

How do peanut and nut-allergic consumers use information on the packaging to avoid allergens?

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Abstract

Background: Recent legislation has sought to improve the information printed on packaged foods relevant to the safety of food allergic consumers. We aimed 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.

Methods: The behaviour and ‘thinking aloud’ of 32 participants were recorded during their normal food shop, followed by a semi-structured interview. During the interview they were given 13 potentially problematic packaged foods, and asked if they would purchase the product and what their reasons were. Transcribed data from the shop, interview and 13-product task were analysed to explore use of allergy advice boxes, ingredients lists and other packaging information.

Results: Some participants used the ingredients list as their primary check for allergens, but most used the allergy advice box. Package-based information was generally considered reliable, but some supermarket and brand labels were trusted more than others. Images and product names were used to draw inferences about the presence of nuts. A number of improvements were suggested by participants, particularly a request for more ‘nut free’ labelling.

Conclusions: Food labels were used in conjunction with nonpacket-based strategies (e.g. previous experience) to make choices. External factors (e.g. trust of manufacturer) informed interpretation of and confidence in labels. Images and product names, not intended by manufacturers as an allergen risk assessment aid, were also used to inform choices.

Consumers are constantly faced with products made with multiple ingredients, where they cannot know the composition unless supplied with adequate information. Most consumers balance a number of considerations when deciding what to eat, for example the cost, taste and whether the food is ‘healthy’ (1, 2). Food allergic consumers have the additional life-saving need to avoid allergens.

There is no treatment for peanut or tree nut allergy, and management consists of careful allergen avoidance and emergency treatment of reactions (3–5). To assist peanut and tree

nut-allergic consumers avoid allergens, there are several sources of information on food packaging, including product name, ingredients list, allergy (‘contains’) advice and precautionary (‘may contain’) information. In the recent past, ingredients lists and allergy advice labels were often incomplete, used uncommon allergen names (e.g. casein) and in some cases used confusing symbols to indicate allergens, e.g. D for dairy (6). To address this, labelling on packaged foods became a focus of policy initiatives, including the development of new legislation and guidelines in Europe (Table 1). European Directives for labelling rules (2003/89/EC and 2006/142/EC) require a full list of ingredients on prepacked food. Any of the 14 specified common allergenic sources must be declared in the ingredients list and can be declared

Abbreviations

OAS, oral allergy syndrome; PCRT, product choice reasoning task; SUHT, Southampton University Hospital NHS Trust.

Table 1 Legislation, requirements and recommendations for labelling of packaged foods in Europe. This study was conducted in UK and specific UK guidance and legislation is therefore provided where it differs from the rest of Europe

	EU	UK specific
Legislation or requirements for specific labelling of allergenic foods	<p>EU Labelling Directive (Directive 2000/13/EC) Specifically refers to allergenic foods. Requires manufacturers to declare all ingredients in prepackaged foods with very few exceptions</p> <p>The European Directives for labelling rules (2003/89/EC and 2006/142/EC) ensure that retailers and manufacturers provide a full list of ingredients on their prepacked food packaging to help consumers with a food allergy identify ingredients that they should avoid</p> <p>Directive 2007/68/EC lists all 14 allergenic foods that must be clearly labelled wherever they are used as ingredients in prepacked food or food supplied to mass caterers. Brings all of the food allergens that must be labelled (and the exemptions) into one place</p> <p>Regulation (EC) No 415/2009 provides an extension to the temporary exemption from labelling egg albumin as a fining agent for wine and lysozyme used in wine and for milk casein used as a fining agent for wine</p>	<p>UK Legislation is necessary to provide enforcement powers of the EU legislation. The following UK legislation therefore applies:-</p> <p>The Food Labelling (Declaration of Allergens) Regulations 2008, implements the provisions of Directive 2007/68/EC into UK Law</p> <p>The Food Labelling (Declaration of Allergens) (England) Regulation 2009 implements the amendment made by Regulation (EC) No. 415/2009 into UK Law</p>
Relevant requirements under Food Law	<p>EU General Food Law (Regulation (EC) No 178/2002) imposes general obligations to provide safe food and requires Regulation (EC) No 852/2004 food businesses are required to implement procedures to prevent unsafe foods</p>	<p>Food Safety Act 1990 (as amended) makes it an offence to falsely describe or present food. In particular for food labelling to be false or likely to mislead as to the nature, substance or quality of the food (Section 15)</p>
Individual food allergens that must be labelled when used as ingredients in prepacked foods and food sold to mass caterers	<p><i>Allergenic sources and products of those sources:</i></p> <p>Fish</p> <p>Eggs</p> <p>Crustaceans</p> <p>Cereals containing gluten (i.e. Wheat, rye, barley, oats, spelt, kamut or their hybridized strains)</p> <p>Peanuts</p> <p>Soybeans</p> <p>Milk</p> <p>Nuts (i.e. almonds, hazelnuts, walnuts, cashews, pecan nuts, Brazil nuts, pistachio nuts, macadamia nuts and Queensland nuts)</p> <p>Celery</p> <p>Mustard</p> <p>Sesame seeds</p> <p>Sulphur dioxide and sulphites at concentrations of more than 10 mg/kg or 10 mg/l expressed as SO₂</p> <p>Lupin</p> <p>Molluscs</p>	
How should allergens be declared?	<p>Must be declared in ingredient list</p> <p>In addition may be included in a voluntary allergy advice box</p>	
Law or code that regulates font size and legibility	No	No

Table 1 (Continued)

	EU	UK specific
Voluntary advisory labels		The Food Standards Agency's Guidance on Allergen and Miscellaneous Labelling Provisions (2009) suggests advisory labelling e.g. allergy information box, is placed in the same field of vision as ingredients list. If advisory labelling is provided, then this must be accurate and not misleading and include all food allergens listed in the ingredients list http://www.food.gov.uk/multimedia/pdfs/publication/allergenlabelguidance09.pdf
'May contain' addressed in food safety law or food labelling law?	No	No

voluntarily in an allergy advice (or 'contains') box. In the event that a food may contain traces of allergen, not as an intentional ingredient, but as a result of unavoidable cross-contamination, the risk is often indicated by a precautionary 'may contain X' label. These precautionary statements are not regulated. However, there is a general requirement for food labelling not to be misleading, and to be safe under general food law (178/2002EC Article 14).

Physicians, dietitians and other health professionals have a vital role in providing information regarding effective avoidance diets (3), but need to understand allergic consumers' current behaviour. Several studies have addressed the use of food labels by food allergic individuals since the implementation of the aforementioned labelling laws (7–10), but these were not designed to provide insight into the complex decision processes undertaken in making a risk assessment (8, 9). A study of 40 food allergic consumers from the Netherlands and Greece, immediately after the introduction of the EU legislation, reported problems with readability and difficulty finding the relevant allergy information, which was often 'lost' amongst the nonallergy information (7). A questionnaire survey of 184 parents of peanut- and/or tree nut-allergic children focussed upon 'may contain' labels, not covered by legislation. It reported a large number of patients ignored cautionary 'may contain' labelling or assumed that there was a gradation of risk, dependent on the wording of the statement (8). A review of 20 000 products reported that 17% used cautionary labelling, using 25 different terminologies (9). 'May contain' labels are a substantial topic in their own right, not addressed in detail in this manuscript, which will be the subject of a separate paper.

This study sought to understand the complexities and reasoning behind decisions made by peanut and tree nut-allergic adults when shopping for food. A qualitative study was designed to provide insights into participants' experiences and perspectives, which could not be gained from quantitative surveys (11). We explored the role of product-based information in contributing to food-choice decisions, by exploring how allergy advice boxes, ingredients lists and

other packaging information were used. We identified when and why participants were satisfied with, and confident in, packet information. Finally, we noted ways in which participants suggested that packaging information could be more helpful.

Methods

Study population

Ethical approval was gained from the National Research Ethics Service and the University of Surrey Ethics Committee. To ensure a diverse range of participants in terms of their exposure to official clinical guidance and other more informal information sources, participants were identified from three sources: (i) specialist allergy clinics at Southampton University Hospital Trust, (SUHT) (ii) from one of three primary care settings or (iii) from staff and students of the University of Surrey (who had received medical care from a mixture of primary, secondary and tertiary care). Potential recruits completed a postal screening questionnaire. Eligible respondents were 16 years or older and had a clinical history compatible with IgE-mediated reactions to peanuts or tree nuts. Volunteers recruited from SUHT had positive skin prick tests and/or specific IgE measurements; volunteers from the University of Surrey and from primary care settings reported being seen by their GP or a hospital specialist who had diagnosed nut allergy and prescribed rescue medication. Individuals with allergies or intolerance to foods other than peanut or tree nuts were excluded, with the exception of oral allergy syndrome (OAS) to fruits and/or vegetables. Unlike egg or milk for example, avoidance of fruit and vegetables was unlikely to create significant dilemmas during the shop or product choice reasoning task (PCRT), which focused on packaged foods. The severity of a participant's worst ever reaction to nuts was graded using a classification previously used for peanut allergy (12). Eligible participants participated in an accompanied shop followed by an interview and PCRT.

Accompanied shop

Participants were observed during their normal food shopping at the supermarket or local shop. Before commencing the shop, a training procedure was carried out to familiarize participants with the 'think aloud' methodology (13–15). During the shop, participants were observed and asked to talk aloud at all times about what they were thinking with regard to their shopping. The researcher did not enter into conversation or ask questions but would use prompts such as 'what are you thinking now?' The researcher recorded notable behaviours and comments made by the participant for follow-up in the subsequent interview.

Semi-structured interview

An in-depth semi-structured interview was conducted in the participant's home following the accompanied shop. They were asked about behaviours or decisions noted during the shop, for example, avoidance of particular products or aisles. They were also questioned about their views on product labelling.

Product choice reasoning task

During the interview, each participant was presented with 13 products. To explore a range of dilemmas that food choice issues pose to allergic participants, we selected a range of readily available supermarket products for their consideration. To ensure a broad range of dilemmas, they were based around product categories that were identified by the allergy dietitian as those that allergic individuals might consider as being either high or low risk (see Table 2) independently of what information is presented on the label. Participants were asked whether they would eat each food, with particular reference to their allergy and were further probed to gain understanding about how they were making decisions, and the sorts of dilemmas and difficulties they encountered whilst doing this.

Analysis

The accompanied shop, interview and PCRT were audio-recorded and the resulting data were fully transcribed. The interview transcripts were coded by two researchers using NVivo qualitative data analysis software (version 8 2008; QSR International Pty Ltd, http://www.qsrinternational.com/support_faqs_detail.aspx?view=11). Thematic coding (16) was used to capture the key opinions that were expressed, and interpretations were developed looking at both converging and diverging views within the themes.

Results

Study participants

All 32 respondents who were eligible and consented to participate within the time-frame of the study were recruited (9 men; age range 16–70 years). Twenty-two participants

were recruited from SUHT specialist allergy clinics, four from primary care settings and six from University staff and students. Eighteen participants described previous severe reactions, 12 moderate and two mild. Five participants had peanut allergy alone, nine tree nut allergy alone and 18 had both. On average, they had been diagnosed for 20 years (range 1–63 years). Fifteen had suffered a reaction within the past year, and a further seven within 2 years. Five had OAS to fruit and/or vegetables. There was no difference in the strategies used by participants with previous severe reactions in comparison with milder symptoms.

How was the information on food packaging used to help make food choices?

Participants sometimes used the product brand or name as a source for their risk assessment, reflecting on prior experience with the product. Where this first-line strategy did not lead them to a confident decision, participants used other printed packet information such as the ingredients list.

Brands and supermarkets

Preference for supermarkets was often determined by the confidence that participants had in their labelling system (Box 1A, B, E). Participants would often choose brands and supermarkets that they considered reputable, and that they trusted (Box 1B–E). Their trust in the producer or supermarket, based on broader qualities such as perceived safety and quality, provided an important context for confidence in, and interpretation of labelling (Box 1D, E). Well-known brands were often trusted in relation to 'problematic products' (Box 1C, D). Reservations were sometimes expressed around a brand that produced well-known 'nutty products' (Box 1F, G) with concerns about cross-contamination. On occasions where a participant had previously reacted to one product within a brand, they expressed lack of trust in the whole brand range (Box 1H).

Allergy advice boxes

In general, allergy advice boxes ('contains boxes') were trusted as a reliable and relevant guide for assessing risk. All participants except one were familiar with allergy advice boxes and most participants used them as a key part of their decision-making, often preferring them to ingredients lists (Box 2A–E). Most participants used allergy advice boxes in conjunction with the ingredients list. Participants with longstanding allergies acknowledged 'contains' boxes were a welcome improvement on previous practice (Box 2F). Almost invariably, the voluntary status of these boxes was not understood by participants.

Participants found the readability, standardized format and speed of access of these boxes helpful (Box 2D, E). Most participants liked the concise summary of allergens provided by an allergy advice box but others disliked the lack of detail. Importantly, the absence of the allergy advice box was often incorrectly considered to be a signal that there was nothing to worry about (Box 2G). There was a clear exception to

Table 2 Products included in the Product choice reasoning task

Product description	Branded or supermarket own	Type of food	Allergen advisory labelling information	Anticipated dilemma
'High Risk' category foods				
Sesame and pumpkin seed Flat breads	Branded	Biscuit/cracker	'This product has been made in a bakery that handles nuts (no peanuts)'	Product has a precautionary warning about nuts but not necessarily the ones to which the participant is allergic
Wasabi bean mix	Branded	Savoury snack	'Contains soya' 'This product may contain traces of other nuts and seeds'	An unfamiliar product therefore decisions have to be made from scratch
Cantonese curry cook-in-sauce	Branded	Cook-in-sauce	'Contains celery, produced on a line which handles sesame'	This is normally a high-risk food category, for those with nut allergies; however, this product does not contain nuts or have contamination risk and therefore there is no nut warning on the label
Vanilla ice cream with chocolate sauce	Branded	Ice-cream	No allergy or may contain advice	This is normally a high-risk food category, for those with nut allergies; however, this product does not contain nuts or have a contamination risk and therefore there is no nut warning on the label
Oat-based breakfast cereal	Branded	Breakfast cereal	'Not suitable for peanut allergy sufferers. May contain traces of other nuts'	The label suggests the product is not suitable for nut allergy sufferers but other cereal products of the same brand are well known as not containing nuts and do not have such a warning
Cake bars	Branded	Cake	No warning but ingredient list states 'hazelnut paste'	Nuts are present as a minor ingredient at the bottom of the ingredients list, which is hard to find. There is no allergy advice box, so the consumer has to look through the ingredients list and then decide whether or not the product is suitable for them
Own brand freshly baked chocolate chip cookies	Supermarket own	Biscuit/cracker	'This product may contain traces of nuts or seeds'	This product is normally a high-risk product for those with nut allergies, with 'may contain nuts' warning (this is general and only pertains to bakery goods sold loose in general – not specific to this product)
Dairy-free chocolate snack bar with puffed rice	Branded	Chocolate	No allergy advice	There is no nut information on the label although chocolate is usually considered a high-risk food category for those with nut allergies. However, this is a 'free from' product in respect of other allergies
Chocolate buttons	Branded	Chocolate	'Contains milk'	This is normally a high-risk food category for those with nut allergies, but this particular product does not contain nuts or have a contamination risk and therefore there is no nut warning on the label

Table 2 (Continued)

Product description	Branded or supermarket own	Type of food	Allergen advisory labelling information	Anticipated dilemma
'Low Risk' category foods				
Cheese and onion crisps	Branded	Crisps	'Made in a bakery handling nut (not peanut)'	This product category is often safe for those with nut allergies but this particular product contains a nut warning
Macaroni cheese	Branded	Canned meal	'May contain egg'	This is a tinned food and therefore a low-risk category food for allergen cross-contamination. Will the individual's look for the allergy labelling?
Cauliflower cheese ready meal	Supermarket own	Ready meal	Recipe: no nuts; Ingredients: cannot guarantee nut free; Factory: before being prepared for manufacture of this product, the equipment was previously used to make products containing nuts	Although it is a low allergen risk food category, as it is a supermarket own product it has the standard allergy warning format which states it cannot be guaranteed nut free
Yoghurt coated fruit snack	Branded	Dried fruit snack	'This product is made in a factory which also handles nuts'	This product category is generally considered low allergen risk but it is labelled with a nut warning

Box 1 Trust in brands or supermarkets**Preference for brand or supermarket based on the labelling system used**

- AI always shop at [supermarket name] as well because other supermarkets aren't as good at labelling. (F,I Severe)
 B They are quite good [supermarket name]- they break it up, so you've got the recipe which has no nuts and then ingredients...can't guarantee... and then factory...but I'm usually OK with that. I mainly look at the recipe to be honest. (M,I Moderate)

Trust of the brand or supermarket

- C There we go.....[brand name]...just read the back, because I'm quite fussy with sauces, because I don't always know what's in them, so I normally go for well-known makes because they're a bit more reliable. That one's OK. (F,AS Severe)
 D With [brand] again, I suppose because it's a company, for right or wrong, I kind of trust, then when I see them mentioning something like "not suitable for peanut allergy sufferers" I'm more inclined to think then...they're not covering their backs, which is ridiculous because they're probably more likely to cover their backs! But I'm more willing to sort of listen to their words of caution so I would probably not eat them. (M,PCRT Moderate)
 E So [supermarket name 1], for me, is very good labelling and I trust them- that's why I shop there. I think some other places like [supermarket name 2], I wouldn't trust them as much, which probably means it's snobbery, but also I think [supermarket name 1] goes with very good products and very careful what they do. So [supermarket name 2], if it said it's been made in a factory that contains nuts I wouldn't go near it, whilst [supermarket 1], I might. It comes down to the brand, you know, marketing and brand safety I think. (F,I Severe)

Reservations about a brand that produces "nutty" products as well as "safe" products

- F ...when it comes to cereal, again, I'll always eat the same ones, but sometimes, when I do try something new, there's brands that I won't eat if they make another flavour that contains nuts. (F,I Severe)
 G The [product name]....surely all [brand name and product name] are made in the same factory, and then, so therefore peanut [product name] would be made in the same factory, so therefore like I shouldn't be able to eat it, but it doesn't say on the label, so..... (F,I Severe)

A bad experience with one product being generalised to other products within the brand

- H It's like "Oh, I remember once I felt a bit ill after eating....." It was actually some [brand name] oxtail soup and it just made me feel ill, so I just avoid [brand name] soups like the plague now just in case they make me ill for some reason. So there's brands with negative connotations to them. (M,I Severe)

Quotes are labelled as (gender, method from which quote is drawn, severity of most severe reaction). Gender M = male; F = female. Method from which quote is drawn: AS, accompanied shop; I, interview; PCRT, product reasoning task. Severity, Severe, moderate or mild (12). Direct quotes from participants are included. Square brackets containing text [] are used to provide information that is required for clarification purposes.

Box 2 Use of 'Allergen Advice' information**Preference for advice boxes over ingredients lists**

- Aboxes that have got allergy information – hopefully they've got them. If not, then I have to look through the ingredients list, but again, if it's too busy, you know, if the packaging is too busy, with lots of writing, I just won't even bother. (F,I Severe)
- B Allergy information, and that's the first place I look to. Where I'm used to look at like so many products, I can like scan it really quickly and just see straightaway. If there isn't any like...like it doesn't say anything about nuts, then I usually scan the ingredients, just to like double-check that it just hasn't been put in. (F,AS Moderate)
- C You can tell straightaway if you look there. Even then, I still quite often check the ingredients – go back through the ingredients away, but...em... it definitely sort of speeds things up, and it's also quite reassuring to see. (M,I Moderate)

Visibility and ease of reading

- D the ingredients are printed so small. Sometimes you're just scanning over it. If you're looking at so many, you can easily miss something, so I think allergy boxes are really helpful, and it's helpful when they sort of...they're a bit bigger and they stand out a bit more. That's good. (F,I Severe)
- E It does help when they're like big and bold, if they've got a .. colour, because you know exactly where to look for, whereas, if they're not there, it is quite unclear, and it all just blends in. It's just like a whole load of nutritional information, ingredients, and it's just...it kind of like all blurs, and you're like, "Am I looking at the right thing or not?" so the allergy boxes definitely do help, and they are really useful, yes" (F,I Moderate)

Improvements in recent years

- F *And what are your general views on allergy advice boxes?* They're getting better. Years ago, they weren't, but they're getting better and I use them all the time now. (M,I Severe)

Decisions when advice box not provided

- G We're going to try go for the (brand name) with no warnings or anything on, so that's good (F,AS Severe).
- H Pasta sauce... This is actually quite...a nut issue, [or it is for me]..... See what they say... Em... Yeah, I'm just looking for the sort of allergy advice part of it, and...I'm sure it has one somewhere, because they all do... I'm being completely blind here I think. I can't believe that! How have I not..?! I think I haven't spotted it, because there's no way in the world it wouldn't have one! That's ridiculous – I'm sure I used... Well...now it doesn't say anything, I'm a bit suspicious as to... For some reason, I'm a bit suspicious that they might just have left it off, but if it doesn't have an allergy advice, usually you probably just follow the ingredients and see that there's nothing in there which has nuts, but...I'm sure I'm missing it still, because literally, I've never seen...I've never seen one of these without allergy advice written on it. (M,AS Moderate)

See footnote of Box 1.

Box 3 The use of ingredients lists when making decisions**Preference for ingredients lists over advice boxes**

- A Yes, the ingredients really. I do notice the allergen labelling second, but I don't – I don't trust it, because what they pick out might not be...em...you know, relevant to me, so I like to check for myself, and because I know some of the...some of the sort of, you know, Latin names for nuts, I sort of look for that as well, because it's – not everything has got that allergen labelling. So yeah, I look at the ingredients, and if they're ambiguous, like with that pesto, not explaining what that means, which I think is really poor practice actually, then... You know, red pesto, what the hell's that, you know? It doesn't mean anything! Then I won't buy it, full-stop. (F,I Moderate)

Use of ingredients lists in conjunction with other product information

- B If it's a totally new product, then I'll go through all the ingredients as well, and then I look at everything on the packet to see if there's something hidden somewhere or within the ingredients. (F,I Mild)
- C If it was a new product that I've not eaten, I will read every ingredient in the full ingredients list and not just the "contains" section, but when it's a brand that I get comfortable with, I'll just scan it quickly in case they've changed – just the "contains" section, in case they've changed an ingredient, but because it's one I've eaten all the time, just to keep my own sanity, I'll just read the highlights. (F,I Severe)

See footnote of Box 1.

this. Participants were concerned about the absence of labelling when this conflicted with their other strategies for assessing risk. For example, pasta/curry sauce was designated as a 'problematic product' for a number of participants. During the accompanied shop, one participant was troubled by the lack of an allergy advice box on a curry product and was

reluctant to interpret no mention of allergy as indicating no risk (Box 2H).

Ingredients list

Some participants expressed reservations about allergy advice boxes and expressed an explicit preference for using the

Box 4 Other packet information used to assist decisions

- A *And finally, Cake Bars...*
Yeah, I'd probably just pick them up and...yeah, yeah, absolutely no problem again.
And again, your judgement's just made on...?
Yeah, there's a visual image, so obviously it's sponge cake, it's got chocolate in, covered in chocolate. If the texture was a bit granular, slightly like the.....like that, if the image had shown that there were other bits in, you'd think, oh hang on, there might be more in there than is obvious. (M,PCRT Moderate)
- B I bet those have got nuts in. Anything which sounds Oriental is more likely to have nuts in, so... I don't know... It says "Made in a factory using shrimp and egg ingredients" so it probably would be fine actually but..... (M,AS Moderate)
- C Product name is first filter – I'll look at the general description. Like, on a pizza, if it says Pepperoni Pizza with Pesto or something, then obviously I wouldn't buy it. That's the quickest way is if it's in the main description. (F,I Moderate)

See footnote of Box 1.

Box 5 How can labelling be improved?**'Nut-free' labelling**

- Athese are always good for parties because they...generally usually have on them that they're free from...they're usually free from dairy and gluten and nuts. Here we go..."Gluten-free, nut-free, milk-free, soya-free", so that's good labelling!As I say, with things...some of the things that we've looked at, the things that they tick are "free from", it's much easier to identify than then having to look at the warnings and make a decision from there. (F,AS Severe)
- B Ah yes! That's really good! You never find that on anything – "Made to a nut-free recipe in a nut-free environment". That's the first time I've ever actually read that on a product. Yes! Nut-free would be amazing, but no one...realistically, no one's ever going to do that because then it leaves them wide open to stuff, but that would be brilliant. Like if it's nut-free, then it's okay to say it's nut-free! That would be really – yeah, definitely. Like seriously, it would be so good. (F,AS Severe)
- C "Made in a nut-free environment". That is just superb. When you see that, you want to go – you actually want to write to them, and in fact, I did, because I wrote to (company) that make the (brand name) flapjacks. They actually put – they've got a little picture of a nut with a big cross through it, saying "This is made in a nut-free environment". (F,AS Severe)
- D Either it does or it doesn't, and I think anybody that could come up with a product and say "My products do not contain nuts", I think they can make a killing, simple as that! (M,I Severe)

Greater detail on labels

- E Yeah, risk categories. A factory that doesn't use nuts at all – absolutely perfect scenario! A factory that handles seeds and nuts, probably I'd say low risk. A line handling these nuts would be medium risk, and then high risk would be obviously if it actually contains nuts. (F,I Severe)
- F It's that when I...when you go shopping and they say....like my cereal – it says it's got almonds in it and it says it's got hazelnuts, so I trust it, because I know I can eat them, but I really do think that the companies that make things that have got nuts in, or even make things where a nut could be in it, that they should state what actual nuts it is. Because if everybody knew, you know, this product's been prepared by something where there's pecans and walnuts, then I wouldn't touch it at all, whereas if they said this has been produced near where there could possibly be peanuts in it, I wouldn't worry. (F,I Moderate)
- G This is allergy advice, so it should be in a recognisable symbol, consistent across all products because then you know what you're looking for before you pick it up. I know there's a war going on out there, isn't there, about these things here? The big supermarket chains haven't agreed on what this sort of...this sort of information should look like. There's different ways of signifying it. So what would be good is an allergy equivalent of something ... but let's just have one and not several, because then you could drum it into people at an early age and they know what they've got to look for and they could do it. (M,I Severe)

See footnote of Box 1.

ingredients list (Box 3A). Participants generally noted the value of the ingredients list for resolving uncertainties regarding the suitability of an unfamiliar or novel product (Box 3B, C). Many found the ingredients list more difficult to read than the allergy advice box and this was directly observed in the PCRT and was reported within the interview.

Other packet information

Some participants used images printed on the packets or wording not directly referring to ingredients (e.g. the description of the product) to help inform their choices. A number

of participants explained how they used the texture visualized in a picture to make inferences about the presence or absence of nuts. During the accompanied shop and PCRT, there were numerous examples of participants using such information to inform judgments. For example, one participant used a computer-generated image of a cake bar on the packaging to judge that the cake was smooth textured as opposed to containing 'bits' which could indicate nuts (Box 4A). Some participants avoided products where the product name raised concerns for them even if the ingredients list and allergy advice box indicated the product to be safe (Box 4B, C).

How can allergy labelling be improved?

Participants felt that more 'nut free' labelling, as well as greater detail (e.g., listing tree nut types), would be helpful. Some participants considered that greater standardization would be valuable. These were not options that were suggested to participants, rather they were raised spontaneously as the participants discussed their experiences and in response to the question as to what changes in labelling, if any, participants would find helpful.

The greatest consensus, particularly by those with a history of previous severe reactions, was around the value of using labels to specify products as 'nut free' (Box 5A–D). 'Nut free' labelling was trusted by all participants but such labels were rarely encountered. Some highlighted the potential to increase sales by nut-free labelling (Box 5D).

Participants pointed out two areas where greater detail of labelling would be beneficial. The first related to the production process and the second was in relation to the types of tree nuts in the product. Some participants indicated that they would make different decisions based on the different processing scenarios (Box 5E). Participants also explained how greater detail about which tree nuts the product contains would assist with making decisions. Not surprisingly, this was considered particularly valuable by people that were allergic to individual nut types (Box 5F).

Participants were aware of differences in the way companies presented allergy information and tended to have a preference for, or more often against, particular labelling practices. A number of participants drew attention to the value of standardizing labelling so that, for example, allergy advice boxes were of a particular size or colour with the information presented in the same order. The other possibility mentioned by several participants was of a visible symbol as a general warning and prompt to seek out further information from elsewhere on the packet (Box 5G).

Discussion

This study has provided novel insights into the actual use of food package-based information by peanut and tree nut-allergic individuals, when making decisions about purchasing food. The cross-task analysis enabled insights into both 'normal' strategies in a routine shopping environment alongside detailed consideration of particular products. Our approach involved a systematic study of what allergic individuals actually do, rather than simply asking them to reflect on their previous practice.

The brand and supermarket were important rules of thumb allergic people used in deciding whether to trust a product as suitable for them. Participants trusted the labelling of certain food companies over others, sometimes based on previous bad experiences, but often because of assumptions about a company's safety policies, or the quality of their products. We found no evidence that this strategy was based on an informed knowledge of the company or its safety practices. Some participants used a wide variety of supermarkets, to buy products that came with particular allergy relevant guarantees and assurances.

In general, participants used allergen advice boxes in preference to the ingredients list. They would then sometimes, but not always, check the ingredients list. Of concern, the vast majority of participants did not understand the voluntary nature of allergen advice boxes and some assumed that absence of a box indicated the safety of the product. This suggests the importance of omnipresent labelling. Greater clarity of text in the advice box was appreciated by participants who were frequently frustrated by the small, cramped text in the ingredients list. A number of studies have reported problems related to the readability of the ingredients list, for example because of small font size and poor contrast between text and background (6, 7, 17).

Most participants reported an accidental exposure within the past 2 years. A survey of Canadian food-allergic children reported an annual incidence of food allergic reactions of 14.3% (18), and an American study reported accidental exposures in 55% of peanut-allergic and 20% of tree nut-allergic children over 5.5 years (19). A significant reduction in accidental reactions was obtained by providing families with an educational package (3), suggesting that the way that consumers had previously made food choices was responsible for a number of reactions. Our study has shown that allergic individuals develop a wide range of strategies for making risk assessments when purchasing foods. Over-reliance on the allergy advice box could potentially lead to problems, particularly if consumers trust that absence of a box indicates that the product is safe for them to eat. The use of printed images on the packet is clearly unreliable, but was a strategy used by a number of participants, admittedly as part of a wider risk assessment.

Most of the suggestions to improve labelling in previous publications have related to changes to 'may contain labels.' In this study, participants expressed a desire for products that are clearly labelled as 'free from'. Participants with tree nut allergy would like labels to list the individual nut types. It may also be useful for an allergen advice box to be mandatory and to state 'no peanut' or 'no tree nut' when this is the case.

Labelling legislation dictates that ingredients must be included in the ingredient list with special rules for allergenic ingredients e.g. the use of easily understandable names. Advice to scrutinize the ingredients lists is logically the most reliable strategy for clinicians to recommend. As discussed, this study revealed that nut-allergic consumers do not often use this as a primary source of information. This may reflect their lack of understanding of the legal status of the ingredients list relative to the voluntary status of the allergy advice box, as well as difficulties with readability of the ingredients list. In the absence of legislation to standardize the allergen advice box, allergic individuals must be educated and encouraged to scrutinize ingredients lists, to improve allergen avoidance. Food regulators and the food industry must ensure that these lists are clear to read.

One focus for future research should be on developments to improve the way we educate allergic consumers regarding interpretation of packaging information, and methods to facilitate reading and interpretation of labels whilst shopping. Such education provision should be designed and delivered in

ways that take into account the range of 'rules of thumb' and strategies that people use in making food choices that have been identified in this study. Alongside initiatives that are targeted at the consumer, it is vital that the food industry ensures that ingredients are labelled clearly by internal and external audit of the labelling to demonstrate that a range of customers can access the key information. Allergic consumers can have a role in highlighting poor examples of food labelling, and it is likely that retailers or manufacturers who invited consumers to provide such examples (e.g. by uploading pictures to a designated webpage) and subsequently addressed these issues would greatly enhance trust in their brands.

In summary, peanut and nut-allergic individuals develop a range of strategies to ensure avoidance of these allergens, and various elements of the packet are used as part of the process of risk assessment. This qualitative study demonstrates that adults with established peanut and tree nut allergy utilize the information in ways not necessarily intended by those responsible for food labelling for example assuming that a product does not contain nuts if an allergy advice box is absent, or interpreting labels based on assumptions about the broader qualities of the supermarket. Educators and clinicians should be aware of the way in which various elements of food packet labelling are used in practice and take this into account when developing educational material and providing clinical advice. Food regulators and industry should consider the extent to which consumers rely on unregulated 'advice boxes' and how ingredients lists might play a greater role in decision-making.

Collaboratively, healthcare professionals, manufacturers, government and patient groups must develop a range of measures to enable clear and confident decision-making on the part of consumers that are allergic to peanuts and tree nuts.

Contribution of authors

All authors have participated in the design of the study and the preparation of the manuscript. JB was principal investigator with primary responsibility for the study and analysis of data. JL and KM conducted all interviews and participant tasks. KG provided allergy dietetic expertise particularly for the PCRT. RS and MR provided expertise regarding labelling. MHG provided advice as an allergic consumer. JSL is an allergist and provided clinical expertise for the study design and analysis. JSL led the writing of this manuscript.

Conflicts of interest

None declared by any named author.

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