

Do nutrition and health claims on food packaging impact on consumers' choice?



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Foreword

Food labels contain many facts that can be used by consumers to make informed choices. The content and format is regulated by European Union legislation. Food labels must include the name of the food; the ingredients; the quantity of certain ingredients; the net quantity of the food (that is, the weight of food without the packaging); instructions for use (if needed); an indication of minimum durability (the “use by” or “best before” date); an indication of storage conditions and/or conditions of use; the name or business name and address of the food business operator in the European Union; the food’s place of origin, or provenance (the origin of the main ingredient if implied by the name of the food); highlighted information on the presence of 14 food allergens and ingredients made from these; and nutrition information.

In addition, food labels can include information that is not required by law, such as marketing terms; food production details; serving suggestions; vegetarian or vegan labelling; and “front-of-pack” nutrition labelling or nutrition and health claims.

Nutrition and health claims are statements that highlight particular nutritional or health benefits of foods. Previous research funded by **safefood** found that, in an experimental setting, adults perceived foods with claims such as “lower in fat” to be healthier and therefore a reason to eat a bigger portion (1), even though, unknown to most participants, the standard version and the “lower in fat” versions of the products contained the same number of calories. International research also indicates that these types of claim may promote a “halo effect”, whereby people think a food product is healthier than it is, based on a single statement, and this actually encourages people to eat larger portion sizes (2, 3). However, little data exists on the impact on these claims on the island of Ireland.

In order to promote healthy eating and guide consumers on using labelling information it is important to be aware of the current knowledge, attitudes and behaviour of adults on the island of Ireland regarding nutrition and health claims. This research was commissioned to explore the impact of nutrition and health claims on consumers’ perceptions and portion size selection.

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Executive summary

Aim

The project aimed to gain a greater understanding of the impact of one aspect of food labelling – nutrition and health claims – on consumers’ perceptions, food choices and actual physical fullness.

Objectives

- Determine (through focus groups made up of adults on the island of Ireland) if nutrition and health claims stated on food packaging and advertising can affect:
 - Consumers’ perceptions (how a claim is regarded, understood or interpreted; for example, its perceived tastiness, healthiness and “fillingness” or satiety).
 - Consumption behaviour.
- Explore (through a nationally representative survey of adults on the island of Ireland) the relationships between nutrition and health claims, food portion size selection, sociodemographic factors (for example, age, gender, and socioeconomic status), personal characteristics (for example, motivations, knowledge, attitudes) and other factors.
- Investigate (using buffet meal experiments) the impact of nutrition and health claims on consumer portion size selection at:
 - a single meal (breakfast, hot meal, snack)
 - a subsequent meal.
- Examine (through an experiment where participants consume breakfast) whether actual physical fullness (as measured by the gut peptide ghrelin) varies depending on the perceptions a person has of a food product before consuming it.

Methods

A literature review (a review of published food consumption surveys and nutrition and health claim studies) was conducted to identify the most commonly used claims and associated food categories.

Data was collected to understand the impact of nutrition and health claims on consumers’ perceptions, portion size selection and consumption behaviour:

- Qualitative data (observations and insights) were collected from focus groups (5 in Northern Ireland and 5 in the Republic of Ireland). The focus groups examined consumers’ thoughts, attitudes and experiences of using nutrition and health claims.

- Quantitative (measurable) data were collected from a survey of 1,039 participants. The survey used a representative sample to determine if nutrition and health claims influence what individuals think about foods and their portion size selection.
- Quantitative data was also collected from 3 experiments (2 in Northern Ireland and 1 in the Republic of Ireland).
 - Experiment 1 used a buffet meal (consisting of real and replica food or "fake food") to understand the effects of nutrition and health claims on portion size selection at a single meal.
 - Experiment 2 used a buffet meal (also consisting of real and fake food) to understand the effects of nutrition and health claims on portion size selection at a subsequent, or later, meal.
 - Experiment 3 involved participants consuming 2 nutritionally identical breakfast products – one with no nutrition and health claims and another with nutrition claims such as "low fat" and "low sugar" – to compare their perceptions of the products' fillingness with their physical responses to the products (measured through the levels of ghrelin in their blood).

Results

The literature review found that claims related to fat were the most common nutrition claims, while claims related to the digestive system and cholesterol were common health claims. Breakfast cereals, dairy products (particularly yoghurts) and drinks were often found to carry nutrition and health claims.

Focus group participants had a good awareness of nutrition and health claims and the reasons food producers might have for making claims. These consumers had relatively good knowledge of claims and were able to give examples of claims when prompted. However, they did not extend to understanding the exact technical meaning of claims.

- Participants did not distinguish between nutrition and health claims.
- The type of person, the type of product and the brand influenced whether participants believe claims (how much they think they are accurate and true), whether they are influenced by claims and whether claims affect their perceptions of a product.

Survey participants had relatively little knowledge and did not understand what nutrition and health claims meant.

- Nutrition and health claims did not affect how healthy or tasty these consumers thought a selection of 4 different foods to be, but did influence how filling they

thought the foods would be. Claims explained little of the differences in how healthy, tasty or filling participants thought food would be.

- Psychological factors explained the greatest differences in these consumers' perceptions of food, such as use and knowledge of claims, eating behaviour, general health interest, believability in claims and familiarity with the foods. In particular, those who believed the claims were more likely to view food as healthier, tastier and more filling than those who did not believe the claims.
- These psychological factors also explained the greatest differences in portion size selection. People with less control over their eating, with a lower interest in health, with higher beliefs in the claims and who were less familiar with the foods selected larger portion sizes for the 4 different food types presented.
- Nutrition and health claims did not affect the portion size that survey participants selected.
- In **buffet meal experiment 1**, participants served themselves larger servings of drinks when there were no claims present, while the amount of solid food served was not affected by the presence of nutrition and health claims.
- In **buffet meal experiment 2**, researchers found that nutrition and health claims did not affect meal-to-meal compensation – that is, participants did not adjust their portion size selection at a subsequent meal having selected food and drink with claims at the previous meal.
- In the **breakfast experiment**, researchers found that the presence of claims on a granola and yoghurt product affected how healthy participants thought the breakfast was and how healthy they felt whilst eating the breakfast.
 - In addition, the presence of claims increased participants' subjective (personal or individual) satiety, or feelings of fullness.
 - However, taste, smell, palatability (how pleasant or acceptable the food seemed), enjoyment and physical satisfaction of hunger (levels of ghrelin found in participants' blood) were not affected.

Conclusions

- Consumers' understanding of the exact technical meaning of nutrition and health claims is limited.
- Despite their interest in nutrition and health claims, when consumers were shown claims they did not demonstrate using them when making portions size selections in the context of the experiments.

- The most influential factors in explaining consumers' perceptions of the tastiness, healthiness and fillingness of the 4 different foods are an individual's
 - Type of eating behaviour (restrained, uncontrolled, emotional)
 - Health interest
 - Motivation to process (their interest in and use of) nutrition and health claims
 - Knowledge of claims
 - Believability in claims (how much consumers they think they are accurate and true)
 - Familiarity with the food.
- Nutrition and health claims had little impact on portion size selection.

Recommendations

Promote food literacy (label-reading skills)

Consumers should be supported in how to read and interpret food labels as one aspect of food literacy. Improving consumers' knowledge will enable them to understand nutrition and health claims and they can use this knowledge when they are deciding what to buy and how much to eat or drink.

Key messages for consumers

- Did you know that nutrition and health claims can only be placed on products that meet certain criteria? For example, for a product to be labelled as “low fat” it must contain no more than 3 grams of fat per 100 grams of product.
- Nutrition and health claims made on food are regulated at a European level – for more information visit the [EU register](#).
- Just because a food or drink product has a nutrition or health claim on the packet such as “low sugar” does not mean that it is a healthier choice – check the nutrition information on the label and the front-of-pack label, too.

Encourage serving recommended portions only

Consumers should be encouraged to follow healthy eating guidelines for food choices and to serve or consume the recommended portion sizes of all food and drink products, including those carrying nutrition and health claims.

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1 Introduction

Obesity action plans in both Northern Ireland (NI) and the Republic of Ireland (ROI) have highlighted the need to encourage and support individuals to make healthier choices, particularly in relation to food (4, 5). One method of potentially helping individuals to make healthier food choices is through labelling and nutrition information on food and drink.

A 2009 study reported that 44% of consumers on the island of Ireland (IOI) report that they read labels “usually” or “always” (6). In 2011, research by **safe food** found that 7 in 10 consumers refer to food labels to some degree but 1 in 5 adults on the IOI reported difficulty in understanding food labels (7). A more recent publication by **safe food** (2016) reported the findings of a survey of 1,049 adults, that approximately 28% of the survey participants read food labels (8) [13].

Nutrition and health claims are one piece of information on food labels that may inform individuals’ food choices. The focus of this research is the perception and use of nutrition and health claims by consumers.

Nutrition and health claims are statements that highlight particular nutritional or health benefits of foods.

- A **nutrition claim** is any claim that states, suggests or implies that a food has beneficial nutritional properties due to the energy it provides or does not provide or the nutrients or other substances it contains or does not contain. Examples of nutrition claims include “low in fat” and “source of protein”.
- A **health claim** is any statement about a relationship between food and health. An example of a health claim is “vitamin D is needed for the normal growth and development of bone in children” in a food containing vitamin D.

Both nutrition and health claims are regulated at a European level(9). Claims are detailed in the *European Union Register of Nutrition and Health Claims Made on Foods* [EU Register](#).

While nutrition and health claims may aid consumers in making healthier food choices, evidence has shown that they can have a “halo effect”, whereby consumers believe that a food is healthier than it actually is, based on a single statement, leading to increased consumption (10-12). Nutrition and health claims have also been found to influence the physical feeling of fullness (as measured by the gut peptide ghrelin) (13).

Previous research on nutrition and health claims by the Food Standards Agency (FSA) found that the relationship between products, claims and consumers is complex. Consumers use and are influenced

by claims, yet they can also be confused and sceptical or doubtful about claims (14). Further research by the FSA on health claims found that understanding and beliefs were important in how consumers view and make sense of claims (15).

In addition to research on consumers' perceptions and understanding, the impact of nutrition and health claims on portion size selection and consumption has also been examined. In a key study in this area, snacks labelled as "low fat" were found to increase consumption (12). More recently, a review of studies found that these types of claim increase consumption or buying of the foods (16). These findings may be explained by the "health halo effect" (12).

Despite these effects that nutrition and health claims can have on consumers, little research exists regarding their impact on the behaviour of consumers on the IOI. This research was carried out to address this gap in knowledge.

2 Aim and objectives

The project aimed to gain a greater understanding of the impact of nutrition and health claims on consumers in terms of perceptions, food choices and physical fullness. This was investigated using a “mixed methods” approach consisting of a review of relevant published studies, qualitative (observational) studies (the focus groups) and quantitative (measurable) methods (the survey and the meal experiments).

The specific research objectives were to

1. Determine (through focus groups made up of adults on the IOI) how nutrition and health claims on food packaging and advertising can affect
 - a. Consumers’ perceptions (that is, the way in which a claim is regarded, understood or interpreted; for example, perceived tastiness, healthiness and fullness (satiety))
 - b. Consumption behaviour.
2. Explore (through a nationally representative survey of adults on the IOI) the relationships between nutrition and health claims, food portion size selection, sociodemographic factors (for example, age, gender, and socioeconomic status), personal characteristics (for example, motivations, knowledge, attitudes) and other factors.
3. Investigate (using buffet meal experiments) the effects of nutrition and health claims on consumers’ portion size selection at
 - a. A single meal (breakfast, hot meal, snack)
 - b. A subsequent meal.
4. Examine (through an experiment where participants consume breakfast) whether physical fullness (as measured by the gut peptide ghrelin) varies depending on the perceptions a person has of a food before consuming that food (for example, how healthy the food seems and how filling it will be).

3 Methods

Literature review

A review of published food consumption surveys and nutrition and health claim studies was conducted to identify the most commonly used claims and associated food categories, to be used in the research.

The researchers reviewed food consumption databases from the United Kingdom (UK) and the ROI (17-19) to understand the most commonly eaten foods bearing claims on the IOI. Previously published nutrition and health claims audits and prevalence studies were reviewed and selected (20-22) to understand the most common claims and associated food categories.

Focus groups

Focus groups were conducted to understand how nutrition and health claims can affect consumers' perceptions and consumption behaviour.

These groups allowed for an in-depth exploration into how consumers understand and process nutrition and health claims and their attitudes and thoughts regarding claims. Specifically, participants were asked about the tastiness, healthiness and fillingness of products with nutrition and health claims. They were also asked to recall if the presence of a claim on a product had ever led to them eating more or less.

Participants

"Convenience sampling" (simply targeting individuals who are near to the researchers) was used to recruit 78 participants aged between 18 and 64. These were divided into 10 focus groups (5 in Belfast, NI, and 5 in Sligo, ROI), each consisting of between 6 and 9 participants (Table 1). Individuals with advanced knowledge of food, nutrition or diet and those working or living in a household with people working in related areas were excluded due to their higher level of knowledge.

Given the potential differences in opinions and knowledge between males and females and younger and older participants, groups consisted of a single gender and either younger (18 to 34) or older (35 to 64) individuals. To further gather a range of opinions, individuals were from a mix of socioeconomic groups (Table 2). Higher (ABC1) status often includes higher and intermediate managerial or professional as well as supervisory occupations. Lower (C2DE) status includes skilled, semi-skilled or unskilled occupations as well as those unemployed.

Table 1: Composition of focus groups across the island of Ireland conducted to understand effects of nutrition and health claims on consumers

Location	Gender	Age range	Socioeconomic status	Number (n) of participants
NI	Male	36–64	Mixed	7
NI	Female	36–64	Mixed	8
NI	Male	18–35	Mixed	7
NI	Female	18–35	Mixed	9
NI	Female	36–64	Low	6
ROI	Male	36–64	Mixed	8
ROI	Female	18–35	Mixed	9
ROI	Male	18–35	Mixed	7
ROI	Female	36–64	Mixed	8
ROI	Male	18–35	Low	9
Total n = 78				

Table 2: Characteristics of individuals who participated in focus groups across the island of Ireland conducted to understand effects of nutrition and health claims on consumers

Characteristic	Number of participants (n)	Percentage of total (%)
Location		
NI	37	47.4
ROI	41	52.6
Gender		
Male	38	48.7
Female	40	51.3
Age		
18–34	39	50.0
35–49	23	29.5
50–64	16	20.5
Socioeconomic status (based on occupation of main income earner)		
ABC1	61	78.2
C2DE	14	17.9
Unknown	3	3.8
Education		
Primary school or less	1	1.3
Secondary school to age 15/16	7	9.0
Secondary school to age 17/18	16	20.5
Additional training	13	16.7
Undergraduate	17	21.8
Postgraduate	24	30.8
Self-reported body mass index (BMI)		
Underweight	3	3.9
Normal weight	40	51.3
Overweight and obese	34	43.6
Unknown	1	1.3
Total n = 78		100.0

Materials

A topic guide was created based on a review of relevant literature. The guide was designed to draw out participants' views on nutrition and health claims (Appendix 1). A pilot session using the topic guide with a group of 8 female participants was conducted. Following this, some minor changes were made

to the guide, such as the addition of “show cards” with definitions of nutrition and health claims (Appendix 2).

Participants were asked about their thoughts on food packaging, nutrition claims and health claims. The order of the questioning was designed to allow spontaneous (unprompted) mentions of nutrition and health claims, followed by specific questions focussing on perceptions (tastiness, healthiness and fillingness) and consumption behaviour in relation to nutrition and health claims. Participants were also asked about their familiarity with and knowledge of nutrition and health claims.

Show cards were used to prompt discussion (Appendix 2). In addition, a chocolate bar and a box of cornflakes, both featuring numerous nutrition and health claims, were used as prompts. A questionnaire was also created to gather data on sociodemographic characteristics and information on participants' dietary and health behaviours and nutrition and health claims knowledge (Appendix 3).

Procedure

The focus group moderator guided the discussion using the topic guide (Appendix 1). At the end of each session, participants were told about the purpose of the study and then completed a demographic questionnaire (see Appendix 3). Each group session was audio recorded and lasted approximately an hour.

Participants were paid a small fee of £20 (in NI) or €25 (in the ROI) for their time and travel costs.

Data analysis

Audio recordings from each of the focus groups were typed out exactly word for word and imported into NVivo 11 software (QSR International) for analysis. Inductive analysis was used to understand the data and identify themes. (In inductive analysis, software is used to convert printed and recorded material into data and then search for patterns that may provide new insight or information to researchers.)

Analysis followed the procedures described by Braun and Clarke (23). Researchers read the transcripts twice to become familiar with the data. The key themes apparent in the data were noted. Initial codes in the data were identified and these were arranged into themes. These themes were then reviewed and checked by a second researcher and any necessary refinements were made. Following this, the themes were named and defined and any links between themes were established.

Finally, transcripts were read again to ensure that the themes accurately represented the data and that there were no further themes to be extracted. Quotations or statements appropriate to each theme were then selected.

Survey

A survey was conducted to explore the relationships between nutrition and health claims, food portion sizes, sociodemographic factors (such as age, gender and socioeconomic status), psychological factors (such as eating styles or behaviours and health consciousness), nutrition and health claims behaviour and knowledge (such as interest in and use of claims), attitudes and other factors.

Photographs of product packaging with different claims were included in the survey to gauge perceptions. Participants were asked to select the portion size that they would consume of these products using a series of 8 photographs of increasing portions.

Participants

One thousand and thirty nine participants aged between 18 and 64 from across IOI took part in the survey (Table 3). “Quota sampling” was used to select individuals to participate. This involved applying quotas (the numbers of participants to be recruited) similar to the populations in NI and the ROI for age, gender and socioeconomic group and finding individuals who match these quotas, to create a representative sample of consumers to survey.

Those with advanced knowledge of food, nutrition or diet and those working or living in a household with people working in advertising, marketing, the food industry or a nutrition and diet related area were excluded. In addition, those with severe food allergies or intolerances, those following vegan, vegetarian or pescatarian diets and those who had never eaten any of the foods selected for examination in the survey were also excluded.

Table 3: Characteristics of individuals who participated in a representative household survey across the island of Ireland examining effects of nutrition and health claims on consumers’ perceptions and portion size selection

Characteristic	Number of participants (n)	Percentage of total (%)
Location		
NI	328	31.6
ROI	711	68.4
Gender		
Male	485	46.7
Female	554	53.3
Age (years)		
18–34	336	32.3
35–49	396	38.1
50–64	307	29.6

Socioeconomic status (based on occupation of main income earner)		
ABC1	506	48.7
C2DE	533	51.3
Education		
Primary school or less	48	4.6
Secondary school to age 15/16	167	16.1
Secondary school to age 17/18	300	28.9
Additional training	217	20.9
Undergraduate	231	22.2
Postgraduate	76	7.3
Self-reported body mass index (BMI)		
Underweight	21	2.0
Normal weight	372	35.8
Overweight and obese	389	37.4
Refused/unknown	257	24.8
Total n = 1,039		100.0

Materials

Questionnaire

Each participant completed a questionnaire (Appendix 4). The questionnaire was tested with a group of 12 people, resulting in minor edits to improve clarity. The questionnaire referenced a number of factors including:

Physiological variables

- **Physiological status (current hunger and thirst)** were measured on scales of 1 to 7 (1 = not hungry at all, 7 = extremely hungry; 1 = not thirsty at all, 7 = extremely thirsty).

Sociodemographic variables

- **Sociodemographic details** recorded included each participant's age, gender, socioeconomic status, occupation, marital status and income.

Psychological variables

- **Cognitive restraint, uncontrolled eating and emotional eating** were measured using a Three-factor Eating Questionnaire (24) consisting of 18 "items" (questions or other tasks). "Cognitive restraint" refers to intentionally controlling food intake to prevent weight gain. "Uncontrolled eating" refers to the inability to control food intake or stop eating once started. "Emotional eating" is the extent to which emotions and feelings influence eating behaviours.

- **Health consciousness** was measured using the General Health Interest scale (25).
- **Health and lifestyle** – participants' own perception of their health – was measured with 1 item on a scale of 1 to 5 (1 = excellent, 2 = very good, 3 = good, 4 = fair and 5 = poor).

Nutrition and health claims behaviour and knowledge

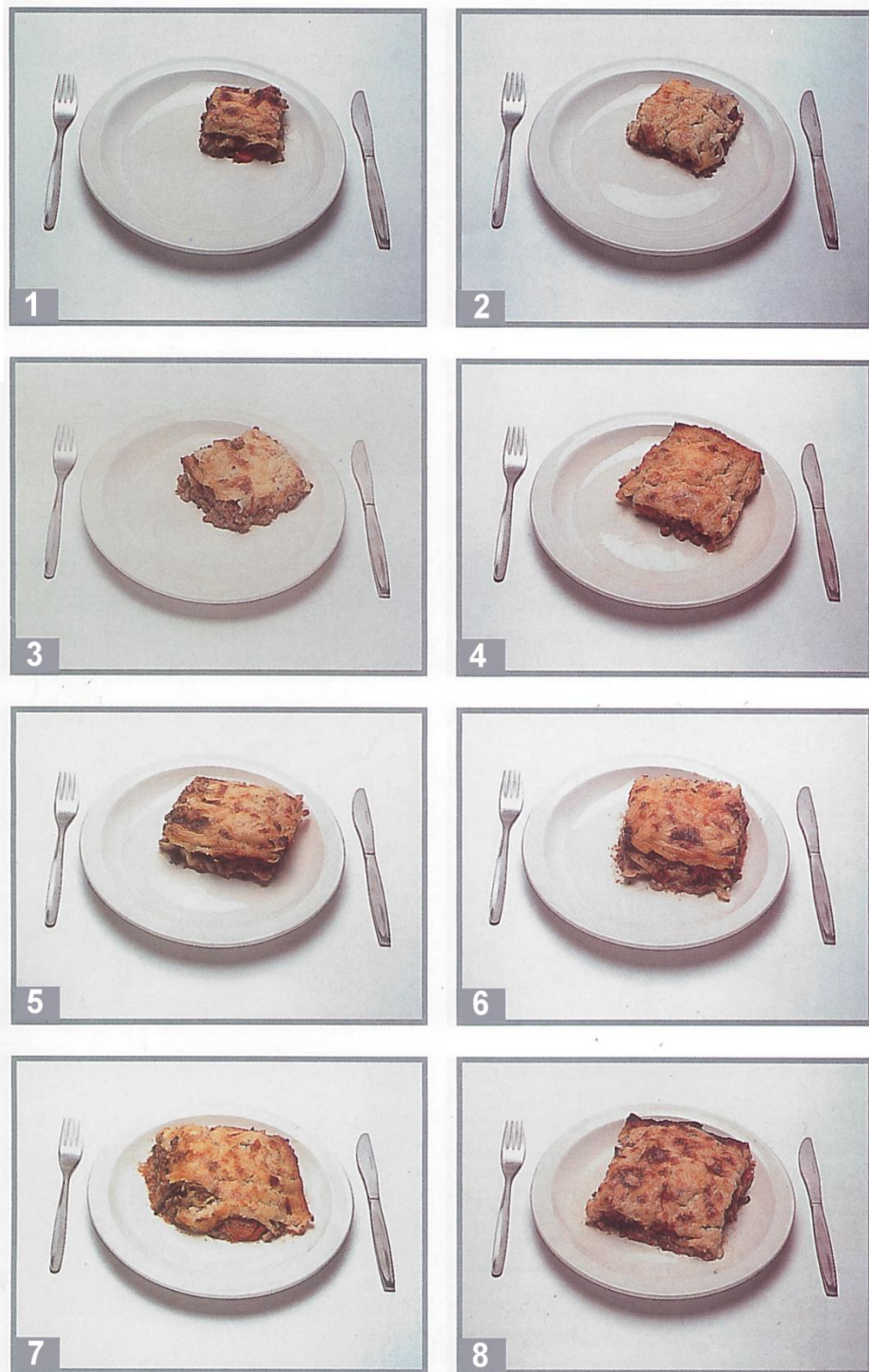
- **Motivation to process nutrition and health claims** (that is, consumers' interest in and use of claims) was measured using 3 items adapted from Moorman (26): "I am interested in looking for nutrition and health claims on food", "I pay attention to nutrition and health claims on food" and "I often use nutrition and health claims while shopping". All 3 items used a scale from 1 (strongly disagree) to 5 (strongly agree).
- **Subjective nutrition and health claims knowledge** was measured using 3 items adapted from Moorman and colleagues (27). These asked participants how they feel their knowledge compares to other people's knowledge. A composite subjective nutrition and health claims knowledge scale was created by adding together the scores of the 3 items. The total score could range from 3 to 15, with a higher score indicating greater subjective knowledge.
- **Objective nutrition and health claims knowledge** was measured using 2 items from the *EU Register of Nutrition and Health Claims Made on Foods* relating to iron and omega-3 fatty acids. The claims were adapted from Hung and colleagues (28). To improve accuracy, 3 additional items were created based on the EU Register. Each item had 1 possible correct answer from a choice of 4. Correct answers of all 5 items were added together to create a composite objective nutrition and health claims knowledge score. The total score could range from 0 to 5, with a higher score indicating greater objective knowledge.
- **Believability** of selected claims was measured on a scale of 1 to 7 (1 = not believable at all, 7 = extremely believable), adapted from Choi and Springston (29). This examined how sceptical participants were of claims and the extent to which they believe that products carrying nutrition claims contained the stated level of nutrients, or the extent to which they believe that products carrying health claims do what they claim.
- **Familiarity with selected claims** (how often the participant had seen the food product) was measured on a scale of 1 to 5 (1 = never, 2 = rarely, 3 = sometimes, 4 = often and 5 = always).
- **Recall of claims** was also measured. Participants were asked to recall which nutrition and health claims they had seen on the photographs of packaging (Figure 1) used earlier in the survey. Their recall gave an indication if participants had paid attention to the claims that were presented to them. Six claims were provided, 3 of which had been used in the survey and 3 that had not. Correct answers were scored "1" and added together. The total score could range from 0 to 6, with a higher score indicating greater recall.

Participants' perceptions of foods and portion size selection

Also included were a number of questions to assess participants' perceptions of foods, and questions to gauge portion size selection.

- **Perceived tastiness, healthiness and satiety of selected foods** referenced in the survey were measured on a scale of 1 to 7 (1 = not tasty at all, 7 = extremely tasty; 1 = not healthy at all, 7 = extremely healthy; 1 = not filling at all, 7 = extremely filling).
- **Portion size selection** was measured by asking participants to choose from selected foods presented as a series of photographs of 8 different sized portions. Examples are shown in Figure 1. The photographs were taken from Atkinson and Meyer's *A Photographic Food Atlas of Food Portion Sizes* (30) with portions increasing in weight from the fifth through to the ninety-fifth centile of portion size from Gregory and colleagues' *Dietary and Nutritional Survey of British Adults* (31).

Figure 1: Example of series of photographs of food portions used in the representative household survey conducted to examine effects of nutrition and health claims on consumers' perceptions and portion size selection



Product packaging “show cards”

To examine the impact of nutrition and health claims on participants’ perceptions and portion size selection, “show cards” were created (see example in Figure 2) for 4 food products:

- Cornflakes cereal (breakfast)
- Chicken soup (lunch)
- Lasagne (dinner)
- Vanilla yoghurt (snack).

These products were selected based on the literature review, which found that breakfast cereals and yoghurts commonly carry nutrition and health claims. In addition, the ability of the products to be portioned and availability of validated portion size photographs were important criteria. Furthermore, as each product was required to carry each of the selected claims, it was important that each claim could realistically apply to each product.

Three nutrition and health claims were used:

- Nutrition claim “low in fat”
- Health claim “with plant sterols – proven to lower cholesterol”
- Health claim “fuller for longer” (intended to relate to satiety, or the feeling of fullness).

The presence of “no claim” was also investigated.

Generic (unbranded) packaging was used across all products. For authenticity, or realism, product images were also labelled with an appropriate product weight and Guideline Daily Allowance (GDA) “traffic lights” nutrition summary label. The weight and GDA summary label were the same within each product, regardless of nutrition and health claims version.

In total, there were 16 different possible show cards (4 meals with 4 different claims, including “no claims” types). Participants answered questions on a random allocation of 4 meals – 1 of each product – with a different claim. For example, an individual participant might answer questions on cornflakes cereal with no claims, chicken soup with health (satiety) claim, lasagne with health claim and vanilla yoghurt with nutrition claim.

Figure 2: Example of product packaging used in the representative household survey examining effects of nutrition and health claims on consumers' perceptions and portion size selection



Survey administration

Data was collected by a market research agency using computer assisted personal interviewing, which involves interviewers asking respondents questions and inputting their answers to a handheld computer. Participants were interviewed face-to-face by experienced interviewers in their own home.

To assess the impact of nutrition and health claims on perceptions of food, participants were shown a randomly selected product show card and answered questions related to their perceptions, followed by indicating the portion size that they would eat. Participants completed this in turn for each of the 4 selected foods.

Interviews lasted approximately 25 minutes.

Data analysis

All data were analysed using IBM SPSS Statistics v22 software.

Descriptive statistics (mean, or average, deviation and standard deviation – how far values range from the average) were used to explore the data. Analyses of variance (ANOVAs, which detect significant differences in the averages of at least 2 unrelated categories of data) were conducted.

Tukey's Honestly Significant Difference tests were used to assess the differences between effects of the various nutrition and health claims on consumers' hypothetical portion size selection and the perceived tastiness, healthiness and satiety of the 4 foods.

A series of hierarchical multiple regression analyses were used to assess predictors of perceived tastiness, healthiness, satiety and portion size selection for the different foods with each claim. Hierarchical regression is a statistical method of exploring the relationships among, and testing hypotheses about, a dependent variable and several independent variables. A value of 0.05 was used as the significance level for interactions in the analysis.

Experiments

Buffet meal experiment 1, examining effects of nutrition and health claims on consumers' portion size selection at a single meal

The first buffet meal experiment was a "repeated measures" study conducted in NI only. It was designed to understand the impact of nutrition and health claims on food selection at 3 separate eating occasions (breakfast, hot meal and snack).

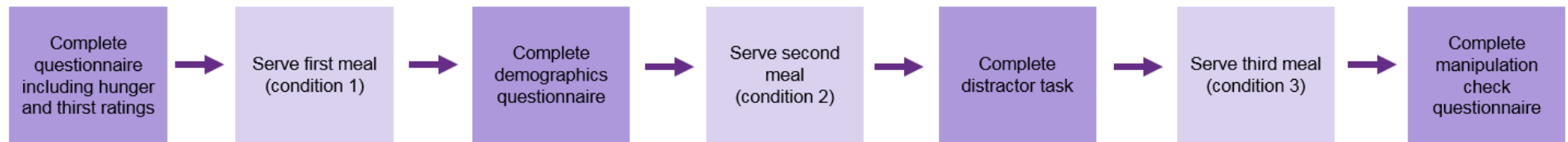
Participants served themselves 6 separate meals (3 from buffets containing products with claims and 3 from buffets containing products without claims) using real food and lifelike food replicas or "fake food". These meals were weighed and compared to measure the impact of claims on portion size selection. A distractor task which aims to direct the participants focus elsewhere before being presented with the next task was used. An overview of this experiment is presented in Figure 3.

Participants

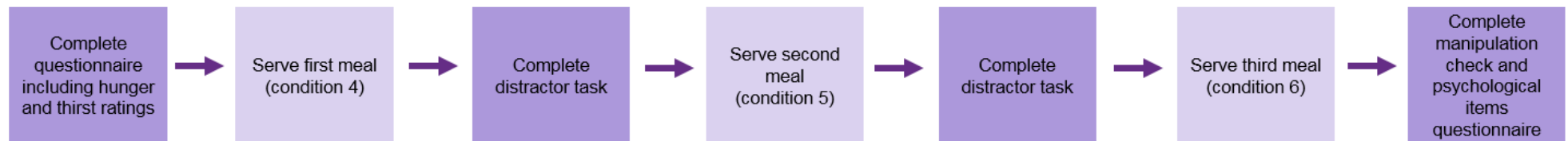
Convenience sampling was used to recruit 60 participants aged between 18 and 64 (Table 4). Participants were recruited using posters and emails and by word of mouth. Individuals with advanced knowledge of food, nutrition or diet and those working or living in a household with people working in these areas were excluded. In addition, to control strong influences on food choices, those who never eat breakfast, those who were strictly limiting their food intake due to intolerances or health conditions and those following vegan, vegetarian or pescatarian diets were excluded. Those who had participated in the focus groups for the project were also excluded.

Figure 3: Overview of method of buffet meal experiment 1, examining impact of nutrition and health claims on consumers' portion size selection at a single meal

Session 1



Session 2 (approximately one week later)



Participants completed a total of six conditions randomised over two sessions: 1. Breakfast buffet containing products with no claims; 2. Breakfast buffet containing products with claims; 3. Hot meal buffet containing products with no claims; 4. Hot meal buffet containing products with claims; 5. Snacks buffet containing products with no claims; 6. Snacks buffet containing products with claims

Table 4: Characteristics of individuals from Northern Ireland only who participated in buffet meal experiment 1, examining effects of nutrition and health claims on consumers' portion size selection at a single meal

Characteristic	Number of participants (n)	Percentage of total (%)
Gender		
Male	31	51.7
Female	29	48.3
Age		
18–34	38	63.3
35–49	19	31.7
50–64	3	5.0
Socioeconomic status (based on occupation of main income earner)		
ABC1	46	76.7
C2DE	14	23.3
Education		
Primary school or less	1	1.7
Secondary school to age 15/16	3	5.0
Secondary school to age 17/18	14	23.3
Additional training	10	16.7
Undergraduate	19	31.7
Postgraduate	13	21.7
Self-reported body mass index (BMI)		
Underweight	1	1.7
Normal weight	30	50.0
Overweight and obese	29	48.3
	Total n = 60	100.0

Fake food buffet

A buffet consisting of a mix of real food and fake food was used to examine consumers' food choice and portion size selection. The fake food buffet is a new, validated method used in nutrition research and involves the use of lifelike polyvinyl chloride (PVC) replicas of food (32). Benefits of using the fake food buffet over real foods include time savings in preparation, consistency across conditions and lack of food waste. Where fake food was not available or practical, real food was used. A list of real and replica foods used is presented in Appendix 5.

Products selected were commonly consumed on the IOI, based on findings from the *North/South Ireland Food Consumption Survey* (19), *National Adult Nutrition Survey* (17) and the *National Diet and Nutrition Survey* (Public Health England, 2014) (33). The products were of medium-high energy density¹ and available in NI supermarkets.

Where possible, researchers selected products that had a version with no claims and an equivalent with a nutrition or health claim within the same brand – for example, wheat biscuits and “protein” wheat biscuits. A full list of all claims is provided in Appendix 5.

A selection of fake foods was tested with focus group participants for acceptability before the fake food buffet took place. The majority of participants felt that the foods looked real. In addition, in the buffet experiments, each participant rated the realism of the foods.

Three different food stations were used: a breakfast station, a hot meal station and a snacks station. Items were either contained within their packaging (for example, milk) or placed in containers next to their packaging (for example, chips). Each station had a version of products that had at least 1 nutrition and health claim and a version of products with no nutrition and health claims². Overall, there were a total of 6 different conditions. Photographs of the buffet conditions are presented in Appendix 6.

Participants were free to choose from a range of tableware of different sizes. Plates were available with a diameter of 15 centimetres (cm), 20 cm or 27 cm; bowls with a diameter of 13 cm (6 cm deep) or 16 cm (7 cm deep); glasses with a capacity of 230 millilitres (ml), 400 ml or 500 ml; and various serving tools (tongs, scoops, slicers and servers) were at each station.

Additional items such as cutlery were used to enhance the realism of the buffet setting.

Questionnaires and distractor tasks

Between stations or meal servings, participants completed a total of 4 questionnaires and 5 distractor tasks (Appendix 7). The questionnaires were created based on a review of the literature that examined factors influencing portion size and food choices, as well as items specifically related to nutrition and health claims.

Information about the participating consumers was collected through the following items and scales of measurement that were included in the questionnaires.

¹ Some lower energy density products were included in the fake food buffet to make the buffet realistic. Examples include milk as an accompaniment for cereal. Fruit juices were included as these are a product category found to have a relatively high prevalence of nutrition and health claims in the literature review. Chicken was included as it is a commonly eaten food on the IOI.

² Sugar was the only product in the fake food buffet with no nutrition and health claims. To make the buffet realistic, this was included in both the breakfast “no claims” and breakfast “with claims” conditions.

- **Sociodemographic items** about age, gender, occupation, self-reported height and weight and household composition.
- **Current physiological state**, consisting of hunger and thirst, measured at the beginning of each session on scales of 1 to 6 (1 = not hungry at all, 6 = very hungry; 1 = not thirsty at all, 6 = very thirsty), adapted from Bucher and colleagues (2014) (34).
- **Current mood**, measured at the beginning of each session using the International Short Form of the Positive and Negative Affective Schedule (35). This scale measured participants' positive mood (their "affect") and their negative mood or affect.
- **Liking of each item in the buffet**, measured at the beginning of session 1 on a scale of 1 to 6 (1 = do not like at all, 6 = like very much) (36) or "never eaten before".
- **Perceived healthiness of each item in the buffet**, measured at the end of the experiment, on a scale of 1 to 6 (1 = not healthy at all, 6 = very healthy) (34).
- **Authenticity of the fake foods used**, measured on a scale of 1 to 6 (1 = not realistic at all, 6 = very realistic) (36).
- **Subjective nutritional knowledge**, measured using 2 items from Van Trijp and Van der Lans (2007) (37).
- **Health-related items** about medical problems, physical activity and diet.
- **Health consciousness**, measured using the General Health Interest scale (25).
- **Subjective nutrition and health claims knowledge**, measured using 3 items adapted from Moorman and colleagues (27).
- **Motivation to process nutrition and health claims** (that is, consumers' interest in and use of claims), measured using 3 items adapted from Moorman (26): "I am interested in looking for nutrition and health claims on food", "I pay attention to nutrition and health claims on food" and "I often use nutrition and health claims while shopping". All 3 items were measured on a scale of 1 to 5 (1 = strongly disagree, 5 = strongly agree).
- **Familiarity with nutrition and health claims used in the buffet**, measured on a scale of 1 to 7 (1 = not very familiar, 7 = very familiar).
- **Believability of all nutrition and health claims used in the buffet**, measured on a scale of 1 to 7 (1 = not very believable, 7 = very believable), adapted from Choi and Springston (29). "Believability" in this instance refers to how much an individual believes that a claim is accurate or true.
- **Cognitive restraint, uncontrolled eating and emotional eating**, measured by a Three-factor Eating Questionnaire consisting of 18 items (24). "Cognitive restraint" refers to intentionally controlling food intake to prevent weight gain. "Uncontrolled eating" refers to the inability to control food intake or stop eating once started. "Emotional eating" is the extent to which emotions and feelings influence eating behaviours.

- **Awareness of the nutrition and health claims** was assessed by 2 open-ended questions (requiring more than a simple yes/no answer) that probed for details of the buffet and also acted as a manipulation check.
- **Distractor tasks** (in this instance “spot the difference” puzzles) were used as to prevent “carryover effects” i.e. effects of a previous experimental condition that are affecting a current experimental condition. from one meal serving to the next, based on previous research using similar tasks (38).

Food weighing and nutrient value calculation

Participants’ food choices were weighed (out of view) and the weight of each food and drink item chosen was entered into a spreadsheet that calculated nutrient values for the meal. A conversion factor was used for all fake food so that the nutritional value of the equivalent real food weight could be calculated.

Procedure

The experiment was piloted (trialled) with 5 individuals, leading to minor changes to the questionnaires and distractor tasks. Participants arrived at the testing room individually and were provided with written instructions outlining the experiment. Each participant was then led to a meal station by the researcher and the station cover was removed. Conditions were randomised and counterbalanced to prevent “order effects”.

The researcher informed each participant to act as though they were at home and to select a meal that they would eat from the station, using any of the bowls, plates or glasses available. The researcher then left the serving area and returned when the participant indicated they had finished making their selection.

The participant then left the serving area and completed a distraction task or questionnaire. Meanwhile, the researcher collected the foods and drinks chosen, covered the used meal station and then uncovered the next station.

After completing their questionnaire or distraction task, the participant returned to the serving area and completed their second meal serving at the next station, using the same procedure.

Finally, the participant completed their last meal serving.

Participants returned approximately 1 week later to complete their second session, consisting of their remaining 3 meal servings. Each session lasted around 30 minutes.

In total, participants selected food from 6 conditions across the 2 sessions: breakfast containing products with no claims, breakfast containing products with claims, hot meal containing products with no claims, hot meal containing products with claims, snacks containing products with no claims and snacks containing products with claims.

Participants were paid a small fee of £40 for their time and travel costs.

Data analysis

Nutritional information from food quantities served and from the questionnaire data were entered into IBM SPSS Statistics v22 software and then “cleaned” to remove any corrupted or irrelevant data.

Dependent “t-tests”, which detect significant differences in the averages of 2 sets of statistics, were used to compare nutritional information for the meals served with and without claims. For data that were not normally distributed, Wilcoxon Signed-Rank Test (which compares 2 related samples) was used.

Buffet meal experiment 2, examining effects of nutrition and health claims on consumers’ portion size selection at a subsequent meal

The second buffet meal experiment was a repeated measures study conducted in the ROI only. It was designed to understand the impact of nutrition and health claims on meal-to-meal compensation. “Meal-to-meal” compensation refers to adjusting eating behaviour or portion size selection at a meal to account for food consumed at a previous meal.

Participants in this experiment selected a meal from a breakfast buffet containing products with claims, after which they selected a meal from a lunch buffet. In a separate session, participants selected a meal from a breakfast buffet containing products with no claims; after which they selected a meal from a lunch buffet. All buffets contained a mix of real food and fake food.

Meal selections were weighed and compared to measure the impact of claims on meal-to-meal compensation.

An overview of this experiment is presented in Figure 4.

Recruitment

Fifty-five participants aged between 18 and 64 took part in this experiment at St. Angela’s College Sligo (Table 5). Convenience sampling was used to recruit participants using posters and email and by word of mouth.

Individuals with advanced knowledge of food, nutrition or diet and those working or living in households with people working in these areas, as well as those who never eat breakfast, those strictly limiting intake due to intolerances or health conditions and those following vegan, vegetarian and pescatarian diets were excluded.

Table 5: Characteristics of individuals from the Republic of Ireland only who participated in buffet meal experiment 2, examining effects of nutrition and health claims on portion size selection at a subsequent meal

Characteristic	Number of Participants (n)	Percentage of total (%)
Gender		
Male	12	21.8
Female	43	78.2
Age		
18–34	27	49.1
35–49	12	21.8
50–64	16	29.1
Socioeconomic status (based on occupation of main income earner)		
ABC1	40	74.1
C2DE	14	25.9
Education		
Primary school or less	0	0.0
Secondary school to age 15/16	1	1.8
Secondary school to age 17/18	12	21.8
Additional training	15	27.3
Undergraduate	15	27.3
Postgraduate	12	21.8
Self-reported body mass index (BMI)		
Underweight	0	0.0
Normal weight	23	41.8
Overweight and obese	31	56.4
Total n = 55		100.0

Fake food buffet

As with buffet meal experiment 1, a buffet consisting of a mixture of real foods and lifelike PVC replicas of medium-high energy density foods was used. Given their potential impact on health, there was a focus on products with claims relating to fat and sugar.

Two different meal stations were used – breakfast and lunch. Two versions of the breakfast station were used, 1 with nutrition and health claims and 1 without nutrition and health claims. Appendix 8 lists the foods used in the breakfast buffet along with their claims.

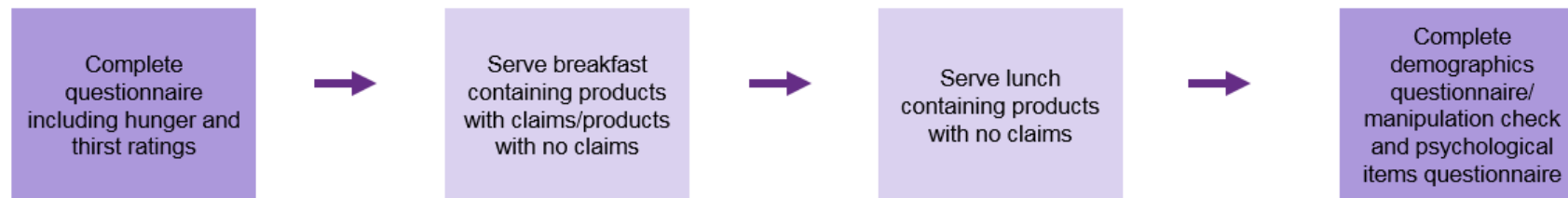
Breakfast was selected as the meal to be manipulated. This is because breakfast-related items such as cereals, dairy products and fruit juices were found to have relatively high proportions of claims compared to other product categories in the literature review conducted at the beginning of the project.

The breakfast station consisted of 30 different food and drink items and the lunch station consisted of 47 different food and drink items. Items were either left in their packaging (for example, milk) or placed in containers beside their packaging (for example, chips).

As the focus was meal-to-meal compensation and the manipulation of breakfast nutrition and health claims, only 1 version of the lunch station was used, with no nutrition and health claims present.

Similar to buffet meal experiment 1, participants were free to use a range of serving tools and crockery.

Figure 4: Overview of methods of buffet meal experiment 2, examining effects of nutrition and health claims on consumers' portion size selection at a subsequent meal



Breakfast condition was randomised such that half of participants served from the breakfast buffet containing products with no claims in session 1, and the remaining half served from the breakfast buffet containing products with claims in session 1. Participants then completed the opposite condition in session 2.

Questionnaires

Between stations or meal servings (the different “conditions”) participants completed 4 questionnaires (Appendix 9). The items used were identical to those used in buffet meal experiment 1. However, no distractor tasks were required as participants completed questionnaires only between conditions to prevent carryover effects. In addition, the manipulation check was changed to be more specific so that it asked participants about the claims rather than the buffet in general.

Participants were presented with 4 pairs of product images of the same food. One of each pair had nutrition and health claims and 1 was without nutrition and health claims. Participants were asked to identify which product they had seen in that session. This helped to explain whether the results of the experiment (that is, the effects on portion size selection at a subsequent meal) were due to the claims (if participants noticed and correctly identified the products they had seen) or may be due to other factors.

Food weighing and nutrition calculation

Participants’ food choices were weighed (out of view) and the weight of each food and drink item chosen was entered into a spreadsheet that calculated nutrient values for the meal. A conversion factor was used for all fake food so that the nutritional value of the equivalent real food weight could be calculated.

Procedure

Participants were provided with written instructions outlining the study. After completing an initial questionnaire, participants were led to the breakfast station and asked to serve themselves breakfast that they would have.

To control for the effects of special occasions on portion size, for example holidays or eating out, individuals were asked to imagine that this was a typical day.

As in buffet meal experiment 1, participants could use any bowl, plate or glass from the range available. To encourage examination and awareness of the nutrition and health claims, participants were also told that they were free to examine any product packaging.

The researcher exited the serving area and returned when the participants indicated that they had finished serving. Next, the researcher collected the breakfast served and moved this to the lunch station. The lunch station was uncovered and participants were asked to imagine that they had eaten the breakfast served and to now select the lunch they would have later. The selected breakfast remained close to the lunch station for reference.

The researcher again exited the serving area and returned when the participant indicated they had finished serving. Both meals were collected by the researcher and the participants completed a final questionnaire.

Participants returned approximately 1 week later to complete their second session, this time with the presence of nutrition and health claims in the breakfast station changed. For example, if a participant completed breakfast containing products with no claims followed by lunch in their first session, their second session consisted of breakfast containing products with claims followed by lunch. Each session lasted around 30 minutes.

The order of presentation was counterbalanced and randomised, with half of the sample selecting from the breakfast containing products with no claims condition on their first session and half selecting from the breakfast containing products with claims condition on their first session.

Participants were paid a small fee of €40 for their time and travel costs.

Data analysis

Nutritional information from the meals served and questionnaire data were imported into IBM SPSS v22 software and cleaned. As with buffet meal experiment 1, dependent t-tests were used to compare nutritional information for meals served with and without claims. For data not normally distributed, Wilcoxon Signed-Rank Test was used.

Breakfast experiment, examining effects of claims on consumers' perceptions of fullness and actual physical fullness

An experiment was undertaken to examine whether physical fullness varies depending on the perceptions that a person has of a food before consuming that food.

Participants consumed a breakfast presented as a healthier option: it was contained in packaging labelled with nutrition claims. On a separate visit, participants consumed a breakfast presented as an indulgent option: this was contained in packaging with no nutrition or health claims. However, participants were unaware that both breakfasts were nutritionally identical.

Participants answered questions on their perceptions of the products. Their physical fullness after eating the breakfasts was measured by analysing levels of the hormone ghrelin in participants' blood samples.

The impact of nutrition and health claims on consumers' perceptions and physical fullness was explored by comparing measures collected for the healthier option and measures collected for the indulgent option.

Participants

Convenience sampling was used to recruit participants through various media outlets. This included advertising on the NI Clinical Research Facility website, placing posters in public places and an intranet advertisement through Queen's University Belfast (QUB) staff updates. Other recruitment methods included word-of-mouth personal referrals from existing participants and QUB researchers.

Participants were excluded if they were pregnant, had diabetes (type 1 or 2) or reported taking medication that affects their appetite, taste or smell. The study also excluded those who reported having dietary restrictions relating to wheat, nuts and dairy products (including eggs).

Fifty participants (34% male) were recruited of whom 48 participants completed all of the self-reported measures of appetite, and 45 participants provided all of the blood samples for ghrelin analysis. Due to issues with the samples of 7 participants, a sample of 38 was used for the blood ghrelin analysis.

Participants were aged between 19 and 60 (mean 30.1 years; standard deviation \pm 10.4 years.), were more likely to live in urban areas (62%) and reported spending a mean (or average) of 18.4 ± 3.1 years in full-time education (Table 6). The majority of the sample were either QUB undergraduate or postgraduate students (62%) or staff members (32%).

All participants were non-smokers, had a mean (SD) Dutch Eating Behaviour Questionnaire (35) restrained eating score of 2.82 ± 0.79 and a mean (SD) BMI of 24.6 ± 3.6 kilograms per metre squared (kg/m^2). A total of 38% of the sample were classified as overweight or obese.

Table 6: Characteristics of individuals from Northern Ireland only who participated in the breakfast experiment, examining effects of nutrition and health claims on consumers' perceptions of fullness and actual physical fullness

Characteristic	Number of participants (n)	Percentage of total (%)
Gender		
Male	17	34.0
Female	33	66.0
Age		
18–34	36	72.0
35–49	11	22.0
50–64	3	6.0
Education		
8–12 years (secondary)	1	2.0
13–14 years (secondary)	4	8.0
Over 15 years (further)	45	90.0
Measured body mass index (BMI)		
Underweight	0	0.0
Normal weight	31	62.0
Overweight and obese	19	38.0
Total n = 50		100.0

Questionnaire

At the first visit participants were asked to complete a questionnaire that collected sociodemographic, medical and lifestyle information.

A subscale of the Dutch Eating Behaviour Questionnaire to assess dietary restraint (39) was also completed at this visit. Scoring of the Dutch Eating Behaviour Questionnaire involved adding the scores of the 10 items (on the 5-point Likert Scale, which is used to represent peoples' attitudes) to produce a raw score. The raw score was then divided by 10 to compute a scale score for restrained eating behaviour.

For analysis participants were separated into "high restraint" and "low restraint" eaters using a "median split" (median score: 2.7; interquartile range [IQ]: 2.2 to 3.4). Applying a median split means those with scores below the median, or mid-range point, are put in one group and those with scores above the median in a second group. Interquartile values are those at one-quarter and three-quarters of the range, for example data for the twenty-fifth and seventy-fifth highest hormone levels out of 100 blood tests taken.

Anthropometry (body mass index)

At the first visit participants' height and weight were measured to the nearest 0.1 cm and 0.1 kg, respectively, using a seca® 220 electronic personal scale. Body mass index (BMI) was calculated as weight (kg) divided by height (m) squared.

Blood sample collection and processing

At each visit 6 ml blood samples were collected at three time points: after a 20-minute rest period (baseline measurement), after 60 minutes ("anticipatory" measurement, taken before consuming the products) and after 90 minutes (taken after consuming the product), illustrated in Figure 7. The samples were taken to measure levels of acylated ghrelin (a gut peptide that is a measure of physical hunger or satisfaction of hunger).

To prevent the degradation of acylated ghrelin, a protease inhibitor (4-[2-aminoethyl] benzenesulfanyl fluoride hydrochloride, or AEBSF) was added to the blood samples during blood collection.

Samples were processed within 15 minutes of collection, and plasma stored at -80 degrees Celsius (°C) until analysis.

Samples were batch analysed to identify and quantify the presence of acylated ghrelin using an enzyme-linked immunosorbent assay (ELISA) method (BioVendor, Czech Republic) on an automated Triturus® analyser at QUB. For results to be accepted, the coefficient of variation (CV) percentage had to be less than 18%. (The CV shows the extent of variability from the average results in the study.) The ELISA assay CV in this analysis was 5.9%.

Self-reported appetite

Visual Analogue Scales (VAS), which help to measure subjective (personal) and other unquantifiable responses, were used to assess participants' levels of hunger, satiety, fullness, possible or likely food consumption and strength of desire to eat (40, 41).

The VAS presented was 100 millimetres (mm) in length with words anchored at each end, expressing the most positive and the most negative rating. Participants indicated their response by marking on the 100 mm line scale.

These were completed 10 minutes before each blood sample was taken.

Breakfast label rating

During the first interval between blood sample collections (that is, between the 20-minute and 60-minute time points), participants were asked to rate the breakfast label based on its appearance and perceived healthiness. Responses were assessed using 100 mm Visual Analogue Scales with words anchored at each end, expressing the most positive and the most negative rating.

Participants were also provided with a list of information that would typically appear on a food label, such as nutritional information, health claims, allergen information, the ingredients list and so on. They were asked to report how frequently they read such information before buying food products (always, often, occasionally, rarely or never).

Palatability rating

While consuming the breakfast, participants were asked to rate the breakfast based on its visual appeal, smell, taste, aftertaste and overall palatability. Responses were assessed using 100 mm VAS with words anchored at each end, expressing the most positive and the most negative rating.

Procedure

Eligible participants were invited to attend the NI Clinical Research Facility, Belfast City Hospital, on 2 separate occasions, with an interval of 1 week between the visits.

Visits were in the morning between 7.30 and 11.30 a.m., following an overnight fast. Participants were asked to arrange both visits at the same time of day, and were assessed individually.

At the first visit participants were told that researchers at QUB had developed 2 different granola and yoghurt breakfast products with different nutrient contents, and that they would taste 1 breakfast product at the first visit and the other breakfast product at the second visit. They were told that the overall aim of the study was to evaluate whether the breakfast products tasted similar and to examine the body's response to the different options (high fat against low fat products, high sugar against low sugar products and higher calorie against lower calorie products).

Participants were not aware that the breakfast products presented at the 2 visits were identical, and that it was only the food packaging and labels that differed.

One of the breakfast products was presented as an “indulgent” option that was high in calories (500 kilocalories, or kcal), fat and sugar. The other breakfast product was presented as a “sensible” option that was low in calories (250 kcal), fat and sugar.

The European Commission’s regulations on nutrition labelling and claims were used when developing the labels. The labels are shown in Figure 5 and Figure 6. The order of the breakfast options, “indulgent” or “sensible”, was randomly allocated using block randomisation (block size 4) to neutralise possible “learning effects”.

Participants were unaware of which breakfast option they would be consuming first until they arrived at the first visit.

Figure 5: “Indulgent” granola and yoghurt label with no nutrition and health claims used in the breakfast experiment, examining effects of nutrition and health claims on consumers’ perception of fullness and actual physical fullness

Rich, creamy yogurt and granola with blackcurrant compote

Nutritional Information

Serving size 230g

Typical values	Per Portion (230g)	% reference Intake*
Energy	2100kJ/500kcal	25%
Fat	22.8g	33%
of which saturates	8.7g	44%
Carbohydrate	59.3g	23%
of which sugars	38.4g	43%
Fibre	4.4g	15%
Protein	9.6g	19%
Salt	0.3g	5%

*Reference intake of an average adult (8400kJ/2000kcal)

Ingredients:
 Granola (22%): Wholegrain Oat Flakes, Sugar, Vegetable Oils (Rapeseed Oil, Palm Oil), Honey, Sunflower Seeds, Natural yogurt (55%): Milk, Whipping Cream (milk), Live Cultures: Bifidobacterium, Lactobacillus Acidophilus, Streptococcus Thermophilus; Compote (13%): Blackcurrants, Sugar, Water, Blackcurrant Cassia, Corn Starch.

Allergy information:
 Free from: Gluten
 Contains: Milk and Oats
 May contain: Barley, Wheat, Rye and Nuts

Storage: Please keep refrigerated. Once opened, eat within 3 days.
 For 'Use By' date, see lid.



Figure 6: “Sensible” granola and yoghurt label with nutrition claims used in the breakfast experiment, examining effects of nutrition and health claims on consumers’ perceptions of fullness and actual physical fullness

Low fat natural yogurt and granola with blackcurrant compote

Nutritional Information

Serving size 230g

Typical values	Per Portion (230g)	% reference Intake*
Energy	1050kJ/250kcal	13%
Fat	6.9g	10%
of which saturates	3.5g	18%
Carbohydrate	34.7g	13%
of which sugars	11.5g	13%
Fibre	3.0g	10%
Protein	7.8g	16%
Salt	0.1g	2%

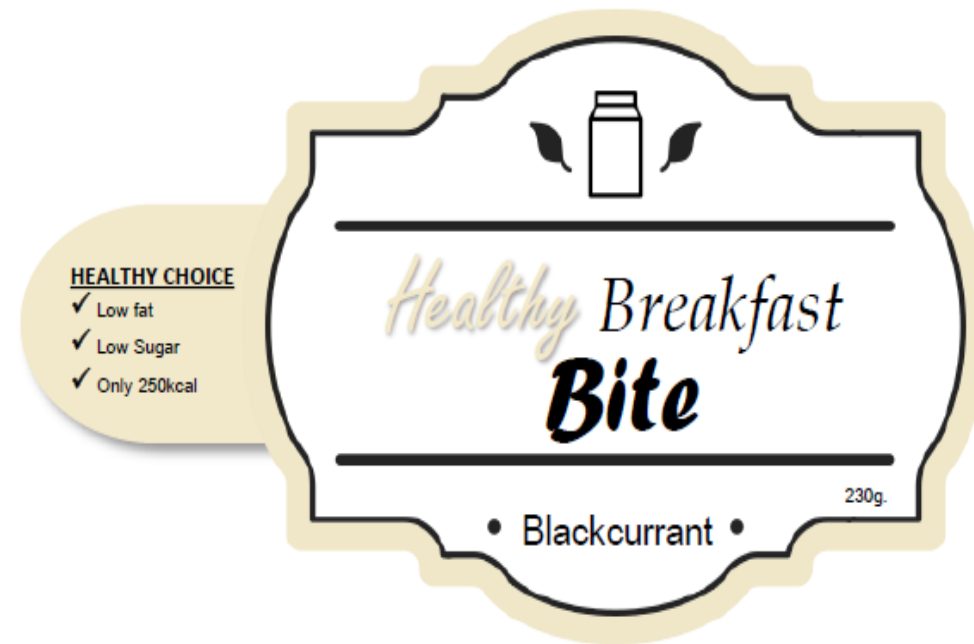
*Reference intake of an average adult (8400kJ/2000kcal)

Ingredients:
 Granola (22%): Wholegrain Oat Flakes, Sweetener (Sucralose), Rapeseed Oil, Honey, Sunflower Seeds, Natural Flavouring; Low Fat Natural Yogurt (85%): Milk, Gelatine, Live Cultures: Bifidobacterium, Lactobacillus Acidophilus, Streptococcus Thermophilus; Compote (13%): Blackcurrants, Sweetener (Sucralose), Water, Blackcurrant Cassia, Corn Starch.

Allergy Information:
 Free from: Gluten
 Contains: Milk and Oats
 May contain: Barley, Wheat, Rye and Nuts

Storage: Please keep refrigerated. Once opened, eat within 3 days.
 For 'Use by' date, see lid.

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Blood samples were collected at 3 time-points at each visit:

- “Baseline” measurement, taken after a 20-minute rest period
- “Anticipatory” measurement, taken after 60 minutes (before consuming the products)
- “Post-consumption” measurement, taken after 90 minutes (after consuming the products).

Participants were asked to complete self-reported appetite measures 10 minutes before each blood sample was taken.

During the first interval (between 20 and 60 minutes) participants were asked to rate the breakfast label.

During the second interval (between 60 and 90 minutes) participants were instructed to consume the whole breakfast product within 10 minutes, while rating the breakfast’s sensory appeal.

Figure 7 outlines the experiment timeline.

Data analysis

All analyses were performed using SPSS for Windows v22 and Microsoft Excel software. Descriptive statistics were used to describe participants’ characteristics.

To investigate the effect of different breakfast conditions (“indulgent” against “sensible”) on participants’ rating of the breakfast labels and the breakfasts’ palatability, a CROS analysis was conducted; this is a step-by-step method using 2-sample t-tests adjusting for the “period effect” (42) i.e. where the participants characteristics change during the study.

The change in self-reported appetite scores were computed for both breakfast conditions and for both visits, from the following blood measurement time points: baseline to anticipatory (20 to 60 minutes), anticipatory to post-consumption (60 to 90 minutes) and baseline to post-consumption (20 to 90 minutes).

To investigate the effect of different breakfast conditions (“indulgent” against “sensible”) on change in self-reported appetite at these time points, CROS analyses were conducted. This analysis was also used to investigate the change in acylated ghrelin (participants’ actual physical fullness) between these time points.

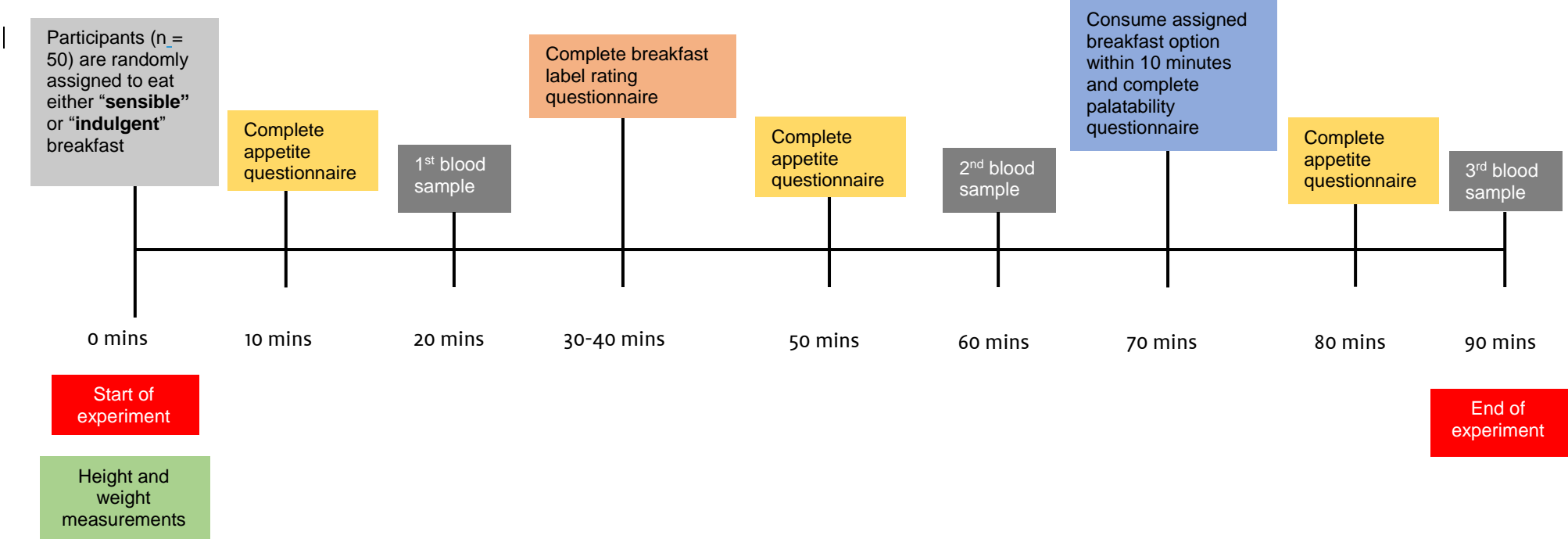
Participants were categorised into 2 groups according to their reported level of restrained eating behaviour (“high restraint” against “low restraint”) using median split, and the above analyses repeated separately for each group.

Ethical approval

Ethical approval for all studies was obtained from Queen’s University Belfast.

Written consent was obtained from all participants prior to each study.

Figure 7: Timeline of breakfast experiment, examining effects of nutrition and health claims on consumers' perceptions of fullness and actual physical fullness



4 Results

Literature review

The literature review found that

- Breakfast cereals, dairy products and beverages commonly carry nutrition and health claims.
- Yoghurts and yoghurt drinks have a relatively high proportion of health claims.
- Claims relating to fat, such as “low in fat”, were the most common nutrition claims.
- The most common health claims were general claims relating to the digestive system and lowering cholesterol.

Focus groups

The focus groups allowed for an in-depth exploration into how consumers understand and process nutrition and health claims and their attitudes and thoughts about claims.

Six key themes were identified from the analysis:

- Knowledge of nutrition and health claims
- “Believability” of nutrition and health claims (how much an individual believes that a claim is accurate or true)
- Influence of nutrition and health claims on product purchases
- Target markets for food products with nutrition and health claims
- Consumers’ perceptions and the perceived characteristics of products with nutrition and health claims
- Consumption of products with nutrition and health claims.

Knowledge of nutrition and health claims

The majority of participants were aware of nutrition and health claims and were able to provide examples of a range of claims and products that typically carry these. There was a general understanding of what claims mean:

“It means that per 100 grams, or whatever the measure is, that there’s a certain level where ... there’s categories, ‘low’,

‘medium’ and ‘high’. It will be under the, obviously, ‘low’, on the low spectrum to do with fat.” (Group 1 participant)

Some participants felt they had more knowledge than the average person:

“Well, I hope somebody doesn’t eat one and says, ‘Oh, God, that’s making my bones so much easier’, because you would have to do it over a matter of time, you’d have to maintain it.” (Group 5 participant)

“In my opinion, people get caught up far too much on whether something’s ‘low in fat’, ‘high in sugar’, because you need a bit of everything in your diet.” (Group 1 participant)

However, this knowledge appeared to be limited, such that participants had no deep or exact technical knowledge. For example, none of the participants knew that the claim “low fat” means 3 grams of fat or less per 100 grams of product.

When asked for separate examples of nutrition claims and health claims, participants provided examples of health claims as nutrition claims and nutrition claims as health claims, suggesting consumers do not distinguish between the types of claims. This lack of detailed knowledge led to confusion for some consumers:

“Some of it can be confusing, I think. ‘Low fat.’ And then you are trying to work out between ... one says it’s low fat and then when you actually look into it, it’s not ...” (Group 2 participant)

“I wouldn’t know what your daily recommended allowance should be, so I wouldn’t have a clue if that’s [low fat claim] good or bad.” (Group 3 participant)

Believability of different nutrition and health claims

The “believability” of claims (how much participants believed that a claim is accurate or true) differed depending on the carrier product. Some participants felt that claims on “healthier” products such as cereals were more likely to be believed than claims on “less healthy” products. Others felt that there should be a link between the ingredients and the product to be believable:

“All those cereals, you see all these ‘healthy’ muesli, your cereals with your red berries in it – I don’t know if they could claim that, because they are quite high in sugar and fat.” (Group 2 participant)

“The likes of cereal bars, I don’t believe it at all.” (Group 4 participant)

A few participants also commented on the impact of brand on believability:

“Before we would have tended to trust the big names, like McVities or Kellogg’s, but now ... we don’t really trust them and the whole thing has lost its credibility. It’s just a series of numbers and percentages and grams and claims and people generally don’t really trust them.” (Group 2 participant)

“I wouldn’t believe it straightaway, because there’s Tesco on it.” (Group 8 participant)

There were differing opinions about whether claims were simply highlighting and making clear the beneficial nutritional properties of products, or whether nutrition and health claims were misleading and used as a marketing tool to sell products:

“It’s stating a fact; it’s not really anything more than stating a fact.” (Group 1 participant)

“Sometimes they’re highlighting the good things maybe just to detract from the bad things.” (Group 1 participant)

“Well, if they’re going to come out with their best health claim, the likes of that there again, you’d wonder about all the other stuff that’s in the background ... Where’s all the sugar in it? Maybe they’re covering up something.” (Group 6 participant)

Overall, there was some acknowledgement that nutrition and health claims are governed and that claims on packaging are subject to regulations and law, and so must be true:

“This is going to sound – maybe it is naïve – but I do believe that the rules governing packaging means that it says ‘low in fat’, then it is low in fat.” (Group 2 participant)

“Well I would [believe it] anyway, because they can’t make that claim without it actually being ‘low in fat’ or ‘source of vitamin D’. Obviously, the research is there to show and to prove so that if somebody did question it, they can give reasons why they put it on the box; that’s my thinking of it anyway.” (Group 6 participant)

A few participants felt that health claims were more believable than nutrition claims:

“If they’re saying that they’re suitable for people with a particular medical condition, then I kind of feel like that advertising must be strictly regulated, whereas I kind of feel like the other stuff – and maybe it’s my own ignorance in this area – but I don’t believe any of the stuff that’s says ‘low in fat’ ...” (Group 9 participant)

In summary, participants’ belief in a claim depended on a number of factors relating to the product, such as the type of food. Participants generally believed nutrition and health claims as they understood that these need verification before being stated on packaging, particularly health claims. However, there was no agreement on what factors made a product or claim more or less believable.

Influence of nutrition and health claims on purchases

Nutrition and health claims were identified as being an influence on shopping. Some participants’ purchases were influenced by nutrition and health claims:

“... that’s a big factor, isn’t it, you know, saying ‘diet’ on it, or ‘light’. You would think, ‘Okay, I’ll go for that option.’” (Group 1 participant)

“... if I did see two products, I would feel better buying a product that is ‘low fat’. Even seeing that symbol – I wouldn’t feel the need to read the contents at the back, but you just feel a bit better.”
(Group 4 participant)

While some of those who were influenced by claims mentioned that they use claims in general, some others highlighted that they were only influenced with certain products or in certain instances:

“I will look at them, that’s the truth, but on certain foods, right – I’m sceptical on a lot of things – but on certain foods I will consider looking for the lower-fat option.” (Group 1 participant)

“A lot of the breakfast choices, I’m influenced, like I would eat oats because I’m influenced by the cholesterol thing ...” (Group 2 participant)

In contrast, other participants remarked that claims do not influence their purchasing behaviour and that they do not look for these when shopping:

“I generally don’t buy food based on health claims – at all.” (Group 1 participant)

“I wouldn’t look for it but if it was on the packaging, you think, ‘Ah, it’s grand; it’s a wee bit extra’. I wouldn’t purposely go out

and say, 'I'm only buying yoghurts that are fortified with calcium ...'"(Group 7 participant)

Some claimed that while nutrition and health claims did not influence their own purchasing behaviour, they may influence others'.

"I think anything that says 'no sugar' would influence a lot of people."(Group 1 participant)

Participants also acknowledged that while nutrition and health claims on packaging may not directly impact upon purchasing, claims sometimes made them more interested in a product and invited closer inspection, therefore acting as advertising.

"If I was buying yoghurts that – we would buy yoghurts – but if it said '0% fat' I would check, and if there's added sugar I probably wouldn't buy it."(Group 1 participant)

"You'd actually have to read the labels on the back to see what fat is in the inside, because all chocolate is made from fat ..."(Group 3 participant)

Overall, some participants were influenced by nutrition and health claims while others were not. This influence appeared to depend upon different factors including their personal characteristics and the type of food that carried the claim. There was an awareness among participants that claims may act to increase attention for a product for both themselves and others.

Target markets for food products with nutrition and health claims

Several groups were identified by participants as being most likely to use or to benefit from nutrition and health claims. An obvious group identified were those who were on specific diets or monitoring their weight and those eating healthily:

"Yeah, I just joined Slimming World, so that's a big thing for me. I'm looking for 0% fat on things like dairy products, fromage frais, that kind of thing. Or Diet Coke, I'd go to that, because it's no sugar compared to Coke, and that sort of thing."(Group 4 participant)

"... if you were doing training and stuff and you were on a certain type of diet, like protein diets – if you heard something was high in protein, you'd go after it."(Group 6 participant)

Those with certain health conditions or illnesses were also identified as a possible target market for products with nutrition and health claims.

“I think maybe in your diet, maybe if you’re low in iron and you pick a product that is high in it, then you feel a wee bit better that you’re helping yourself. Or if you’re maybe elderly and you’re trying to prevent osteoporosis, if you buy calcium products then you feel automatically better.” (Group 4 participant)

“I do believe that it will help make you better, especially calcium and things like that, because I remember someone that was very sick, and these drinks – it did say ‘high fibre’, it did bring her back. ‘High calcium’ and all that – it did help immensely.” (Group 7 participant)

The final prominent group identified as being a target market for nutrition and health claims was parents:

“Sometimes I look for one of your ‘five a day’ on certain things. When I’m buying for my daughter, I have a look for those things.” (Group 1 participant)

“... you do want them [children] to grow up, and they need healthy bones, so the parents would get the stuff that contains calcium.” (Group 10 participant)

In conclusion, it was clear that participants viewed nutrition and health claims as beneficial for certain individuals or groups or as a useful tool when purchasing for those with certain diet or health-related goals.

Consumers’ perceptions of characteristics of products with nutrition and health claims

Nutrition and health claims affected the way the product carrying the claim was perceived. Participants felt that if a product had a nutrition or health claim then a higher price had to be paid for the benefits that claims inferred:

“It’s like the Danone and Actimel for the kids, they are still very expensive because they are good for your immune system or whatever.” (Group 7 participant)

“They make it more expensive, I suppose. They put up the price of it ... making it that bit more expensive than the competitors.” (Group 10 participant)

There was also a belief that if a product has a claim this means that certain ingredients are substituted so that there is a “trade-off” in the ingredients. A commonly mentioned example was the belief that a product with a “low fat” claim typically means that the reduction in fat has led to an increase in sugar:

“When I hear ‘low fat’, I think they must balance it with high sugar, because that’s what they tend to do, they go higher with one and lower with the other ... They only tell you the one they’re lowering, not the one they’re putting up ...” (Group 1 participant)

Some participants also felt that this substitution of ingredients had an impact on the taste of a food. In particular, participants commonly mentioned that products with claims would be bland (tasteless) or poor in taste:

“You know, you just see ‘low in fat’ and you think it’s missing something, something’s been pulled out of the process and it’s not going to taste as good.” (Group 6 participant)

“It might be good, the health benefits of it, but it mightn’t taste as nice as one that isn’t claiming to be as healthy. I think it’s great that it has live cultures and it’s gluten-free and everything, but I don’t know if I would expect it to taste as nice.” (Group 9 participant)

There were also perceptions that nutrition and health claims impact upon portion size, particularly in terms of making serving and portion sizes smaller:

“... it says it’s low in fat, but it weighs less than something beside it which doesn’t say ‘low in fat’.” (Group 4 participant)

However, in general, participants perceived products with nutrition and health claims as being healthier than products without claims:

“Yes, if something has a health claim, like ‘antioxidants’, things like that, you do tend to think of them as healthy things or good things.” (Group 2 participant)

“Well it sort-of implies that it’s a healthy product, because it’s good for you; it’s good for your bones.” (Group 9 participant)

Interestingly, when presented with a chocolate bar carrying claims, participants appeared confused and this prompted discussion as to whether the bar was “healthy”. Despite being classified as a “less healthy” food according to the Food Standards Agency Northern Ireland Nutrient Profile Model (43), a sizeable proportion of participants felt that the bar was healthy. This suggests that consumers’ typical

healthiness perceptions of a food may be strongly influenced or changed if claims are present on a product:

“I think it’s something that’s coming across as healthy, but there’s something behind it. I’m suspicious of it.” (Group 4 participant)

“As a treat, I think it is a good treat. You know what I mean. If you’re going to allow yourself something, it’s a healthy option.” (Group 9 participant)

In summary, nutrition and health claims do influence consumers’ perceptions and the perceived characteristics of food products in a number of different areas. The presence of nutrition and health claims on products may influence consumers to change pre-existing ideas and their understanding of a product. There is a possibility that less positive foods may be viewed more positively by consumers due to the presence of claims on packaging.

Consumption of products with nutrition and health claims

Some participants believed that claims had no effect on their consumption or eating behaviours. However, other participants did mention that their consumption had been influenced, with most stating that claims had or would increase their consumption:

“I think ‘low calorie’ – as I was saying, the WeightWatchers thing – you end up having two or three packets, because you think it’s very low calorie.” (Group 1 participant)

“I would probably do it if there were vitamins on it, I’d probably take that more because it’s a health thing.” (Group 10 participant)

A few participants mentioned that claims might decrease consumption mainly due to the taste of products with nutrition and health claims.

“The taste was just, like, ‘I can’t eat this’. It might be healthy but it’s rotten.” (Group 1 participant)

In summary, participants acknowledged that nutrition and health claims could influence their consumption (mainly increasing it) and were able to provide examples of when this had happened in the past.

Key findings from focus groups

- Overall, participants had a good awareness of nutrition and health claims. They could give examples of claims and understood that claims may be used as a marketing tool, that they are

subject to laws and regulations and that they can be a useful aid for themselves or for certain groups of people.

- There was a degree of scepticism among participants as to the use of claims: participants were well aware that claims can be used to highlight positive aspects of a product and that the presence of a claim is only one aspect of the information on the food packet.
- While awareness was good, this knowledge did not extend to technical specifics such as the meanings or exact understanding of claims.
- The type of person, the type of product and the brand influenced whether participants believe claims (how much they think they are accurate and true), are influenced by claims and if claims affect their perceptions of a product.

Survey

Nutrition and health claims knowledge and awareness

- Overall, participants had a relatively low level of objective knowledge of nutrition and health claims, with a mean score of 2.3 (possible range of 0 to 5). Only 4% achieved the maximum possible score of 5, with a further 13% scoring 4.
- More than three quarters (77.6%) of respondents correctly identified a health claim that has been authorised for use on food products (Table 7).
- Less than 1 in 4 respondents (18.3%) were able to identify the correct nutrition claim from a list of options.
- Only 1 in 3 respondents (33.7%) were able to provide the exact meaning of the nutrition claim “low in fat”.
- Approximately half of participants were able to understand the alternative meaning of 2 different health claims.

Table 7: Objective knowledge of nutrition and health claims among participants in a representative household survey across the island of Ireland examining the effects of nutrition and health claims on consumers’ perceptions and portion size selection

Question and responses (correct answers provided in bold)	Number of participants (n)	Percentage of total (%)
Which one of the following is a health claim that has been authorised for use on food products?		
Calcium is needed to strengthen nails	84	8.1
Calcium is needed for the maintenance of normal bones	806	77.6
Calcium helps to reduce weight	64	6.2
Calcium helps to reduce the risk of heart disease	55	5.3

Don't know	30	2.9
Which one of the following is a permitted nutrition claim under EU regulations?		
Original	117	11.3
Organic	402	38.7
Free range	236	22.7
Source of fibre	190	18.3
Don't know	94	9.0
What is the maximum amount of fat per 100 grams that a solid food product can contain for it to be labelled as "low fat"?		
Maximum of 1 gram of fat per 100 grams	220	21.2
Maximum of 3 grams of fat per 100 grams	350	33.7
Maximum of 5 grams of fat per 100 grams	250	24.1
Maximum of 10 grams of fat per 100 grams	71	6.8
Don't know	148	14.2
The claim "Iron contributes to normal cognitive function" in other words means:		
Iron contributes to normal brain function	455	43.8
Iron contributes to normal joint function	322	31.0
Iron contributes to normal bowel function	137	13.2
Iron contributes to normal anti-aging effect	39	3.8
Don't know	86	8.3
The claim "Omega-3 fatty acids help to maintain a healthy cardiovascular system" in other words means:		
Omega-3 fatty acids help to maintain heart health	606	58.3
Omega-3 fatty acids help to maintain bone health	227	21.8
Omega-3 fatty acids help to maintain gut health	90	8.7
Omega-3 fatty acids help to maintain brain health	84	8.1
Don't know	32	3.1
Total n = 1,039		100.0

The subjective knowledge score in the context of the survey refers to the belief that participants held, that they had more knowledge and understanding of nutrition and health claims compared with other people.

- The mean score was 10.2 (range 3 to 15), indicating that, overall, participants believed they had relatively good knowledge.

- One in 10 participants (10%) felt they had a high level of knowledge, rating the maximum score of 15.
- One in 20 (5%) indicated that they had very poor knowledge, scoring the minimum of 3.

There was a significant positive relationship between subjective nutrition and health claims knowledge and objective nutrition and health claims knowledge, indicating that those who felt they had better objective knowledge than others did in fact have better knowledge. However, this was a very weak relationship ($r=0.089$, $p=0.005$).

With regards to the recall of claims that were used in the survey, participants had a median score of 4 out of a possible 6 (minimum 0 and maximum possible 6). This indicates that participants paid attention to the nutrition and health claims used in the survey.

Individuals reported that they were “somewhat interested” in using nutrition and health claims, with a mean “motivation to process claims” score of 9.86 (minimum possible 3, maximum possible 15).

Effects of nutrition and health claims on consumers' perceptions

Table 8 shows participants' perceptions of tastiness, healthiness, and fillingness when a range of nutrition and health claims were placed on 4 different foods.

- The yoghurt with the “lower cholesterol” claim was perceived to be less filling than the yoghurt with the “fuller for longer” claim.
- Cornflakes with the “lower cholesterol” claim were perceived to be less filling than all other cornflakes.

This suggests that the type of claim affects fillingness perceptions of some foods even if it does not affect the taste or healthiness perceptions.

Table 8: Effects on perceptions of tastiness, healthiness and fillingness (satiety) for four foods when presented with no claims and 3 different claims to participants in a representative household survey across the island of Ireland, examining effects of nutrition and health claims on consumers' perceptions and portion size selection

			No claims	Low-fat	Fuller for longer	Lower cholesterol
	F statistic (degrees of freedom)	p	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Tastiness						
Chicken Soup	0.12 (3,1038)	0.950	4.9 (1.6)	4.9 (1.6)	4.9 (1.5)	4.9 (1.5)
Lasagne	1.74 (3,1038)	0.157	5.0 (1.5)	4.8 (1.6)	5.0 (1.6)	5.0 (1.6)
Yoghurt	1.88 (3,1038)	0.132	4.7 (1.7)	4.9 (1.7)	4.9 (1.7)	4.6 (1.7)
Cornflakes	0.93 (3,1038)	0.424	4.6 (1.7)	4.7 (1.6)	4.8 (1.6)	4.5 (1.6)
Healthiness						
Chicken Soup	0.27 (3,1038)	0.850	4.9 (1.5)	4.9 (1.4)	4.9 (1.3)	5.0 (1.4)
Lasagne	0.18 (3,1038)	0.912	4.3 (1.6)	4.3 (1.5)	4.3 (1.6)	4.4 (1.7)
Yoghurt	1.64 (3,1038)	0.179	4.6 (1.5)	4.9 (1.5)	4.8 (1.5)	4.8 (1.5)
Cornflakes	1.72 (3,1038)	0.161	4.6 (1.5)	4.7 (1.4)	4.7 (1.4)	4.5 (1.5)
Fillingness						
Chicken Soup	0.50 (3,1038)	0.686	4.5 (1.6)	4.5 (1.5)	4.5 (1.4)	4.6 (1.5)
Lasagne	2.04 (3,1038)	0.107	5.2 (1.5)	5.0 (1.5)	5.3 (1.4)	5.3 (1.3)
Yoghurt	2.79 (3,1038)	0.039*	4.3 (1.6) ^a	4.4 (1.6) ^a	4.5 (1.5) ^{a, b}	4.1 (1.7) ^{a, c}
Cornflakes	4.63 (3,1038)	0.003**	4.6 (1.4) ^a	4.6 (1.4) ^a	4.7 (1.4) ^a	4.3 (1.5) ^b
Total n=1039						

*Superscript letters depict where a significant difference occurs between the food product with or without claims; * = $p < 0.05$; ** = $p < 0.01$. Range 1 (low) to 7 (high).*

Effects of psychological, sociodemographic and claim type factors on consumers' perceptions of tastiness, healthiness and fillingness (satiety)

Hierarchical regressions were used to examine the effect of psychological, sociodemographic and claim type factors on participants' perceptions of tastiness, healthiness and fillingness after controlling for hunger and thirst. The combination of psychological, sociodemographic and claim type factors explained between 2.3% and 12% of the total variance in taste, healthiness and fillingness: 6.6% to 12% of the total variance in taste, 2.3% to 11% of the total variance in healthiness and 2.6% to 11.3% of the total variance in fillingness. (Data are presented in full in Appendix 10).

While they accounted for a relatively small amount of the total variance (2-9%), the psychological variables explained the greatest amount of variance in perceptions of tastiness, healthiness and fillingness, relative to the sociodemographic and claim type factors. This means that collectively the most influential factors in explaining consumers' perceptions of the tastiness, healthiness and fillingness of the 4 different foods were an individual's:

- Type of eating behaviour (restrained, uncontrolled, emotional)
- Health interest
- Motivation to process (interest and use of) nutrition and health claims
- Knowledge of claims
- Believability in claims
- Familiarity with the food.

The type of claim significantly explained further variance for perceived healthiness for the cornflakes and fillingness for the lasagne, cornflakes and yoghurt (accounting for an additional 1% to 2% of the variance). This suggests that claims explain little variance in the prediction of consumers' perceptions over and above psychological and sociodemographic variables, and only for some perceptions and particular foods.

Consumers' perceptions of product "tastiness"

Those who were less familiar with the foods perceived all the products to be tastier. Those who believed in the claims also perceived the foods to be tastier. Those with higher scores in "uncontrolled eating" perceived soup and lasagne to be tastier. The perceived tastiness was not affected by the type of claim shown on the packaging.

Consumers' perceptions of product "healthiness"

Familiarity with the food and belief in claims were significant predictors of participants' perception of the "healthiness" of a product. Those who believed the claims and those who were less familiar with the foods perceived all foods to be healthier. When the health claim "fuller for longer" (which is meant to relate to fillingness) was present, participants were more likely to perceive cornflakes as less healthy.

Consumers' perceptions of product "fillingness"

Familiarity with the food and belief in the claims were the strongest predictors for consumers' perceived satiety or fillingness of all foods, with the exception of belief in claims for health (intended as claims for satiety) for lasagne. Greater belief in claims and less familiarity with the foods predicted a higher perception of fillingness. The presence of the "fuller for longer" claim was associated with a higher perception of fillingness for lasagne but a lower perception for cornflakes. This suggests that the effect of the "fuller for longer" claim on perceived fillingness (and healthiness) appears to depend on the product carrying the claim.

In conclusion, these results suggest that how tasty, healthy and filling participants perceive a food to be depends on their familiarity with the food, the product type, and their subjective belief in the claims. The health claim "fuller for longer" (meant to relate to satiety) was the only individual claim which influenced perceptions. The claim influenced fillingness perceptions of cornflakes and lasagne and healthiness perceptions of cornflakes.

Effects of nutrition and health claims on consumers' portion size selection

There were no differences between the influence of claims on the portion size that respondents indicated they would select, with the exception of lasagne (Table 9) – for portion weights see Table 10. There was a trend among those who saw lasagne with a nutrition and health claim indicating they would select smaller portions, compared with those who saw the lasagne with no claims.

The predictors of portion size selection were also examined (Appendix 11). Psychological variables (different possible factors) explained the largest amount of variance in all models (accounting for between 9% and 14% of the variance). The addition of different claim types significantly explained further variance for lasagne (accounting for an additional 0.5% of the variance). This suggests that psychological factors have a greater influence than nutrition and health claims on consumers' portion size selection.

Psychological factors

Larger portions were chosen by those with higher "uncontrolled" eating scores. General Health Interest (GHI) was a significant predictor across all food types, with those with lower GHI selecting larger portion sizes. Those who were less familiar with the foods and those who believed the claims also selected larger portion sizes. While having any claim influenced consumers' portion size selection for the lasagne, the type of nutrition or health claim did not affect portion size selection for any of the foods.

Sociodemographic factors

Gender significantly predicted portion size selection, with men selecting larger portions than women (Appendix 11).

Table 9: Effects on portion size selection for 4 foods presented with no claims and with 3 different claims to participants in a representative household survey across the island of Ireland, examining effects of nutrition and health claims on consumers' perceptions and portion size selection

	Sample overall			No claims	Low-fat	Fuller for longer	Lower cholesterol
Number of participants (n)	1,039			280	280	280	280
	M (SD)	F (df)	<i>p</i>	M (SD)	M (SD)	M (SD)	M (SD)
Portion size for:							
Chicken soup	4.7 (1.7)	0.68 (3,1038)	0.564	4.7 (1.6)	4.7 (1.7)	4.7 (1.7)	4.8 (1.8)
Lasagne	4.8 (1.9)	2.64 (3,1038)	0.049*	5.1 (1.8)	4.7 (1.9)	4.6 (2.0)	4.8 (1.8)
Yoghurt	4.4 (2.0)	1.99 (3,1038)	0.114	4.7 (2.1)	4.3 (1.9)	4.5 (1.9)	4.2 (1.9)
Cornflakes	4.4 (1.9)	0.98 (3,1038)	0.399	4.2 (1.9)	4.5 (1.9)	4.46 (1.9)	4.4 (1.9)

* = $p < 0.05$; Portion size selection range 1 to 8 in increasing equal increments.

Table 10: Portion sizes for 4 foods presented to participants in a representative household survey across the island of Ireland examining the impact of nutrition and health claims on consumers' perceptions and portion size selection

Photo number	Portion	Weights	in	grams (g)
	Cornflakes	Soup	Lasagne	Yoghurt
1	16	33	135	48
2	23	89	187	73
3	31	145	238	98
4	38	201	290	123
5	45	257	341	147
6	52	313	393	172
7	60	369	444	197
8	67	425	496	222

Key findings from survey

- Participants had relatively low detailed knowledge of nutrition and health claims.
- The presence of 3 different claims did not affect how tasty or healthy participants believed a food to be, although claims did influence how filling participants thought a food would be. For example, participants thought that the “low cholesterol” cornflakes would be less filling.
- Psychological variables such as consumers’ use and knowledge of claims, eating behaviour, health interest, believability in claims and familiarity with the foods explained the most variance in perceptions of foods. In particular, those who believed the claims were more likely to view food as tastier, healthier and more filling than those who did not believe the claims. Claims explained little of the variance in how tasty, healthy or filling participants perceived the food to be.
- Psychological variables explained the most variance in consumers’ portion size selection. Participants with less control over their eating, with a lower interest in health, with higher beliefs in the claims and less familiarity with the foods selected larger portion sizes.
- In terms of sociodemographic factors, gender significantly predicted portion size selection, with men selecting larger portions than women.

Experiments

Buffet meal experiment 1, examining effects of nutrition and health claims on consumers’ portion size selection at a single meal

Authenticity and acceptability of foods

- Participants indicated that the fake foods presented in the study were realistic (mean of 4.6 on a scale where 1 = not realistic at all and 6 = very realistic) and were acceptable and that they liked the buffet (mean of 4.1 on a scale where 1 = do not like at all and 6 = like very much).

Awareness of and motivation to process nutrition and health claims

- Participants indicated that they were neither motivated nor unmotivated in their use of and interest in claims (mean of 9.0 on a scale ranging from 3 to 15).
- Unprompted, only two respondents specifically mentioned nutrition and health claims, indicating a lack of awareness of the nutrition and health claims used in the study.

Differences between sessions 1 and 2

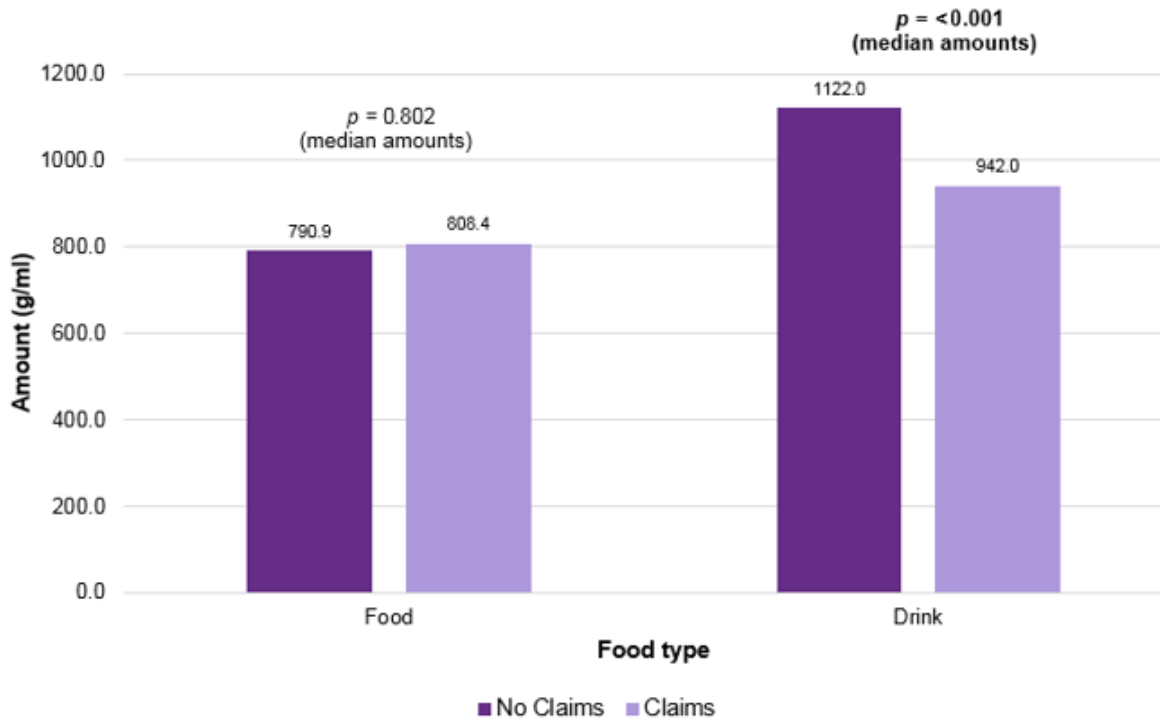
To investigate the effects of appetite status and mood on portion size selection, differences in hunger, thirst and mood between the 2 sessions were examined.

- Participants' positive affect was similar across both sessions (session 1 $M = 15.1$, $SD = 3.5$; session 2 $M = 14.9$, $SD = 3.7$; $t(55) = 0.54$, $p = 0.589$).
- Participants' negative affect was significantly higher in session 1 ($Md = 6.0$) compared with session 2 ($Md = 5.0$) ($Z = -2.89$, $p = 0.004$), possibly as a result of the novelty and unfamiliarity with the experiment in session 1.
- Both hunger and thirst differed between the 2 sessions. Participants indicated they were less hungry in session 1 ($Md = 3.0$) than in session 2 ($Md = 3.0$) ($Z = -2.49$, $p = 0.013$), and less thirsty in session 1 ($Md = 3.0$) than in session 2 ($Md = 4.0$) ($Z = -2.332$, $p = 0.020$).
- Despite these differences in mood and appetite status between sessions, there were no differences in the portion size selected. Similar amounts of food were served by participants in session 1 ($Md = 1,883.7$ g) and session 2 ($Md = 1,995.9$ g) ($Z = -0.390$, $p = 0.696$), and similar amounts of energy served in session 1 ($M = 1,627.4$ kcal, $SD = 633.5$ kcal) and session 2 ($M = 1,618.4$ kcal, $SD = 612.4$ kcal) ($t[59] = 0.59$, $p = 0.558$).

Amount served by participants

- Participants served themselves similar amounts of food for conditions containing products with claims ($Md = 808.4$ g) and conditions containing products with no claims ($Md = 790.9$ g, $Z = -0.250$, $p = 0.802$).
- There was a significant difference in the amount of drinks served between the conditions containing products with no claims ($Md = 1,122.0$ ml) and conditions containing products with claims ($Md = 942.0$ ml, $Z = -4.144$, $p < 0.001$) (Figure 8). While this difference may be a result of the claims, other factors may have been influential such as the selection of drinks available. For example, only "vitamin-enriched" water (rather than still bottled water) was available in the "with claims" conditions.

Figure 8: Portion sizes of food and drinks that participants served themselves in “claims” and “no claims” conditions in buffet experiment 1, examining effects of nutrition and health claims on portion size selection at a single meal



Buffet meal experiment 2, examining effects of nutrition and health claims on portion size selection at a subsequent meal

Buffet meal experiment 2 was a “repeated measures” study conducted in the ROI. It was designed to understand the impact of nutrition and health claims on portion size selection at a later meal, or “meal-to-meal” compensation. Meal-to-meal compensation refers to adjusting portion size or eating behaviour at a meal to account for food choices at a previous meal; for example, eating less at lunch because a bigger breakfast was eaten.

Authenticity and acceptability of foods

- Participants found the fake foods presented in the buffet to be realistic (mean of 4.5 on a scale where 1 = not realistic at all and 6 = very realistic).
- Participants moderately liked the buffet foods presented (mean of 3.7 on a scale where 1 = do not like at all and 6 = like very much).

Awareness of and motivation to process nutrition and health claims

- Participants were slightly motivated to process (be interested in and make use of) nutrition and health claims (mean score of 10.5, with a minimum possible score of 3 and maximum possible 15).

To check if participants paid attention to the nutrition and health claims present in the study, and to understand whether results were due to the claims or may be due to other factors, participants were asked to identify the correct product packages with claims that were present during their session.

- Only four respondents (7%) were able to select all of the correct product packages with claims that were present during their session.
- A further 19 participants (34.5%) identified 3 of 4 correct packaging images.
- This shows that less than half of the participants were aware of nutrition and health claims used in the study.

Differences between session 1 and session 2

To identify if mood or hunger were different between the conditions, the status of participants' appetite and mood between each session was investigated.

- There were no differences in hunger between session 1 ($Md = 2$) and session 2 ($Md = 2$; $Z = -1.37$, $p = 0.171$) or in thirst between session 1 ($Md = 3$) and session 2 ($Md = 3$; $Z = -0.142$, $p = 0.887$).
- There was no difference in positive affect between session 1 ($Md = 17$) and session 2 ($Md = 16$; $Z = -0.049$, $p = 0.961$) or negative affect between session 1 ($Md = 5$) and session 2 ($Md = 5$; $Z = -0.653$, $p = 0.513$).

Amount served by participants

To examine the effects of nutrition and health claims on consumers' portion size selection at a subsequent meal, the overall amount of food and drinks participants served themselves for lunch following a breakfast containing products with no claims was compared with the amount of food and drinks served for lunch following a breakfast containing products with claims (Figure 9).

- A median amount of 805.2 g was served for lunch following a breakfast containing products with no claims.
- A similar amount was served for lunch following a breakfast containing products with claims ($Md = 853.6$ g), with no significant difference ($Z = -0.80$, $p = 0.426$).

To investigate the effects of nutrition and health claims on the total amount of food and drink that participants served themselves (breakfast and lunch combined), the breakfast containing products

with claims, plus lunch, was compared with the breakfast containing products with no claims, plus lunch.

- Participants served themselves a mean of 1,540.3 g (SD 501.9 g) for the breakfast containing products with no claims, plus lunch.
- Participants served themselves a mean of 1,555.3 g (SD 488.0 g) for the breakfast containing products with claims, plus lunch.
- This difference was not statistically significant ($t [54] = -0.20, p = 0.841$).

The breakfasts that participants served themselves with no claims present and with claims were compared also.

- There was no significant difference between the amount participants served themselves when nutrition and health claims were absent (M 695.3 g, SD 270.6 g) compared with when nutrition and health claims were present (M 692.8 g, SD 342.5; $t[54] = 0.07, p = 0.948$).
- These results show that the presence or absence of claims did not affect portion size selection for breakfast alone and there was no effect on meal-to-meal compensation in this study.

Food and drink that participants served themselves were examined separately.

- There were no significant differences in the amount of food participants served themselves for breakfast ($t [54] = 0.98, p = 0.331$), lunch ($Z = -0.77, p = 0.441$) or breakfast and lunch combined ($t [54] = 0.27, p = 0.787$) (Figure 10).
- There were no significant differences between the amount of drinks participants served themselves for breakfast ($Z = -0.21, p = 0.831$), lunch ($Z = -0.64, p = 0.520$) or breakfast and lunch combined ($t [54] = 0.67, p = 0.507$) (Figure 11).

Figure 9: Overall amount of food and drinks with claims and with no claims that participants served themselves in each meal in buffet experiment 2, examining effects of nutrition and health claims on portion size selection at a subsequent meal

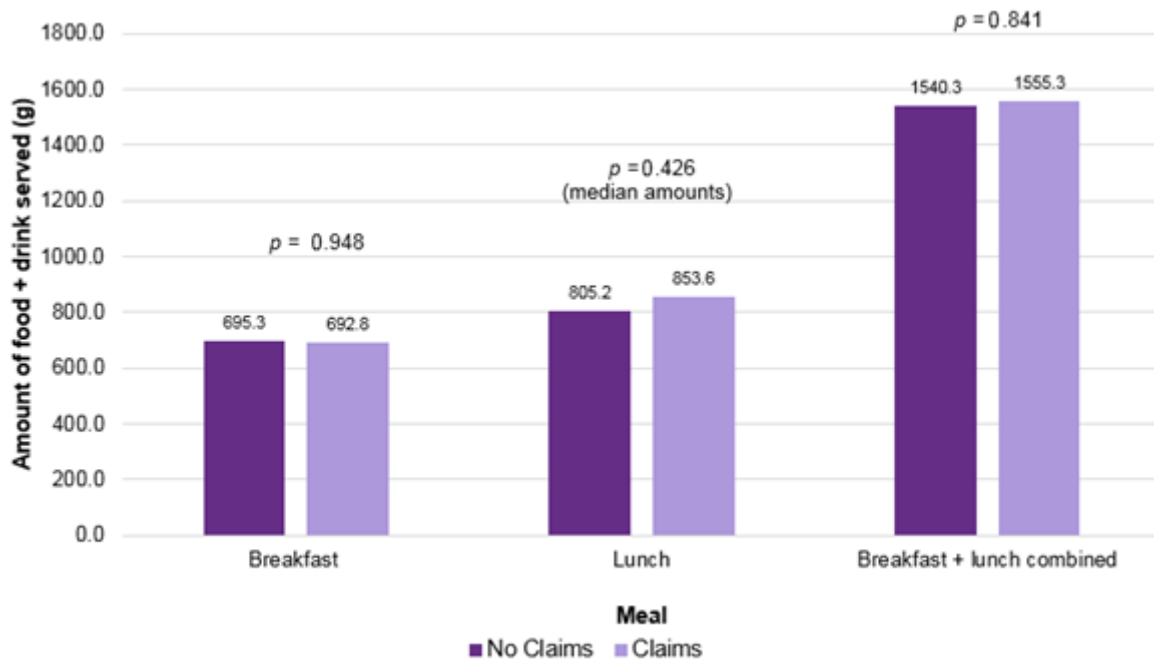


Figure 10: Amount of food with claims and with no claims that participants served themselves for each meal in buffet meal experiment 2 examining the effects of nutrition and health claims on portion size selection at a subsequent meal

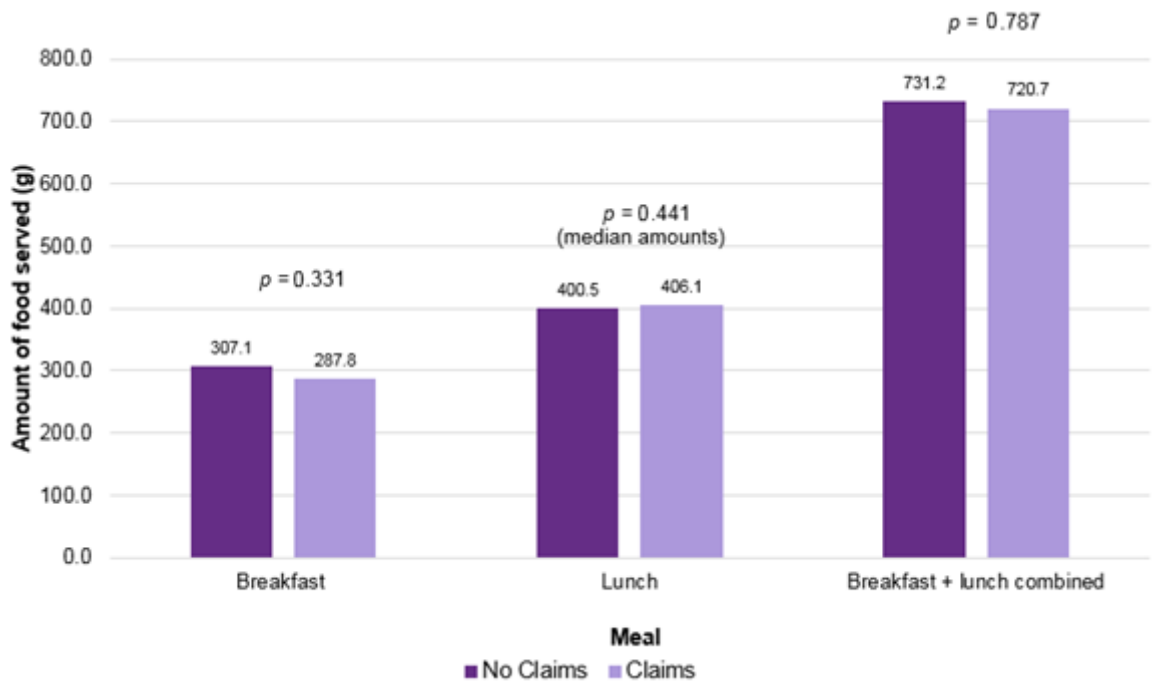
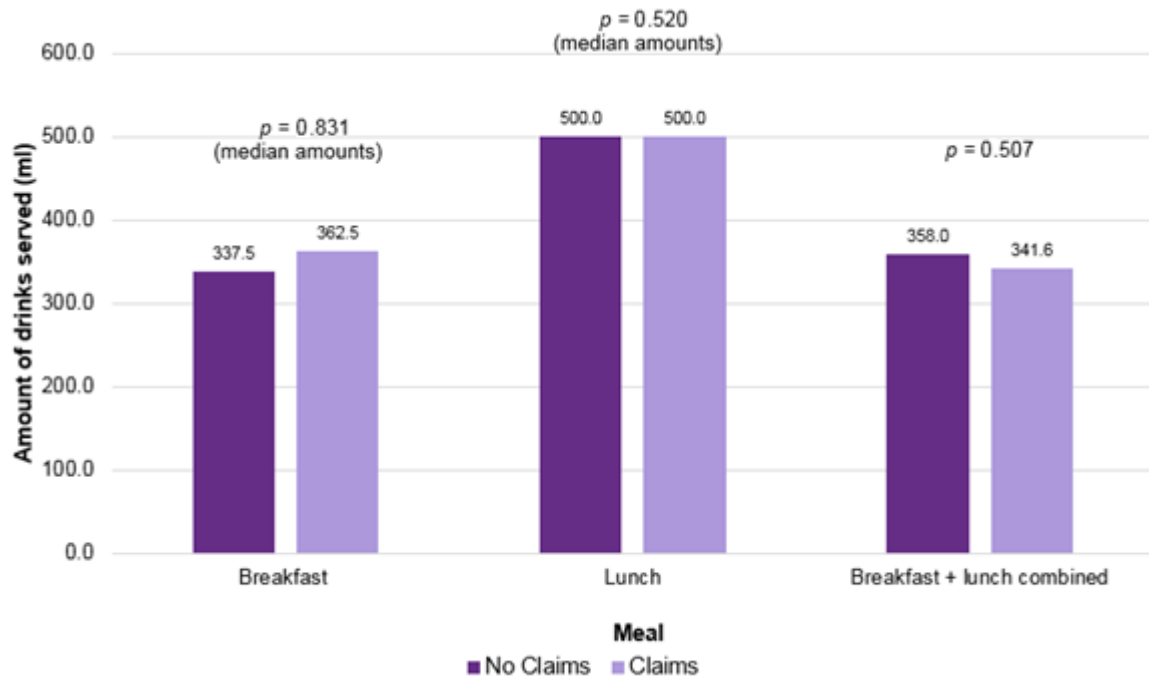


Figure 11: Amount of drinks with claims and with no claims that participants served themselves for each meal in buffet meal experiment 1, examining effects of nutrition and health claims on portion size selection at a subsequent meal



Breakfast study, examining effects of claims on consumers' perceptions of fullness and actual physical fullness

This study involved participants consuming two nutritionally identical breakfast products – one with no nutrition and health claims and another with nutrition claims such as “low fat” and “low sugar” – to compare their perceptions of the products’ fullness with their physical responses to the products (measured through the levels of ghrelin in their blood).

Breakfast label and palatability ratings

- Almost half (44%) of the participants reported reading health claims often or always.
- Approximately 60% reported they read nutritional information on food labels often or always.
- The presence of claims impacted upon perceptions of a product’s “healthiness”, with participants rating the “indulgent” (no claim) breakfast packaging as more appealing (mean difference: 17.3 [95% CI: 11.6, 23.0]; $p < 0.001$) and less healthy (mean difference: -24.8 [95% CI: -31.6, -17.9]; $p < 0.001$) than the “sensible” breakfast before consuming it (Table 11).
- Similarly, participants rated the overall appearance of the “indulgent” breakfast higher than the “sensible” breakfast (mean difference: 5.0 [95% CI: 0.7, 9.3]; $p = 0.024$).

- However, participants felt less healthy when consuming the “indulgent” breakfast (mean difference: -13.2 [95% CI: -18.8, -7.6]; $p < 0.001$).
- Participants did not rate the breakfasts differently according to their taste, smell, overall palatability and enjoyment.

Measurement of consumers’ perceptions of fullness and actual physical fullness

Nutrition and health claims impacted on consumers’ perceptions of fullness.

- Participants reporting a significantly higher mean change in “fullness” score (that is, they reported feeling more full) for the “indulgent” breakfast than the “sensible” breakfast, from the anticipatory time point to post-consumption (at 60 and 90 minutes) (Table 12).
- Analysis of the blood samples showed that there were no significant differences in acylated ghrelin levels (measurement of physiological satiety, or physical fullness) of participants between the breakfasts at any of the time points (Table 13).
- This suggests that while participants’ perceptions of the breakfasts were affected by the nutrition and health claims on labels, claims did not impact upon participants’ actual physiological satiety.

Key findings from experiments

- Participants in experimental buffet study conditions selected larger servings of drinks in the “no claims” conditions, while the amount of food served was not affected by nutrition and health claims.
- Nutrition and health claims did not affect meal-to-meal compensation in the context of the buffet meal experiments; that is, participants did not adjust their portion size selection at a subsequent meal having served themselves food and drink with claims at the previous meal.
- In an experimental breakfast study, participants’ perceptions of breakfast products were affected by nutrition and health claims but the claims did not impact on participants’ actual physiological satiety (physical fullness).

Table 11: Effects of “indulgent” (“no claims”) and “sensible” (“with claims”) breakfast conditions on ratings for breakfast product labels and palatability among participants in a breakfast experiment, examining effects of nutrition and health claims on consumers’ perceptions of fullness and actual physical fullness

	“Indulgent” breakfast (no claims)		“Sensible” breakfast (with claims)		Mean difference (95% CI) ^a	<i>p</i> -value
	N	Mean (SD)	N	Mean (SD)		
Visual Analogue Scales (VAS)						
<i>Breakfast label rating</i>						
Appeal	48	87.2 (10.5)	48	69.7 (19.3)	17.3 (11.6, 23.0)	<0.001***
Perceived healthiness	48	45.8 (21.1)	48	70.5 (13.6)	-24.8 (-31.6, - 17.9)	<0.001***
<i>Breakfast palatability rating</i>						
Appearance	48	84.3 (12.4)	48	79.1 (13.8)	5.0 (0.7, 9.3)	0.024*
Smell	48	77.1 (16.2)	48	75.8 (13.7)	1.5 (-2.4, 5.3)	0.455
Taste	48	80.0 (13.0)	48	78.3 (13.2)	1.7 (-2.8, 6.1)	0.462
Overall palatability	48	79.4 (16.1)	48	80.2 (13.8)	-0.7 (-6.0, 4.5)	0.777
Enjoyment	47	80.2 (16.1)	47	77.3 (15.6)	2.8 (-3.0, 8.6)	0.336
Healthy feeling while eating breakfast	47	58.9 (19.8)	47	72.2 (13.3)	-13.2 (-18.8, - 7.6)	<0.001***

N – number of participants; * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$

Table 12: Effects on “indulgent” (“no claims”) and “sensible” (“with claims”) breakfast conditions on self-reported appetite among participants in the breakfast experiment, examining effects of nutrition and health claims on consumers' perceptions of fullness and actual physical fullness

	“Indulgent” breakfast (no claims)		“Sensible” breakfast (with claims)			
Appetite measures	N	Mean change (SD)	N	Mean change (SD)	Mean change difference (95% CI)	P- value
<i>Baseline to anticipatory time points (20 to 60 minutes)</i>						
Hunger	48	15.3 (14.0)	48	13.3 (17.9)	1.7 (-4.4, 7.9)	0.572
Satisfied	48	-7.3 (15.1)	48	-8.1 (15.8)	1.0 (-4.9, 6.9)	0.736
Fullness	48	-5.7 (9.7)	48	-2.9 (14.6)	-2.9 (-5.9, 0.1)	0.059
Quantity ^a	48	10.7 (12.1)	48	10.0 (11.2)	0.6 (-4.4, 5.6)	0.801
Desire strength ^b	48	10.5 (14.2)	48	12.3 (14.6)	-1.9 (-6.0, 2.1)	0.340
<i>Anticipatory to post- consumption time points (60 to 90 minutes)</i>						
Hunger	48	-55.3 (22.5)	48	-50.1 (22.6)	-5.1 (-11.4, 1.3)	0.114
Satisfied	48	51.7 (25.1)	48	48.3 (24.8)	3.4 (-2.6, 9.4)	0.259
Fullness	48	57.2 (21.7)	48	50.0 (22.9)	7.2 (0.7, 13.6)	0.030*
Quantity	48	-46.2 (19.0)	48	-45.2 (19.6)	-1.1 (-5.7, 3.6)	0.653
Desire strength	48	-52.5 (23.4)	48	-47.5 (21.2)	-4.8 (-11.9, 2.2)	0.176
<i>Baseline to post- consumption time points (20 to 90 minutes)</i>						
Hunger	48	-40.0 (23.6)	48	-36.8 (22.4)	-3.3 (-9.5, 2.8)	0.282
Satisfied	48	44.3 (27.5)	48	40.2 (25.1)	4.4 (-3.0, 11.8)	0.237
Fullness	48	51.5 (21.2)	48	47.0 (21.5)	4.3 (-2.0, 10.6)	0.179
Quantity	48	-35.5 (17.3)	48	-35.2 (19.3)	-0.4 (-6.0, 5.1)	0.879
Desire strength	48	-41.9 (26.8)	48	-35.2 (24.8)	-6.8 (-13.8, 0.2)	0.058

N=number of participants; ^a“Quantity” means “How much do you think you could (or would want to) eat right now?”; ^b Desire strength” means “How strong is your desire to eat?”; * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$

Table 13: Effects of “indulgent” (“no claims”) and “sensible” (“with claims”) breakfast conditions on acylated ghrelin levels among participants in the breakfast experiment, examining effects of nutrition and health claims on consumers’ perceptions of fullness and actual physical fullness

	“Indulgent breakfast” (no claims)	“Sensible breakfast” (with claims)		
Ghrelin measures	Mean change (SD) pg/ml	Mean change (SD) pg/ml	Mean change difference (95% CI) pg/ml	<i>P</i>
Baseline to anticipatory time point (20 to 60 minutes)	9.86 (42.47)	15.12 (50.77)	-2.78 (-26.66, 21.11)	0.815
Anticipatory to post-consumption time point (60 to 90 minutes)	-27.20 (35.29)	-33.61 (51.27)	5.46 (-9.93, 20.86)	0.476
Baseline to post-consumption (20 to 90 minutes)	-17.34 (47.30)	-18.49 (36.38)	2.69 (-13.69, 19.07)	0.741

5 Discussion

This research was a wide ranging review of the impact of nutrition and health claims on consumers' perceptions and portion size with likely influence by complex factors. Section 5 reviews the results from the different components of the research as a whole.

Literature review

Given the relatively little research on nutrition and health claims on the island of Ireland, a starting point for the project was to understand the most common claims used and the food products that often carry these claims.

- While there appear to be no studies specific to the island of Ireland, studies in the Republic of Ireland and the UK have produced similar findings that show breakfast cereals, dairy products (particularly yoghurts) and drinks often carry nutrition and health claims.
- Statements related to fat are the most common nutrition claims, while statements related to the digestive system and cholesterol are common health claims.

Focus groups

Consumers' awareness and knowledge of claims

- Participants in the focus groups indicated that they had seen and were aware of nutrition and health claims.
- In line with previous research (44), participants made no distinction between a nutrition claim and a health claim or further subtypes of claims. This may be due to lack of consumer knowledge about the exact technical meaning of claims or because the difference between the 2 types of claims had no practical relevance to participants.
- The idea that claims are marketing tools and can mean higher prices was also raised. This scepticism is also apparent in previous research (45, 46).

Impact of nutrition and health claims on consumers' perceptions

- Consumers appeared to perceive products carrying nutrition and health claims as being "healthier". This is a challenge for those communicating (or trying to communicate) health

messages especially because products viewed as healthier may also be perceived to be less tasty.

- Participants did mention that claims may affect consumers' perceptions of the tastiness of a product.
- Satiety and fullness perceptions did not emerge as prominent themes in the discussion.

Impact of nutrition and health claims on consumers' portion size selection

- Participants identified that nutrition and health claims may have an impact on portion size selection and their consumption of products with such claims.
- Participants felt that packet sizes are different for products carrying nutrition and health claims (generally smaller).
- While some participants remarked they would decrease their consumption in relation to claims, the main reported effect was to increase consumption of food or drink products with nutrition and health claims.

Survey

Consumers' awareness and knowledge of claims

Similar to the findings from the focus groups, participants' specific technical knowledge relating to nutrition and health claims was relatively low, with a mean score of 2.3 on a scale of 0 to 5. A recent study of 10 European countries found consumers had fair to moderate claims knowledge, scoring 3.0 on a scale of 0 to 5 (28). However, it is important to note that these scores are not directly comparable due to the use of different questions.

Impact of nutrition and health claims on consumers' perceptions

- The claims on food packaging labels did not affect how healthy or tasty participants believed a food to be.
- The claims did influence how filling participants thought a food would be.
- In particular, the health claim "lowers cholesterol" was associated with a lower fullness rating for yoghurt when compared with the health claim (intended to relate to satiety) "fuller for longer". The "lowers cholesterol" claim was also associated with a lower fullness rating compared with all other claims for cornflakes.
- In addition, after controlling for related variables, claims remained a significant predictor of consumers' perceptions of fullness for cornflakes, lasagne and yoghurt.

- These findings are in line with previous research, which found that those who ate food framed by a claim of “healthy” reported feeling hungrier than those who ate food framed as “tasty” (47). This may be due to healthier foods typically being less energy dense and therefore viewed as less filling by consumers) (48).

Impact of nutrition and health claims on consumers’ portion size selection

- In contrast to the focus group findings, where participants reported that nutrition and health claims affect their consumption, survey participants reported that claims did not affect portion size selection.
- This finding is also in contrast with a review of studies, which found that claims increase consumption or purchasing of foods (16). However, this review consisted mainly of choice and consumption experiments.
- The current survey was the first to measure the portion size of food with claims that would be selected by consumers. In this study it was found that variables such as knowledge, eating behaviour, familiarity with the food and believability of the claim were more likely than nutrition and health claims to influence portion size selection.
- The factors measured in this study only explained a small amount of variance in portion size selection. It is important to note that other factors such as gender (men choosing larger portions than women), uncontrolled eating behaviour and an individual’s liking for the food have been previously found to influence portion size selection (49).
- The survey found that those who believed the nutrition and health claims chose larger portion sizes compared to those who did not believe the nutrition and health claims.
- Therefore, consumers who believe in claims should be made aware of the potential to see claims as a reason to select larger portion sizes and consume more of products carrying nutrition and health claims.

Experiments

Impact of nutrition and health claims on consumers’ perceptions

- In line with the results from the focus groups, the presence of claims impacted upon how healthy participants believed that a food was. Participants in the breakfast study believed that the product labelled “healthy breakfast bite” and carrying nutrition claims was healthier than the product labelled using the terms “luxury”, “indulge and enjoy” and “premium” with no claims present.
- Participants also reported feeling fuller having eaten the “indulgent” breakfast.

- There was no impact of claims on other perceptions such as taste.

Impact of nutrition and health claims on consumers' portion size selection

- Participants served themselves similar amounts of food regardless of the presence of claims at either single meal occasions or at a subsequent meal.
- While participants served a larger volume of drinks when no claims were present, this may have been due to the limited selection of beverages in the “with claims” conditions (where only “vitamin-enriched” water was available).
- In the second buffet meal experiment, when the selection of beverages carrying claims was changed, there was no effect of claims on the amount of drinks served by participants.
- The finding that nutrition and health claims did not impact on portion size selection is in contrast with the focus group findings, when participants said that the presence of claims may impact on how much they consume. These differences in findings may be due to methodological differences between the studies (a quantitative laboratory setting for the experiments as against qualitative methods for the focus groups); or they may be due to differences between participants' claimed (or intended) and actual food buying and consumption behaviour.

Interpretation of project findings

The differences in findings between the studies conducted in this research project (Table 14) may have several possible explanations:

- The focus groups are a qualitative research method while the survey and experiments are quantitative methods. The different methods were used in the project to understand the impact of nutrition and health claims from different perspectives and at different levels.
 - Qualitative research methods such as focus groups use prompts and guides to explore attitudes and thoughts. Participants are provided with the opportunity to discuss these in detail, which does not happen using quantitative methods such as surveys or experiments. This will have allowed participants the time, which they may not otherwise have, to explore their own thoughts.
- The data from both the focus groups and the survey rely on participants' self-reported behaviour, which may in fact differ from their actual behaviour.
- There are differences in the sample of participants for each of the studies.

- The survey used a representative household sample, from which results can be estimated for the wider population of the island of Ireland. However, participants in both the focus groups and experiments were not representative samples.
- The majority of the participants in the focus group were from a higher socioeconomic group and more highly educated.
- Participants in the experiments were mostly female, more educated and with a higher socioeconomic status.
- The different methods used in the focus groups, the survey, the buffet meal experiments and the breakfast experiment may also have reached different levels of participant engagement.
 - Focus groups collect information on thoughts and feelings that participants are willing to disclose only.
 - In the survey and particularly in the buffet meal experiments, where portion size selection was assessed, a participant's responses and behaviour are likely to be more habitual or automatic.
- Different foods and claims were used in the different studies.
 - The use of a "fake food" buffet that included lifelike replicas of food may also have impacted on the results from the 2 buffet meal experiments.

It is also important to note that the studies as a whole focussed solely on consumers' perceptions of nutrition and health claims in isolation, even though this is just one of the pieces of information present on food packaging and labels.

Table 14: Impact of nutrition and health claims on consumers’ perceptions, portion size selection and nutrient composition across all project components

Did nutrition and health claims impact upon consumers’....				
Study	Tastiness perceptions	Healthiness perceptions	Fillingness/satiety perceptions	Portion size selection/reported consumption
Focus groups conducted to understand effects of nutrition and health claims on consumers’ perceptions and portion size selection	Yes	Yes	No	Yes
Survey conducted to understand effects of nutrition and health claims on consumers’ perceptions and portion size selection	No	No	Yes	No
Buffet meal experiment 1: Effects of nutrition and health claims on consumers’ portion size selection at a single meal	N/A	N/A	N/A	No
Buffet meal experiment 2: Effects of nutrition and health claims on consumers’ portion size selection at a subsequent meal	N/A	N/A	N/A	No
Breakfast experiment to understand effects of nutrition and health claims on consumers’	No	Yes	Yes	N/A

perceptions of fullness and actual physical fullness

N/A = Not assessed or not a focus of the study

6 Conclusions

- The majority of participants were aware of nutrition and health claims in a general sense but not very knowledgeable or familiar with the technical details. Participants did, however, show a level of interest in and used claims.
- Participants did not distinguish between nutrition claims and health claims.
- Participants acknowledged that nutrition and health claims may impact upon their perceptions and consumption behaviour but generally this was not found in actual behaviour such as portion size selection, in the context of the experimental conditions.
- Psychological factors such as believability in claims (how much an individual believes that a claim is accurate or true) and familiarity with the foods carrying nutrition and health claims was found to influence perceptions and portion size selection much more than the presence or absence of nutrition and health claims.
- Despite consumers believing that nutrition and health claims will not affect fullness, the survey and the breakfast study showed that the presence or absence of claims on food did in fact affect perceptions of satiety, or fullness.
- Collectively, the most influential factors in explaining consumers' perceptions of the tastiness, healthiness and fullness of foods are an individual's
 - Type of eating behaviour (restrained, uncontrolled, emotional)
 - Health interest
 - Motivation to process (their interest in and use of) nutrition and health claims
 - Knowledge of claims
 - Belief in claims (how much participants they think they are accurate and true)
 - Familiarity with the food.
- In particular, participants who believed the claims were more likely to view food as tastier, healthier and more filling than those who did not believe the claims.
- Claims explained little of the variance in how healthy, tasty or filling participants perceived the food to be.
- Psychological variables explained the most variance in portion size selection. Larger portion sizes were selected by participants with
 - Less control over their eating
 - Lower interest in health

- Higher believability in claims
 - Less familiarity with the foods.
- Of the sociodemographic factors, gender significantly predicted portion size selection, with men selecting larger portions than women.

7 Recommendations

Promote food literacy (label-reading skills)

Consumers should be supported in how to read and interpret food labels as one aspect of food literacy. Improving consumers' knowledge will enable them to understand nutrition and health claims and they can use this knowledge when deciding what food to buy and how much to eat.

Key messages for consumers

- Did you know that nutrition and health claims can only be placed on products that meet certain criteria? For example, for a product to be labelled as “low fat” it must contain no more than 3 grams of fat per 100 grams of product.
- Nutrition and health claims made on food are regulated at a European level – for more information visit the [EU register](#).
- Just because a food or drink product has a nutrition or health claim on the packet such as “low sugar” does not mean that it is a healthier choice – check the nutrition information on the label and the front-of-pack label, too.

Encourage serving recommended portions only

Consumers should be encouraged to follow healthy eating guidelines for food choices and to serve or consume the recommended portion sizes of all food and drink products, including those carrying nutrition and health claims.

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