



Public Health
England

Protecting and improving the nation's health

From Plate to Guide: What, why and how for the eatwell model

About Public Health England

Public Health England exists to protect and improve the nation's health and wellbeing, and reduce health inequalities. We do this through world-class science, knowledge and intelligence, advocacy, partnerships and the delivery of specialist public health services. We are an executive agency of the Department of Health, and are a distinct delivery organisation with operational autonomy to advise and support government, local authorities and the NHS in a professionally independent manner.

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List of annexes

PHE externally commissioned two phases of qualitative research during its review of the eatwell model.

Findings are provided in the following annexes:

Annexe 1

Qualitative research findings of phase one informing design direction by understanding responses to the eatwell plate, alongside initial suggestions for changes in execution, content and supporting messages.

Annexe 2

Qualitative research findings of phase two testing updated visuals.

Glossary

AOAC Fibre:	Ass. of Official Analytical Chemists' method for total dietary fibre analysis
BC1:	UK Office for National Statistics socio-economic classification including lower middle and middle class
C2DE:	UK Office for National Statistics socio-economic classification including skilled working class, working class and non-working
COFIDS:	The Composition of Foods Integrated Dataset
COMA:	Committee on Medical Aspects of Food Policy
DRVs:	Dietary Reference Values
EAR:	Estimated Average Requirement (50% of population's requirement met)
ERG:	External Reference Group
FSS:	Food Standards Scotland
LRNI:	Lower Recommended Nutritional Intake (2.5% of population's requirement met)
NDNS:	National Diet and Nutrition Survey
NMES:	Non-milk extrinsic sugars
RNI:	Reference Nutrient Intake (97.5% of the population's requirement is met)
SACN:	Scientific Advisory Committee on Nutrition

Executive summary

In 2014, Public Health England (PHE) committed to reviewing the eatwell plate to ensure its consistency with latest dietary recommendations and key public health messages as part of its remit to provide evidence-based advice to government, local government, the NHS, public health professionals and the public.

An external reference group (ERG) was formed to provide advice to PHE on the approaches taken and included members from a range of umbrella organisations representing health, voluntary and industry (including trade and levy organisations) groups.. The group provided routes for wider engagement and comments were encouraged throughout the period of the review. The group was not involved in the final development of the new visual, which was the responsibility of PHE in collaboration with the devolved administrations.

Development of the Eatwell Guide used similar approaches to that of its predecessors, but relied upon more detailed information and more robust and objective approaches. The use of linear programming in refreshing the food model provided the opportunity to utilise the most up to date data available on current food patterns in the UK, drawn from the National Diet and Nutrition Survey (NDNS), the most up to date recommendations from Scientific Advisory Committee on Nutrition (SACN) on Dietary reference values (DRVs) and the most up to date and robust methodology for calculating an optimised food model. The modelling approach taken was agreed by the ERG and conducted independently by the University of Oxford. This allowed the food group segment sizes of the Eatwell Guide to be developed entirely objectively.

The supporting consumer research ensured that the output and design of the guide would be acceptable and understandable for consumers. The underlying assumptions input into the model enabled development of a final model that meets DRVs whilst retaining a diet that consumers recognise.

The Eatwell Guide was launched in March 2016 and replaced the eatwell plate as the UK's healthy eating tool. The guide illustrates the different types of foods and drinks, and in the proportions in which they should be consumed, to achieve a healthy balanced diet. The guide reflects up to date dietary recommendations, including those on sugar and fibre.

PHE commissioned the Carbon Trust to conduct a *post hoc* sustainability assessment of the Eatwell Guide. This indicated that eating a diet in line with the guide has an appreciably lower environmental impact than the current UK diet.

In light of the levels of diet related disease in the UK, there is an increasing need to move the population to a healthy balanced diet, as shown by the Eatwell Guide.

Introduction

In the UK, government dietary recommendations reflect evidence based advice from independent expert committees, namely the Committee on Medical Aspects of Food and Nutrition Policy (COMA) and its successor since 2000, the Scientific Advisory Committee on Nutrition (SACN).ⁱ

Dietary recommendations come in the form of Dietary reference values (DRVs) and food based guidelines. DRVs include the range of figures for recommended nutritional intakes for the UK population. The DRVs can be divided into three types: RNI - Reference Nutrient Intake (97.5% of the population's requirement is met); EAR - Estimated Average Requirement (50% of the population's requirement is met); LRNI - Lower Recommended Nutritional Intake (2.5% of the population's requirement is met).

Many countries around the world translate the complexities of Dietary reference values and food based recommendations into easily understandable visual messages through the use of national food models. Many countries present this information in the guise of different shapes such as a pyramid or plate according to local understanding, custom and belief¹.

In the UK a national food model has been used to visually represent the types and proportions of foods needed for a healthy balanced diet for more than 20 years. This visual model has evolved during that time and is described later in this report.

Government encourages organisations and individuals to use the national food model to ensure provision of a consistent message. As well as being used by the NHS and health care professionals, it is used by a range of other organisations including (but not limited to) industry, charities and educational settings.

This report describes the approach taken by Public Health England (PHE) to refresh the eatwell plate, which was the UK's national food model from 2007 to 2016, to ensure it represents the most up-to-date government dietary recommendations while remaining meaningful to the public.

ⁱ <https://www.gov.uk/government/groups/scientific-advisory-committee-on-nutrition>

History of the national food model in the UK

The Balance of Good Health

The first national food model used in the UK, 'The Balance of Good Health' (appendix 1), was produced in 1994 collaboratively between the Department of Health and the Ministry of Agriculture, Fisheries and Food and Health Education Authority². It was developed as part of a programme of action drawn up by the Government's Nutrition Task Force³; the aim of which was to achieve the dietary targets set out in the Health of the Nation white paper⁴ through the use of a nationally recognised and consistently used guide to food selection.

'The Balance of Good Health' showed drawn images on a tilted plate format including a knife and fork and split into five segments representing the contribution that the different food groups should make to achieve a healthy balanced diet.

The visual was developed based on consumer research⁵, examining preferences related to design eg (plate versus pyramid) and title, understanding and recall of dietary messages and intended food purchasing behaviour following exposure to stimulus materials. Professional perspectives, including those from dietitians, were also gathered.

Segment sizes were based upon a model average diet developed as part of the COMA Diet and Cardiovascular Disease report⁶ using household food purchasing data from the 1992 National Food Survey^{2,5,7}. Further details are given in the 'The National Food Guide: development of dietetic criteria and nutritional characteristics' publication⁵.

'The Balance of Good Health' was widely used by health professionals and was produced as a leaflet (including guidance material for health professionals) and as a 'postcard' for the public. It was produced and promoted by the Health Education Authority.

The eatwell plate

Whilst 'The Balance of Good Health' was considered a useful aid in helping consumers to consider their diet, from 2000 onwards professionals began to express an interest in seeing an updated, more appealing visual. Consumer research was conducted in 2005 to understand attitudinal and behavioural responses to differing visual representations of healthy eating and the context in which people viewed these⁸. Since government dietary advice had not changed since the development of 'The Balance of Good Health', the proportions associated with different food category groups was not reviewed.

Plate based designs were still preferred and foods illustrated were considered relevant. Specific improvements were suggested such as keeping visuals simple and straightforward, direct, positive, adult to adult, colourful and inspirational. Participants thought it important that

messages should not be serious, medical, threatening or patronising, nor assume too much prior knowledge, set in an everyday setting, and should make reference to foods that are likely to be eaten.

Consumer testing revealed the eatwell plate design as the most successful. It was received positively with most participants reporting that it was simple, clear, colourful and appetising. The food category names were generally understood and the title was found to reinforce the idea of healthy eating and balance. Respondents felt the message was relevant to them personally but one that needed to be communicated as often as possible. As a result, several changes were subsequently made to the visual and text, showing a wider range of real foods and a change to some of the titles of the food groups. The new eatwell plate was launched in 2007 (appendix 2), published by the Food Standards Agency who, at that time, had responsibility for public health advice on nutrition.

The refresh of the eatwell plate

PHE was established in 2013 and the national food model transferred as part of its diet and obesity remit. In June 2014, PHE published 'Sugar reduction - Responding to the challenge'⁹, committing to reviewing the eatwell plate to ensure its consistency with dietary recommendations and key public health messages. This was largely in response to publication of the draft SACN report on carbohydrates and health proposing revising dietary recommendations for sugars and fibre, which was subsequently finalised in July 2015¹⁰. The recommendations for decreasing sugars and increasing fibre intakes were accepted by all UK health ministers and now form part of government advice. This includes guidance, for the first time, that sugar sweetened drinks should not form part of a child's daily diet and should be minimised in adults. Additionally, since development of the eatwell plate a number of SACN reviews have been published with changes on recommendations related to energy¹¹, iron¹², and fish¹³. As such, the refresh of the eatwell plate was timely.

In recent years there has been growing interest in sustainable diets; although health was the primary consideration for this refresh of the national food model, PHE commissioned a *post hoc* sustainability assessment of the model by The Carbon Trust.

Approach to refreshing the eatwell plate

External reference group

In July 2014, PHE established an external reference group (ERG) with an independent chair to provide advice on methodologies for refreshing the eatwell plate. The ERG was established by inviting umbrella organisations representing health, voluntary and industry (including trade and levy organisations) sectors to an initial meeting. Membership, as detailed in appendix 3, was discussed and agreed at the first meeting with no additional members suggested. Government departments, agencies and the devolved administrations were involved in all meetings as observers.

The remit of the ERG was specifically to provide advice to PHE on:

- approaches to revising the segment sizes for the eatwell plate
- approaches to reviewing the visual aspects of the plate model
- approaches for reflecting messages on foods that should be consumed in limited amounts
- approaches for reflecting hydration messages
- opportunities for promotion of any amended visual

Papers and action notes were published on government websites¹⁴ to ensure that advice to PHE was delivered in an open and transparent manner. A total of four meetings were held between July 2014 and December 2015. The ERG was not asked to comment on, approve or amend the final visual.

Consideration of methodologies

The ERG discussed and agreed advice to PHE on five potential approaches to reviewing the proportions and types of foods that reflect a healthy, balanced diet:

- identifying individuals within the National Diet and Nutrition Survey (NDNS) who already meet revised DRVs/food based guidance
- modelling based on substituting individual products within NDNS for those lower in salt, fat, sugar and higher in fruit, vegetables, oily fish and fibre to meet revised DRV's/food based guidance
- adjusting the Food Standards Scotland (FSS) eatwell week¹⁵ to meet revised DRVs
- adjusting PHE's example menus in its healthier and more sustainable catering guidance¹⁶ to meet revised DRVs
- undertaking linear programming modelling to meet revised DRVs

In order to ensure that the outcome was robust it was important that:

- dietary intake data was the most up to date and robust
- data on the nutrient content of foods was up to date and robust
- food categories in the data could be mapped against the food groups understood by the public

The NDNS¹⁷ provided the first of these requirements and The Composition of Foods Integrated Dataset (COFIDS)¹⁸ provided the second. The NDNS assesses the diet, nutrient intake and nutritional status of the general population in the UK. The NDNS provides the only source of high quality nationally representative data on the types and quantities of foods consumed by individuals, from which estimates of nutrient intake for the population are derived. The COFIDS dataset brings together all of the data from the Composition of Foods book series into a single electronic file.

Given the wide range of foods consumed in the UK and that many, for example meat and meat products, contain foods from more than one food group in our visual models, PHE developed an approach for most commonly consumed composite foods (ie those with more than one ingredient) which is described in more detail in appendix 4.

The ERG noted that each of the potential approaches had opportunities and limitations as shown in Table 1.

The ERG agreed and recommended to PHE that a linear programming approach would be the most robust and only truly objective method for generating food group segment sizes.

In order to ensure approaches remained meaningful to the public, consumer research was also conducted.

Table 1. Opportunities and limitations of different approaches to meeting new dietary recommendations

	Individuals in NDNS already meeting recommendations	Substituting within NDNS with lower salt, fat and sugar foods	Adjusting the FSS eatwell week	Adjusting PHE catering menus	Linear Programming
Individual vs population	Identifies individuals within a cohort	Population	One individual woman	Mixed population	Mixed population
Variety of foods	Extreme patterns of food intake; few foods included	Wide variety overall but likely limitation of substituted options	Limited food inclusion	Wider range of foods but choice architecture subjective	Similar variety to NDNS
Intake data	NDNS	NDNS	N/A	N/A	NDNS
Food composition data	COFIDS – assumed free sugars definition equated to NMES	COFIDS – assumed free sugars definition equated to NMES	COFIDS – assumed free sugars definition equated to NMES	COFIDS – adjusted to account for free sugar definition	COFIDS - adjusted to account for free sugar definition
Bias	Small group (<30) with unusual /extreme patterns of intake, including energy, thus not representative of overall population	Introduces a degree of subjective substitution/removal: <ul style="list-style-type: none"> • Foods high in free sugars (soft drinks, sugar confectionery and confectionery) were removed entirely • Breakfast cereals and biscuits were substituted for an alternative in the same sub food group, which was lower in free sugars • Consumption of certain foods high in free sugars (ice cream, puddings, 	Starting point is healthier than UK intakes Subjective and limited food choices	Subjective choice architecture	Objective based on input constraints that equate to meeting DRVs and food based guidelines

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		buns, cakes, pastries, fruit pies, biscuits, yogurt and sugar) were halved, as a pragmatic approach			
Generalisability / acceptability to the public	Unlikely due to limited number of foods and unusual patterns of intake	Possible but limited by subjective choice options by single analyst	Possible but only reflects one individual over 7 days; insufficient variety for whole population	Possible but reflecting estimated choices within a controlled menu choice structure	Based on current intake patterns with the fewest changes introduced to meet guidance

NMES: Non Milk Extrinsic Sugars

COFIDS: The Composition of Foods Integrated Dataset

NDNS: National Diet and Nutrition Survey

DRVs: Dietary reference values

Methods

Linear programming for determining the proportions of the food groups in the Eatwell Guide

Linear programming is an accepted approach for optimisation analysis to identify, for example, diets that achieve recommendations. It has previously been used to formulate food-based recommendations that are consistent with nutrient recommendations and food habit.^{19, 20, 21} The approach uses a mathematical function (for detailed methodology see appendix 4 and 'The Eatwell Guide: modelling the dietary and cost implications of incorporating new sugar and fibre guidelines' publication²²) that measures the divergence of the modelled scenario from the diet currently consumed; resulting in a scenario that has the fewest number of changes to achieve dietary recommendations.

The Nuffield Department of Population Health, University of Oxford was independently commissioned to conduct the linear programming. The outcome variables were developed to reflect the potential dietary guidelines that were anticipated might emerge following the finalisation of the SACN Carbohydrate and Health report. Table 2 provides the dietary recommendations and the model constraints that reflect the recommendations that were finalised by SACN and subsequently agreed by government.

Post hoc analysis was undertaken to assess the outcome of modelling on average population vitamin and mineral intakes.

Consumer research

Define Research & Insight Ltd was independently commissioned by PHE to undertake qualitative research on the understanding of current messages and explored ways to improve communication of messages so that the model fully supports consumers to eat a healthy diet in keeping with government advice.

The research aimed to assess:

- the extent to which the eatwell plate visual approach and style was still appropriate
- how consumers respond to changes reflecting the potential new recommendations
- the information/messages within or alongside the visual that worked best for maximum accessibility, engagement and understanding across the diverse consumer audience.

The research was conducted in two phases with phase one informing design direction by understanding responses to the eatwell plate alongside initial suggestions for changes in execution, content and supporting messages; and phase two testing updated visuals (developed in response to findings of phase one and initial linear programming outputs).

Qualitative work took place across the UK involving 152 individual in depth interviews with individuals (60 from BC1, 92 from C2DE) in phase one and 80 individual depth interviews (20 BC1, 61 C2DE) in phase two. Interviewees included Caucasian, Afro-Caribbean, African, Chinese, South Asian and mixed race individuals. Further details of the methodology and inclusion criteria are provided in appendix 5.

Table 2. Constraints utilised in the linear programming to develop the visual reflecting government dietary recommendations.

	Dietary recommendation	Constraint
NUTRIENTS		
Energy	2250 kcal (9414 MJ) ¹	No increase ⁴
Carbohydrates	≥50% of food energy	≥50% of food energy
Free sugars	≤5% food energy	≤5% food energy
Fat	≤35% food energy	≤35% food energy
Saturated fat	≤11% food energy	≤11% food energy
Protein	Approx. 15% food energy	≥14.5 & ≤15.5% of energy
Salt	≤ 6g/2363 mg sodium	≤ 6g/2363 mg sodium
Fibre (AOAC)²	30g	≥30g
FOODS		
Fruits and vegetables³	At least 5 portions of a variety each day	≥5 portions a day
Fish	At least 2 portions a week, one of which should be oily	≥ 2 portions (2*140g) a week, one of which should be oily
Red and processed meat	High consumers should reduce their intake to the average of the population (70g)	≤70g/day

AOAC: Association of Official Analytical Chemists method for total dietary fibre analysis.

¹ assumes mixed population average

² equivalent 18g non-starch polysaccharide fibre

³ includes a maximum of: 1 portion of juice (from fruit / vegetable juice or that in a smoothie); 1 portion of beans; (portion sizes: 30g dried fruit; combined total of 150ml of fruit and / or vegetable juice and / or smoothie; 80g all other fruits & vegetables)

⁴ in energy from NDNS intakes (weighted average for adults equivalent to 1711kals (7159 MJ).

Results

Linear programming

The linear programming modelled scenario met all of the UK dietary recommendations for the average adult (Figure 1).

Post hoc analysis showed small fluctuations in micronutrient consumption (figure 2). While iron, potassium and folate increase calcium and zinc are reduced. Average consumption of calcium would, however, still meet dietary recommendations while zinc and potassium would fall to just under the RNI.

At the time of the modelling, there was no general recommendation for population intake of vitamin D for adults as it was assumed that summertime exposure to sunshine fulfilled requirements. Subsequently vitamin D recommendations have been revised in order to ensure that the majority of the UK population has satisfactory vitamin D blood levels throughout the year²³.

Figure 2 shows that consumption in line with the modelling would increase vitamin D intake by 44% compared to current intakes.

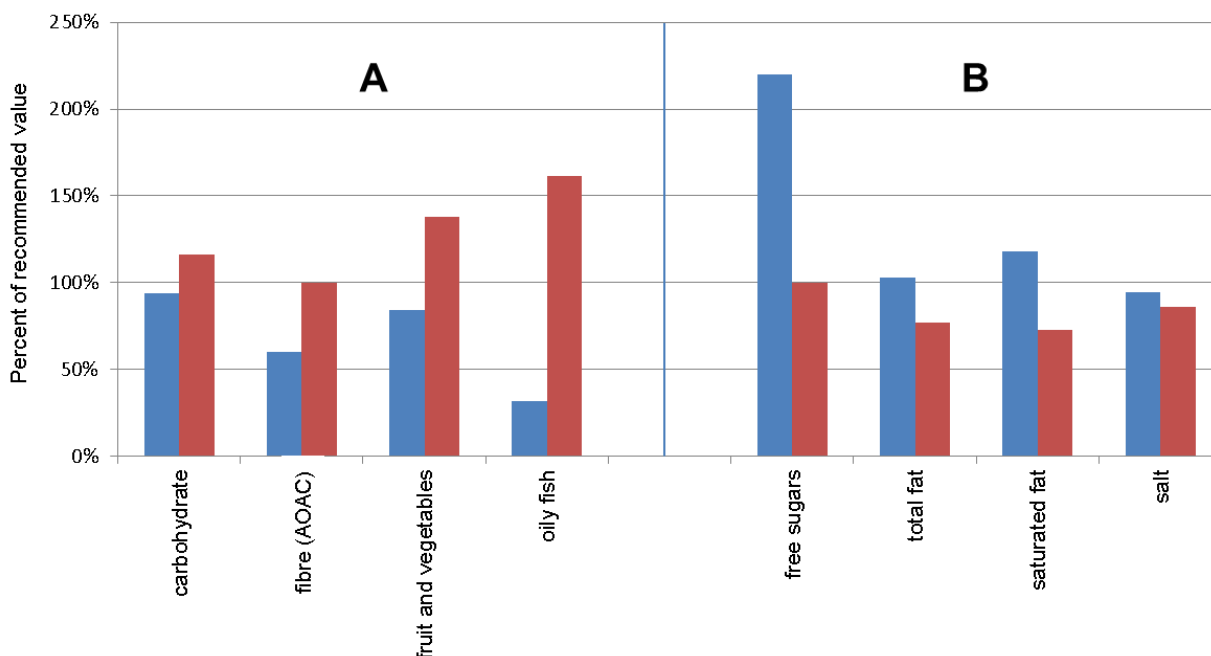


Figure 1: Average intake of nutrients/foods in weighted NDNS sample (■) and modelled intake (■) for nutrients/foods with (A) a minimum recommendation and (B) a maximum recommendation

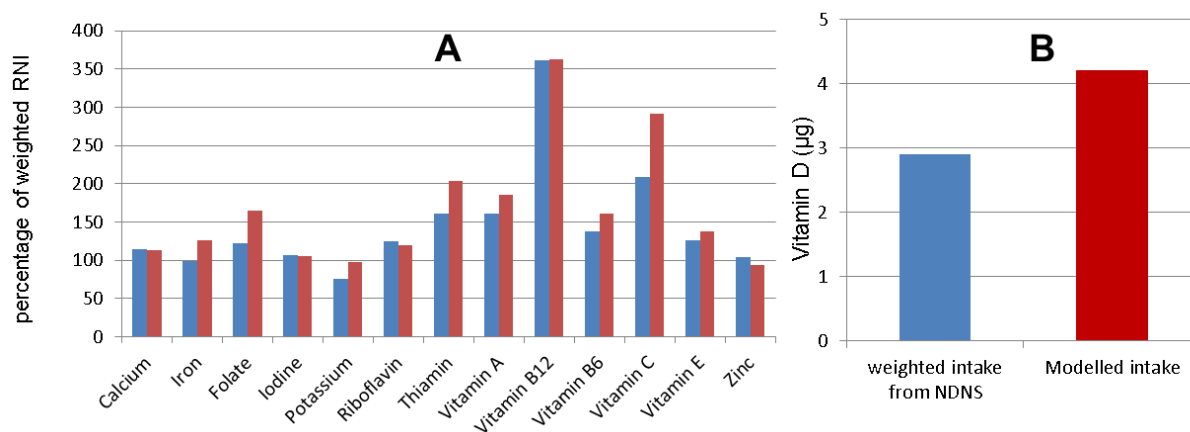


Figure 2: Average intake of micronutrients in weighted NDNS sample (■) and modelled intake (■) (A) and vitamin D content of diet (B)

Appendix 6 provides the outcome of the modelled scenario and gives details of the specific changes to the NDNS food categories compared to the current diet. To meet the revised UK dietary recommendations, current average consumption of potatoes, bread, rice, pasta and other starchy carbohydrates and fruit and vegetables categories would need to increase respectively, with corresponding falls in all other categories.

Table 3 shows the impact of this on the food groups presented in the Eatwell Guide as percentage food weight (in keeping with the development of the UK food guide since 1994).

Table 3. Contribution of Eatwell Guide food group to overall dietary intake

Food category	Weight of food (%)
Fruit and vegetables	39%
Potatoes, bread, rice, pasta and other starchy carbohydrates	37%
Beans, pulses, fish, eggs, meat and other proteins	12%
Dairy and alternatives	8%
Oils and spreads	1%
Foods to eat less often and in small amounts (although not shown visually as a segment in the final image)	3%

Consumer research

A summary of the phase one research and stimulus materials is provided in annexe 1 alongside a report on phase two in annexe 2. Phase one of the consumer research was used to test consumer accessibility and understanding of the food model, as well as basic design preferences.

Across the whole sample, the plate model was recognised as having educational value to consumers and was generally seen as easy to use. There was good understanding of the

overall plate mechanic which was generally understood to describe the overall proportions of different food types and drinks that comprise a healthy diet.

For most respondents, the overall content highlighted some discrepancies with their own current diets; indicating that it fulfilled its role in providing a point of comparison in an accessible/assessable way. This was both true of the eatwell plate and the different stimulus materials used to investigate alternative approaches.

Differences were not evident according to geography, socioeconomic group, ethnicity, size or composition of family, use of internet and age. Across the research, however, respondents fell into two broad groups:

- those who are **more** engaged: likely to know more about nutrition and nutrition issues (even though their diets may not be ideal) and have pre-existing sense of risk. These individuals enjoy food shopping and preparation and are more likely to buy fresh or component foods
- those who are **less** engaged: tend to have less knowledge about nutrition (as well as a sense of risk) but are also likely to find food shopping a chore and include more pre-prepared foods in their diets

Key findings are summarised in Table 4.

Overall, responses indicated that either of the design approaches tested at phase two was fit for purpose, as both designs performed well in terms of overall comprehension when seen in its own right. However, in terms of the specific designs, different elements from across the two came out strongest. There was also consistency in which were perceived as most useful and clear to consumers, whether more or less engaged and irrespective of SEG, gender, nation or ethnicity.

Although additional messaging was likely to be overlooked initially by those who are less engaged its presence was not found to be offputting. Furthermore, it was clear that all consumers learnt more when more messaging was present and the findings clearly demonstrated which messages worked best for comprehension and understanding.

An optimised design taking the successful elements of the two models tested informed the final Eatwell Guide image.

Table 4. Key findings of qualitative research at phases one and two.

	Phase one	Phase two
Images	<p>Drawn images were preferred to photography, which displayed raw foods (including meat and fish). While there was a split in terms of stylistic preference/appeal, participants felt the drawn images performed best overall.</p> <p>Drawn style worked better for the 'less engaged' and was acknowledged by 'more engaged' as likely to be more effective as an educational tool.</p> <p>Drawn images in stimulus material felt to be somewhat childish.</p>	<p>Drawn style worked better for the 'less engaged' and was acknowledged by 'more engaged' as likely to be more effective as an educational tool.</p> <p>Images were different having been redrawn based on feedback from phase one and were acceptable to most participants.</p>
Food category segment names	<p>Clear wording preferences expressed about specific wording in segment names: in particular that related to dairy and alternatives.</p>	<p>Changes to food segments understood.</p>
Additional messaging accompanying the segments	<p>Wording of messages outside of the segments were identified as useful, but care was needed not to appear to be telling people what to do.</p> <p>Wording that provided new information/facts or useful suggestions were found to be most helpful.</p> <p>Consumers understood messages about eating less meat, and preferred messaging that reflected the types of meat.</p>	<p>In general terms consumers preferred more rather than less messaging, as this increases the value they get from the design.</p>
Foods high in sugar and fat	<p>Splitting oils and spreads that can form part of the diet from foods high fat/sugar and labelled as such, helped audience understanding of the need</p>	<p>Splitting occasional foods sent the clearest and most consistent message to consumers ie that these foods not recommended as part of a healthy diet.</p>

	to limit consumption.	Furthermore, outside of the main image, the label 'occasional' was more likely to be interpreted as less than daily (more likely, once to several times a week, or at weekends). By contrast, the design that included occasional foods within the main image was thought to communicate that these foods are accepted – or even recommended.
Fluid message	Useful for clarity although there was some confusion about whether the fluid messages included tea and coffee.	Size of the message could be increased relative to the main image to draw attention to the message.
Inclusion of cutlery	Inclusion of cutlery lacked meaning and added little to participants' understanding. Without the cutlery, however, the use of the 'eatwell plate' as a title also became unhelpful.	
Border including calorie information	[Not tested]	This provided a good overall impression and performed a function in terms of setting the food guidelines in the context of overall quantity and limits. Calorie limits were felt to be very useful. It performed a function in terms of overlaying a time period to the guide by putting it in the context of a day. Although other elements of the plate indicate alternative time periods (eg fish consumption over a week, occasional foods), respondents felt a strong 'daily' message was helpful to encourage

		appropriate proportions, variety and hydration.
Front of pack colour coded image	[Not tested]	Most respondents felt that the panel needed some further explanation to make it most useful. That is, an explanation in supporting information of how the panel is intended to work and, for some, total recommended limits on sugar, salt and fat.

Sustainability Assessment

PHE commissioned the Carbon Trust to conduct a *post hoc* sustainability assessment of the modelled scenario. Whilst the outcome of this assessment did not inform decisions around the final model, it indicated that the modelled scenario had an appreciably lower environmental impact than the current UK diet²⁴.

Output: The Eatwell Guide

The Eatwell Guide was drawn to reflect current government advice on a healthy balanced diet, results from the linear programming modelling and consumer research. The linear programming method used to inform the food group segment sizes was unbiased in its approach and the output ensured that the fewest changes from the average current diet would be required by consumers to achieve these set goals making it realistic and achievable.

The modelling confirmed that consuming a diet consistent with the pattern depicted in the Eatwell Guide ensures all government dietary recommendations would be met. While many aspects of the previous model, the eatwell plate, were unchanged other elements were adapted principally to reflect findings from the consumer research. This included:

Removal of the knife and fork

Consumer research highlighted that the knife and fork were no longer considered appealing aspects of the overall design. It was felt that these added little to the meaning of the model and could cause confusion when interpreting the plate to be a recommendation for every mealtime.

Drawn images instead of photographs of foods

Consumer research indicated that those who are more likely to have a poor diet, preferred drawn images. To make the model accessible to the whole population drawn images have been used. The foods included were understood by consumers to be emblematic of the wider food group and are representative of commonly consumed and widely recognised foods.

Segment names

Have been updated to place emphasis on certain food products within a food group that can be considered more environmentally sustainable as well as to improve clarity and support consumer understanding.

Foods high in fat and / or sugar have been separated into two distinct categories.

The guide differentiates unsaturated oils (such as vegetable / olive) and lower fat spreads from other foods that are high in fat and sugar with the small size of the section reflecting that oils and spreads are high fat and so should be consumed in small amounts.

Foods high in fat and sugar have been placed outside of the main image.

Research highlighted this aided consumer understanding of the role of these foods and drinks in the diet whilst feeling that the Eatwell Guide was an achievable target for their food consumption habits.

Inclusion of a hydration message

Reinforces fluid recommendations and the healthier drinks to choose.

Additional messages for further guidance.

Consumer testing highlighted that most people found it helpful to have additional messaging on the guide as this helped to answer some of the immediate questions raised. The wording that was found to offer the greatest impact and understanding was adopted for the final model; this includes messaging on wholegrain and higher fibre, choosing foods with less fat, salt and sugar, messaging on red and processed meat and 5 A Day.

Inclusion of energy requirements

Reinforces the message that all food and drinks consumed contribute to total energy intake. Research revealed that this provided adults with a useful benchmark for their own consumption. Energy requirements for different age groups have not been included because everyone has slightly different needs and due to the limitations of a single image these could not be included.

Inclusion of a front of pack nutrition label

Helped to respond to consumer comments regarding the lack of guidance on choosing foods lower in fat, salt and sugars when shopping. The version displayed is consistent with Government guidance.

Given the exclusion of 'foods to eat less often and in small amounts' from the central image of the Eatwell Guide, the segment sizes of the other food groups become slightly greater than that shown in Table 3.

For the purposes of drawing the central image of the Eatwell Guide the segment sizes are calculated as:

Segment size = a/b

Where:

- a = weight of food in individual food group
- b = sum of weight of food main food groups (not including foods to be eaten less often and in small amounts)

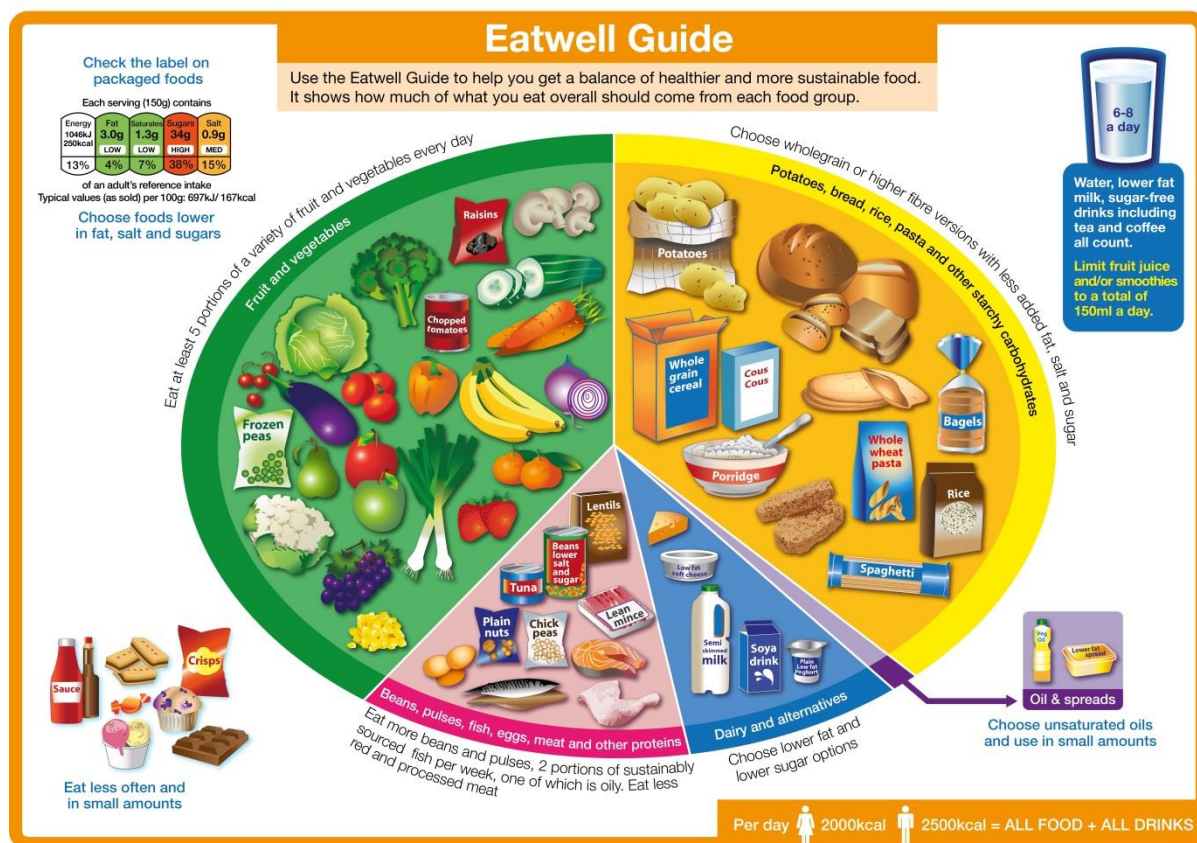
The final food category segment sizes for drawing the central image of the Eatwell Guide are shown in Table 5.

Table 5. Segment sizes for drawing the central image of the Eatwell Guide

Food category	Weight of food (%)
Fruit and vegetables	40%
Potatoes, bread, rice, pasta and other starchy carbohydrates	38%
Beans, pulses, fish, eggs, meat and other proteins	12%
Dairy and alternatives	8%
Oils and spreads	1%

The final model, The Eatwell Guide, is shown in Figure 3.

Figure 3. The Eatwell Guide



Source: Public Health England in association with the Welsh Government, Food Standards Scotland and the Food Standards Agency in Northern Ireland

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The analysis undertaken to develop the revised visual model was based on data for adults from the NDNS. Energy requirements of children aged 11 and over are set at the same value as adults within government recommendations in part to address issues of overweight and obesity. However, some micronutrient intakes for young people aged 11-14 years are higher than that for adults. *Post hoc* analysis revealed that the intake of nutrients of potential concern remained achieved for this age group.

Although sustainability was not a key element of the consideration for determining the revision of the national food model, the sustainability of diets is of ongoing interest in the UK. Messages around sustainability were tested during the consumer research and the best performing aspects incorporated into the guide.

PHE commissioned the Carbon Trust to conduct a *post hoc* sustainability assessment of the Eatwell Guide compared to the current diet. Whilst the outcome of this assessment did not inform decisions around the final model, it indicated that eating a diet in line with the Eatwell Guide has an appreciably lower environmental impact than the current UK diet²⁴.

The development and approval of the final Eatwell Guide visual was the responsibility of PHE in consultation with officials in the devolved administrations. It was published in March 2016 and replaced the eatwell plate in all four countries of the UK.

PHE encourages all organisations and individuals to use the Eatwell Guide and will ensure it remains fit for purpose and reflective of future changes in the evidence base.

Appendix 1

The Balance of Good Health



Appendix 2

The eatwell plate

The eatwell plate

Use the eatwell plate to help you get the balance right. It shows how much of what you eat should come from each food group.



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Appendix 3

The eatwell plate external reference group:

Members:

- a) The Agricultural and Horticultural Development Board
- b) The Association of Directors of Public Health
- c) The Association for Nutrition (chair)
- d) The Association of Convenience Stores
- e) The British Dietetic Association
- f) The British Nutrition Foundation
- g) The British Retail Consortium
- h) The Food and Drink Federation
- i) Institute of Grocery Distribution
- j) The Royal College of Nursing
- k) UK Health Forum

Observers:

- l) Food Standards Scotland
- m) Welsh Government
- n) Food Standards Agency Northern Ireland
- o) Public Health Agency Northern Ireland
- p) Health Education England
- q) National Institute for Health and Care Excellence
- r) Dept. of Health

Appendix 4

Linear programming: optimisation modelling methodology

Linear programming analysis was conducted using the solver function in Excel²². To achieve the dietary recommendations, modelling constraints were set as shown in Table 1, and the optimisation variable was the deviation between the modelled scenario and current consumption in the UK.

For food category i a deviation index was calculated as:

$D_i = (c_{mod} - c_{base})^2$: where c_{mod} is consumption (g/d) of i in the modelled scenario, and c_{base} is current consumption of i .

The optimisation consisted of finding the diet that met all constraints whilst minimising the sum of D_i across all food categories.

Table 1. Constraints utilised in the linear programming to develop the visual reflecting government dietary recommendations.

	Dietary recommendation	Constraint
NUTRIENTS		
Energy	2250 kcal (9414 MJ) ¹	No increase ⁴
Carbohydrates	≥50% of food energy	≥50% of food energy
Free sugars	≤5% food energy	≤5% food energy
Fat	≤35% food energy	≤35% food energy
Saturated fat	≤11% food energy	≤11% food energy
Protein	Approx. 15% food energy	≥14.5 & ≤15.5% of energy
Salt	≤ 6g/2363 mg sodium	≤ 6g/2363 mg sodium
Fibre (AOAC) ²	30g	≥30g
FOODS		
Fruits and vegetables ³	At least 5 portions of a variety each day	≥5 portions a day
Fish	At least 2 portions a week, one of which should be oily	≥ 2 portions (2*140g) a week, one of which should be oily
Red and processed meat	High consumers should reduce their intake to the average of the population (70g)	≤70g/day

AOAC: Association of Official Analytical Chemists method for total dietary fibre analysis.

¹ assumes mixed population average

² equivalent 18g non-starch polysaccharide fibre

³ includes a maximum of: 1 portion of juice (from fruit / vegetable juice or that in a smoothie); 1 portion of beans; (Portion sizes: 30g dried fruit; combined total of 150ml of fruit and / or vegetable juice and / or smoothie; 80g all other fruits & vegetables)

⁴ in energy from NDNS intakes (weighted average for adults equivalent to 1711kals (7159 MJ).

Data collected for the NDNS between 2008 and 2011 (NatCen, 2015) were used to calculate current average adult intake of foods in the UK. Data collected on children and adolescents under the age of 19 were removed and the NDNS survey weights were applied to analyses to account for differential response rate by age and sex. The final sample included data on all participants that collected food diary data for at least three days: 1491 adults, 841 of which were women.

The NDNS collected data by food diaries over four days. The foods that were recorded in the food diaries were matched with food items from over 8,000 foods in the UK Nutrient Databank food composition tables¹⁸ and serving size estimates were matched with standard portion size²⁵.

The NDNS categorises foods by allocating each food item into one of 140 sub food groups, which in turn are categorised into 58 food groups. For this analysis, dietary data from vitamin and mineral supplements, alcoholic drinks, artificial sweeteners and infant or baby food were not included, leaving 125 sub food groups: 80% of food and drink consumption.

In order to model the food based recommendations shown in Table 2 and to be able to combine the results of the optimisation modelling into categories used by the eatwell plate, it was necessary to supplement the UK Nutrient Databank with estimates of the proportion of each food item that consisted of foods that are used for the constraints or are included in the eatwell plate categories. To achieve this weighted NDNS data for years one to three was mapped against the eatwell plate categories (aged 16+ only). Alcohol consumption was removed from the dataset.

The following steps were followed to map foods to the eatwell plate categories:

- for most foods, the classification from the National Food Guide was applied
- for commonly consumed composite products, the information from the homemade recipe versions of these products in the NDNS was used to derive an approximate allocation to eatwell groups (based on grams). This process was followed for lasagne, spaghetti bolognese, cottage pie, meat pies, fruit pies, pizza and soup.
- for commonly used condiments which were not allocated to a group in the National Food Guide, online recipes were used to derive approximate allocation to eatwell groups (based on grams). This process was followed for mayonnaise (full and low fat), salad cream and ketchup. This method was also used to disaggregate chips/roast potatoes and custard.

Liquid volumes were adjusted for consistency with previous analyses⁵. In particular:

- the volume of milk and fruit juice was halved
- the water component of soup was removed
- the water component of sugary drinks was excluded

For each NDNS participant, the average consumption (g/d) of each food item, its average nutritional quality (g per 100g for macronutrients and micronutrients) and average contribution to SACN's food based recommendations and eatwell plate categories by sub food group was estimated. These variables by sub food group across all participants weighted by survey weights were then averaged. This gave a dataset of 125 sub food groups with average consumption for both consumers and non-consumers combined, and average nutritional quality and contribution to food-based recommendations and eatwell categories of consumed foods within the sub food groups. This was the dataset used for the optimisation modelling.

The eatwell plate segment 'foods and drinks high in fat and/ or sugar' was subsequently disaggregated into two separate groups 'oils and spreads' and 'foods to be consumed less often and in small amounts' in keeping with findings from consumer testing and feedback (appendix 5).

Appendix 5

Qualitative research methodology

Define Research & Insight Ltd was independently commissioned by PHE to undertake qualitative research on the understanding of current messages and explored ways to improve communication of messages so that the model fully supports consumers to eat a healthy diet in keeping with government advice. The research aimed to assess:

- the extent to which the eatwell plate visual approach and style was still appropriate
- how consumers respond to changes reflecting the potentially new recommendations
- which information/messages within or alongside the visual for maximum accessibility, engagement and understanding across the diverse consumer audience.

Inclusion criteria for participation in the research were as follows:

All to:	<ul style="list-style-type: none"> • have sole or joint responsibility for household food shopping; • be undertaking 'at risk' behaviours in relation to <i>their own</i> or their <i>family/children's food consumption</i>, and relevant to the eatwell plate changes, ie consuming high fat and/or high proportion of processed or convenience food and/or snacks;
Across <u>Younger Family</u> (at least one child aged 5-11 but <i>no children</i> over 11) and <u>Older Family</u> (at least one child aged 5-11 but have older children at home in addition), thorough mix of:	<ul style="list-style-type: none"> • Size of family • Composition of family <ul style="list-style-type: none"> – Spread of age – good spread of ages 5-11 within sample – Representation of boys and girls • Single and two parent households • Age of parent • Gender of parents: include at a minimum 6/ 8 Mums, minimum 2/ 4 Dads • Spread of warmth to C4L, approx. 50:50 warmer: colder (warmer = more aware/signed up in past, colder = not heard of it/low awareness)
All family respondents to:	<ul style="list-style-type: none"> • be sole or joint carers of children in household in which they currently live
Across <u>Young Independent</u> (no children):	<ul style="list-style-type: none"> • mix of single and partnered
Across <u>Older Independent</u> (no children at home or empty nest):	<ul style="list-style-type: none"> • mix of no children at all and empty nesters • mix of single and partnered
None to have:	<ul style="list-style-type: none"> • any specific dietary requirements within family, ie serious allergies or medical conditions which dictate dietary requirements;
Ethnic minority	<ul style="list-style-type: none"> • clustered in appropriate locations;

respondents:	<ul style="list-style-type: none"> • South Asian respondents including even spread of: Indian, Bangladeshi, and Pakistani;
At least half respondents:	<ul style="list-style-type: none"> • frequent internet users with access to internet at home and/or have a smart phone and to have used apps
Spread of age	<ul style="list-style-type: none"> • representation of 18-60+

Phase one involved 152 individual in depth interviews with individuals from two demographic classifications (60 from BC1, 92 from C2DE). Interviewees included Caucasian, Afro-Caribbean, African, Chinese, South Asian and mixed race individuals. This phase sought to gather understanding around the eatwell plate and suggestions for changes in execution, content and supporting messages.

Phase two involved 80 individual depth interviews (20 BC1, 61 C2DE) lasting 40 minutes each and tested updated designs based on insight gathered from Phase one and an initial readout of the linear programming model.

Specific questions used in phase two to help gather feedback on an updated model included:

- what messages and information are communicated clearly (and which are less clear)?
- how do consumers understand the overall design and different components, labels and messages in the updated designs?
- to what extent do design approach alternatives affect: overall appeal, accessibility and understanding?
- what else might be required to optimise the model or support it to ensure that consumer take out is as intended?
- what is the optimal solution from the consumer perspective (but which delivers government guidance as intended) across the different designs and design components shown?

Appendix 6

Impact of the modelled scenario on NDNS food categories

NDNS - main food group	Current intake g/person/day	Model Outcome
PASTA RICE AND OTHER CEREALS	72.4	85.2
WHITE BREAD	49.5	67.6
WHOLEMEAL BREAD	18.3	53.7
OTHER BREAD	2.9	3.4
HIGH FIBRE BREAKFAST CEREALS	19.4	49.7
OTHER BREAKFAST CEREALS	5.6	5.1
BISCUITS	12.5	6.4
BUNS CAKES PASTRIES & FRUIT PIES	17.8	7.1
PUDDINGS	12.3	10.8
WHOLE MILK	31.3	13.7
SEMI SKIMMED MILK	100.5	111.4
SKIMMED MILK	19.9	15.5
OTHER MILK AND CREAM	13.0	8.9
CHEESE	16.3	1.7
YOGURT FROMAGE FRAIS AND DAIRY DESSERTS	29.2	13.9
EGGS AND EGG DISHES	18.7	2.3
BUTTER	4.1	0.2
PUFA MARGARINE & OILS	0.44	0.41
LOW FAT SPREAD	1.5	1.4
OTHER MARGARINE FATS AND OILS	1.4	1.1
REDUCED FAT SPREAD	6.6	2.4
BACON AND HAM	14.5	0.0
BEEF VEAL AND DISHES	26.3	5.6
LAMB AND DISHES	8.7	3.7
PORK AND DISHES	7.8	2.6
COATED CHICKEN	5.5	3.5
CHICKEN AND TURKEY DISHES	40.5	5.6
LIVER & DISHES	1.5	1.3
BURGERS AND KEBABS	5.7	3.6
SAUSAGES	11.6	2.4
MEAT PIES AND PASTRIES	9.0	6.9
OTHER MEAT AND MEAT PRODUCTS	5.1	3.5
WHITE FISH COATED OR FRIED	9.3	14.1
OTHER WHITE FISH SHELLFISH & FISH DISHES	14.4	19.1
OILY FISH	10.0	41.5
SALAD AND OTHER RAW VEGETABLES	44.6	78.8
VEGETABLES NOT RAW	123.4	232.4
CHIPS FRIED & ROAST POTATOES AND POTATO PRODUCTS *	40.6	70.2
OTHER POTATOES POTATO SALADS & DISHES	52.1	106.3
FRUIT	99.5	209.5
SUGARS PRESERVES AND SWEET SPREADS	12.7	1.7
CRISPS AND SAVOURY SNACKS	6.1	6.0
SUGAR CONFECTIONERY	1.6	1.2

NDNS - main food group	Current intake g/person/day	Model Outcome
CHOCOLATE CONFECTIONERY	8.1	0.0
FRUIT JUICE	53.1	24.4
MISCELLANEOUS	57.8	27.9
TEA COFFEE AND WATER	1117.7	1117.8
ICE CREAM	5.4	2.9
NUTS AND SEEDS	2.9	3.0
SOFT DRINKS NOT LOW CALORIE	119.9	59.1
SOFT DRINKS LOW CALORIE	84.6	83.3
BROWN GRANARY AND WHEATGERM BREAD	14.5	29.1
1% Fat Milk	1.6	1.6
SMOOTHIES 100% FRUIT AND/OR JUICE	0.8	0.8

*includes baked products

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