed with Coeliac disease and/or gluten sensitivity, and 43 diagnosed Coeliacs, participated in a series of focus groups, paired in-depth interviews, and individual face-to-face interviews. The sampling method in this study aimed to achieve a representative sample by including self and doctor-diagnosed gluten-sensitive or Coeliac participants. Prior to attending the interviews, all participants were asked to keep a three-day food recall to aid researchers in validating data provided during the interviews and focus groups. Face to face interviews were conducted at participants' homes to allow moderators to view the types of foods purchased, and verify the information collected via the recalls. The researchers also accompanied participants on a typical weekly

shop to form a complete understanding of purchasing habits and considerations given their dietary requirements.

Results revealed participants relied heavily on information displayed in the allergen box, particularly in the absence of explicit “free from” claims. Allergy boxes were viewed favourably by consumers, as they were easy to identify, and led to easier and faster decision making.

However, it was important that the information presented in the allergen box be consistent and correct, as some participants expressed frustration with accuracy issues forcing them to read the full statement of ingredients and defeating the purpose of the summary allergen box. While the study made every effort to standardise procedures (e.g. through interviewer training, briefing and debriefing), the majority of Coeliacs recruited for the study were members of a support group (80%) and therefore sampling bias may have occurred.

5.1.5 Percentages in the statement of ingredients

Five studies (Choi & Choi, 2016; NFO Donovan Research, 2004; TNS Social Research, 2009; Voordouw et al., 2009; Voordouw et al., 2011) found a consumer preference for declaring the amount of the allergen present in brackets in the statement of ingredients; e.g. peanuts (2%). This was seen to enable risk assessment, particularly for those who believe they can tolerate trace amounts of an allergen.

Only two of these studies were conducted in Australia or New Zealand. In the aforementioned survey conducted on behalf of FSANZ in 2003 (NFO Donovan Research, 2004), respondents were asked if they had any suggestions for how food labels could be improved to assist in identifying allergens. Respondents were asked to provide free text responses to this question. Six percent of Australian respondents and two percent of New Zealand respondents suggested that all ingredient percentages should be listed on the label (to ascertain the level of the ingredient in the food). Similarly, in the follow-up survey (conducted from November 2008 to April 2009) six percent of Australian respondents and seven percent of New Zealand respondents suggested including percentages for each ingredient (TNS Social Research, 2009).

In Choi and Choi’s (2016) previously-discussed survey of supermarket shoppers (FAIs and members of the general public), respondents reported concern with the exact quantity of the allergen present in a food product, and suggested percentage labelling would enhance transparency.

In Voordouw et al.’s (2009) interview study, some participants (particularly those from Greece) suggested it would be useful to list the percentages of all the ingredients on the food label. They noted that some FAIs can tolerate traces of an allergen, and so if the quantity of the allergen in the food product was small they could potentially eat it.

This desire was also expressed by respondents in the aforementioned survey conducted in Germany, Greece and the Netherlands (Voordouw et al., 2011). The FAIs and parents of food-allergic children in this study rated the option for percentage labelling for allergens significantly higher than either showing percentages of all ingredients in the statement of ingredients, and/or not showing percentages at all. It is important to note the issue of percentages becomes irrelevant when referring to IgE-mediated allergies, as even small quantities of the allergen can trigger a (potentially fatal) reaction.

5.1.6 Allergen symbols

The desire for a universal, harmonised allergen symbol labelling system was noted in 12 studies (Binsfeld et al., 2009; Brown et al., 2015; Chow, 2011; COI Communications & Creative Research, 2002; Define Research & Insight, 2009; Marra et al., 2017; Noimark et al., 2009; Soogali & Soon, 2018; Voordouw et al., 2009; Voordouw et al., 2011; Voordouw et al., 2012). This formatting element was the most frequently cited in the studies included in this review, suggesting it is one of the most popular (cross-cultural) labelling options amongst FAIs and those who shop for them.

The use of symbols has been suggested as a useful aid for children, those who shop for FAIs, vision impaired, and/or consumers from a CALD background (Noimark et al., 2009).

In Voordouw and colleagues' (2011) aforementioned high-quality international study, respondents supported the use of a standardised symbol representing allergy information, located at the front and back of the package. The use of a symbol was seen to be particularly beneficial for small packaging, where small font size limited legibility.

In Brown and colleagues' (2015) aforementioned qualitative study, focus group participants (members of the general public and FAIs) noted symbols would be very useful for those not directly affected by allergy, and those of low English proficiency. Participants did however, acknowledge it would be difficult to introduce a symbol for each potential allergen due to the sheer number that exist.

In the above-mentioned study conducted in the Netherlands and Germany (Voordouw et al., 2012), respondents indicated a preference for symbols, as these were seen to speed up the decision making process. However, this came with the caveat that symbols required explanation if consumers were to use them correctly (e.g. whether a symbol on a food label indicated the presence or absence of an allergen). During the qualitative component of the study, participants were presented with the "ideal label", constructed on the basis of consumer research investigating preferences for allergen labelling. When presented with this ideal label (which included symbols), two research participants stated:

"The symbols are very useful. Although, explanation of the symbols is necessary. Symbols are fast to read".

"For me the symbols are a bit confusing, however after [getting] used to the symbols [they] will be very informative".

Similar results were found in another Voordouw and colleagues' (2009) study conducted in Greece and the Netherlands. In this high-quality study, participants expressed positive views regarding symbolic representation of allergens e.g. a cow's head and glass of milk to represent cow's milk. Some participants did indicate confusion about whether the presence of an egg symbol indicated the presence or absence of egg in the product, and that this should be clarified when symbols are used to display allergen information on food labels. Importantly, symbolic representation was viewed favourably in addition to (but not as a replacement for) text information. Participants ideally wanted symbols to be placed on the front of the food package to act as a first-line alert that would prompt inspection of the allergen box and/or statement of ingredients.

As in the above studies, in the aforementioned UK study (Define Research & Insight, 2009) examining foods marketed as gluten free, participants shopping for those avoiding gluten found the use of symbols aided in their decision-making.

However, Coeliac participants reported confusion over whether the presence of a symbol indicated the presence or absence of gluten without supplementary text information e.g. “gluten free”.

Results from a previously discussed international survey (Soogali & Soon, 2018) revealed 88% of shoppers (FAIs and members of the general public) felt symbols were useful in indicating the presence of allergens, particularly when declaring whether a product was gluten free. Consumers suggested the use of asterisks next to allergens wherever they appeared in the statement of ingredients e.g. sugar, milk*, apple, soy*. Similar to emboldening, this was seen to make allergens easily distinguishable from other ingredients in what can often be an extensive statement of ingredients.

In Chow’s (2011) previously discussed high-quality Canadian study, participants viewed an allergen-free symbol to be an eye-catching cue that drew immediate attention, especially when located on the front of the food package. Symbols were apparently viewed as particularly useful in this study, where participants main labelling concerns (reported by 58%) were terminology related (e.g. complex and vague terms). Whereas in Chow’s (2011) study participants desired a symbol to indicate the product was safe for consumption (e.g. ‘dairy free’ or ‘gluten free’), in the study commissioned on behalf of Food Standards Agency UK (COI Communications & Creative Research, 2002) consumers expressed a preference for the use of symbols as a prominent first line alert the product did contain allergens (e.g. ‘contains nuts’). In the latter study, focus group and interview participants expressed the desire for the symbol to be placed in a prominent and consistent position on the label, ideally at the front, and also next to the allergen summary statement at the back. The sample in this study included a mix of FAIs and those who shop for them (e.g. parents of food-allergic children).

In the aforementioned high-quality experimental study (Marra et al., 2017) label elements (e.g. use of voluntary precautionary statements, symbols, and placement of information) were manipulated and presented to participants ($n = 985$) across 18 choice sets. Responses were used to determine which elements best aided in allergen identification. Data analysis clustered participants into three main groups based on a range of demographic variables. Results revealed participants in two groups – FAIs or those purchasing for an FAI, and older individuals who were not in a partnership, had not completed high school or post-secondary education and who considered allergens for more than one reason (e.g. potentially working in a service industry where allergens may be an issue) preferred the use of allergen declarations (text) in addition to symbols.

Prior to developing the choice sets, a series of focus groups were conducted to determine labelling elements that were most important to consumers when avoiding allergens. It is important to note that participants in the final study were recruited through a market research company’s panel, potentially resulting in selection bias.

Overall, while most consumers (FAIs and those who shop for them) saw benefit in including an allergen symbol, there were some issues noted in the operationalisation of this e.g. whether the presence of a symbol indicated the presence or absence of an allergen. Other issues related to the use of allergen symbols could involve instances where several allergens are present in a single product (whether this would require several symbols that occupy valuable packaging space), and how to best graphically represent certain allergens without a clearly distinguishable appearance e.g. lupin. Further, if symbols were to be introduced, it would be important that these be standardised across products (and potentially countries) to be effective. Consumers’ desire for consistency is noted in every labelling element examined in this review – location, terminology, and formatting, which will be discussed below.

5.2 Consistent Format

There was a strong consumer desire for consistency in formatting of allergen information. This was consistent across FAIs and those who shop for them – both frequently (e.g. parents of food-allergic children), or infrequently (e.g. members of the general public). Consistency was seen to reduce the time taken to identify allergens, particularly if inspecting a new product. Eight studies (Brown et al., 2015; Chow, 2011; COI Communications & Creative Research, 2002; Noimark et al., 2009; TNS BMRB, 2016; Voordouw et al., 2009; Voordouw et al., 2011) suggested consistency in font size, colour, emboldening, and symbol use could aid in allergen identification.

A desire for consistency in formatting even applied across elements within the same label. For example, consumers expressed a desire for emboldening (TNS BMRB, 2016) and the same colour to be used (COI Communications & Creative Research, 2002; Voordouw et al., 2009) when displaying allergen information whenever it appeared on the label (statement of ingredients, allergen summary statement, voluntary precautionary statement). This was seen to reduce identification time, while also alerting consumers to the fact the information was allergen-related.

Consistency across products was also valued. Some studies noted how consistency would facilitate at-a-glance decision-making when confronted with a new product. Consistency was also seen to reduce the likelihood of confusion e.g. over whether the presence of a symbol indicated the product was safe or should be avoided (Voordouw et al., 2009). There is evidence that consistency in formatting may create habitual behaviours in consumers (e.g. mentally associating emboldened font with allergens) that could facilitate faster allergen identification and potentially reduce the number of accidental exposures (Wortman, 2016).

6 Labelling of cereals containing gluten

This section will address what terms gluten-sensitive² consumers and consumers with Coeliac disease⁸ (or those purchasing food for them) find to be the most effective for identifying the presence of gluten in a food.

Key findings:

- Four studies [2 High, 2 Medium quality] examined the labelling of cereals containing gluten. None of these studies were conducted in Australia or New Zealand.
- Two studies [1 High, 1 Medium quality] suggest individuals who believe they are following a gluten free diet (GFD) are not readily able to correctly identify foods that are gluten free based on current labelling practices. This presents a safety concern, as well as potential labelling issues. These studies suggest highly processed packaged foods are the hardest for gluten-sensitive consumers to identify, presumably due to terminology issues and the use of an extensive statement of ingredients.
- Terminology issues were noted in one qualitative study [High quality], with the use of scientific names viewed by participants as misleading and ambiguous, and leaving them uncertain of the safety of certain ingredients e.g. Barley Malt Extract.
- In three [2 High, 1 Medium quality] studies, consumers expressed a desire for the word 'gluten' to appear somewhere on the label. This was seen to be especially important for consumers with non-coeliac gluten sensitivity, those newly diagnosed

⁸ The Code requirements are established to enable people with Coeliac disease and dermatitis herpetiformis (not those with gluten sensitivity) to make safe food choices.

with Coeliac disease, CALD, and younger consumers, as well as for those who may be shopping for someone that has a dietary requirement to avoid gluten. The word 'gluten' on the label was less important for consumers who had more experience living with a diagnosis of Coeliac disease

- No studies examined whether gluten-sensitive consumers, wheat allergic consumers, or those purchasing food for them required the specific cereal name (e.g. barley) to be declared on the label when trying to identify the presence of gluten. However, extrapolating from prior findings discussing the consumer preference for specificity in terminology (see section 4), it can be assumed that a greater level of detail is desired. Previously discussed research has found consumers are more readily able to identify source ingredients, and express a desire for ingredient names to be as specific and transparent as possible to reduce ambiguity.

6.1 Terminology in declaring gluten

Four studies (Define Research & Insight, 2009; Silvester, Weiten, Graff, Walker, & Duerksen, 2016; Verrill et al., 2013; Zarkadas et al., 2013) included in this review examined the labelling of cereals containing gluten. None of these studies were conducted in Australia and/or New Zealand, demonstrating a need for local research in this area. Despite the different products available and labelling legislation overseas, the four studies included were conducted in English-speaking countries (Canada, the US, and the UK). Therefore, results may extrapolate to an Australian and/or New Zealand context, where the stimuli customers are presented with would be similar.

Two studies (Silvester et al., 2016; Zarkadas et al., 2013) suggest individuals who believe they are following a gluten free diet (GFD) are not readily able to correctly identify foods that are gluten free. In Silvester and colleagues' (2016) medium-quality Canadian study, a list of foods (the Gluten-Free Diet Knowledge Scale) was presented to participants. Seven of these were foods permitted on a GFD (e.g. milk), seven were ambiguous (but not permitted) (e.g. croutons), and three were clearly not gluten free (e.g. spelt). Adults trying to follow a GFD were recruited through a local Coeliac support group, specialist clinics and advertisements at retail locations specialising in gluten free products. Those who reported having a medical diagnosis of Coeliac disease and/or dermatitis herpetiformis were invited to access an anonymous online questionnaire, which included a labelling task.

None of the participants ($n = 82$) correctly classified all foods on the GFD-KS. Of the incorrect responses, 22% of decisions would put participants at risk of consuming gluten containing food, and 78% at risk of unnecessarily restricting a food. Both results are associated with adverse health outcomes. Over 95% of participants correctly classified milk and chickpea flour as gluten free. Only 73% correctly identified spelt as a gluten containing grain. Croutons, imitation seafood, and rice crisp cereal were amongst the foods most commonly misclassified. The gluten free foods most commonly questioned and/or unnecessarily restricted included corn starch⁹ (39%), cocoa (33%), and glutinous rice (32%). These findings suggest that people following a GFD would have trouble assessing whether some ingredients that appear in a statement of ingredients (e.g. spelt flour) are gluten free or not. Including the term 'gluten' either in connection with these ingredients (e.g. 'spelt flour (gluten)' in the statement of ingredients) or in an allergen summary statement may assist with this lack of knowledge.

⁹ The study did not specify whether this referred to corn-based corn starch.

While the questionnaire was developed by an expert panel based on previously validated items, the small sample size limited the statistical analyses that could be performed. External validity was also restricted as a result of small sample size. Self-selection into the process may have resulted in sampling bias.

In Zarkadas and colleagues' (2013) Canadian survey, respondents were asked to review a list of 15 foods and ingredients and identify those that were not permissible on a GFD. Only 49% of respondents correctly identified all items. The strategy respondents reported they would most use (96%) in making their determination when unsure included reading every ingredient on the statement of ingredients of packaged foods. This large-scale survey included 5912 FAIs, recruited from two Coeliac associations across the country. The questionnaire was developed by a range of professional bodies and data was analysed by subject matter experts.

While the sample was recruited to be representative of the Canadian gluten-sensitive and Coeliac populations, sampling bias may have influenced results as respondents were members of support groups and may have been more motivated to participate. The high response rate of 72% supports this notion. It was not revealed which terms were specifically tested on the stimuli.

Interestingly, in this study, the most commonly reported (79%) difficulty in adhering to a GFD was the absence of the word 'gluten' on some gluten containing products that were deemed to be ambiguous. Sixty nine percent of participants also reported travelling was difficult due to the term 'gluten' not being easily identifiable on some foreign labels. In fact, in three (Define Research & Insight, 2009; Verrill et al., 2013; Zarkadas et al., 2013) of the four relevant studies examining cereals containing gluten, consumers expressed a desire for the word 'gluten' to appear somewhere on the label. In a large scale US study (Verrill et al., 2013) examining food label usage, on average adults with non-coeliac gluten sensitivity reported slightly more difficulty following a GFD than those with Coeliac disease. Factors associated with difficulty following a GFD included consuming more packaged processed foods and searching for gluten free claims more often. Reading the entire food label was related to less reported difficulty following the GFD. The authors conclude that respondents with non-coeliac gluten sensitivity may rely more heavily on the gluten free claims for information about a product's gluten content. Whereas individuals with Coeliac disease may be more experienced food label readers, and so may tend to rely on the statement of ingredients to identify the presence of gluten.

FAI respondents ($n = 1583$ Coeliac and $n = 797$ non-coeliac gluten sensitivity) were recruited using purposive sampling methods (Verrill et al., 2013). Only respondents who indicated Coeliac disease diagnosis by biopsy of the small intestine were included in the Coeliac disease group. All other respondents were classed as having non-coeliac gluten sensitivity. While the large sample was geographically dispersed and recruited to be as representative as possible in terms of age, gender and ethnicity, reporting, social desirability and sampling bias may have influenced results. The study also failed to obtain the views of those purchasing for FAIs.

Overall, results suggest the inclusion of the word 'gluten' may assist those who have difficulty determining whether certain processed, packaged foods (often with an extensive and complex statement of ingredients) are safe to consume. This may be especially beneficial for CALD, those less literate and/or newly diagnosed FAIs, who may still be educating themselves on which ingredients must be avoided.

It may be that those with Coeliac disease and/or those who have been following a GFD for a longer period of time have a greater level of knowledge and/or practice in identifying gluten containing cereals on a food label. These consumers may therefore be less reliant on the

inclusion of the word 'gluten' in determining whether a product is safe for consumption. Nevertheless, the mention of the word 'gluten' somewhere on the label is still preferred by the majority of consumers, as it is seen to speed up the process of allergen identification.

Supporting Verrill and colleagues' (2013) findings, an aforementioned qualitative UK study found most participants did not feel confident enough to simply rely on reading the products' composition, and preferred to have some mention of 'gluten'. The mention of the word 'gluten' was important in confirming its presence (e.g. 'contains gluten') or its absence (e.g. 'gluten free'). As with the terminology issues noted for other allergens in section 4 of this review, the use of scientific terms to describe ingredients containing gluten was viewed by participants as misleading and ambiguous. This study did include the views of those shopping for an FAI ($n = 15$ parents of children adhering to a GFD), in addition to adults with Coeliac disease ($n = 43$).

Many research participants expressed a preference for products that carried a 'gluten free' claim due to the certainty this provided. However, there was a view among some participants that these products were unnecessarily more expensive than their 'ordinary' counterparts. This belief guided some focus group and interview participants to opt for 'ordinary' gluten free foods that were not marketed as such. Participants claimed that in the absence of 'gluten free' claim, they relied heavily on the information provided elsewhere on the label e.g. an allergy advice box or the statement of ingredients to determine its presence in a product.

6.2 Specifying gluten source

No studies were identified examining whether non-Coeliac gluten sensitive consumers or Coeliac consumers (or those purchasing food for them) required the specific cereal name (e.g. barley) declared on the label to identify the presence of gluten. However, extrapolating from prior findings discussing the consumer preference for specificity in terminology (see section 4 on terminology), it can be assumed that a greater level of detail is desired.

Previously discussed research has found consumers are more readily able to identify source ingredients, and express a desire for ingredient names to be as specific and transparent as possible to reduce ambiguity.

7 Limitations

7.1 Location of research

Just four studies (Henderson, 2003; Hu et al., 2007; NFO Donovan Research, 2004; TNS Social Research, 2009) in this review were conducted in Australia or New Zealand. This gap was particularly noticeable in relation to terminology for declaring gluten containing cereals. No Australian or New Zealand research was identified which examined this issue.

However, the majority of international studies were conducted in English speaking countries (e.g. United States, United Kingdom, Canada). Although these countries have different labelling regulations, consumers in Australia and New Zealand are likely to have the same understanding (or misunderstanding) of terminology used in food labelling. Therefore FSANZ considers the findings of these studies to be relevant to the Australia and New Zealand setting.

In addition, the impacts of formatting factors (e.g. font size, boldening) are likely to be similar across countries (even non-English speaking countries).

7.2 Research design

Many of the studies described in this literature review relied on self-report through surveys, focus groups and interviews. Where participants were asked to recall their past behaviour or experiences with food labels, the results may be affected by recall bias. Participants may forget some of their past experiences or behaviours (and so not report these in the survey).

Further, social desirability may be an issue when using survey or interview methodology to collect information on behaviours regarding allergen avoidance. It may be the case that some FAIs are reluctant to admit when they are engaging in risk-taking behaviours (e.g. purchasing and consuming products despite not being convinced they are allergen-free). For example Chow (2011) found that FAIs and those that shop for them tend to over report how often they check food labels for allergens.

As noted throughout the literature review, many of these surveys ask respondents about their preferences for allergen labelling. The results of these surveys provide a good indication of consumers' preferences. But preferences for changes to food labels (e.g. emboldening, declaring the source allergen) do not necessarily mean that such changes will improve consumers' ability to accurately identify allergens.

Stronger evidence for the impact of changes to allergen labelling comes from experiments. For example, Parikh et al. (2018) tested the impact of an allergen summary statement on the time taken to evaluate whether a food was safe for someone with a nut allergy. Six experiments were included in this literature review (Binsfeld et al., 2009; Joshi et al., 2002; Marra et al., 2017; Parikh et al., 2018; Sakellariou et al., 2010; Weber et al., 2007).

An issue with most of the research designs included in this literature review is that participants are likely to make more careful evaluations of whether an allergen is present in a study situation. This can occur for a range of reasons. For example, participants may have more time to evaluate food labels in a survey or experiment than they would in a normal shopping trip. They are also likely to face fewer distractions while participating in the research study compared to a supermarket environment. They may wish to appear careful and knowledgeable about allergen labelling to the researchers, and therefore take more time and care in evaluating food labels. In some studies participants were compensated for their time and this may have further encouraged them to make careful evaluations. However, despite the extra time and care participants may have taken in these studies, errors (where allergens were missed or safe foods were classified as unsafe) were still common among participants. These are likely to be even more common in real life shopping environments.

7.3 Research participants

Many of the studies included in this literature only included FAIs or those who regularly buy food for them (e.g. a parent or a partner). It is important that food labels are designed with these frequent allergen labelling users in mind. However, it is also important that those who do not use allergen labelling frequently can make accurate evaluations. For example, a grandparent temporarily caring for a grandchild with a food allergy or a person inviting friends with food allergies to dinner should be able to identify whether a particular allergen is present in a packaged food. Few studies in this literature review included participants who were not FAIs or people who buy food for them. It is likely that people who do not use allergen labelling regularly would be less accurate in their evaluations and take longer to make them. However, many of the potential improvements described in this literature review (e.g. declaring the source allergen) are likely to also assist less frequent allergen labelling users as well.

8 Discussion

This literature review provides a broad analysis of available evidence in Australia, New Zealand and internationally regarding consumer awareness, attitudes, preferences, understanding and behaviours related to allergen labelling on food products. Conducted as part of a broader program of work, this review examines the evidence for both mandatory and voluntary labelling, as well as how these elements may assist or restrict consumers' ability to identify and choose foods and beverages based on their dietary restrictions. A total of 34 articles were included. The bulk of the research identified examined consumer preferences and was collected using survey or interview methodology.

The primary focus of this review was use, preference and understanding of allergen labelling in Australian and New Zealand contexts. However, Australian and New Zealand research is limited in these areas and tends to be older. For this reason, international research has been included. Although the international research provides additional insights, differences in food regulation, labelling, culture and diet mean that some results may not be readily generalisable to Australian and New Zealand contexts.

Nevertheless, overall the research appears united in that consumers (in Australia, New Zealand and internationally) appear to be dissatisfied with current allergen food labelling regulation and practice. Food allergic individuals and those who either frequently or infrequently purchase food for them reported confusion and frustration at inconsistencies and ambiguities in labelling practices, particularly relating to location of allergen information, terminology being too vague or too technical to understand, formatting issues, and failures to list the source allergens (e.g. 'almond' versus 'tree nut'). These labelling issues may result in either overly cautious or risk-taking behaviour, with the latter having potentially fatal consequences. Overly cautious behaviour may further restrict dietary choices for a population that already has a limited diet, and runs contrary to the Australia Dietary Guidelines (2013) which recommend food variety for optimal health and wellbeing.

In his review of Food Drug Administration (FDA) related food product recalls, Demkin (2017) found that inconsistencies in displaying allergen information on food labels led to consumer confusion about which elements were mandatory and which were voluntary. For example, many consumers report being unaware emboldening of allergen declarations is optional, and if bold text is not apparent, then they may incorrectly assume the product is safe to consume. Clearly this poses a major food safety concern. The paper concludes with the argument that greater government regulation is necessary for allergen labelling, as if left to industry to implement on a voluntary basis, inconsistencies will continue.

It may be these frustrations that are leading consumers to disregard food labels when making allergen risk-assessment decisions. In a survey conducted in the UK, Cochrane and colleagues (2013) found that only 4% of FAIs, and 53% of those purchasing for an FAI reported always reading product labels, although this did increase to 82% and 84% respectively for new products. It may be that FAIs are more willing to engage in risk-taking behaviour when purchasing for themselves, as opposed to those shopping for FAIs, who are more cautious. In the latter scenario, the adverse implications of making a purchasing error (i.e., purchasing a product that is not safe for FAI consumption) will affect another person, often a child (Cochrane et al., 2013). These findings also suggest consumers are more wary when purchasing a food item for the first time (examining the label as part of their risk-assessment decision), and become more lax as they become familiar with the product.

Other literature has found that consumers are much more likely to inspect the statement of ingredients of a product when reviewing it for the first time. In a Canadian study (Gardiner, 2014), an experimental design was used to test the implication of repeated readings of the

statement of ingredients on food labels for food safety judgements. Results revealed participants were much more likely to refer to the statement of ingredients (and endure the time burden) when shown a product for the first time. After several exposures to the same product, participants tended to rely on memory and product familiarity in making their judgements, and as a result did not feel inspecting label elements was necessary. This has potential safety implications when applied to allergen detection, particularly when a product that was once safe to consume is reformulated. Under current labelling regulations (Food Standards Australia New Zealand, 2010), there is no mandatory requirement to notify consumers anywhere on the food label when a recipe is changed. Consumers must rely on allergen declarations, which are usually made in the statement of ingredients or in an allergen summary statement.

Despite being frustrated by current labelling practices, consumers in these studies would appear to still prefer food labelling as their primary source of allergen information. In a qualitative cross-cultural study by Cornelisse-Vermaat and colleagues (2008), the standardised food label was the preferred method of information delivery in all focus groups (82%). This was predominantly attributed to legal reasons, and the fact that reading food labels was viewed as the simplest, most feasible and practical option for communicating allergen information when compared to alternative options (an electronic personal shopping assistant, a handheld scanner, information booklets, an information terminal in the supermarket, an allergen-free aisle in the supermarket, staff training and education, and/or internet shopping).

Studies on the location of allergen information demonstrated a consumer preference (both in FAIs and those who shop for them) for an allergen summary statement in addition to allergen information being displayed in the statement of ingredients. Experimental evidence indicates allergen summary statements can reduce the time needed to evaluate whether a food is safe for someone with an allergy to eat and may improve the accuracy of these evaluations. Consumers expressed a preference for the allergen summary statement to be located either adjacent to, or above, the statement of ingredients, not below it where it could be easily missed. This desire appears to be cross-cultural, with several international studies finding similar results. In a review of European allergen labelling practices, Hendricks and colleagues (2011) concluded that consumers often missed allergen summary statements when located some distance from the statement of ingredients.

Vague (generic), overly technical and inconsistent terminology is perhaps the biggest concern regarding allergen labelling in both FAIs and those who purchase for them. These terminology issues were noted in 24 studies included in this review.

Studies found a lack of consistency in terminology used across food labels, and/or amongst terms used on different elements of the same label (e.g. in the allergen summary statement and statement of ingredients). Echoing the findings from the aforementioned FSANZ report (2016), 15 studies found a strong consumer preference for the use of plain English allergen labelling. In these studies, consumers reported not understanding many of the technical, scientific terms used to describe common allergens (e.g. casein for milk or ovalbumin for egg). This appeared to be the case both for FAIs and those who either frequently, or infrequently shop for them.

However, experienced label readers did appear to make fewer allergen identification errors in the limited number of studies that incorporated a label identifying task. The research suggests that repeated label reading may be more beneficial than formal education (e.g. nutrition counselling through an allergy clinic or support group) in learning to identify allergens declared using complex terminology. However, noteworthy is the fact that familiarity with a product may lower the likelihood of label reading. This could have dire

safety implications when products change formulation (Barnett, Leftwich et al., 2011). In addition, errors were still common among experienced label readers.

The use of general, vague terminology to declare certain allergens has also been noted as an issue causing consumer confusion and frustration. In their cross-cultural review of allergen labelling, Brough and colleagues (2015) noted the general, vague terminology used to describe peanuts (a legume) and tree nuts caused consumer confusion and excessive avoidance practices. The authors used the example of 'nuts' being declared as an allergen, and confusing consumers into believing they must avoid all foods that contain the word 'nut' e.g. nutmeg, butternut pumpkin, palm nuts etc.

In nine studies identified in this review, consumers expressed a strong preference for the source allergen/ingredient to be identified whenever allergen information was presented (e.g. in the statement of ingredients *and* allergen summary statement). This was particularly the case (mentioned in five studies) for specifying the type of nut included in a product e.g. 'almond', as opposed to the current use of generic terms such as 'tree nuts'. Another cross-cultural review of allergen labelling (van Hengel, 2007) concluded the use of specific, plain language should be applied to all label elements where allergens are declared (e.g. allergen summary statement and statement of ingredients).

As with location and terminology used in declaring allergens, formatting appeared to be another label element where consumers expressed a desire for greater consistency (mentioned in nine studies in this review). Eight strong themes emerged from the existing literature surrounding formatting of allergen information - a desire (and in some cases demonstrated efficacy) for: consistency, large font size, coloured font for allergens, high contrast between allergen information and the background label colour, the use of symbols, listing the percentage amount of the allergen present, the boldening of allergens in the statement of ingredients and allergen summary statement, and placing the allergen summary statement in a box/attention-grabbing shape.

Many of these factors were also identified in a FSANZ-commissioned review of the impact of label format on consumers' attention and comprehension of label elements (Instinct and Reason, 2013). The use of a symbol was considered especially important for Coeliac and gluten-sensitive consumers (and those shopping for them) to indicate a product was gluten free.

This review examined consumer preferences for terminology concerning cereals containing gluten separately, as this issue emerged as a separate topic in stakeholder submissions during the 2016 W1070 project¹. In a UK survey of FAIs avoiding gluten, 73% of respondents who reported not understanding food labels were classified as not adhering to a gluten free diet, when compared to 45% of respondents who reported understanding food labels. Findings from this study highlight the importance of labelling in guiding FAIs food purchase and consumption decisions. However, consumers having to follow a GFD report dissatisfaction with current labelling practices. Results from a New Zealand Coeliac Health Survey (Sharp, 2013) revealed 73.2% of respondents found it was occasionally difficult to determine if foods were gluten free just from reading the labels.

While there is limited literature concerning the declaration of gluten-containing cereals, the four relevant studies included in this review suggest gluten-sensitive consumers, those purchasing for them, or those newly diagnosed rely heavily on the inclusion of the word 'gluten' somewhere on the label. This is in addition to the source of the cereal still being identified in the statement of ingredients, as the consumer desire for specificity extends to gluten containing cereals. Specifying the allergen source conveys to consumers that the allergen content of the food product has been assessed and considered by the manufacturer.

Despite its broad scope, several areas that may provide important insights may not have been captured in this review. For example, there are many factors involved in shopping and consumption decisions. These may be factors such as: shopping time, habit, taste preferences, heuristics, price, brand loyalty, and motivation. It is important to understand the context of label use; such as whether consumers only use labels (and allergen information) when purchasing an item for the first time. If consumers are not checking nutrition labels for frequently purchased items (after first purchase), labelling may have a lesser effect than intended on consumer use of allergen information. Therefore, it may be that factors not explored within this literature review provide additional (potentially better) insights into consumer use and understanding of allergen labelling. In addition, the effect of other factors (e.g. susceptibility to take risks) may have a greater impact on behaviour than the effect of information communicated via labelling.

A further limitation of this review is that prior research has shown self-reported use of nutrition labels (e.g. through focus group and survey methodology) does not always align with actual use (e.g. measured through real shopping experiences and eye-tracking studies). This may mean that some findings may not translate to real world behaviours and purchase decisions. Nevertheless, the findings of this review add to current knowledge of consumer preferences for how allergen information is displayed on food labels, and has identified certain gaps in the existing literature.

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Appendix 1: Literature Review Method

Search strategy

Six separate online database searches were undertaken using simple Boolean search term combinations. Grey literature was also searched using Google Scholar.

Online database searches

Databases searched were: PubMed, Science Direct, Food Science Source, FSTA - Food Science and Technology Abstracts, MEDLINE with Full Text and SocINDEX with Full Text. The search included articles published in English between January 2002 and 3 August 2018 (the date searching was undertaken). Based on previous peer-review feedback, only one search string was used to conduct the major search. This was:

TI(allerg* OR gluten* OR intoler* OR celiac*) AND AB((allerg* OR gluten* OR intoler* OR celiac) AND (consumer* OR people OR person OR "allergen sensitive consumer" OR babysitter OR "baby sitter" OR "baby-sitter" OR parent* OR adult* OR infant* OR baby OR babies OR child* OR infant* OR pediat* OR teenager* OR adolescent* OR caregiver* OR "care giver" OR "care-giver" OR individual) AND (label* OR pack* OR list* OR claim* OR contain* OR "ingredient list" OR "ingredients lists" OR "ingredient lists" OR "summary statement" OR "nutrition facts" OR "nutrition information" OR "back of pack" OR "back-of-pack") AND (understand* OR interpret* OR aware* OR decid* OR use* OR usable* OR choos* OR choic* OR buy OR purchas* OR select* OR inten* OR prefer* OR pick* OR behav*))¹⁰

The first 2000 results (out of a total of 3000) returned by the search strings were exported and screened for relevant articles.

Other sources

To ensure the literature review was as thorough as practicable, the following additional searches were performed:

- FSANZ consumer research reports and literature reviews, including those commissioned
- FSANZ Behaviour and Regulatory Analysis section bibliographic database (target searches for "allergy labelling" and "gluten")
- The reference lists of identified relevant papers were hand-searched to identify additional relevant studies
- Articles that were relevant to the subject matter but failed to directly answer the social science questions were included in the introduction, discussion and summary table (not the body of the review and no quality assessment)

¹⁰ 'AB' = term is required in the abstract of articles searched. 'TI' = term to appear in the title of articles searched.

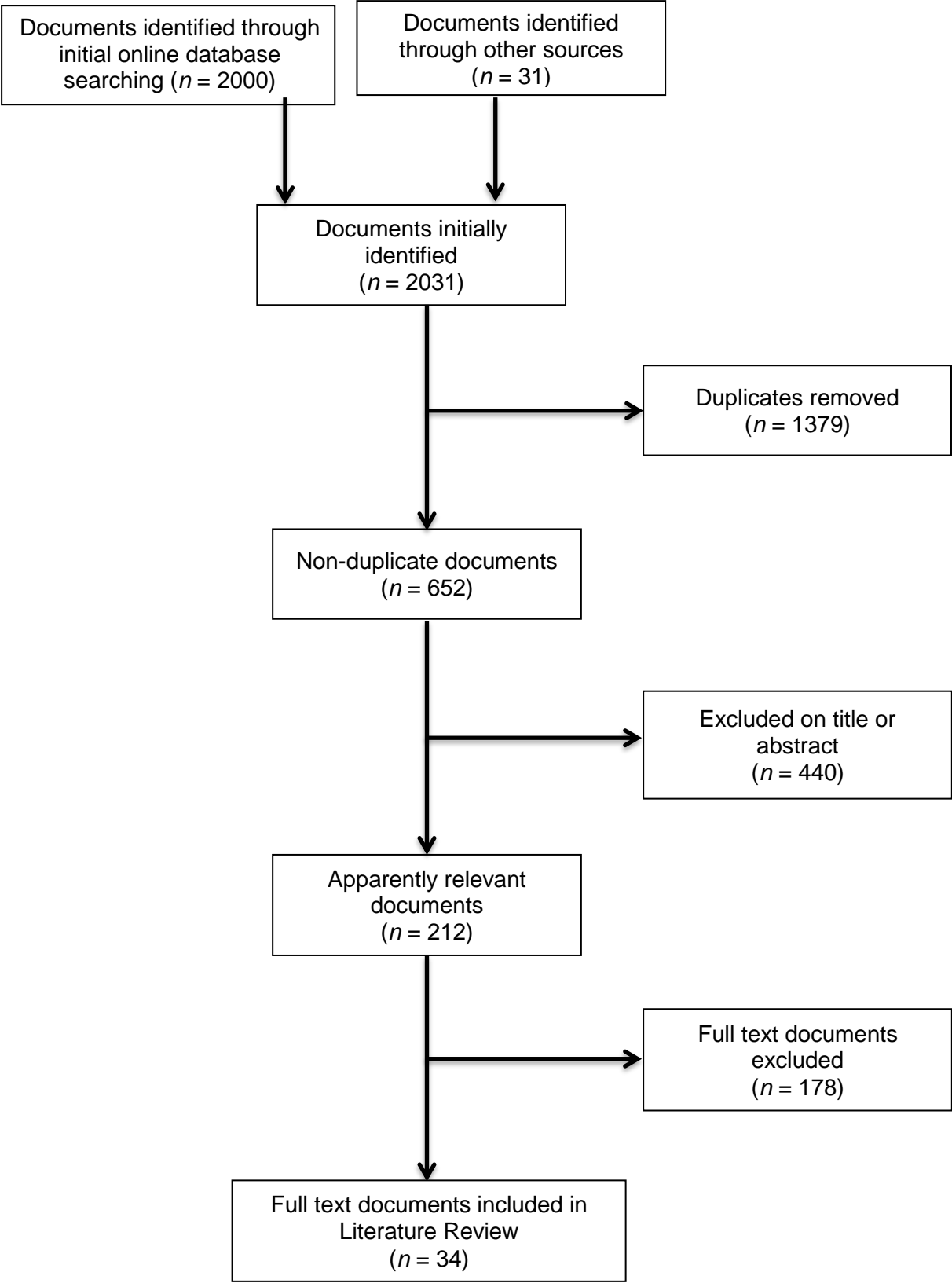


Figure A1.1: Number of documents retrieved at various stages of the review process

Appendix 2: Summary of studies used

Table A2.1 Overview of key features of studies

NB: Some studies included in this table are only used in the discussion or introduction to this literature review and therefore are not part of the 34 allergen labelling studies used in the body of the review.

Authors	Country	Study type	Products/Stimuli	Relevant outcome measure(s)
Barnett et al. (2011a) How do peanut and nut-allergic consumers use information on the packaging to avoid allergens?	United Kingdom	Observational and semi-structured interview	All packaged foods (potential purchases) examined by participants while shopping at their local grocery store that bear a label and may contain traces of peanuts and nuts	<p>Some participants used the statement of ingredients alone as their primary check for allergens, but most used the allergy advice box, or a combination of the two. Allergy declarations were deemed easier to read than the statement of ingredients. The concise summary of allergens was welcomed, however the lack of detail (e.g. no elaboration on which type of nut was present) was disliked, particularly for products considered foreign.</p> <p>Participants disliked allergens being listed at the end of often an extensive statement of ingredients due to their minor (albeit significant) presence in a product.</p> <p>Participants expressed frustration with the small font size of the statement of ingredients and poor contrast between text and background.</p> <p>A desire for allergens within statement of ingredients to be bolded and in colour so as to stand out was expressed.</p> <p>Where the first-line strategy (examination of product by type or brand name) did not lead to a confident decision, participants used other printed packet information such as the statement of ingredients. Images and products names (not intended by manufacturers as a risk assessment aid) were used to draw inferences about the presence of nuts.</p> <p>Participants preferred labelling was clear in its indication of nuts in the statement of ingredients combined with a 'nut free' or 'contains nuts' label to prompt inspection of the statement of ingredients.</p>

Authors	Country	Study type	Products/Stimuli	Relevant outcome measure(s)
Barnett et al. (2011b) Using 'may contain' labelling to inform food choice: A qualitative study of nut allergic consumers	United Kingdom	Observational and semi-structured interview (qualitative)	Natural observation – included all packaged foods examined by participants while shopping at their local grocery store	<p>Clear nut warnings were seen to convey the message the nut content of food products had been assessed and considered by the manufacturer. More specific wording (e.g. reference to the type of nut) indicated there is some particular knowledge by the manufacturer about the increased risk of the presence of allergens and participants were more likely to take precautionary action accordingly.</p> <p>There was evidence that variation in labelling wording played a role in leading nut allergic individuals to choose or reject foods on the basis of minor (and often meaningless) variations.</p> <p>The authors suggest that standardised wording may be usefully backed up by legislation.</p>
Binsfeld et al. (2009) Knowledge of industrialized dairy product labels by parents of patients allergic to cow's milk	Brazil	Label identifying task (experiment) followed by structured interviews	<p>12 grocery labels of common products containing different terminology used to identify cow's milk/ingredients derived from cow's milk</p> <p>4 terms tested: lactose, casein, caseinate, and whey protein</p> <p>9 ingredient names tested: powdered milk, skim milk, milk whey, milk protein, butter serum, cheese, lactose, hydrolysed casein and caseinate</p>	<p>48.1% of participants reported having doubts when reading the label.</p> <p>55.8% of the participants correctly identified lactose and 53.8% identified milk. 38.5% identified milk whey, 36.5% cheese/cream cheese, 26.9% casein, 13.5% milk protein, 7.7% traces of milk, and a much smaller percentage identified caseinate and butter (only 5.8% for both terms) on all labels that included these terms. Only one participant correctly identified all terms.</p> <p>Considering all patients in the trial had received medical and nutritional guidance, the percentages of correct answers were lower than expected, revealing poor retention of information provided and therefore a strong need for clearer labelling.</p> <p>Many parents also reported difficulty locating the statement of ingredients, and so relying on the front of pack general label. When they did find the statement of ingredients, they struggled with its the small font size and extensive length.</p> <p>The authors suggest the statement of ingredients uses large font, present objective information in easily understandable language. A mandatory warning and universal symbol are also proposed.</p>
Brough et al. (2015) Dietary management of peanut and tree nut allergy: What exactly should patients avoid?	EU, UK and USA	Literature review	N/A	<p>The general, vague terminology used to describe peanut and tree nuts can cause confusion and excessive avoidance practices e.g. it is common for people to restrict any foods that contains the word "nut" – nutmeg, butternut, water chestnuts, palm nuts – even if they are non-allergenic. Another misconception occurs with fruits that have stones that may be misclassified as nuts e.g. peach, plum. Peanuts are referred to as 'ground nuts' or 'monkey nuts'.</p>

Authors	Country	Study type	Products/Stimuli	Relevant outcome measure(s)
				Consumers expressed a desire for clear labelling of food products with potential allergen contamination, so they can make an informed choice about level of risk they are willing to assume.
Brown et al. (2015) Canadian policy on food allergen labelling: Consumers' perspectives regarding unmet needs	Canada	Focus groups	All frequently purchased grocery items that bear a label and may/may not contain allergens	<p>Clear "Contains", "Allergen-free", and "Does not contain" statements were preferred to PAL.</p> <p>Symbols were deemed to be very useful for those not directly affected by allergy and for those with low English proficiency. Participants did acknowledge it would be difficult to include a symbol for each potential allergen due to the sheer number.</p> <p>Participants from the general public preferred allergen information to be located on the front of package, while those directly affected preferred it to be near the statement of ingredients.</p> <p>Both groups wished for labels to be legible and easy to read. Standardising terminology, allergen information placement, and formatting of symbols was also stressed.</p>
Choi & Choi (2016) Perception of food labelling about allergens in food products in South Korea	South Korea	Survey	All food items bearing a label that may contain potential allergens. Questions related to labelling elements.	<p>Most respondents agreed improvement was needed in allergen labelling.</p> <p>Respondents reported food allergen font, colour and size needed to be improved to distinguish it from general nutrition information.</p> <p>Respondents desired a mandatory bolded allergen cautionary statement, and reported frustration at the current location of allergen information, which is often under the nutrition information and difficult to identify.</p> <p>Respondents were concerned with the exact quantity of the allergen present in the food product, suggesting the need for a (%) behind each allergen.</p> <p>These responses were consistent amongst those purchasing for themselves or others, and those with a previous or no previous history of allergic reaction.</p>

Authors	Country	Study type	Products/Stimuli	Relevant outcome measure(s)
<p>Chow (2011)</p> <p>Everybody else got to have this cookie: The effects of food allergen labels on the well-being of Canadians</p>	Canada	Survey and accompanied shop/interview	Items bearing a label the participants chose to purchase at the grocery store	<p>Most participants searched for allergen warnings as the primary source of information, followed by the statement of ingredients. Participants trusted allergen free and contains claims more than precautionary allergen labelling.</p> <p>Allergen warnings (e.g. allergen summary statements) were viewed as an indication of the company's awareness of food allergies, and their commitment to adopting good manufacturing practices.</p> <p>An allergen-free logo was found to be an eye catching cue that drew immediate attention.</p> <p>The most frequently voiced concerns were terminology related (58%). Hidden ingredients and words not being in lay terms (e.g. spices) was an issue.</p> <p>25% reported small font sizes, 8% reported inconsistent labels, and 42% reported location of allergen information. When asked to report where improvements could be made: 58% reported font size and bold text in the statement of ingredients, 33% reported consistent labels, location of allergen information, stricter regulations, 25% reported other and colour contrast, and 8% reported identifying tree nut type in labels.</p>
<p>Cochrane et al. (2013)</p> <p>Characteristics and purchasing behaviours of food-allergic consumers and those who buy for them in Great Britain</p>	Great Britain	Survey	<p>Food products bearing a label and commonly purchased as part of a routine supermarket shop</p> <p>14 allergens examined: milk, egg, fish, crustacean, molluscs, lupin, peanuts, tree nuts, cereals containing gluten, sesame, soya, celery, mustard and sulphites and their derivatives (unless specifically exempted) when used as ingredients in pre-packed foods</p>	<p>27% of respondents buy products with a cautionary statement if the allergen is not listed as an ingredient in the statement of ingredients, and 8% if they regularly purchase the product without reaction.</p> <p>There was a significant association between severity of symptoms and more cautious purchasing behaviours e.g. always reading the label.</p> <p>Only 4% of FAls and 53% of those buying for another reported always reading product labels, although this did increase to 82% and 84% respectively for new products.</p>

Authors	Country	Study type	Products/Stimuli	Relevant outcome measure(s)
<p>COI Communications on behalf of Food Standards Agency UK (2002)</p> <p>Nut allergy labelling – report of research into the consumer response</p>	<p>United Kingdom</p>	<p>Individual interviews and focus groups</p>	<p>Common foods found in the respondents' houses that bear a label</p>	<p>In making decisions about whether to purchase a product, the food label was the most relied upon method, as it was perceived to be the most up to date source of information.</p> <p>Participants gave support for greater standardisation across allergen labelling (both content and format of presentation).</p> <p>A symbol as a prominent first line alert (placed in a prominent and consistent position on the label – ideally the front and the back of the pack next to the cautionary statement) was also suggested, with the text "Take Care - Nuts". Greater visibility was desired for the three main components considered essential to a food allergic individual (symbol, nutrition table with statement of ingredients, and allergen summary statement or warning), all in a consistent position.</p> <p>Participants desired more simpler and definitive wording in the form of an allergen summary statement e.g. "contains nuts", with reference to the species of nut in the statement of ingredients and highlighted. The allergen summary statement was desired to be positioned above or to the left of the statement of ingredients, not below it.</p> <p>Participants suggested placing allergen information in a different coloured panel if the colour of the packaging makes it difficult to distinguish from other information.</p> <p>They desired a consistent colour used for the statement of ingredients, symbol, and cautionary statement as an alert this all referred to allergen information.</p> <p>The requested font size be large enough for those to read without glasses, and use a mix of upper and lower case.</p>

Authors	Country	Study type	Products/Stimuli	Relevant outcome measure(s)
<p>Cornelisse-Vermaat et al. (2008)</p> <p>The information needs and labelling preferences of food allergic consumers: The views of stakeholders regarding information scenarios</p>	<p>Netherlands, Greece, Germany, Spain and Portugal</p>	<p>Focus Groups</p>	<p>Information delivery methods tested: 1) Personal shopping assistant – small computer with information database on allergic details; 2) Handheld scanner to obtain ingredients/allergen info; 3) Information terminal in the supermarket; 4) Information booklets; 5) Special aisle for allergen-free products; 6) Training of staff; 7) Internet Shop; 8) Standardised labelling/and or symbols – allergy information located close to the statement of ingredients, universally recognised symbols located on the front of pack of the product</p>	<p>The standardised label was the most preferred method of information delivery in all focus group meetings (82%).</p> <p>This was predominantly attributed to legal reasons, and for all participants, labels are of key importance in provision of information for food allergic consumers.</p> <p>Participants suggested developing and implementing internationally recognised rules for labelling – although stakeholders from the food industry expressed difficulties with adding symbols to existing food labels (limited space, should not substitute written text).</p> <p>The costs for implementing new labelling strategies were thought to be relatively high.</p> <p>Industry expressed reluctance to implement these changes voluntarily, unless enforced via legislation.</p>
<p>Creative Research on behalf of Food Standards Agency UK (2015)</p> <p>Understanding of food labelling terms used to indicate the absence or reduction of lactose, milk or dairy</p>	<p>United Kingdom</p>	<p>A mix of telephone and face-to-face interviews</p>	<p>Packaged products that bear a label and that contained milk/milk by-products</p> <p>The terms: 'lactose', 'milk' and 'dairy' were examined</p>	<p>Products described as 'lactose free' were generally assumed to be suitable for people with lactose intolerance, but there was considerable uncertainty about whether or not they were suitable for people with a milk allergy or intolerance.</p> <p>Participants with a lactose intolerance were uncertain whether products described as 'dairy free' or 'milk free' were suitable for them. It was understood to refer to the absence of both milk and products derived from milk, such as butter, yoghurt, and cheese, although some mistakenly thought this also meant the product was free from eggs.</p> <p>There was significant confusion about the term 'milk free', as this was thought to mean the absence of alternative 'milks' made from plants e.g. soy, as well as animal milks. Others thought this only referred to cow's milk. There was confusion about whether 'milk free' products could contain butter, yoghurt, and cheese, or were just free from milk itself.</p> <p>Health professionals and consumer respondents displayed similar uncertainties regarding terminology use.</p> <p>"Dairy free" was the term that seemed to have broadest appeal across all audiences.</p>

Authors	Country	Study type	Products/Stimuli	Relevant outcome measure(s)
<p>Define Research & Insight – Commissioned by Food Standards Agency UK (2009)</p> <p>Consumer understanding of new labelling terms for foods marketed for people with gluten intolerance</p>	<p>United Kingdom – England, Northern Ireland, Scotland & Wales</p>	<p>A combination of focus groups, paired in-depth interviews and face to face interviews</p>	<p>Labels of common food products found at participants' local supermarkets and home</p>	<p>While on the whole participants prefer products to be marked as “gluten free” or “containing gluten”, some felt these products were unnecessarily more expensive than their ‘ordinary’ counterparts and therefore sought gluten-free products that were not marketed as such.</p> <p>Symbols to indicate a product is gluten free or contains gluten was viewed favourably by food allergic individuals, but often not understood for those shopping for Coeliacs.</p> <p>In the absence of the word “gluten”, there is a heavy reliance on the information provided on the label and packaging.</p> <p>Allergy boxes were viewed favourably as they are seen to ease and speed up the decision making process. Some accuracy issues with allergy boxes were noted as a source of frustration.</p> <p>The use of ‘scientific’ terms for the ingredient’s names were noted by some as misleading and ambiguous, and some were unsure about the suitability of certain ingredients e.g. Barley Malt Extract.</p> <p>Most participants did not feel confident enough to simply rely on reading the products’ composition, and preferred to have some claim/mention of gluten.</p>
<p>Demkin (2017)</p> <p>Paediatric food allergies: Pitfalls in current food labelling regulations</p>	<p>United States</p>	<p>Literature review</p>	<p>N/A - the article examines labelling requirements for all US packaged and unpackaged food items</p>	<p>Food allergen labelling problems were the most common cause of FDA-regulated food product recalls in 2013. Examples: wrong label, terminology problems, lack of declaration of an allergen from an ingredient, cross-contamination, problems occurring where consumers do not read full statement of ingredients but just the allergen summary statement, and discrepancies often exist between the two. Consumers are also unaware emboldening of text is optional, so if no bold text is apparent they may incorrectly assume there are no allergens.</p> <p>These issues outline the importance of consistency in labelling.</p> <p>The authors suggest government regulation is necessary, as if left to industry to mandate inconsistencies will continue.</p>

Authors	Country	Study type	Products/Stimuli	Relevant outcome measure(s)
<p>Food Standards Australia New Zealand (2016)</p> <p>Qualitative Survey of Allergen Labelling</p>	Australia & New Zealand	Survey	<p>Products listed on NutriWeb database (2015 dataset) of packaged foods available for sale from the two main NZ supermarket retailers in Auckland. The terms used for allergen declaration on 713 food labels of products sold in Australia and New Zealand (biscuits, breakfast cereals, fish and fish products, convenience foods) were examined.</p>	<p>Labels of many cereals products used 'gluten' in the allergen summary statement instead of 'gluten containing cereals' or the actual cereal name as recommended by the AFGC, which could be confusing for consumers who have an allergy from cereals e.g. wheat that is not related to gluten (even when the name of the cereal is included in the statement of ingredients). Products containing crustacea or molluscs were being declared in 'contains' statements as 'fish', which may cause consumers to unnecessarily restrict products or consume products that contain the relevant seafood allergen (even when the name of the fish species is included in the statement of ingredients).</p> <p>There were a number of terms used for the declaration of milk that could be considered confusing or unclear e.g. rennet, whey and caseinate. Although it is not mandatory to declare these, it is possible some consumers would not recognise them as being derived from milk, and thereby make inappropriate product choices.</p>
<p>Gardiner (2014)</p> <p>The implication of repeated readings of ingredient lists of food labels on food safety judgements</p>	Canada	Experiment	<p>Mock food labels (30 products presented 15 times). Each label contained a product name, and a coordinating list of ingredients, based loosely on real-world food items but simplified so only simple ingredient names (no compounds) were used.</p>	<p>Participants were much more likely to look at the statement of ingredients (and endure the time burden) when they were shown a product for the first time, versus the fifteenth presentation.</p> <p>The findings from this study suggest that people probably choose not to read food labels as often as they should (especially after repeated exposure to a product), and may miss seeing target ingredients when they are consulting the label.</p> <p>Despite participants having access to the statement of ingredients, which in theory meant they should be reaching 100% accuracy by the last presentation of each item, due to the fact they were relying on memory after initial exposure to a product, only 90.2% of guesses were correct.</p> <p>This may have implications warranting the use of symbols/short contain statements/other information other than a statement of ingredients as an information tool when communicating allergen advice.</p>

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Henderson (2003) The impact of FSANZ labelling changes	Australia	Survey	Four allergen food labels for a range of Heinz products (soup, baked beans and spaghetti) were presented and respondents asked to indicate their preference and why	<p>Only 50% of respondents were shown how to recognise alternative allergen ingredient names that trigger their allergy during their time of diagnosis.</p> <p>Only 39% of respondents knew to look for allergens in the statement of ingredients.</p> <p>36% believed allergen declarations were located on the front of the food label, and if not, this signified the products were allergen-free.</p> <p>The most popular label option had allergens emboldened in the statement of ingredients, in addition to a summary of allergens at the end of the list. Respondents felt having allergens displayed twice increased their likelihood of detecting it.</p>
Hendricks et al. (2011) Allergens in law – European legislation assessed against the preferences of food allergic consumers	Europe	Literature Review	N/A	<p>Consumers experience difficulties reading the label due to small font sizes, poor colour contrast and shiny packaging materials.</p> <p>FAI consumers are concerned about the use of cautionary labelling, as it is located separately from the statement of ingredients, which may result in the consumer experiencing difficulties locating it.</p> <p>Consumers expressed a preference for the labelling of allergens in the statement of ingredients to be in bold letters or standardised colour. Preference has also been expressed for the provision of a “box” on the label summarising the allergens present, or the use of symbolic labelling indicating the presence/absence of an allergen.</p> <p>Consumers would prefer a universal (harmonised) approach to allergen labelling.</p> <p>A preference for the inclusion of percentages of ingredients on the label was expressed, which is relevant when the issue of allergen “thresholds” is addressed.</p> <p>The authors recommend legislative changes to address font size, spacing, font colour, and contrast. All packages (even those with surface less than 10cm²) should list allergens, as should single wrapped product packages sold within a bigger box.</p> <p>Cheese, butter, fermented milk and fermented cream should label their ingredients, e.g. milk as an ingredient, together with its source.</p>
Hu et al. (2007) Parental food allergy information needs: A qualitative study	Australia	In-depth semi-structured interviews and focus group discussions	N/A	<p>Parents expressed confusion at what to exclude from their child’s diet and environment e.g. whether all foods from a group (e.g. tree nuts) should be avoided if their child had been diagnosed with an allergy to one food e.g. peanut.</p>

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<p>Instinct and Reason (2013)</p> <p>Commissioned report for FSANZ: Literature review on the impact of label format on consumers' attention and comprehension for mandated label elements</p>	<p>Australia and New Zealand</p>	<p>Literature Review</p>	<p>N/A – revised studies examining all packaged foods including beverages that bear a label</p>	<p>Factors than gain attention on labels:</p> <ul style="list-style-type: none"> - Include information on the front of products - Increase warning sizes (centre warning message), and reducing the information surrounding this message - Increase amount of label space on food given to mandatory information so it is comparable to commercial information - Use of pictorials and visual salience e.g. by contrast - Text printed horizontally (not vertically, and use of a signal word to attract attention e.g. warning, caution) - Reduced visual clutter - A short claim on the front of the food package and more detailed instructions elsewhere - Allergens to be listed in the statement of ingredients – inclusion of specific allergy information above this may reduce the need for searching - A standard approach to presenting allergy information or having a standardised symbol to indicate allergens - Terminology that is easy to understand - Using TALL man lettering
<p>Joshi et al. (2002)</p> <p>Interpretation of commercial food ingredient labels by parents of food-allergic children</p>	<p>United States</p>	<p>Survey followed by allergen identification task (experiment)</p>	<p>23 food labels taken from widely available commercial products – allergens to identify included milk, soy, peanut, wheat and egg (including traces of these allergens)</p>	<p>Of parents of milk-allergic children, 7% were able to identify all 14 labels indicating milk. Errors occurred where milk by-products were a part of “natural flavour”.</p> <p>Only 22% of the parents of soy-allergic children correctly identified soy protein in all 7 products. Errors occurred where the word soy was buried in an extensive statement of ingredients. Parents incorrectly assumed foods containing refined soybean oil in the ingredients to be allergenic and restricted these.</p> <p>Peanut was identified correctly in all 5 products by 54% of parents restricting peanut. Errors occurred on a product where “trace peanut” was not included within or adjacent to the main statement of ingredients.</p> <p>Wheat (10 labels) and egg (7 labels) were correctly identified by most parents.</p> <p>Survey results revealed differences in ingredients amongst different package sizes, differences between ingredient labels on inner packaging and ingredient labels on outer packaging, and ingredients visible in the product that were not listed on the label.</p> <p>In this study, milk was the ingredient most difficult to identify. The authors suggest simple terms e.g. milk in place of casein.</p>

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Ju et al. (2015) Attitudes and preferences of consumers toward food allergy labelling practices by diagnosis of food allergies.	Korea	Survey	Allergens studied: eggs, cow's milk, buckwheat, peanuts, crab, shrimp, soybeans, wheat, mackerel, pork, peaches, tomatoes, Sulphite, other. Six label items examined: bold font, font colour, box frame, warning statement, front label, and addition of potential allergens	All respondents (self and doctor diagnosed) reported that all six items (bold font, font colour, box frame, warning statement, front label, and addition of potential allergens) was necessary for an improved food allergen labelling system. While the doctor-diagnosed group was more concerned with the checking of food allergens on labels, the non-allergy group was more concerned with checking product brands.
Marchisotto et al. (2017) Food allergen labelling and purchasing habits in the United States and Canada	United States and Canada	Survey	Food products bearing a label and featuring different types of Precautionary Allergen Labelling (PAL)	Wording and terminology differences cause confusion and anxiety in food-allergic individuals and their caretakers. 29% of respondents did not know that names of major allergens were legally required to be reported on labels. 37% assumed advisory labels were based on the amount of allergen present.
Marra et al. (2017) Consumer preferences for food allergen labelling	Canada	Experiment	18-choice sets (representing hypothetical but realistic scenarios) per version to examine consumer preferences for different attributes of food labelling - precautionary statements ("not suitable", "may be present", "may contain", "contains"), safety statements ("does not contain"), use of symbols, and placement of information in various places (front, next to ingredients, package front and next to ingredients)	The use of safety symbols and precautionary labels was the most important food allergen-labelling attribute for those in class 1 (44% of participants who reported considering allergens when buying food due to presumably having someone in their household having a food allergy). Those in class 2 (older individuals, not in a partnership, who had not completed high school or post-secondary education and who considered allergens for more than one reason e.g. potentially work in a service industry where allergens may be an issue) preferred the use of safety statements and both precautionary and safety symbols. Class 3 (who did not consider allergens when buying foods, were not willing to pay for the inclusion of allergen information) reported no difference in the relative importance of each labelling attribute. Participants reported inconsistent terminology and placement leaving them confused. Most preferred allergen information to be on the package front and next to the statement of ingredients at the back, as opposed to it in one location or no information at all.

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Monks et al. (2010) How do teenagers manage their food allergies?	United Kingdom	Semi-structured interviews	N/A - Topics examined included food allergy, avoidance, managing allergic reactions, family/home, friends/peers, school/work, hobbies, travelling away from home and education/support	Simpler, more consistent allergy warnings were suggested as possible solutions for determining when avoidance was warranted.
NFO Donovan Research on behalf of Food Standards Australia New Zealand (2004) Quantitative consumer survey on allergen labelling: Benchmark survey 2003	Australia and New Zealand	Survey	Household grocery items that may contain allergens listed in Standard 1.2.3 of the Code, including: wheat (gluten containing cereals and their products); eggs and egg products; fish and fish products; milk and milk products; nuts and sesame seeds (including their products); peanut and soybeans (including their products) and added sulphites (in concentrations of 10mg/kg or more)	The ability of respondents to identify food products that contained allergens varied considerably depending on the terms used on the labels to declare the allergen. Those with tree nut, milk or egg allergies were most accurate in their assessment of ingredients whilst those with peanut and wheat allergies were less accurate. The complexity or lack of clarity of terms used on labels (e.g. substances like 'emulsifiers') were attributed to some of the errors. Further, the derivation of some ingredients in foods e.g. source of vegetable oils not stated, unlabelled ingredients, changes to the ingredients in products without notice, and food labelling information e.g. location of the information on the labels or the belief there was a difference in labelling requirements for imported foods were also noted as barriers to effective identification. Respondents noted clarity of labelling information could be improved by: adopting more meaningful or accurate labelling or advisory statements, ensuring the origin/derivations of certain ingredients are stated, using uniform wording in plain English, using % labelling for allergens to indicate how much of the substance of concern is in the food to enable risk assessment, and considering formatting issues e.g. print size and standard placement fields
Noimark et al. (2009) Parents' attitudes when purchasing products for children with nut allergy: A UK perspective	United Kingdom	Survey	Five common labelling options were presented to parents of food allergic individuals to answer 'yes' or 'no' when asked if a product bearing such a label would be avoided due to their child's nut allergy	Forty four percent of respondents would avoid nutmeg and coconut because of concerns they were nuts, with 71% of respondents avoiding chestnuts for this reason. approximately 50% of respondents reported ignoring certain labels despite their children being at risk of an anaphylactic reaction to nuts. The authors suggest a universal, common symbol for individual allergens to assist the many patients that visit their clinic who do not speak English fluently and struggle to read the statement of ingredients.

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<p>Parikhal et al. (2018)</p> <p>These labels are nuts: Challenges to safe product identification for nut-allergic consumers.</p>	<p>United States</p>	<p>Experiment</p>	<p>49 products were selected based on a combination of ingredients, presence or absence of a nut warning label, visual style of warning (e.g. just in the statement of ingredients or advisory statement), type of package – without regard for brand or food type (products were equally divided into six categories by the amount and type of nut-related information on the packaging)</p>	<p>When products were examined carefully and for longer, participants were generally able to accurately identify both safe and unsafe products. However, ensuring a product was safe (contained no nuts), rather than eliminating unsafe products, took significantly more time and led to more errors than identifying a product as unsafe.</p> <p>Older consumers required additional time to safely categorise each item compared to younger consumers.</p> <p>Participants seemed to adopt a “better safe than sorry” mentality; if they were unsure of safety, after a period of time they gave up on searching and defaulted to avoiding the product.</p> <p>Non FAI participants reported the burden of reading food labels placed on FAIs and expressed empathy for the additional difficulties FAIs experience while grocery shopping.</p> <p>Safe products with a nut-free label were examined significantly faster and more accurately than those without a nut-free label. Similarly, unsafe products with a ‘contains’ label were identified faster and more accurately than unsafe products without a ‘contains’ statement.</p> <p>The lack of consistency in warning labels (e.g. mismatch between information presented in the product name, allergen summary statement and statement of ingredients) created a high burden for food allergic consumers, who had to re-assess food labels whenever they shop. This may have accounted for the fact that unsafe products containing allergen warnings took more time to classify as opposed to other unsafe products with no warning. These products were incorrectly categorised as safe just as frequently as products with nuts in the ingredients but no warning label.</p> <p>Participants also noted formatting issues posed additional barriers to easily classifying products, such as glossy packaging, poor contrast between font and packaging background and small font.</p>
<p>Pfaff et al. (2007)</p> <p>Innovative information delivery for food allergic consumers</p>	<p>The Netherlands, Greece, Germany, Spain and Poland</p>	<p>Survey followed by focus groups</p>	<p>Information delivery tools included: personal shopping assistant, handheld scanner, information terminals, information booklets, having a special allergen friendly aisle, training of staff, internet shop, and standardised labelling and/or symbols</p>	<p>EU-wide standardisation of allergen food labelling, in combination with symbols indicating the presence of specific allergens, was the preferred option by 82% of participants, who suggested implementing a harmonised international approach to allergen labelling to reduce trade issues.</p> <p>Participants agreed with applying consumer acceptability criteria identified through other studies e.g. readable font size, high contrast between font colour and background, non-use of shiny background, complete statement of ingredients, easily identifiable location for allergen information, and avoidance of difficult terminology and symbols.</p>

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Pieretti et al. (2009) Audit of manufactured products: Use of allergen advisory labels and identification of labelling ambiguities	United States	Administrative Data Analysis	Commercially packaged supermarket product labels were examined, including those found on: baby food, baking mixes, flour/meal, fresh bread/rolls, frozen bread/dough, cold and hot cereal, chocolate, candy, frozen dinners/entrees, ice cream, sherbet, seafood, frozen seafood, gravy/sauce mixes, pancake mixes, syrups, pasta, pasta sauces, salad dressings, salty snacks, cookies, oil, soup and spices/seasonings	In addition to lack of consistency, other labelling ambiguities included: sources of gelatine (e.g. fish, bovine) not disclosed for 96% of products. For lecithin, the source, which could be soy, egg, sunflower, seeds or rice was not disclosed for 2.5% of products. Some products listed “flour” without the source. Products labelled as containing shellfish also failed to disclose the type. Nonspecific terms such as “natural flavours”, “flavours”, and “spices” were frequently used and not linked to a particular ingredient (11% of products examined). Overall, nonspecific terms used without reference to an ingredient or allergen were included in 54% of the products. The authors advocate for the use of standardised declarations of allergens – especially for those who have multiple allergens or consumers who have difficulty with English or reading small print.
Sakellariou et al. (2010) Food allergen labelling and consumer confusion	Greece	Experiment	A list of 59 terms used on food labels describing common allergenic ingredients was analysed	Those who reported having children with specific allergies e.g. (egg or milk) were found to correctly guess scientific terms for these ingredients more than those who did not. The authors conclude there is profound need to state exact terms for use for each food allergen in plain English.
Sharp (2013) The NZ Coeliac Health Survey	New Zealand	Survey	All food products sold in NZ (that bear and do not bear a label)	Of the 877 respondents, 1.7% found it difficult to determine if foods were gluten-free from reading their labels all of the time, 7.9% most of the time, 73.2% some of the time, and 17.2% never had an issue. 48.2% believed better labelling of gluten-containing ingredients in foods would contribute the most to improving the lives of individuals with Coeliac Diseases (CD).

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<p>Sheth et al. (2010)</p> <p>Role of food labels in accidental exposures in food-allergic individuals in Canada</p>	Canada	Survey	All packaged foods bearing a label were assessed	<p>Food-allergic individuals who were allergic to peanut, tree nut, fish or shellfish were less likely to experience an accidental exposure due to the allergen not being identified in plain language. Historically, these four allergens are known to cause more severe reactions, and therefore manufacturers are likely to be more prudent about clearly identifying them. Further, there are few, if any, alternative terms to describe these allergens when compared to allergens such as milk and egg, which are sometimes identified by complex terminology e.g. casein or ovalbumin, which are not readily recognised by consumers.</p> <p>Labelling issues noted: allergen not identified in plain language (e.g. “casein” instead of milk”), allergen listed but not clearly visible on the label or package (e.g. boldfaced or listed on the main food label with other ingredients), allergen was a hidden ingredient that was not listed/declared on the food label (e.g. “natural flavouring” listed but contained traces of milk), and errors in translating an ingredient from one country to another</p>
<p>Silvester et al. (2016)</p> <p>Is it gluten-free? Relationship between self-reported gluten-free diet adherence and knowledge of gluten-content of foods</p>	Canada	Survey	<p>17 foods – seven foods allowed, seven foods questionable, and 3 foods not allowed on a gluten free diet (GFD). Foods included those that may be consumed on their own and/or appear on a statement of ingredients as a component of another food (e.g. milk), as well as complex foods that contain many ingredients with various recipes (e.g. sausages). Oatmeal was included, as it has recently been recognised as acceptable on a GFD in Canada.</p>	<p>None of the foods presented were correctly categorised by 100% of respondents.</p> <p>Over 95% correctly recognised milk and chickpea flour as gluten free. Only 73% correctly identified spelt as a gluten-containing grain.</p> <p>Croutons, imitation seafood and rice crisp cereal were the foods most commonly misclassified.</p> <p>The gluten-free foods most commonly questioned or restricted unnecessarily were modified corn starch (39%), cocoa (33%) and glutinous rice (32%).</p> <p>Of the incorrect responses, 22% of decisions would put respondents at risk of consuming gluten-containing food and 78% at risk of unnecessarily restricting a food. Unnecessary restriction increases the likelihood of nutrient deficiencies in a population (individuals with Coeliac disease) that are already at risk.</p> <p>Results suggest food allergic individuals who believe they are following a GFD are not readily able to correctly identify foods that are GF.</p>

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<p>Simons et al. (2005)</p> <p>Impact of ingredient labelling practices on food allergic consumers</p>	United States	Survey	Allergens examined included peanut, tree nut, milk, egg, wheat, shellfish, fish and soy	<p>Allergic reactions were attributed to misunderstanding label terms (16%) and to nonspecific terms (spice, flavour – 22%).</p> <p>Product brand choice was “very much influenced” by the manner of labelling for 86%.</p> <p>Based on results, the authors suggest removing the use of the word casein or albumin to refer to milk and eggs.</p> <p>80% of people with milk allergy also reported avoiding lactose, which may be unnecessary.</p> <p>This study indicates that many FAIs unnecessarily avoid products because of ingredients that may not contain relevant amounts of allergenic proteins, and that simplified labelling may actually increase this number.</p>
<p>Soogali & Soon (2018)</p> <p>Food allergies and perceptions towards food allergen labelling in Mauritius</p>	Mauritius	Survey	All food products that contain a label sold in Mauritius.	<p>Over 80% of respondents felt allergens in the statement of ingredients should be emphasised (e.g. in bold font – the most preferred/commonly used, or contrasting colour, italics, or enlarged font) and appear in plain English (or French) e.g. “milk” instead of “milk protein, casein and whey”.</p> <p>59% of respondents felt the statement of ingredients could provide more information about food allergens in the label.</p> <p>56.6% agreed it is difficult for those with food allergies or intolerances if there are different variations of food labels among imported products.</p> <p>87.6% felt symbols could be used to indicate the presence of allergens. Symbols such as asterisk (*) were used in food labels to indicate presence of allergens e.g. in vitamins* where this indicated the presence of soybean oil. Symbols were preferred to indicate a product is gluten-free.</p> <p>73.5% indicated that allergy warning could be placed adjacent to the statement of ingredients.</p>
<p>TNS BMRB on behalf of Food Standards Agency (2016)</p> <p>Understanding NI consumer needs around food labelling</p>	Ireland	Survey	N/A – respondents were questioned on current labelling practices and asked suggestions for improvement	<p>Respondents valued label consistency to create habitual use e.g. allergen emboldening. This included format, positioning and language, which could encourage more regular usage of labelling information.</p> <p>For respondents, the ability to use allergen information rested on finding information instantly understandable and accessible, and this could only be achieved when it was presented in recognisable, repeated formats which could facilitate “at a glance” decision making.</p>

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<p>TNS Social Research on behalf of Food Standards Australia New Zealand (2009)</p> <p>Consumer Study on Food Allergen Labelling: Follow-on Survey 2008–09</p>	Australia and New Zealand	Survey	<p>Allergies targeted: peanut, soy, wheat, egg, tree nuts, fish, shellfish, sulphites and sesame seeds</p> <p>General questions regarding allergy management strategies (including for packaged and unpackaged foods)</p>	<p>Both PAL and the statement of ingredients were used by respondents in determining the presence of allergens.</p> <p>Issues arose where a technical name or code number, or derivative was listed without individual ingredients broken down and spelled out in plain English.</p> <p>43% reported being able to find the information they need on food labels. 7% reported lack of understanding over some terms, 7% not knowing what the ingredient listed is derived from, and 4% being confused over the use of a non-specific term. 20% reported coming across products with different names on labels for ingredients which should be avoided.</p> <p>Consistency in labelling (common format and method for highlighting allergen), and addressing issues regarding unpackaged and imported products were all cited as at-risk consumer wants.</p>
<p>van Hengel (2007)</p> <p>Declaration of allergens on the label of food products purchased on the European market</p>	Europe (UK, Belgium, Netherlands)	Observational + literature review to reflect on findings	<p>550 packaged food products bearing a label and available across a range of countries were analysed. Researchers attempted to select a range of food products, that were produced by different manufacturers, and were considered to be frequently purchased by consumers within the nations examined</p>	<p>Issue identified: a single allergenic food could be known under several synonyms e.g. peanut may be referred to as a groundnuts and monkey nuts on labels. For allergen purposes, the use of “peanut” as a single, well-known term is preferred.</p> <p>Discrepancies were also identified by comparing the different language versions on single labels – e.g. a product purchased in Romania had label which declared the presence of peanut in Romanian and presence of hazelnut in English.</p> <p>The use of specific terms like “peanut” or “hazelnut” was preferred to more generic terms like “nuts” – this applied to both statement of ingredients and PAL.</p> <p>Other issues identified included small text and poor colour contrast on the font.</p> <p>The authors advise having a separate list of all allergens (specified to the source allergen) just beneath the statement of ingredients. The provision of information may also be aided with the assistance of colour coding or universal symbols to indicate the presence/absence of allergenic ingredients.</p>

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Verrill et al. (2013) Food label usage and reported difficulty with following a gluten-free diet among individuals in the USA with Coeliac disease and those with non-Coeliac gluten sensitivity	United States	Survey	Food labels (some containing gluten free claims) of commonly purchased supermarket food items	<p>On average, gluten-sensitive (GS) individuals reported slightly more difficulty following the gluten free diet (GFD) than did respondents with Coeliac disease.</p> <p>Reading the food label often was significantly associated with less reported difficulty following a GFD, whereas consuming packaged processed foods and looking for GF claims more often were significantly associated with more reported difficulty for both respondent groups.</p> <p>The authors conclude respondents with GS may rely more heavily on the GF claims for information about a product's gluten content. Individuals with Coeliac Disease (CD) may be more experienced food label readers and may rely more on the statement of ingredients for finding GF foods.</p> <p>Gluten free claims may assist those who have difficulty determining whether certain processed, packaged foods are safe to consume without the need to review the statement of ingredients (e.g. CALD, those less literate or newly diagnosed).</p>
Vierk et al. (2007) Prevalence of self-reported food allergy in American adults and use of food labels	United States	Survey	Questions asked about commonly purchased food products with either stand-alone or combination allergens e.g. milk/dairy, fish, eggs, crustaceans, tree nuts, wheat/gluten, peanuts, soy, fruit/vegetable, shellfish, chocolate and food additive (general term)	<p>Forty percent of respondents with food allergies who read food labels found the following labelling issues were serious or very serious barriers to them effectively managing their allergy: 1) some statement of ingredients give a general name for an ingredient without specifying the source e.g. spices and flavours 2) inconsistency in terms used for the same allergen across food products.</p> <p>One third of respondents rated as a serious or very serious label issue that words on some statement of ingredients are too technical or hard to understand.</p> <p>Over a quarter of respondents rated as a serious or very serious problem the length of statement of ingredients, which makes it difficult to locate the ingredient of concern. This did not differ between those who were self or doctor diagnosed.</p> <p>32% said that if a 'may contain' or 'contains' statement lists only one potential allergen e.g. "may contain egg", they took this to mean no other allergen was present.</p>

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<p>Voordouw et al. (2009)</p> <p>Food allergic consumers' preferences for labelling practices: A qualitative study in a real shopping environment</p>	<p>Greece and The Netherlands</p>	<p>Observational and Interview</p>	<p>Participants asked to purchase 15 potentially problematic food items as if for their own household. Potential allergen included milk egg, and/or tree nuts or peanuts</p>	<p>Colour contrast of the label was reported to be low, and packaging was sometimes shiny or glossy (or used white font), making the label difficult to read.</p> <p>Participants suggested a preference for emboldening of the allergens in the statement of ingredients to increase readability and assist with locating relevant information faster. A desire for the statement of ingredients to be written in a specific colour was expressed. Greek participants suggested allergen information be contained in a box to stand out.</p> <p>A standard location for allergen information was also preferred – e.g. above the statement of ingredients to reduce likelihood of consumers missing it and having to read the entire statement of ingredients.</p> <p>Origin of the ingredients e.g. in oil or starch should be specified. Participants wanted milk proteins to mention lactose if it was present. Food additives (preservatives, emulsifiers, stabilizers, taste/flavour enhancers, and antioxidants) and E-numbers caused a lot of confusion among food allergic individuals.</p> <p>If the additional allergen information did not include the allergen in question, participants would proceed to read the full statement of ingredients, increasing the time spent on shopping.</p> <p>Participants expressed positive views on symbolic representation of allergens (e.g. a cow's head and glass to milk to indicate presence of cow's milk). Some indicated confusion about whether the presence of an egg symbol indicated the product did or did not contain egg, and that this should be clarified. Symbolic information was viewed favourably in addition to (not as a substitute for) written allergen information, with a desire for it to be placed on the front of the packet.</p> <p>Participants suggested limiting the number of languages present, and translating ingredients correctly. Consistent terminology in preparation methods and the statement of ingredients was desired, as was including the % of each allergen in the statement of ingredients.</p>

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<p>Voordouw et al. (2011)</p> <p>Preferred information strategies for food allergic consumers: A study in Germany, Greece and the Netherlands</p>	<p>Germany, Greece and the Netherlands</p>	<p>Survey</p>	<p>Milk, eggs and/or tree nuts or peanuts were selected as the allergens to study from the EU list of 14 potential food allergens</p> <p>Information delivery scenarios tested included: standardised label with symbols, booklet with allergen information, and information communication technologies e.g. personal shopping assistant, information terminal, handheld scanner, or an internet shop.</p>	<p>The option to show the percentage of allergens was rated significantly higher than either showing percentages of all ingredients, and not showing percentages at all.</p> <p>Respondents supported the use of an eye-catching box with a standardised allergy information and placed in a standardised location versus no box.</p> <p>A standardised symbol representing allergy information at the front and back of the product was preferred, especially for small packaging.</p> <p>The inclusion of a food allergy glossary in any ICT approach was preferred.</p> <p>Participants in all countries gave the highest average preference rating to an adjusted label, ICT as the second best solution (especially from non-native speakers/bi-lingual participants), and the booklet as the least preferred solution.</p>
<p>Voordouw et al. (2012)</p> <p>Optimising the delivery of food allergy information. An assessment of food allergic consumer preferences for different information delivery formats</p>	<p>Netherlands and Germany</p>	<p>Survey</p>	<p>Three categories of food were included: ready-made meals, snacks and pre-prepared salads. Two products were provided for each category – one containing at least one allergen and one allergen free. Fictitious food products bore an 'ideal format' label that had been developed based on consumer preference research.</p>	<p>Some respondents indicated their appreciation of the symbols (fast to read), with the caveat that the symbols required explanation before they were able to use them correctly. However, some indicated that symbols could lead to confusion as to whether or not the allergen was actually present.</p> <p>The action of using lay terminology in the statement of ingredients, and putting the chemical terminology between brackets afterwards was viewed positively by participants.</p>

Authors	Country	Study type	Products/Stimuli	Relevant outcome measure(s)
<p>Weber et al. (2007)</p> <p>The performance of parents of children receiving cow's milk free diets at identification of commercial food products with and without cow's milk</p>	<p>Brazil</p>	<p>Interviews followed by a label identifying task (experiment)</p>	<p>10 products commonly given to infants and/or toddlers e.g. margarine, cereal, whole milk drink, cookies, and yoghurt</p> <p>12 expressions relating to cow's milk were tested</p>	<p>For technical expressions, the proportions of correct identifications amongst parents who received training versus those who did not were: dairy products (71 vs 9%), traces of milk (54 vs 9%), and milk formulation or preparation (42 vs 13%).</p> <p>Recognition of the scientific expressions did not exhibit statistically significant differences for casein, lactalbumin, or lactoglobulin, whereas for caseinate the difference did have statistical significance between the experimental and control group.</p> <p>A smaller proportion of the control group correctly identified the presence/absence of cow's milk and by-products for all products, however the difference was only statistically significant for margarine without cow's milk.</p> <p>The number of labels read correctly by members of the study group (parents who received education) was lower than expected.</p> <p>Results indicate it is not sufficiently to merely inform or educate parents on allergen terms, but that frequent reading of labels is required to be able to correctly identify (especially more complex) terms.</p>
<p>Wortman (2016)</p> <p>Impact of product label communication congruency on attitude certainty and purchase intention for food allergy stakeholders under high and low levels of elaboration</p>	<p>United States</p>	<p>Survey</p>	<p>Soy yoghurt, coffee creamer, and chocolate</p> <p>Stimuli included mock-up food product labels based on current food product labels available in the marketplace</p>	<p>70% of respondents accidentally purchased a food product containing an allergen they were trying to avoid.</p> <p>Results showed confusion among participants when the label claims did not align with ingredient information.</p> <p>Another issue identified is misleading product names e.g. "Soy Yoghurt" than contained dairy.</p> <p>Greater congruence between information on the front and nutritional content on the back led to more positive attitude towards product safety, as did greater elaboration of allergen information (more methods of information). Congruency and elaboration also led to increased perceived credibility of label claims, and trust in nutrition information, thereby increasing purchase intention</p> <p>Errors were made where a product contained "non-dairy" on the front of the package, but contained milk as an ingredient in the ingredient's list, as consumers stopped at the front of package claim and did not investigate further.</p>

Authors	Country	Study type	Products/Stimuli	Relevant outcome measure(s)
<p>Zarkadas et al. (2013)</p> <p>Living with Coeliac disease and a gluten-free diet: A Canadian perspective</p>	Canada	Survey	All food products sold in Canada (that bear and do not bear a label).	<p>When asked to review 15 foods to see if they were permissible on a gluten-free diet, only 49.3% of respondents correctly identified all items.</p> <p>The most common difficulty reported for struggling to adhere to a gluten free diet was the absence of the word gluten on some gluten-containing products that were deemed to be ambiguous (78.9%). 68.7% found travelling abroad difficult where the term gluten was not easily identifiable on a foreign label.</p> <p>The strategies often used by the largest percentages of respondents included reading every food ingredient list (96.1%) and labelling all gluten-free flours (83.8%).</p>

Table A2.2 Assessment of study quality

Authors	Country	Aim/s	Study type	Achieved sample size	Sampling technique	Internal validity	External validity and generalisability to Australia/New Zealand
Barnett, Leftwich et al. (2011) and Barnett, Muncer et al. (2011)	United Kingdom	“To understand the complex risk assessment decisions made by peanut and nut-allergic adults when purchasing food, with particular reference to use of printed package information”.	Observational and semi-structured interview (which involved questioning on 13 potentially problematic packaged foods)	32 respondents aged 16 years and over with a clinical history compatible with IgE-mediated reactions to peanuts and/or tree nuts	To ensure a diverse sample, participants were recruited via letter or email from three sources – specialist allergy clinics, primary care settings, or from staff and students from the University of Surrey. Potential participants completed a postal screening questionnaire, and those with allergies or intolerance to foods other than peanuts/tree nuts were excluded. Participants were classified as having a mild, moderate or severe allergy by an allergen consultant. Eligible participants participant in the accompanied shop followed by an interview.	<p>Medium</p> <ul style="list-style-type: none"> * Participants took part in three tasks: an accompanied shop, followed by an interview which also included a product choice reasoning task. This triangulation of methods was used to reveal the different dimensions of choice. * Low response rate (59.3%) indicates those who chose to participate were particularly motivated (response bias), and may reflect other systematic differences. * While participants were trained in a ‘think aloud’ methodology prior to the accompanied shop, social desirability and differing levels of literacy may have influenced results. * No mention of how many observers there were, or whether the same observer was used. No mention of participant nor observer blinding. * Potential Neyman’s bias (only FAIs sampled) * Stimuli was realistic (during observational shop participants viewed real labels, and real labels were presented at the interview) * Insufficient information provided to determine whether procedures were standardised * Correlation not causation (participants revealed via interview which label elements they believed caused them to act a certain way, but this was not tested) * Certain wording used in the interview questions may have lead participants to respond in a certain way. 	<p>Low</p> <ul style="list-style-type: none"> * Study examined adult shoppers with a diagnosed peanut/tree nut allergy who did their own shopping, and results may not extrapolate to other allergies and/or members of the general public who may shop for FAIs occasionally * Adults with a known, diagnosed allergy may be more likely to read labels and be more competent at doing so than the general population, children, or those shopping for food allergic individuals * Only 9 out of the 32 participants were male * The variety of packaged foods and labelling regulations differ in the UK from Australian and New Zealand markets * Small sample size from a restricted geographical location limits the external validity and power of the study

Authors	Country	Aim/s	Study type	Achieved sample size	Sampling technique	Internal validity	External validity and generalisability to Australia/New Zealand
Binsfeld et al. (2009)	Brazil	"To evaluate the ability of relatives of patients with cow's milk allergy to identify terms related to cow's milk on labels of manufactured products".	Cross-sectional descriptive study: initial questionnaire , label identifying task followed by structured interviews	52 parents/caregivers of children with a diagnosed milk allergy	All literate parents and caregivers of patients who came for specialty medical visits at an outpatient clinic who met the inclusion criteria were asked to participate. Inclusion criteria: diagnosis of cow's milk allergy confirmed by clinical history of anaphylaxis or double-blind placebo controlled test, with recommendation of exclusion diet suggested by health care professionals. School-aged children who could read the labels were allowed to participate in the study along with their caregivers.	<p>Unknown – limited methodological information provided</p> <ul style="list-style-type: none"> * Using a combination of methods provides further confidence in results, although there is no mention of whether questions/stimuli had been previously validated. Similarly, little information is provided concerning how the experiment and interviews were conducted. *All participants received standardised nutrition counselling provided by the same nutritionist *100% response rate (sampling bias – participants more motivated to participate) *Subjects were informed about the objectives of the study *No mention of whether the food labels presented were real or simulated for the purposes of the study *Participants literacy levels may have affected results 	<p>Low</p> <ul style="list-style-type: none"> * Small sample size comprised predominantly of mothers of patients (80.8%) * Only milk-containing products were tested * Study conducted in Brazil, where language, food choices and labelling requirements may vary considerably from an Australian and New Zealand context – although large imported packaged food market from the US, where labels and food supply more closely resemble that of Australia and New Zealand

Authors	Country	Aim/s	Study type	Achieved sample size	Sampling technique	Internal validity	External validity and generalisability to Australia/New Zealand
Brown et al. (2015)	Canada	“To explore the perspectives of directly affected individuals as well as members of the general public regarding their needs and preferences for precautionary labelling, allergen symbols, and suggestions for improving labelling practices in Canada”.	Series of eight qualitative focus groups	<i>n</i> = 52 participants - FAIs or members of their family (<i>n</i> = 27) and members of the general public who had no FAI in their immediate family (<i>n</i> = 24)	Participants residing in the Vancouver area were invited to participate if they were 19 years or older and fluent in both reading and writing English. Recruitment for the directly-affected individuals (<i>n</i> = 27) was completed through Anaphylaxis Canada, while the general public sample (<i>n</i> = 24) was recruited through IPSOS Reid, a public marketing research firm. A sample that was deemed to be representative of the general public was invited to participate.	<p>High</p> <ul style="list-style-type: none"> * Focus group sizes kept small to allow for adequate exploration of each participant’s perspective *Participation incentive (offered a monetary reward) *Social desirability and confirmation bias may have affected results * Focus groups were digitally recorded and transcribed verbatim for subsequent thematic analysis. Both deductive and inductive approaches to coding were used to identify themes related to the research objectives. *Standardised methods were used to conduct the interviews, although no mention of whether the same interviewer was used, nor whether they were trained *Unknown whether more than one researcher performed the analysis *Selection bias may have occurred for the directly-affected group (membership in support groups is associated with higher income and education) 	<p>Medium</p> <ul style="list-style-type: none"> *Different labelling requirements and products available on the Canadian market mean results may not generalise to an Australian/New Zealand population *The small sample sizes used in focus group methodologies limit external validity, although similar views have been expressed by Australian and New Zealand focus group participants

Authors	Country	Aim/s	Study type	Achieved sample size	Sampling technique	Internal validity	External validity and generalisability to Australia/New Zealand
Choi and Choi (2016)	South Korea	“To investigate what information consumers are concerned with as well as improving the allergen information on product labels”.	Survey	<i>n</i> = 302 (48 excluded as being ineligible for consideration) – a combination of FAls and those with no direct link to food allergies	Respondents were approached in the general community by fieldworkers and asked to participate.	<p>Medium</p> <ul style="list-style-type: none"> *Questionnaire was designed based on previously validated items from prior studies *Questions were screened by experts to ensure readability and comprehension *No mention of response nor dropout rate *Respondents were made aware of the aims of the study * Every attempt was made to obtain a representative sample * Surveys were self-administered (no standardised delivery) *Relatively small sample size for survey methodology *Only perception was analysed, not actual purchasing behaviour or knowledge comprehension. *Response options were limited by the quantitative nature of the study *No mention of the criteria used to exclude the 48 respondents not included in the final analysis *Diagnosis of food allergy had no validation (self-reported) *Recall, memory, and social desirability bias may have affected results *Correlation does not equal causation *Not mentioned whether participants were made aware of the research purpose 	<p>Low</p> <ul style="list-style-type: none"> *Most respondents were young adults who were well-educated and had higher incomes than those in the general population *The food products available in South Korea differ significantly from those available in an Australian and New Zealand setting, and there are different labelling requirements

Authors	Country	Aim/s	Study type	Achieved sample size	Sampling technique	Internal validity	External validity and generalisability to Australia/New Zealand
Chow (2011)	Canada	“To explore the effects of food allergen labels on the well-being of affected Canadians, using a social constructionist framework and a mixed methods approach”.	Survey used to inform shopping-trip observation and interview	<i>n</i> = 1308 completed the survey <i>n</i> = 12 anaphylactic individuals, or parents of anaphylactic children participated in the accompanied shopping trip	Survey data was drawn from a nation-wide, cross-sectional, computer assisted telephone interview survey conducted in 2008. Random sampling was used to select household telephone numbers from the White pages. To recruit shopping participants, recruitment posters were posted at community centres and circulated on Anaphylaxis Canada’s website.	High * Study replicated the methodology of a high-quality study conducted in Greece and Netherlands by Cornelisse Vermaat et al. (2007) * For the interview component, previously validated questions were asked by the same trained interviewer *Participation incentive offered (monetary reward) *Mixed method approach allows for richer data collection *Perceived and doctor-diagnosed allergies were not distinguished amongst FAIs, possibly inflating the estimate of directly affected population *Sampling bias may have affected those recruited for the qualitative component (shopping trip) *Observer was trained (to reduce observer bias) to discretely monitor participants’ shopping behaviour (to minimise the likelihood of social desirability bias)	Medium *Females were over-represented, as were those in the 40–59 age group. Respondents tended to have a higher level of education and income, and lived in metropolitan area. *Only houses with a fixed phone line were included in the phone survey component *Peanut, tree nut and sesame allergies were not well represented *Different food labelling regulation and food supply in Canada may mean results do not extrapolate to an Australian/New Zealand market

Authors	Country	Aim/s	Study type	Achieved sample size	Sampling technique	Internal validity	External validity and generalisability to Australia/New Zealand
COI Communications and Creative Research (2002) – Commissioned by Food Standards Agency UK	United Kingdom	“To explore the response of consumers to nut allergy labelling on pre-packed foods”.	Twenty one in-depth individual interviews (both with FAIs and partners/parents who may occasionally shop for them) in addition to three focus group discussions with six respondents who occasionally shop on behalf of someone with a nut allergy	21 participants in the individual interview component 6 x 3 = 18 participants in the focus group discussions	Participants of varying ages, gender, and ethnicity were recruited from several sites around the UK to ensure a representative sample was obtained. However, recruitment method was not revealed.	Medium *Research was carried out in five locations *Mixed method design was used to obtain richer, and more complete information from a range of consumers *Discussions with individuals or pairs were conducted in their own homes to allow access to food packaging from their own cupboards/fridges to illustrate buying habits and views – allowed for a form of validation and reduced recall/memory bias likelihood *No information was provided as to whether pre-validated questions were asked, although a standardised procedure was followed for questioning *No information supplied about number of interviewers, training etc. *Neymans bias a possibility in individual interviews	Medium * Different labelling regulation and food products available in the UK * Females were overrepresented in the sample (often the case in these studies as females tend to be the main grocery shopper in the household) * The views expressed in the individual interviews may reflect only those of FAIs and those who shop for them (not the general population who may have to on very rare occasions look for allergen information)

Authors	Country	Aim/s	Study type	Achieved sample size	Sampling technique	Internal validity	External validity and generalisability to Australia/New Zealand
Creative Research (2016) – Commissioned by Food Standards Agency UK	United Kingdom (England, Wales, Scotland and Ireland)	“To explore understanding of the terms used on food labelling – ‘dairy free’, ‘milk free’, ‘lactose free’ and others – among three key audiences: consumers with some form of sensitivity to milk, health professionals who may advise such consumers, and food businesses who produce, retail and market products suitable for these consumers”.	Combination of telephone and face-to-face interviews	Total of 63 interviews – $n = 32$ interviews were with consumers, and the remainder split between health professionals – including 6 nurses, 5 GPs, 3 dietitians, and one secondary care specialist ($n = 15$) and food businesses ($n = 16$) – including 2 trade associations, 4 retailers, 4 large food manufacturers 6 with businesses who developed products suited to those with milk sensitivities	* Participants were recruited using mixed methods – recruiters identified consumers through networking and the Galactosaemia Support Group *Health professionals were found using a mix of databases and recruiters on the ground. *Intermediaries and Food Standards’ own internet and retail searchers helped identify businesses. *Recruitment screening questionnaires were used to select consumers and health professionals for interview. Consumers who made use of food labels and who were milk sensitive themselves or who had a child who was affected were selected.	Medium *Demographic data was collected to try to achieve a mix in terms of age, gender and ethnicity *The purpose of the study was made clear to participants *Every attempt was made to standardise interview questions and information collection methods – interviewers followed standardised discussion guides *No mention of whether interviewers received prior training *No mention of whether the same interviewer was used *There may have been systematic differences in how respondents answered depending on whether they were interviewed in person or over the phone (e.g. may be less influenced by social desirability over the phone) *Leading questions may have been an issue *Neyman’s bias may have affected results for FAIs or those who shop for them *Response and memory bias may have influenced results *Only correlational (descriptive) data was collected – cannot draw causal conclusions	High *Given the UK’s dominant language is English and it was the terms, not specific products, that were being assessed, the stimuli examined is relevant to an Australian and New Zealand market *The sample was designed to be as representative as possible

Authors	Country	Aim/s	Study type	Achieved sample size	Sampling technique	Internal validity	External validity and generalisability to Australia/New Zealand
Define Research & Insight (2009) – Commissioned by Food Standards Agency UK	United Kingdom – England, Northern Ireland, Scotland & Wales	“To explore reactions towards the new EU labelling legislation with regard to labelling on products marketed to individuals who follow a gluten free diet. Also, to understand current strategies used by individuals with Coeliac disease – the labels and information used to make informed food choices”.	A combination of focus groups (3–7 participants), paired in-depth interviews and face to face individual interviews with health professionals	Total $n = 58$ (including 15 parents, 43 individuals with Coeliac disease – both doctor and self-diagnosed)	Two methods were used to recruit participants. Many were free-found by recruiters using their contacts (convenience sampling). Coeliac UK’s extensive database was also drawn upon to attract Coeliac participants. A monetary incentive to participate was offered.	<p>High</p> <ul style="list-style-type: none"> *The sampling method aimed to achieve a representative sample (self and doctor diagnosed, a range of ages, genders, ethnicities) *Prior to attending, all respondents were asked to complete a three-day food recall *Face to face interviews were held ‘in home’ to allow moderators to view the types of food purchased and verify information collected via recalls *Interviewers also followed an accompanied shopping trip *The monetary incentive offered to participants may have resulted in selection bias *Interviewer training, briefing and debriefing sessions were held – different interviewers used *Experts e.g. dietitians were consulted throughout the process, including during the formation of questions *Interview procedures were standardised *Most individuals with Coeliac disease recruited were members of Coeliac UK support group (80%), and therefore sampling bias may have occurred *No mention on how data was analysed/themes were drawn out *Participants were made aware of the study’s objectives *Potential for Neyman’s bias 	<p>Medium</p> <ul style="list-style-type: none"> *Despite the different products available for sale and labelling legislation in the UK, the sample exhibited similar shopping behaviour and beliefs about allergen labelling than consumers in Australia and NZ *Results may not extrapolate to other food allergies (only gluten-containing products examined)

Authors	Country	Aim/s	Study type	Achieved sample size	Sampling technique	Internal validity	External validity and generalisability to Australia/New Zealand
Henders on (2003)	Australia	“To discover consumers’, health professionals’ and allergen sufferers’ knowledge and perception of changes to food label regulations by Food Standards Australia New Zealand”.	Survey	<i>n</i> = 170 (<i>n</i> = 107 food allergic individuals and <i>n</i> = 63 health professionals)	<p>Respondents were recruited through Anaphylaxis Australia Inc. A link to the online questionnaire was provided to the organisation, who sent an email to members.</p> <p>Various health professional associations in Australia were contacted via e-mail and asked if the members would be happy to participate and if an advertisement could be included in their newsletter/webpage.</p>	<p>Medium</p> <ul style="list-style-type: none"> *Questionnaire included a combination of closed and open-ended questions *All questions included a clear rationale, and were based off previously-validated instruments *Computer program used to administer survey – may have resulted in sample bias (only those with access could participate) *Pilot questionnaire completed by health care professionals *Incentives offered to participants may have resulted in response bias *Small sample size for survey methodology *Responses may have varied according to the type of food, allergy of the respondent (e.g. a mild peanut allergy versus Coeliac) *No information provided on response rate *Purpose of the study was revealed to participants 	<p>Medium</p> <ul style="list-style-type: none"> *Population of interest (Australia), however small sample size limits generalisability of findings *Results may not reflect the views of those purchasing for food allergic individuals, although the views of doctor and self-diagnosed FAIs was considered *Disproportionate representation of dietitians in the health professionals sample

Authors	Country	Aim/s	Study type	Achieved sample size	Sampling technique	Internal validity	External validity and generalisability to Australia/New Zealand
Hu et al. (2007)	Australia	"To examine information needs and preferences of parents regarding food allergy".	In-depth semi-structured interviews and focus group discussions	<i>n</i> = 84 parents of children with food allergy	Families were recruited from three paediatric allergy clinics in NSW, Australia. Families presenting with a child for evaluation of food allergy were sampled purposively to include a range of allergy types and severity, children's ages and length of time since diagnosis.	<p>High</p> <ul style="list-style-type: none"> *Use of multiple data collection methods is shown to enhance internal validity *Interviews were audio-recorded to allow for later analysis (themes drawn out using the validated constant comparative method) *Summaries of the interviews were returned to participants to check for accuracy *Another follow-up interview was conducted to ensure coverage of all key concerns *A series of follow-up focus group discussions followed to confirm and extend findings *To validate the established thematic categories, a selection of contrasting cases was independently reviewed by six expert reviewers from allergy and non-allergy specialists *High response rate (92%) may reflect sampling bias *Sample & Neyman's bias - the inclusion of consumer organisation members may have skewed results towards a preference for greater information provision 	<p>Medium</p> <ul style="list-style-type: none"> *Target population (Australia) *May not reflect the views of those who only occasionally purchase foods for FAIs *Unknown generalisability as the study was conducted in specific settings, with a selected population *Parents' high level of tertiary education, occupational backgrounds in health and education may not reflect the views of parents in the general population

Authors	Country	Aim/s	Study type	Achieved sample size	Sampling technique	Internal validity	External validity and generalisability to Australia/New Zealand
Joshi et al. (2002)	United States	"To determine the accuracy of label reading among parents of food-allergic children".	Survey followed by a label identifying task/quasi-experiment	91 parents of food allergic children	Parents of children attending the paediatric allergy clinic of a hospital were asked to participate in the study if they indicated on their preclinical screening form their child followed a restricted diet.	<p>Medium</p> <p>*8 parents were not included in the final sample (did not return the initial survey)</p> <p>*Random sampling was used, as were validated methods to measure the predictor and outcome variable</p> <p>*There was no mention as to whether participant/researcher blinding occurred</p> <p>*Limited methodological information provided to ascertain whether standardised procedures were used during the experiment</p>	<p>Low</p> <p>* Small sample size limits external validity</p> <p>* Results may have been biased by the fact 51% of participants had a prior consultation with an allergy clinic, and 70% had been provided materials by a support group</p> <p>(greater contact with the support clinic was associated with more correct responses)</p> <p>*Generalisability is also limited by the controlled surrounding of the clinic, where more focused reading of the label may have occurred than in a supermarket context</p> <p>*No information was provided regarding participants' demographic details (age, sex, ethnicity etc.)</p> <p>*Different (albeit similar) food supply and different labelling regulation in the US</p>

Authors	Country	Aim/s	Study type	Achieved sample size	Sampling technique	Internal validity	External validity and generalisability to Australia/New Zealand
Ju et al. (2015)	Korea	“To analyse allergen labelling preferences”.	Survey	<i>n</i> = 543 participants living in Seoul and Gyeonggi area	No details provided on recruitment method, other than participants were grouped by age; teenagers (elementary – high school), twenties, thirties, forties, fifties and sixties, with a relatively even split amongst all supplied demographic variables (age, sex)	<p>Medium</p> <ul style="list-style-type: none"> *Limited methodological information provided *Used items validated in a Korean population throughout the questionnaire *Survey methodology is subject to several biases (response, social desirability, recall) *High response rate (97.3%) may reflect sampling bias *Surveyed members of the general public in addition to FAIs and those who shop for them *Reasonable sample size *Survey was brief to minimise fatigue 	<p>Low</p> <ul style="list-style-type: none"> *Different language, food supply and labelling requirements in Korea *Nevertheless, the preferences expressed by respondents in this study have been echoed internationally
Marchisotto et al. (2017)	United States and Canada	“To establish knowledge of PAL and its impact on purchasing habits”.	Survey	<i>n</i> = 6684 respondents (84% caregivers of food-allergic children and 22.4% FAIs)	Respondents were recruited through Food Allergy Research & Education (FARE) and Food Allergy Canada’s membership lists and social media. They were invited to participate if they had a food allergy, someone in the family with whom they resided had a food allergy, or they were the parent/caregiver of someone with a food allergy for whom they purchased food. Day-care operators or school personnel were excluded.	<p>Medium</p> <ul style="list-style-type: none"> * The global thresholds survey was developed and validated by FARE for the US FDA to explore consumer opinions *The survey was offered in English, and in Canada in English and French *Despite the large sampling size, self-reported data is subject to biases and causal conclusions cannot be drawn. *Sampling bias may have influenced results *Neyman’s bias may have influenced results from FAIs completing the survey *Demographic characteristics were controlled for statistically *Survey was completed electronically (restricting respondents to those with computer access) 	<p>Medium</p> <ul style="list-style-type: none"> *Despite the large sample size, results may not generalise to the general Australian and New Zealand population because electronic survey respondents were recruited through consumer groups such as FARE and Food Allergy Canada, and tend to be more educated and affluent than the general population *Different labelling requirements and products available in the US and Canada

Authors	Country	Aim/s	Study type	Achieved sample size	Sampling technique	Internal validity	External validity and generalisability to Australia/New Zealand
Marra et al. (2017)	Canada	“To examine consumer preferences in food labelling for allergy avoidance and anaphylaxis prevention. A secondary objective was to identify whether different subgroups within the consumer population emerged”.	Experiment (discrete choice)	<i>n</i> = 985 participants	To obtain a representative sample of the Canadian population, participants were recruited by IPSOS Reid Canada panel of 300,000 residents who have agreed to participate in surveys. Participants had to be over 19 years of age, fluent in English, and residing in Canada. They were remunerated using IPSOS' points based system.	<p>High</p> <ul style="list-style-type: none"> *Discrete Choice Experiment = a validated tool for assessing consumer preferences (selected due to its theoretical validity) *A qualitative study using eight focus groups to identify specific attributes of allergen-related food labelling that are most important to consumers was conducted prior to and to inform the development of the choice sets *Interviews were recorded, transcribed and analysed *The internal consistency of individuals' responses was evaluated and shown to be high *Sampling/selection bias may have occurred - participants were recruited through and an IPSOS panel and only those who had computer access could participate, as the experiment was delivered online *The 10% of respondents considered inconsistent in their responding were omitted from data analysis *18 choice sets were developed to limit the likelihood of participant fatigue – each participant had to choose between two hypothetical scenarios (e.g. use of symbols versus no use) *Study was pilot tested in 100 respondents *Choice scenarios may not reflect realistic examples *Results support those of prior qualitative studies examining similar variables 	<p>Medium</p> <ul style="list-style-type: none"> *Similar, albeit slightly different food supply and different regulations for food labelling in Canada *Every step was taken to ensure the final sample was as representative of the general population as possible in terms of race, sex, SES status and education – including a mix of FAIs and those who shop for them (either frequently or infrequently)

Authors	Country	Aim/s	Study type	Achieved sample size	Sampling technique	Internal validity	External validity and generalisability to Australia/New Zealand
Monks et al. (2010)	United Kingdom	“To understand the practical challenges that teenagers with food allergy experience using a qualitative approach and to generate potential interventions for tackling these”.	Survey and semi-structured interviews	<i>n</i> = 18 participants (10 females)	<p>Participants (aged 11–18 years) were recruited from a Children’s Allergy Clinic</p> <p>Inclusion criteria included an existing food allergy as diagnosed via positive skin prick test or serum-specific IgE.</p> <p>Purposive sampling was used to ensure there was representation from males/females and younger/older teenagers.</p> <p>Sampling ceased when data saturation had been achieved.</p>	<p>High</p> <ul style="list-style-type: none"> *Initial survey was developed from previously validated measures on a similar population *Parents were not present for interviews to minimise likelihood of response and social desirability bias *All interviews conducted by the same, trained interviewer *Unknown whether participants’ responses were fed back to them for verification/ feedback *Open questions guided by a-priori topic areas *Interview transcripts were analysed using a thematic approach. Transcripts were coded into the topic areas pre-determined by the researcher’s clinical experience and prior literature *Emerging themes explored in greater depth *A sample of transcripts were coded independently by two investigators to ensure coding was similar *Results were compared with the survey data *Emerging themes validated in discussion with external experienced multidisciplinary team *The small sample size prevented comparing how behaviour changes across early adolescence *Response biases may have occurred as interviews were conducted by a medical student, who may have been perceived by teenage respondents as being close to their medical team/a source of authority and power 	<p>Low</p> <ul style="list-style-type: none"> *The homogenous nature of the study population in terms of ethnicity, age and allergy status may reduce the generalisability of results, in addition to the small sample size *Participants were recruited from a single location in an affluent suburb *Results may not generalise to an Australian/New Zealand population.

Authors	Country	Aim/s	Study type	Achieved sample size	Sampling technique	Internal validity	External validity and generalisability to Australia/New Zealand
NFO Donovan Research (2004) - on behalf of Food Standards Australia New Zealand	Australia & New Zealand	"The survey was designed to assess the understanding and use of food label information in food selection decisions made by the main grocery buyer in a household when shopping for foods for consumption by those who are 'at risk' of adverse or allergic reactions to food."	Survey	<i>n</i> = 510 respondents (413 from Australia and 97 from New Zealand)	Recruitment undertaken via 3 routes: 1) immunology/allergy clinics in hospitals and medical institutions; 2) private immunology/allergy clinics and 3) allergy support groups across both Australia and New Zealand Children and adults with different types of food allergies were contacted from all states, territories and regions with access to medical specialists. The three recruitment groups were controlled to ensure similar sampling proportion.	High *At the time of the survey, foods were still legally available for sale that had been manufactured and labelled according to the old food standards *A broad definition of food allergy was adopted by FSANZ to target households with members who were 'at risk' of adverse reactions to foods, thereby obtaining a wider cross-section of respondents who may be assessing food labels critically because of concerns about food labelling *Despite validated items being included, survey methodology is subject to several biases (recall, social desirability etc.) The low response rate (45% in Australia and 40% in New Zealand) may reflect sampling bias *Segmentation approach was used to group individuals into segments with like characteristics *Potential Neyman's bias when surveying FAIs	High *Study examined population of interest however NZ was much less represented *Although there was a higher proportion of female respondents, this is expected given the sample comprised main grocery buyers.

Authors	Country	Aim/s	Study type	Achieved sample size	Sampling technique	Internal validity	External validity and generalisability to Australia/New Zealand
Noimark et al. (2009)	United Kingdom	“To understand and quantify the attitudes of parents of children with nut allergy towards labels informing that the product could contain nuts”.	Survey	<i>n</i> = 184 parents of food allergic children	An anonymous questionnaire was given to parents of children with previously diagnosed nut allergy when attending a tertiary referral paediatric allergy clinic.	<p>Medium</p> <ul style="list-style-type: none"> *All parents and patients had previously been counselled and educated regarding restriction of nut products *The questionnaire was completed after initial consultation with the physician, and collected by the allergy nurse immediately after *Data collection occurred at different times in the same location *Unknown whether standardised procedures were used to collect information (e.g. if the same physician administered the test/answered any questions) *Surveys are subject to self-report, Neyman’s, leading questions and wording, acquiescence, social desirability, and recall bias *While the stimuli presented (five real world labels) was reflective of reality, responses relied on participants literacy *Data produced was descriptive in nature *Results may have been influenced by differing levels of familiarity with the small number of stimuli presented *100% response rate may reflect sampling bias 	<p>Low</p> <ul style="list-style-type: none"> *Results may be an overestimate of current attitude towards labels as this study was performed in a tertiary referral population of children with multiple food allergies and perhaps a more wary parent *No demographic details were provided for respondents *Results may not extrapolate to an Australian and New Zealand market due to differing labelling requirements and products available

Authors	Country	Aim/s	Study type	Achieved sample size	Sampling technique	Internal validity	External validity and generalisability to Australia/New Zealand
Parikhal et al. (2018)	United States	“To investigate the speed and accuracy of allergen identification on commercial packaging across different types of warning labels”.	Experiment	<i>n</i> = 32 non-FAIs in reasonably good health for their age (aged 18–24 and 55–69) Participants were equally divided into quadrants depending on age group and gender.	No information regarding sampling technique information provided.	<p>High</p> <p>*The products were placed at random within a large bin to block sight of the products and allowing participants to reach in and retrieve them (participant blinding to stimuli to not allow for spill over effects)</p> <p>*Standardisation occurred across the study procedure *Objective measures (duration spent examining a product, number of times a product was turned, and accuracy of response were measured using a Go-Pro camera) were used *Participants completed a pre-experimental questionnaire and had their vision assessed prior to participation to limit confounding variables</p> <p>*Data was analysed by two trained researchers, and moderated by a third – no mention of researcher blinding</p> <p>*Participants were compensated in this study, and may have been more motivated/spent more time examining each product than they would have in a grocery store, meaning the number of errors may have been underestimated</p> <p>*No information provided on drop-out rate</p>	<p>Medium</p> <p>*The study only examined non-allergic FAIs pretending to shop for a nut-allergic individual</p> <p>*It may be the case FAIs develop strategies or faster search methods while maintaining high accuracy of safe product identification</p> <p>*The sample was balanced for representativeness, however lack of information about recruitment processes makes external validity difficult to determine</p> <p>*The US also has different allergen regulation and food products available – unknown whether findings extrapolate to an Australian and New Zealand market</p>

Authors	Country	Aim/s	Study type	Achieved sample size	Sampling technique	Internal validity	External validity and generalisability to Australia/New Zealand
Sakellariou et al. (2010)	Greece	“To estimate consumers’ ability to recognize food allergens in labels, depending on the existence of personal food allergy history, educational level and professional direction, and suggest changes in labelling”.	Experiment	Total $n = 160$	Group 1: $n = 83$ randomly selected parents of both allergic and non-allergic children selected from the general population (Athens primary schools) Group 2: $n = 34$ parents of food-allergic children, who have visited the allergy clinic of the researcher’s hospital Group 3: healthcare professionals without any food allergy history (details of recruitment not provided)	Unknown *Limited methodological information was provided on how the test was delivered to the different groups, whether procedures were standardised etc. *Random sampling of participants in group 1 suggests the sample may be representative of Greek parents of food allergic individuals, although the sample size is relatively small *Neyman’s bias may have influenced results *Participation rate, dropout rate etc. not reported	Low *While some English words were examined, the different language, food supply and labelling regulation in Greece restricts generalisability of results to an Australian and New Zealand market. Insufficient detail was provided about demographic variables
Sheth et al. (2010)	Canada	“To determine the proportion of food-allergic individuals attributing an accidental exposure to inappropriate labelling, failure to read a food label, or ignoring a precautionary statement and to identify factors associated with accidental exposures”.	Surveys	$n = 1454$	Food allergic individuals or their caregivers were recruited from a Canadian registry of individuals with a physician-confirmed diagnosis of peanut allergy and from allergy awareness organisations. Respondents were >18 years.	Medium: *Given the data was collected retrospectively, recall bias may have affected results. However, to limit this, respondents were contacted by telephone to verify equivocal responses. *Neyman’s bias may have been an issue, as the sample comprised FAIs or their caregivers *Food-allergic individuals may have attributed their accidental exposure to inappropriate labelling but not verified whether this was a manufacturer error e.g. cross-contamination may have been the fault of the consumer, not the manufacturer *Relatively high response rate of 78.1% may reflect sampling bias *No details on method of survey administration e.g. whether systemisation occurred *Questionnaire not provided to determine whether leading questions were used	Medium *Respondents were recruited through food allergy awareness organisations and were highly educated, better informed and more vigilant than the general population of food-allergic consumers *Only those with a peanut allergy (or their caregivers) were sampled, and results may not extrapolate to FAIs with other food allergies *The different labelling requirements and food products available in the Canadian market differ from Australia/New Zealand

Authors	Country	Aim/s	Study type	Achieved sample size	Sampling technique	Internal validity	External validity and generalisability to Australia/New Zealand
Silvester et al. (2016)	Canada	"To assess the relationship between self-reported adherence to a gluten-free diet (GFD) and the ability to determine correctly the appropriateness of particular foods in a GFD".	Survey	<i>n</i> = 82 respondents with a median time of six years following a gluten free diet (GFD)	Participants with self-diagnosed Coeliac disease (<i>n</i> = 76) and/or dermatitis herpetiformis (<i>n</i> = 6) were recruited through clinics and support groups, as well as through advertisements at retail locations specialising in gluten-free products. Interested individuals accessed an anonymous online questionnaire.	<p>Medium:</p> <ul style="list-style-type: none"> *The questionnaire used was developed by an expert panel *Correct classification of foods was determined by a dietitian with expertise in GFDs and verified by reviewing product labels at grocers and shops specialising in gluten-free products *Real world stimuli was not used, simply reference to the food product on the questionnaire *The questionnaire was piloted for face validity *Adherence to a gluten free diet was self-rated, and social desirability may have influenced results *Only foods (not food labels) were tested *The extent of unintended gluten consumption is nearly impossible to quantify and likely higher than what was reported *The cross-sectional design of the study precludes detailed analysis of changes in knowledge over time *Small sample size limits statistical power *Response rate was not reported. *Self-selection into the process may have resulted in sampling bias 	<p>Medium:</p> <ul style="list-style-type: none"> *Different labelling requirements and products available in Canada *The small sample size of predominantly women (88%) aged >55 years with a higher level of education means results may not extrapolate to the general coeliac and/or gluten-sensitive population *The views of those shopping for Coeliac or gluten-sensitive individuals were not obtained

Authors	Country	Aim/s	Study type	Achieved sample size	Sampling technique	Internal validity	External validity and generalisability to Australia/New Zealand
Simons et al. (2005)	United States	"To investigate current responses to food labels so that the impact of future label changes can be anticipated".	Survey	<i>n</i> = 489 adults who attended Food Allergy & Anaphylaxis Network conferences	Adults (18 years +) who attended Food Allergy & Anaphylaxis Network conferences were asked to complete the survey. Invitations were directed toward adult food allergic individuals (FAIs) or adult relatives of food allergic children.	<p>Unknown:</p> <ul style="list-style-type: none"> *Limited methodological information provided *A high participation rate of 84% may reflect sample bias given respondents were recruited across three allergy conferences (potentially more motivated) *The questionnaire was anonymous and reviewed/approved by an institutional review board *No mention is made as to whether items had been previously validated or were developed for the purpose of the study 	<p>Medium:</p> <ul style="list-style-type: none"> *The survey requested the most sensitive FAI to participate, and therefore the sample may not be representative of all FAIs, whose knowledge of food labelling etc. may be lesser due to less severe reactions *Some respondents were relatives of FAIs, and therefore answers may have differed from those of FAIs sampled *Labelling requirements and products available in the US also differ from those of Australia and New Zealand *Those who attended the conferences may be more affluent and educated (not reflective of the general FAI population)

Authors	Country	Aim/s	Study type	Achieved sample size	Sampling technique	Internal validity	External validity and generalisability to Australia/New Zealand
Soogali and Soon (2018)	Mauritius	"To determine the self-reported prevalence of food allergies and consumers' perceptions towards food allergen labelling in Mauritius."	Survey administered using face-to-face interview approach	113 respondents	Shoppers at four separate supermarkets were approached and asked to participate.	<p>Medium:</p> <ul style="list-style-type: none"> *Previously validated items assessing attitudes towards food labelling were included in the questionnaire *A pilot study was conducted to evaluate language, clarity and suitability of wording *The purpose of the study was explained to respondents, potentially discriminating between those who are more motivated in health (especially allergies) *Questionnaires were administered using a face-to-face interview approach as this helps to increase response and completion rate *The researchers controlled statistically for any demographic cofounders. *No information provided as to whether the same person delivered the questionnaire, nor whether training has occurred to ensure delivery was as standardised as possible *Sampling occurred at different times/days in the week in an attempt to capture a diverse demographic of shoppers 	<p>Low:</p> <p>Although English is commonly spoken in Mauritius and imported products from Western nations comprise a large part of the food supply, there are still significant differences in the food products available and labelling regulation.</p>

Authors	Country	Aim/s	Study type	Achieved sample size	Sampling technique	Internal validity	External validity and generalisability to Australia/New Zealand
TNS BMRB (2016) - on behalf of Food Standards Agency	Ireland	“Explore consumer awareness, understanding and views of retail food labelling and how this currently affects purchasing decisions”.	8 focus groups, 8 accompanied shops, survey & online panel	The 8 focus groups included 8 people each (<i>n</i> = 64) Accompanied shops included 8 participants Survey (<i>n</i> = 201)	Respondents were recruited from the Food Standards Agency consumer panel (people who have made a conscious decision to participate in online surveys through a double opt-in registration) to include a mix of those who primarily do their shopping online and those who primarily shop in supermarkets, and included a mix of demographic variables, and whether people suffered from allergies.	High: *A representative sample was recruited *The mixed method design adopted (focus groups, accompanied shops, survey and online panel) increases the reliability of findings *Previously validated measures were used *Quantitative measures were informed by early findings from the focus groups *Online survey was conducted with a representative cross-section of consumers which was monitored by collecting house and demographic information *For the accompanied shop and focus group, interviewers followed a structured discussion guide *Procedures were systemised as much as possible for all data collection	Medium: Large representative consumer sample, however different products and labelling requirements in Ireland limit generalisability

Authors	Country	Aim/s	Study type	Achieved sample size	Sampling technique	Internal validity	External validity and generalisability to Australia/New Zealand
TNS Social Research (2009) - on behalf of Food Standards Australia New Zealand	Australia and New Zealand	"To provide a picture of allergy management and any issues encountered with current labelling and information".	Survey	Total $n = 1028$ – 893 in Australia and 135 in New Zealand	Questionnaire sent to households in which one or more members has a food allergy or allergies. Sampling was opportunistic, with samples drawn from a number of nationally-dispersed hospital-based allergy clinics, private allergy clinics and support groups, many of whom participated in the 2003 benchmark study. Paper questionnaires or a link to complete an identical version of the questionnaire online were sent out through hospitals and allergy clinics. The main grocery buyer within the household (either the FAI themselves or the caregiver of an FAI) was the target respondent.	<p>Medium:</p> <p>*Every step was taken to replicate the methodology and sampling approaches used in the 2003 benchmark study to ensure comparability could be deduced from the data (only minor changes to the original questionnaire)</p> <p>*However, both samples remain opportunistic and therefore may not be representative of the general population, despite the large sample size</p> <p>*There may have been systematic differences between those who participated and those who did not (very low response rate – 25%) – potential participant fatigue ? (response rate was 40% in the benchmark study)</p> <p>*Survey administration was conducted in a controlled environment (may not reflect reality), and several biases (e.g. social desirability, recall, Neyman's, response) may have influenced findings</p> <p>*Data produced was correlational in nature (no cause and effect)</p> <p>*Study was conducted 10 years ago (may be that attitudes and beliefs have changed since then)</p>	<p>High:</p> <p>*Population of interest (Aust. & NZ)</p> <p>*Respondents recruited across all states and territories in Australia, and both islands of New Zealand</p> <p>*The views of members of the general population, who may infrequently purchase for FAIs, was not obtained (although results were compared to those of the general population)</p>

Authors	Country	Aim/s	Study type	Achieved sample size	Sampling technique	Internal validity	External validity and generalisability to Australia/New Zealand
Verrill et al. (2013)	United States	"To explore the link between the food label, gluten-free (GF) claims and the difficulty associated with following a Gluten Free Diet (GFD)".	Survey	<i>n</i> = 2380 - 1583 with Coeliac Disease and 797 with Gluten Sensitivity	Purposive sampling – The FDA conducted a survey and experimental study in early 2010 – the data from the survey was used to inform this study. A notice publicising the web-based survey was disseminated by major Coeliac disease treatment and research centres located in the US and amongst the US-based interest/support groups. Potential respondents had to be 18 years plus, be following a gluten free diet, and have met the criteria for Coeliac disease or gluten sensitivity. Only those who indicated Coeliac diagnosis by biopsy of the small intestine were included in the CD group, others were included in the self-diagnosed GS group.	<p>Medium:</p> <ul style="list-style-type: none"> *Reporting and social desirability bias may have influenced results as data was self-reported (e.g. compliance with a GFD) *The large sample size increases confidence in findings *Participants were geographically dispersed across the country and recruited to be as representative as possible in terms of age, gender and ethnicity *Tests for equality of means provided statistical evidence justifying the need to separate the CD and GS groups for analysis *Results must be interpreted in light of the purposive sampling strategy employed 	<p>Medium:</p> <ul style="list-style-type: none"> *Purposive sampling selected subjects deliberately and may not reflect the views of the broader population, despite the large sample size <p>Different labelling requirements, thresholds, and food products in the American market restrict generalisability to Australia and New Zealand</p> <ul style="list-style-type: none"> *The views of individuals with self and doctor-diagnosed conditions was collected, although the views of those shopping for these individuals was not

Authors	Country	Aim/s	Study type	Achieved sample size	Sampling technique	Internal validity	External validity and generalisability to Australia/New Zealand
Vierk et al. (2007)	United States	“To report the prevalence of self-reported food allergy, to identify the characteristics of food allergy reactions, and to describe the use of labels among adults with food allergy”.	Survey	<i>n</i> = 4482 - those respondents who indicated a sulphite allergy (<i>n</i> = 5) were excluded from analysis	Random sampling (nationally representative single-state sample of telephone numbers generated by the GENESYS Sampling System) was used. The majority of nonresponse was caused by initial refusals, quits, or non-availability of respondents (# not reported). Both individuals with a self-diagnosed and doctor diagnosed allergy were included and separately identified. The family member with the most recent birthday (aged 18 years +) was asked to participate.	<p>Medium:</p> <ul style="list-style-type: none"> *Data from the FDA's 2001 Food Safety survey was analysed to determine prevalence of food allergy and opinions about food labels in the management of food allergy *Validated measures were used *The food allergy questions were cognitively tested with members of the Food Allergy & Anaphylaxis Network for clarity, completeness and relevance of item content *A Spanish version was also developed to capture a wider demographic of respondents *A large nationally representative sample participated, however response rate was low at 35.8%, and there may have been systematic differences between those who refused and those who agreed to participate *Statistical methods were used to control for demographic confounders. However, the correlational nature of survey data prevents causal conclusions being drawn. *Food allergy (even doctor diagnosed) was self-reported *Survey may have been subject to recall error (being asked to reflect on the past year), and no food lists were provided to prompt participants when listing their current/previous food allergies (potential memory bias) *Data almost 10 years old – may not be reflective of current views 	<p>Medium:</p> <ul style="list-style-type: none"> *Despite the large, nationally representative sample, participants may have been more motivated to read labels, as agreement to participate may be reflective of a greater interest in the topic *Results may not generalise to an Australian and New Zealand population where food products and labelling regulations differ

Voordouw et al. (2009)	Greece and The Netherlands	"To investigate whether information provided through current labelling practices meets the need of food allergic consumers".	Observational and Interview	n = 40 participants in total (20 in each country). Half the sample were adults who suffered from single or multiple food allergies, and half were parents of food-allergic children.	Participants in Greece and the Netherlands were recruited through local newspaper advertisements and through patient group websites. Participants were included on the basis of self-reported perceived or diagnosed allergies to milk, egg and/or tree nuts or peanuts (milk being common in children and eggs/nuts in adults).	<p>High:</p> <ul style="list-style-type: none"> *Sample size was determined to be sufficient for an in-depth exploratory investigation, and validated methods were used to assess level of food allergy severity *On face validity, results indicate the presence of the interviewer had minimal effect on respondents' answers and behaviours *Little methodological data provided on the interviewing component *Low, middle and high-priced supermarkets were included in the study to minimise for SES confounding results *Participants were not informed of the reward (paid groceries) at the conclusion of the study to minimise the likelihood of choice bias *A pilot study (with N=4 food allergic consumers) was conducted to check if the study design was appropriate to the objectives *Interviews were audiotaped, transcribed into English, and analysed using a validated coding scheme *A cross-check was performed to assess whether the codes attached to the quotes were assigned the same code by different researchers (inter-coder reliability 70%) *No mention of how many observers were used, whether it was the same observer for each participant, nor whether the observer underwent training *Several food products normally used for preparation of breakfast, lunch and dinner, as well as snacks were included in the shopping (designed to resemble a real shopping list) 	<p>Low:</p> <ul style="list-style-type: none"> *Women were overrepresented in the sample, however this tends to be the case in any study that includes the primary grocery shopper *Small sample size suitable for the methodology but still limit external validity *The significantly different food supply, language and labelling requirements in Greece and the Netherlands limits generalisability to an Australian and New Zealand population
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Authors	Country	Aim/s	Study type	Achieved sample size	Sampling technique	Internal validity	External validity and generalisability to Australia/New Zealand
Voordouw et al. (2011)	Germany, Greece and the Netherlands	"To identify the preference of food allergic consumers regarding different information provision scenarios".	Survey	<i>n</i> = 287 participants - only 255 were included for analysis of ICT data	Adult food allergic individuals and the parents of food allergic children were recruited through advertisements in national newspapers or e-letters from national patient groups related to food allergy in Germany, Greece and the Netherlands. Participants were also recruited through advertisements published trade magazines.	<p>High:</p> <ul style="list-style-type: none"> *A fractional factorial design was employed to minimise the number of profiles presented to respondents *To reduce potential fatigue, each respondent rated half of the profiles (8 questions per information scenario) *The statistical model was shown to be reliable *Demographic information and experience with using ICT tools were controlled for as potential confounding variables *Validated items were used to measure the dependent variable *The questionnaire was piloted in English with students from the three participating countries prior to translation into the relevant language *Important to note the correlational nature of the data (limiting causal conclusions to be drawn) *Demographic data did not allow for accurate separation of self and physician diagnosed food allergy, nor identification of families where multiple members suffered allergies *Neyman's bias may have influenced respondents' answers *Information delivery scenarios (the independent variables) were developed through a combination of stakeholder analysis of what was possible given existing and emerging technologies *Stimuli was presented in theory (through images and questions) – not realistic 	<p>Medium:</p> <ul style="list-style-type: none"> *While consumer preferences for allergen information delivery did not differ profoundly between the three countries, different labelling requirements and products available in Europe make it difficult to determine whether these results would generalise to an Australian/New Zealand population *However, there was a relatively large sample size from several countries examining both adults shopping for themselves and those shopping for others e.g. children. *Authors note participants were not nationally represented in terms of age, gender and SES

Authors	Country	Aim/s	Study type	Achieved sample size	Sampling technique	Internal validity	External validity and generalisability to Australia/New Zealand
Voordouw et al. (2012)	Netherlands and Germany	"To assess the preference of food allergic consumers for different prototype information delivery tools, with the aim of improving informed product choices".	Survey	n = 62 respondents (24 in Germany and 38 in the Netherlands)	Participants (FAls or their spouses or parents of food allergic children) were recruited through advertisements published in national newspapers, on patient organisation websites, and via nutritionists based on their self-reported perceived or diagnosed food allergy or intolerance to at least one of the following: eggs, milk, tree nuts, peanuts, and/or gluten.	<p>Medium:</p> <ul style="list-style-type: none"> *Procedures were put in place to randomise the interaction effect of the food product, the information delivery tool, and the order effect of the tool in each version of the questionnaire *Both quantitative and qualitative (through free text boxes) information was collected *The questionnaire was piloted in the Netherlands, albeit only with three respondents *As much as possible, the limitations associated with questionnaire methodology were controlled for (e.g. participant fatigue, response and social desirability bias) *The small sample size restricted the number of statistical analyses that could be performed *Monetary incentive may have led to sampling and response bias *Stimuli was developed for the purposes of the study (fictitious food products bearing manipulated labels) – may not be reflective of a real-world environment *Neyman's bias may have influenced responding 	<p>Low:</p> <ul style="list-style-type: none"> *External validity limited by the small sample size, international context, and the fact that parents shopping for their allergy-prone children were underrepresented *The authors suggest replicating the study using a larger sample drawn from a greater range of countries to increase generalisability of conclusions and facilitate cross-cultural comparisons *Also noteworthy, 85% of the sample was female, although this is often the case when examining data from the primary grocery shopper of the household *The study examined both medically and self-diagnosed food allergic consumers

Authors	Country	Aim/s	Study type	Achieved sample size	Sampling technique	Internal validity	External validity and generalisability to Australia/New Zealand
Weber et al. (2007)	Brazil	“To investigate how well the parents of children on cow’s milk free diets perform at recognising whether or not expressions describe foods containing cow’s milk proteins”.	Interviews followed by label identification task (experiment)	<i>n</i> = 47 - 24 parents of children on diets free from cow’s milk and by-products (study group) and 23 parents or guardians of children with no need for any type of exclusion diet (control group)	Parents of children treated at the paediatric gastroenterology department were randomly invited to participate in the study. No mention of how parents of children without need for an exclusion diet were recruited.	<p>Medium:</p> <ul style="list-style-type: none"> *Purpose of the study was explained to participants (no blinding occurred) *Study was pilot tested on 10 participants *Questionnaire delivery was standardised *Sample size determined using statistical methods *Differences observed in the experimental component of the study reached statistical significance *Authors suggest replication on a larger, more culturally diverse sample *Groups did not differ in terms of sex, age or economic class *No mention of whether items included on the questionnaire had been previously used/validated, or developed for the purposes of this study *Participants were made aware of their correct/incorrect answers at the conclusion of the experiment *Participant fatigue may have influenced performance on the label identification task (participants had just completed a questionnaire) *Comparison with a control group increases validity of findings 	<p>Low:</p> <ul style="list-style-type: none"> *Small sample size of predominantly women (81%) *The participants in both groups belonged to a range of economic classes and had varying education levels (recruited to be as representative as possible of the Brazilian population) *Examined both parents of FAls and members of the general public *However language, food choices and labelling requirements may vary considerably from an Australian and New Zealand context

Authors	Country	Aim/s	Study type	Achieved sample size	Sampling technique	Internal validity	External validity and generalisability to Australia/New Zealand
Wortman (2016)	United States	“To conceptualise a decision making process based on the degree of elaboration (extent to which congruent and incongruent allergen information is present) the consumer engages in when reading and evaluating information contained on the food product label and nutrition facts panel.”	Four surveys	223 respondents were included in the final analysis (completed all 4 surveys)	Online surveys disseminated by Qualtrics labs (market research company) to self-identified food allergic individuals or caretakers/stakeholders of a food allergic individual(s)	<p>High:</p> <ul style="list-style-type: none"> *Study design replicated a similar prior study *Previously validated items informed development of items included in all surveys *Label stimuli was derived from actual products currently in the marketplace so as to enhance the realism of the manipulations *A pilot study was conducted to check the study design was fit for purpose *Statistical methods were employed to check for validity and reliability of the newly-formed questionnaire *Survey length was kept brief to minimise respondent fatigue *Manipulation checks were also incorporated *A survey setting may not reflect the actual shopping experience, where time constraints and distractions are more likely to lead to errors *Limitations include delivering the survey via a single means (online), potentially restricting the number of respondents who could participate, and investigating a single type of consumer packaged food product (dairy-containing) *No mention of whether participant blinding occurred 	<p>Medium:</p> <ul style="list-style-type: none"> *Reasonable sample size although 89% self-reported as the primary grocery shopper for themselves, and therefore views may not reflect those of parents or caregivers who shop for food allergic individuals *Some products available in the US and tested (e.g. coffee creamer) are not generally consumed by an Australian and New Zealand population

Authors	Country	Aim/s	Study type	Achieved sample size	Sampling technique	Internal validity	External validity and generalisability to Australia/New Zealand
Zarkadas et al. (2013)	Canada	"To evaluate the difficulties experienced, the strategies used and the emotional impact of following a gluten-free diet among Canadians with Coeliac disease".	Survey	<i>n</i> = 5912 respondents (<i>n</i> = 5857 English and <i>n</i> = 1966 French)	The questionnaire was mailed to all members (aged 18 years +) of both the Canadian Celiac Association and the Fondation québécoise de la maladie coeliaque who were currently following a gluten-free diet	<p>High:</p> <ul style="list-style-type: none"> *Questionnaire was developed collaboratively by the CCA Professional Advisory Board and Health Canada, in consultation with FQMC *Questionnaire was developed in English and translated in French, with language equivalence being analysed by subject matter experts *Response rate was relatively high at 72%, potentially reflecting sampling bias *No demographic information was provided regarding demographic variables, however the large sample size was deemed to be as representative as possible of the Canadian population with Coeliac disease *Response and Neyman's bias may have occurred, with members with strong opinions being more motivated to complete and send back the questionnaire *Random sampling was not possible as there is no Coeliac disease registry in Canada 	<p>Medium:</p> <ul style="list-style-type: none"> *Comparison of respondents with members of the general population revealed respondents tended to be women, have a higher annual household income and education, which are significantly associated with key variables in the study e.g. quality of life and diet knowledge – reducing representativeness *Different food supply and labelling regulation in Canada may mean results are not generalisable to an Australian/New Zealand context

Appendix 3: Acronyms

Acronym	Definition
AFGC	Australian Food and Grocery Council
CALD	Culturally and Linguistically Diverse
EU	European Union
FAI	Food-allergic individual (someone who has one or more food allergies)
FDA	Food and Drug Administration (in United States)
FSANZ	Food Standards Australia New Zealand
GF	Gluten free
GFD	Gluten free diet
IgE	Immunoglobulin E
PEAL	Plain English allergen labelling
UK	United Kingdom
US	United States